ENGINEERING TEXTS:

A STUDY OF

A COMMUNITY OF AEROSPACE ENGINEERS,

THEIR WRITING PRACTICES,

AND TECHNICAL PROPOSALS

BY

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Abstract

This is a report of a six-year study of working and writing practices in an engineering environment. It is an investigation into a distinctive discourse community of design engineers conducted from an ethnographic perspective. It surveys the engineers' attitudes towards writing and texts, and describes their distinctive writing practices, including collaborative writing. It shows them to have been acculturated into work attitudes, procedures, and a writing style which are at odds with actual demands made of them in the workplace. The engineering-lore about engineers being generally incompetent or indifferent writers is explored and, for the most part, debunked.

The texts that design engineers write are identified, and it is shown that product design, the type of work activity that most engages and concerns the engineers, provides a common thread throughout all the documents considered. Particular attention is paid to proposals and executive summaries, since they give rise to specifications and requirements, all of which give most cause for concern to the engineers and the company. It is shown that proposals are ultimately persuasive in intent, in which engineers must convince the Customer of the superiority of their 'solution' over the proposal submissions from other companies.

Pragmatism and problem-solving underpin the approach taken to proposal documents, the description and analysis of which is intended to be useful to the engineer writers themselves, and intended to reflect their collaborative writing practices. An analytical approach has been devised, based on information content, which is of potential use for diagnostic or evaluative purposes. Findings arising out the analysis suggest that the proposals and executive summaries written by design engineers comprise a selection of Information Components (ICs) drawn from a finite set of thirty-nine ICs. They indicate the existence of four major foci for proposal texts: three information-based, and one metadiscoursal. The results also seem to indicate that proposal writers may be focusing too much on product design in proposals to the detriment of other key information, which also contributes to the overall 'solution'.

Please note: Many of the original names of companies, projects, products and locations in this thesis have been changed for reasons of confidentiality.

DEDICATION

To all British engineers, who do not receive the appreciation they deserve.

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Contents

Figures

Tables

Photographs

Appendices

APPENDIX A - The questionnaire sent to 120 design engineers via the company's intranet

Glossary

Abbreviations

AECMA	European Association of Aerospace Manufacturers
HISE	Helix Industries Systems and Equipment, the new name of the company, assumed in 2000, when it merged with the defence arm of GEC Bazalgette
REMA	REM Aerospace plc
RASE	the acronym for the REMA subsidiary, REM Aerospace Systems and Equipment Ltd, situated in Plymouth, United Kingdom, until the company's name changed in 2000. The texts produced by this company, and the engineers who wrote them, are the focus of this study.
DCSC	Dependable Computing Systems Centre
EL	English language
EOP	English for Occupational Purposes
EP/ep1234	Cataloguing code for engineering proposals at HISE
ESP	English for Specific Purposes
EST	English for Science and Technology
FWA	Fleet Weapons Acceptance
YGO46	medium calibre gun system code name
ITSEC	Information Technology Security Evaluation Criteria.
IC	Information Component
L1	English used as a first language, or mother tongue
L2	English used as a second language
MoD	Ministry of Defence
NVivo	NUD*IST Vivo, a software package used in this study, produced by QSR (Qualitative Solutions and Research).
RFIs	Requests for Information
RFP	Request for a Proposal
RRFIs	Responses to Requests For Information
RTM	Requirements Traceability Management
SOFT	Strengths, Opportunities, Failures, Threats ['management-speak']
VSG	Vibrating Structure Gyroscope

A note about terminology

1. **Specialist informants -** In most instances, these are referred to as engineers.

2. **The company**, a division of the parent company (that used to be known as REM Aerospace plc but is now HISE) and used to be referred to as RASE [REM Aerospace (Systems and Equipment) Ltd.], its name until 2001 when it assumed the name of its parent company, i.e. HISE.

3. **The Customer** is a term which may refer to one or a group of people, who may work for the Ministry of Defence (MoD), for example, who commission the design and production

of the product (or solution). The Customer vets proposal submissions, and authorises payments, but is not usually the user of the product.

4. **The User** or **customer** [lower-case 'c'] is the person for whom the product is designed, for example, a pilot in the armed forces, or matelot.

Writing conventions

"words in inverted commas" -	enclose verbatim spoken comment
[square brackets] -	enclose author's comment
EP/ep4321 -	['EP' or 'ep' followed by a number] is the company's classification number for an engineering proposal

CHAPTER ONE – INTRODUCTION – PLACE, PEOPLE AND PRODUCT

1.1 Introduction

This chapter explains the mainly social factors that gave impetus to this study, and introduces the company, Helix Industries Systems and Equipment (HISE), and the engineers who helped to inform this study. It reports on their attitudes to their work as engineers, and perceptions of the writing problems they have. It also considers the concept of 'product', since the product is the central concern of any design engineer, and is the focus of the texts that are examined in this study. The chapter also discusses aspects of working and writing practices, the effect of certain physical and organisational aspects of the company on the way engineers work and write, with the aim of providing background information for the analyses which follow in Chapters 4 to 7.

It may be apt to begin with a confession: I started this PhD project in an over-ambitious and rather romantic frame of mind. For the first three years, working as I was among engineers, observing them, interacting with them, and collecting all kinds of spoken and written data, I fancied myself as being a little like Latour and Woolgar (1986), who also observed scientists at work (in their case, biologists) over a two-year period at the Salk Institute. Theirs has been an inspiring study for researchers like me, who are ideologically inclined towards an ethnographic approach to text. Latour and Woolgar's study caused a stir at the time, and risked causing antagonism in the people they studied; through some of their investigative practices, they perpetuated the notion, perceived by some scientists, that sociologists engage in a kind of social muck-raking.

However, I had no wish to engender any antipathy in my specialist informants. Instead, I hoped to be a proper ESP practitioner, and to eventually prove to be useful in some way. In retrospect, my attitude now seems naïve and a tad idealistic. Nevertheless, I set out to emulate those applied linguists whose research has been of pragmatic value to language users (Pauley 1973, Souther and White 1977, Houp and Pearsall 1980, Dudley-Evans 1994, Dudley-Evans and Hopkins 1988, Swales and Feak 1994) who were working on the teaching of writing skills in an academic or work setting. Dudley-Evans and Hopkins, for example, take a pragmatic view of text analysis in that they take as a 'starting assumption' that there should be tangible benefits to those who would make use of the findings of the research, and that any resulting text description should be explicit. I share their fundamental concern that the research should be useful in some way. From their standpoint, the concern is that research is needed to provide information which is pedagogically valuable: teachers need to devise the most effective teaching materials and methodologies, and students need to be able to differentiate between different types of text to better perform the writing tasks that need to be done in English (1988:113).

This research project is slanted differently from the above, however, since it sets out to be useful to engineers without the necessity for a teaching interface. This slant has proved more significant than first anticipated in the way it has influenced both the analytical approach followed, and the manner in which the findings are interpreted and reported.

1.2 How the topic came to be chosen - a move from L2 to L1 engineers

In an indirect way, the political and economic climate at the time I was in Singapore in the 70's and 80's has been influential in determining the choice of topic for this study, which arose out of ESP courses I have run more recently for British engineers. In the earlier period in Singapore, I was working in a context where English was mainly used as a second language (L2), and although this study concerns the use of English as a first language (L1), the similarities between the two are striking. The 1970's and 80's was a time of economic vitality in Singapore, which, for the most part, saw a huge growth in investment and industry in the region, accompanied by the government's preoccupation with converting the working population into one proficient in the use of the English Language (EL), among other economic, political, and social aims.

My own experience of being drawn into this process of language change in Singapore was as an ESP/EOP lecturer working with engineering students and colleagues, mainly mechanical and civil engineers, and quantity surveyors. In addition, I also worked with practising engineers on their documentation, since there existed close links between the worlds of academia and commerce. The prevailing climate at the time saw a national campaign focused on improving, or, as the Singaporeans put it, 'upgrading' their skills, as reflected in government directives, departmental memoranda, and the press discussing the need to improve standards of EL use. (There was also a parallel drive to increase and improve the use of Mandarin.)

In my own sphere of work, there were initiatives to improve EL proficiency in the workplace. The population was often told that, for Singapore to be competitive and prosperous, it had to have a workforce with high levels of language proficiency, in particular in English and Mandarin. Universities and polytechnics were made aware, through articles in the press, of employers' complaints about the poor EL proficiency of university and polytechnic graduates. The students I taught were apologetic about their English and regarded their usage as poor, as did the engineers I worked with in the workplace, who discussed openly what they perceived to be their problems with English, and, more particularly, writing problems.

The L1 position in this country as presented by the British press is reminiscent of the Singapore situation, with criticisms of L1 graduates' poor abilities in the core skills of literacy and numeracy, and the quoting of the complaints of bodies such as the Confederation of British Industry, and the Employers' Federation about L1 graduates' poor communication skills. Considered to be of an even lower standard are the students on engineering courses at British universities, whose lecturers are candid in their criticisms of the writing standards of new undergraduates. However, my investigations show that such complaints are not new, and, in fact, have been voiced in engineering departments for decades. Similarly, there has been a general acceptance in the engineering field and workplace that engineers have long had problems with writing. There is a general feeling of resignation and acceptance in the field of engineering (discussed in more detail in Chapter 2), and often repeated by the engineers themselves, those who manage them, and those who teach them in the tertiary education sector, of the fact that engineers cannot write very well.

It was this discovery that British engineers had low opinions of their own use of English at work, making comments about L1 ineptitude similar to their Singaporean L2 counterparts, that gave rise to the topic of this study.

1.2.1 L1 Engineers' writing problems can prove costly

It is believed that a significant proportion of the estimated annual wastage of £2 billion (of the annual defence budget of c.£20 billion) is attributable to the poor writing of specifications and requirements and badly written contracts (Kincaid 1997:54). Specialist informants have been candid, if not specific, about the losses suffered by HISE that have been incurred by poorly written documents. However, HISE is no exception, since it is generally acknowledged across the industry that bad writing has proved costly to both the customer, usually the Ministry of Defence (MoD), and the defence industry. A senior manager at HISE, for example, expressed the belief that a particular proposal had lost the company millions of pounds because it had been badly written. Other managers have been more chary about revealing such information, but have agreed that poorly drafted documentation has proved, and continues to be, costly to HISE and to the industry as a whole.

Little seems to have changed since the time Hicks wrote:

> ....unfortunately, highly developed engineering or scientific abilities are not always accompanied by well developed writing skills. So we find that some engineering and scientific writing has been poor. (1961:4)

The impetus for the ESP courses I ran came from a dissatisfaction with the way proposals were being written at HISE. At the time, the company wanted to improve all aspects of the bid-writing process and was instigating a review of proposal writing procedures and staff training in order to achieve this. There was a generally accepted view that some of the proposals being produced by HISE engineers reflected badly on the company, and were possibly a hindrance in the company's bid to win more contracts. This observation that the quality of engineers' writing may have had financial ill-effects was possibly influenced by the economic downturn the company was experiencing at the time. As part of its policy to change the way proposals were written, HISE commissioned tailored ESP courses, singling out to attend those engineers who were involved in the bidding process, and who had to write the documentation for the proposals. This is how I came to run ESP courses for REM Aerospace Systems and Equipment Ltd (RASE) engineers over an eighteen month period, how I came to learn about the special features of the texts they wrote, and, finally, how I became intrigued about the particular writing problems that concerned them.

1.2.2 Engineers have to write a lot

What usually surprises anyone from a non-engineering or non-technical working background who observes engineers at work is the sheer volume of written material that engineers have to produce for any project they are working on. The stereotypical picture of an engineer depicts him producing drawings, assembling prototypes, puzzling over pieces of machinery, testing equipment, tinkering with parts of it, and so on.   This perception may be over-simplistic, but few engineers, even those working in software design, would argue with the layman's tendency to associate them with designing things to be used, because this is what most engineers actually like to do and enjoy doing. In fact, it is what many engineers see as being the raison d'être of their working lives. However, a concomitant product of much of the engineers' practical work, and an aspect which they regret, is voluminous text, a result of the need to write sometimes hundreds of thousands of words for any one project. This is indeed an irony considering the fact that many engineers probably chose their professions through a kind of writing-avoidance, the result of some kind of self-awareness of being less proficient in L1 use.

The upshot of modern working practices in an engineering environment is that the paperless office is a myth. In spite of using computers and other electronic means of producing, saving, and sending text, the amount of paper used today is probably greater than four decades ago when Hicks observed of the technical writing process:

> The output varies from a single-page maintenance instruction to a volume of five hundred or more pages covering an important scientific or engineering project. Operating maintenance and instruction manuals for some advanced missile systems run to several thousand pages, weigh 100 or more pounds, stand 5 feet high, and cost almost $1 million to prepare. (1961:2)

When Hicks wrote this, much of the burden of writing was borne by technical authors working with pools of typists, professional draftsmen, illustrators, and printers. He claims that the 'normal duties for which the engineer or scientist is employed *are not* writing' (ibid:3), unlike the findings of this study which reveal that engineers can spend at least 50% of their working time on writing. Now, in the modern engineering office, with working roles less clearly delineated, engineers play a much larger role in the writing process, sometimes taking responsibility for the production of a whole document, if not large sections of it.

The backdrop for this study, then, portrays writing as a major and time-consuming process in an engineer's working life at a company which seems to be continually striving to implement the latest working practices.

1.2.3 Engineers' writing problems

When conducting the needs analyses, and during planning discussions about course content with engineers, it became clear that writing problems I had encountered in an L2 context were recurring in an L1 writing context, for example, being clear about writing purpose, selecting and organising ideas, stylistic appropriacy, grammar, and discourse organisation. Also, most of those surveyed identified grammar and vocabulary usage as being the main problems. Furthermore, similar demands were made of me in both the L1 and L2 contexts, for example, a plea to improve the engineers' grammar, requests for showing how to write elegantly and fluently, the assumption that model texts would solve the problem, the expectation that there was a single correct way of writing, and that I would supply the rules. This situation is much as described by Grabe and Kaplan who, in discussing the concept of 'writing as technology', describe the attitude of certain technical writing specialists in the USA where:

> One often finds the assumption being made that writing can be reduced to a template - to a set of techniques, or a set of simple step-by-step procedures which will guarantee 'correct' and objective language. (1996:148)

The discussions I have had with different groups of L1 and L2 engineers about their English language use were striking by their similarities, to such an extent that I became curious about the specific nature of these problems, and saw it as a logical progression to investigate further. As the study developed, I was given opportunities to become involved in engineers' writing activities, and found myself experiencing at first hand these concerns, including devising model texts, identifying the points needing to be raised in certain documents, describing text structure, deciding upon appropriate stylistic features, and so on. Through working and writing with engineers, I learned they have firm (and, in some cases, entrenched) views about technical writing.

1.3 Main objectives of the study

1 To investigate concerns about writing

One major objective is to investigate engineers' concerns about writing. This includes examining the writing issues raised by engineers working at different levels of the company hierarchy about what the main problems are. The concerns are described from the engineers' own standpoint, and are considered from an investigatory and problem-solving perspective, with the view to eventually respond to the needs arising from the findings that have been identified by the engineers themselves. In a similar vein, the study investigates texts of particular concern to engineers, discussing them in terms of functional categories which relate to the working (and writing) processes in the office, and how they are written and structured. Particular attention has been paid to the texts engineers rate as being important. This has been done in the knowledge that to date this has been a neglected area, with sparse research having been done into writing in the commercial workplace (Grabe and Kaplan 1996:149), with little of it relating to the engineering workplace.

2 To follow, as far as possible, an ethnographic approach

The research approach I follow for this is similar to that taken by Odell and Goswami (1982) in that it takes into account the writers' perspective, in other words, the opinions of those who take part in the process of constructing text within a particular discourse community. However, Odell and Goswami examine the stylistic preferences revealed by the judgements individuals make of administrative texts, like memoranda and letters, which are the sorts of texts Grabe and Kaplan would designate as having bureaucratic usage, and which is well catered for in writing textbooks. This study, instead, concentrates on the technical writing, that is, the non-administrative or bureaucratic writing produced by individuals and groups of engineers working, and writing, collaboratively.

A holistic approach has been taken to the text analysis, in which factors playing a part in the production of a text or document are also considered, including: temporal and financial matters, production processes, physical and sociological writing contexts, writing processes, writer purpose, and audience. This approach borrows ideas from the model immersion-type study done in a scientific laboratory by Latour and Woolgar (1986), in order to provide a situational context for the linguistic aspects of the analysis. The problem solving approach taken in this study was deliberately chosen to be sympathetic with the philosophy underpinning the analysis, which reflects my somewhat puristic interpretation of the term 'applied', in that real problems identified by the engineers themselves should take precedence over my own linguistic inclinations.

3 To devise a useful analytical approach

Ultimately, this study intends to suggest an approach to analysing problematic text which may be of some use to the discourse community which has been hospitable to me.

1.4 The data

From the beginning, a variety of data was collected, some of which was ‘messy-data’, for example, transcriptions of interviews, notes made from riffling through engineers' filing cabinets, examples of engineers' writing, results from an email survey, and texts obtained from the company's electronically-held text banks. Two major problems which emerged during the study were the management of the large quantities of data and deciding how to analyse it. The analytical models that were available only took me part of the way towards achieving my aim of devising something that would be of use to engineers. I looked to software to manage the long tests I was analysing, and eventually chose NUDIST Vivo, which is a rather tricky package that I used to take a grounded approach to an aspect of the text analysis (Glaser and Strauss 1967, Lincoln and Guba 1985, Berkenkotter and Huckin 1995).

Data was gathered over a period of five and a half years (1995 –2000), starting with early attempts at analysing proposals which started soon after I gained access to the HISE site in 1996. I use the term ‘data’ to refer to actual texts collected for analysis, interview transcripts, written responses to the questionnaire, and diary records.

The list below outlines the different sets of data used in this study:

1. information gathered during proposal writing workshops run for HISE engineers in 1994 and 1995, which concentrated on the Executive Summary sections of proposals. During the workshops, engineers brainstormed ideas about the process of proposal writing, brought writing samples for discussion, and composed executive summaries. At the time, I did not anticipate that proposals would become the focus of this research project.

2. the hard copies of half a dozen proposals, in the early stages of the study, which engineers considered to be ‘safe’ enough to give me. Amongst these was the complete set of proposal documents for two medium-calibre gun systems (YGO46), which were handed over because the project was considered to be mature enough for the documents to be examined without the company’s confidentiality agreements being compromised in any way.

3. data gathered from interviews with 15 engineers about proposal writing generally, and about particular proposals they helped to write.

4. data gathered from an email survey in which 59 engineers participated by completing a questionnaire (see later in this chapter and Chapters 2 and 3 for discussion of the findings).

5. a collection of ninety-five proposals held in electronic form in a section of the company's database. This forms the basis of a 600,000 word corpus compiled to facilitate analysis at word and phrase level through the use of computer tools (Wordsmith, Nudist NVivo).

6. a subset of five executive summaries and five proposals drawn from the 95 proposals, mentioned above, which were used to trial an analytical approach using Information Components discussed in Chapters 5 - 7. These ten documents represent the different types of proposal, e.g. solicited and unsolicited, large and small, single/few authors and multi-authors.

This thesis describes the main developments of this investigation and the results they have yielded: the different sets of data gathered during the six years of the project, the results of the surveys and analyses carried out, a description of the texts and engineers that informed the study, and the grounded approach that was taken to analysing the information content of texts. I find myself identifying with Greg Myers (1990), who had similar aspirations about being useful, and who wrote 'But I have found that the biologists who read my chapters (all chapters were read by the writers studied and by other scientists as well) were not surprised by what I had to say, and were only surprised by the lengths to which I went to say it.'(1990:xiii).

1.5 A note about terminology

1.5.1 Referring to text

Throughout the project, my preferences for certain terms changed. For example, when referring to any distinct piece of writing or genre, I vacillated between 'text', 'text type', and 'piece of writing', among others. However, since engineers do not use these terms, and since they occasionally proved a hindrance in discussions with them, it has been more convenient to use their preferred term wherever possible in this study, i.e. 'document', without too many apparent difficulties arising as a result.

An engineer suggested that use of the term 'document' in industry is probably due to the influence of Microsoft software, and its coining of the '.doc' file-type, but I was unconvinced about this, having overheard other engineers using the term when describing the contents of their filing cabinets. These engineers (self-classified as 'oldies') believe that Microsoft has cleverly adopted the term 'document', and others, like 'folder', because it was/is commonly used in the workplace. Those engineers who like to keep all the documents relating to a particular project as paper-based copies, keep them altogether in a filing cabinet, which they refer to as 'the project file'. The paperwork contained within the filing cabinet may be in the form of books/manuals, reports, proposals, specifications, letters, etc, each one of which is referred to as a 'document', a term which is used both generically and hyponymously.

Others in the field also seem to be undecided about suitable words for referring to text. Paradis, for example, in his examination of the role of operators' manuals, in just three paragraphs (1991:264-5), for instance, uses six different terms to refer to writing: 'text' (in an uncountable / mass sense), 'texts', 'written discourse', 'textual field', 'public rhetoric' (referring to any writing made available to the public on the product), and the manifestations of public rhetoric (for example, price lists and manuals) which he refers to as 'documents'. Another example is Freed who begins his discussion of proposals by referring to them as 'an extraordinarily diverse genre', but soon reverts to using 'document' as a kind of default term to refer to them (1987:157, 159). In the event, it will be seen that several terms are used to refer to different texts (or genres/text types), and parts of texts, e.g. 'text', 'segment', 'extract', document', 'genre', 'proposal', 'summary', 'report', etc., appropriate to the particular context of the discussion in each case, it is hoped.

1.5.2 'Product' versus 'solution'

The significance to engineers of various terms may be influenced by prevailing attitudes of management, or views perpetuated by business 'gurus' or management consultants. In the case of proposal writing, or talking about proposals, they prefer the current 'politically-correct' term 'solution' to 'product' to refer to what they are trying to sell to the customer, because it portrays the speaker as having a customer-oriented approach. On occasion, engineers have corrected my usage, suggesting their 'solution' was more acceptable than my 'product'. On balance, however, I have chosen to use more often the term 'product' to refer to what is being proposed to the Customer, for three main reasons:

1. It is what the engineers actually design, and describe in the technical proposal.

2. More tellingly, perhaps, this is the term the engineers themselves use most often in interviews and informal discussion.

3. For more personal, and, arguably, subjective reasons, I prefer to use ‘product’ to describe entities designed by the engineers which usually have physical substance (or, in the case of software, textual substance), rather than ‘solution’. ‘Product’ is capable of conveying the idea of tangible objects, whereas ‘solution’ is more abstract and intangible, with much wider (non-engineering) applicability.

It is possible to see the attraction of ‘solution’, however, since it is a cover-all term, which the engineers see as a means of conveying to the Customer that they have the answer to his problems, and that they are working in the Customer's best interests. And the mellifluous combination of sibilant phonemes is possibly easier on the ear than the plosives in ‘product’. But as the traditional idea of the engineering product is that it has physical substance and shape, and that it is literally hard to the touch, I believe the hard sounds of ‘product’ are eminently more suitable than the vague-sounding ‘solution’. At the start of the study I observed ‘project leader’ becoming unfashionable, and being regarded as almost taboo in office talk, only to be reinstated more recently as acceptable once more. Because of this I initially decided that the (unofficial) corporate language policy may prescribe the use of ‘solution’ to engineers, but that this study did not have to conform. However, the writing of later chapters has seen a softening of this stance: sometimes it is more appropriate to use ‘solution’ when a generic sense is intended, or where the speaker is referring to the whole answer to a Customer’s problem, which may include several aspects, for example, maintenance plan, training for users, and a ‘piece of kit’ [the product]. In the end, and unremarkably, I decided to use both, whichever was most appropriate to the context.

1.5.3 ‘Selling point’ and ‘benefit’

It may also be useful to clarify the terms ‘selling point’ and ‘benefit’ at this point, in the context of proposal writing, although the textual realisations of these are discussed in later chapters. Engineers seem to regard them as synonyms, since they use them interchangeably in discussions, although, having recently been reorganised into ‘value chains’ they are making a conscious effort to be more ‘Customer-focused’, and to reflect this in their language; hence ‘benefit’ is the preferred term. There is a subtle difference between the two terms: presented for the reader’s (i.e. Customer’s) consideration, main aspects of the solution would be, or rather, should be, referred to as ‘benefits’ (customer-oriented), whereas, strictly speaking, from the company’s perspective, these would be considered to be ‘selling points’ (profit-oriented). Nonetheless, in this study, ‘benefit’ will be used wherever possible.

1.6 A note about engineering-related reference material

There have been a few significant studies of the roles of texts in companies, and aspects of their discourse features, as is discussed in later chapters, although there is a shortage of more recent relevant work in the fields of engineering. Even within the general field of engineering texts, any (even remotely) useful work relates to civil engineering and the building industry, whereas mechanical, electrical and electronic engineering appear to be neglected areas. The main library at Birmingham University bears out this impression, yielding but two books related to the writing of design documentation, both of which concern the building industry, but nothing on writing proposals. This is the sorry case (also acknowledged by the technical librarian), in spite of the fact that the university is considered to be one of the leading universities in engineering. When asked about this dearth of books, the librarian mentioned that the British Standards relating to writing about design had been removed from the main library to the store and would take some time to find. It was some consolation to reflect that at least engineer teachers and acolytes at the university manifest the same writing behaviour as engineers in the workplace: writing procedures are produced, but they pay little attention to them (apart from rare incidences). The reasons behind this sorry state of affairs may reflect the fact that engineering undergraduates are not taught about the writing they will have to do, even though it is considered extremely important at work. Therefore, no books are needed in the library. It is assumed they will have to learn on the job.

1.7 The discourse community

1.7.1 Overview of the company

The site, facilities, and key products

The site at Plymouth covers 15 acres, and includes c.260,000 square feet of purpose-built engineering and manufacturing buildings to house design and production teams concerned with systems, software, hardware production, and support engineering. The company supplies customers in both the military and civil sectors, and is primarily concerned with avionics products, and gyroscopes and other sensor products. The public tends to associate HISE with defence products, although this association has been weakening somewhat in recent years, with the company's move into civil-sector provision. The motion sensors for the recently announced Segway HT (Human Transporter), a mini-platform on two wheels for individuals to stand on for mobility purposes, are made at Plymouth. The sensors are based on technology for which HISE in Plymouth is well known, i.e. silicon gyroscopes.

There are also research, testing, development, and environmental facilities on site. In its publicity material, the company clearly regards its self-contained research facilities as an asset, emphasising how they are equipped with all that is needed, by touting in some of their promotional literature, for example, the benefits of their testing and research facilities, significant since the core activity at HISE is product engineering.

1.7.2 An ethnographic underpinning

The HISE site at Plymouth can be seen as a distinctive micro-cosmic culture although it is not of the kind of scale envisaged by Saville-Troike and her ethnographic peers, who envisage cultures on a grander scale. Nevertheless, the parallels that can be drawn indicate that this study, and the holistic approach that has been taken to it, has ethnographic roots. It has been influenced by anthropological and sociolinguistic research methodology, and the holistic emphasis is well expressed by Saville-Troike:

> …its contribution ….will be limited if its methods and findings are not integrated with other descriptive and analytical approaches. It is the nature of ethnography to be holistic in nature, and this should also characterize the disciplinary orientation of its practitioners. (Saville-Troike 1989:10)

I would like to add to Saville-Troike claims that ‘culture is what the individual needs to know to be a functional member of the community’ (1989:7) that not only does the individual need to ‘know’ culture to be a functional member, s/he also needs to know it in order to make informed observations about working and writing practices of the members of that culture. According to the three main criteria Saville-Troike provides for establishing what a speech community is or isn’t, it is clear that HISE in Plymouth is not a speech community, because it is too small and does not offer ‘a full range of role opportunities (a politically organized tribe or nation, but not a single-sex, single-age, or single-class unit like a monastery, home for the aged, or ghetto)’ (1989:18). In a similar spirit, Berkenkotter and Huckin use a variety of research techniques in their studies of disciplinary communication, i.e. academic discourse, which include ‘case studies and ethnographic techniques, and rhetorical and discourse analyses’. It provided some relief to read Berkenkotter and Huckin’s account of their analytical approaches, which, it seems, arose as a natural outcome of their attempts to ‘examine the situated actions of writers, and the communicative systems in which disciplinary actors participate' (1995:ix). This is because it is not difficult, as one becomes immersed in a community and embarks on different investigations as opportunities arise, to question the validity of following various textual trails. In fact, Berkenkotter and Huckin cite Bakhtin (Bakhtin 1986: 63, 80, in Berkenkotter and Huckin 1995:2) to support their observation that investigative work by ‘insiders’, to borrow Berkenkotter and Huckin’s term, is very sparse indeed. They further comment on a tendency amongst ‘genre scholars’ to develop individual approaches to analysis, observing how, for example, Swales (1990) briefly mentions:

> the anthropological research of Knorr-Cetina, Latour and Woolgar, and Gilbert and Mulkay, but otherwise relied heavily on his own text-based analyses. (footnote, Berkenkotter and Huckin 1995:2)

It is possible that highly individual, and even idiosyncratic, analyses are a reflection of the present transitory stage of ESP research, and it is certainly a fair description of the research reported on in this thesis.

Such are the parallels between my approach to this study and that of Berkenkotter and Huckin, and others, that it is possible that, like my applied linguist colleagues, I have been instilled with a 'nose' for observation and investigation in keeping with the practices of others in the field. Berkenkotter and Huckin have developed a 'sociocognitive theory of genre' which is 'grounded'(ibid:3), for the same reasons I claim my findings to be grounded in Chapters 6 and 7. They explain that their knowledge of genres has been gained from their 'participation in the communicative activities of daily and professional life'(ibid:7), much as I have gained understanding of engineers' texts from working and studying amongst them.

However, there is a noticeable difference between my work and theirs. Although they themselves are not inclined towards diagrammatic representation of ideas, I note that, in their discussion of Bakhtin's work, they reproduce a diagram of his denoting 'Structuration of school days through recurrent events' (ibid:9). In my study, diagrams have played an important role in representing ideas, or the development of them, and for this reason, have been included as an integral part of the study. Applied linguistic study is not distinguished by its use of diagrammatic representation, with few exceptions, e.g. Lemke (1992: 84), and my dependence on visual information of this kind may be due to the engineering environment in which I have been working (engineers like diagrams), and my own personal inclinations. In fact, the inclusion of graphics is a natural corollary of any study of scientific or technical language (Davies and Greene 1984, Myers 1990, Halliday and Martin 1993), although there are discernible differences between illustrations intended for scientists and those prepared for 'popular' audiences (Myers 1990:158-59). In retrospect, I can see that several of the graphic representations included in this study were initially devised to communicate my ideas to the engineers. Drawings and diagrams have played a key role in my evolving relationship with them. They often conveyed their thoughts to me by drawing on any piece of paper that was close to hand, and I have tried to reciprocate in a similar fashion.

From the beginning of the study it was apparent that engineers held particular documents in esteem, and seemed to disparage or dismiss others. Figure 1-1 below is one of the early diagrams I sketched to represent the views of an engineer who valued any documents relating to the engineering development of a product. He dismissed as bland and restrictive most other documents. I was to learn that his was a typically product-focused view of text, that not all engineers shared his views about the 'official' category of documents, and that a broader view would gradually emerge of all the documents engineers need to write.

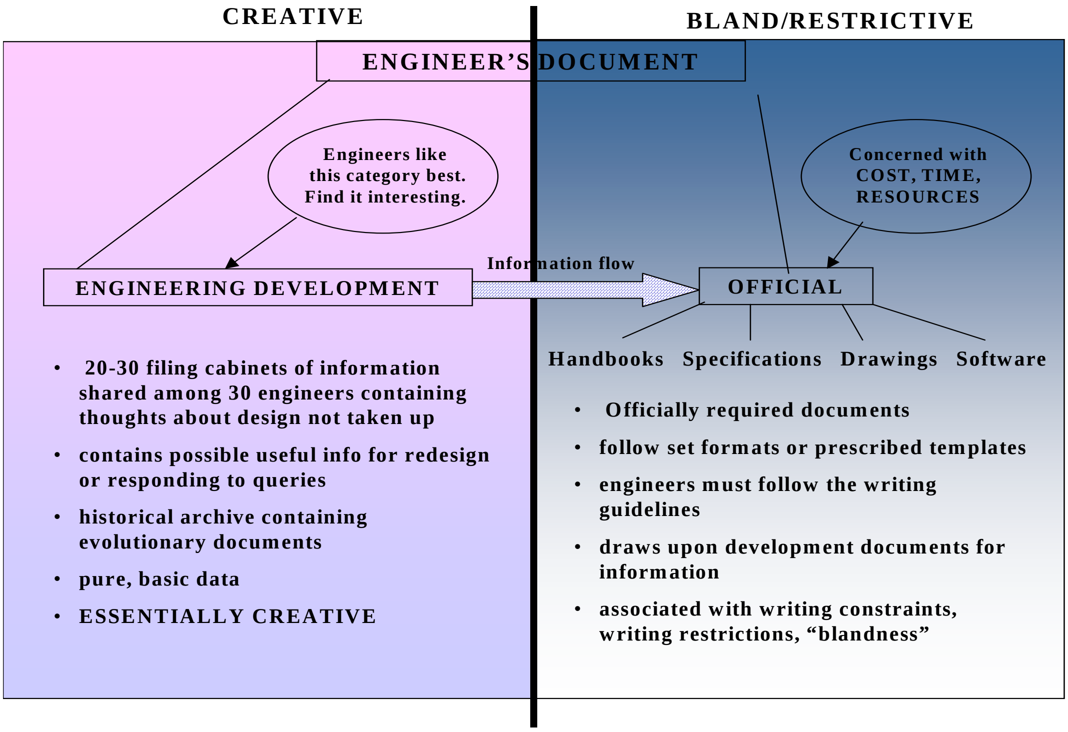


Figure 1-1: An Engineer's view of the documentation he has to produce
(BP Notebook 1 P9, 19.8.96, and Notebook 3 P37, 26.7.01).

A similar research ideology to that underpinning Berkenkotter and Huchin's work, and my own aspirations, seems influential in Swales' more recent study of writing practices, texts, and communities of practice in a university building, where a myriad of factors is considered, including the building's working occupants, work politics, rhythms of work, signage, university clocks, and collections and loans, as well as selected texts. Swales has always been creative with inventing or using terminology, and his coining of the term 'textography' to describe this work is no exception. Very similar to Berkenkotter and Huckin, he claims he is trying to increase understanding of what is meant by saying that academic writing is 'situated', and that types of 'routine writing business' are studied in an attempt to place various bodies of text both within a particular set of disciplinary norms and expectations, and within the local institutional context of their production (Swales 1998:1).

Being used to working with different 'communities' of people, I nevertheless grappled with the theoretical concept of community and its applicability to this study of HISE engineers. It was therefore again reassuring to learn of Swales' own waxing and waning commitment to the concept of discourse community (ibid:21). He refers to discourse community as a troubled concept (1998:20), referring also to the variants ‘disciplinary community’, ‘communicative community’, ‘rhetorical community’, and the more recent 'community of practice'. He discusses Larry Selinker's term ‘discourse domain’, and appears to want to work with this as it would prevent him from making prior assumptions in the categorisation of text (a mistake he says he made in his 1990 book). He also hoped that by following a ‘discourse domain approach’, he might uncover ‘genres and types of writing that were thus far unknown to or been ignored by scholars with professional interests in university writing’ (Swales 1998:23). These aims echo my own in this study. This is what I am hoping to achieve, although the aims of this study are more specific in that the investigation takes into account the perspective of the engineer: I am not just asking what the engineer writes, but what he values, rather than what I, the researcher, consider to be significant.

In spite of his apparent ambivalence towards the term, Swales’ description of a discourse community is clear and useful:

> Discourse communities are sociorhetorical networks that form in order to work towards sets of common goals. One of the characteristics that established members of these discourse communities possess is familiarity with the particular genres that are used in the communicative furtherance of those sets of goals. In consequence, genres are the properties of discourse communities; that is to say, genres belong to discourse communities, not to individuals, other kinds of grouping or to wider speech communities. (Swales 1990:9)

He claims that such communities are essentially occupational or recreational groups that are 'somewhat different' from the sociolinguistic ‘speech communities’ which have their basis in geographical location or delineation (ibid:20), and that ‘In effect, in discourse communities, communalities reside in what people do rather than in who they are’. He sees the varied and diverse verbal activities as ‘recurrent classes of communicative events’ which are ‘genres’ that orchestrate verbal life”(ibid.). He sees this orchestration as:

- providing links between past and present, thereby balancing forces for tradition and innovation
- structuring individuals’ roles within wider frameworks, and
- assisting these individuals with “the actualization of their communicative plans and purposes” (ibid.).

1.7.3 Dwindling size - changing fortunes lead to changes in working practice

This study was carried out over six years from 1996 to 2001. The last decade of the millennium proved a difficult one for the company, for it was a decade which saw the total workforce reduced by nearly 75% from over 3000 employees to the present figure of around 800. Speculation about the future of the company has varied, but is a topic frequently raised in casual chat around the workplace, especially around the time that people are being laid-off.

Such a preoccupation of the workforce is a natural result of the steady reduction in the workforce over ten years. How much of this reduction is due to a business downturn, and how much to changes in working practices is open to speculation. So far as this study is concerned, however, the impact has been significant, especially as almost annual changes to working practices has been imposed by the company during the 1996 to 2001 period. HISE management has reacted to falling fortunes by instigating root-and-branch changes in the way engineers work, which have inevitably had an impact on the way documents are written.

The company, used to be called RASE (see glossary), and was a wholly-owned subsidiary of REM Aerospace plc (REMA). It was distributed over four sites: a production site at York; an office in the USA; another in Germany; and the main site at Plymouth. In 2001, when REMA merged with the defence parts of GEC Bazalgette, the company changed its name to Helix Industries Systems and Equipment (HISE). Then, there was gloomy talk amongst engineers of the probability that the Plymouth site would be shut down. At the start of 2002, however, increasing business, brought especially by the silicon gyroscope, has taken the company into another expansionist phase: eighty new engineers have been taken on, and the company has found it necessary to acquire more acreage of factory space. The situation continues to change at the time of writing-up this thesis: the York site has been closed; after seeming to lose status, the Plymouth site appears once more to be on the ascendant; another reorganisation of office space at Plymouth (the fifth) has begun; and a new site is being sought to accommodate expansion of work. At the latest count, approximately 800 people work at Plymouth, and of this number, around 300 are engineers.

These root and branch changes have brought about fundamental changes to every worker in the company, causing disruption to work patterns and unsettling workers. One example of these effects is provided by the Technical Publications team, comprising technical authors and supporting graphics and word-processing staff. The team used to work together physically as a group in a central location, providing writing support and authoring services to all the engineers. As with any tightly-knit working group, they shared expertise and writing tasks in order to complete writing projects and meet deadlines. The most recent reorganisation into value chains has disbanded the team, so that each member has been allocated to one of the chains. In real terms, this has involved a move to another part of the building to work with a new group, or in current HISE-speak, ‘chain’ of people, to perform a new role to be determined within each chain. Clearly, the idea is that each chain will make use of the experience and skills a person brings, although this does not always happen. The changes may involve the need to learn new skills for a new working role.

It is worth commenting on the approach the company follows to implement change: time was taken to develop a justification for the most recent changes, which are based on a blend of philosophical and business principles. In true engineering fashion, a small team of mainly engineers spent more than a year consulting with managers and staff, analysing work practices, holding numerous staff forums, and devising various possible models of working practice and organisation before finally settling on the 'value-chain' model.

For the most part, the study took place at a time engineers would themselves describe as a difficult four or five years, during which time they have had to contend with the possibility of losing their jobs on at least two occasions. The uncertain future has given them little choice but to change their roles and practices, and to be caught up in an energetic search for improved and innovative methods of working, all with the aim of improving the financial health of the company and enabling them to keep their jobs. Chapter 5 discusses the direct link between text production and job retention, when proposals are examined and shown to impact on the livelihoods of engineers.

Effects of the changes on this study

These changes have in turn affected this study in both a positive and a negative sense. The disruption to work practices was accompanied by the breaking down of established working units and departments, and regrouping the engineers into new teams, or, most recently, 'chains'. Since I was working among the engineers, usually attached to a team of engineers who were willing to offer desk space, and, eventually, a computer to use, my work was subject to the same rises and falls affecting the engineers.

Coming from an academic work environment, I have observed very little structural change, or change to working practices, in the (near) twenty years I have worked in the tertiary sector. Any small change that academic institutions try to implement is, from my observations, achieved only after lengthy consultations and negotiations, which may take years, and even then, end in failure. At HISE, however, fundamental changes are achieved in a matter of a few months, usually, including the unsettling build-up to the change and the settling down afterwards until a fair degree of equilibrium is achieved among the engineers once more. Once decisions have been made, the farewell speeches, and drinks at the pub for those that take redundancy or early retirement; the reformation of work groups; the re-establishment of floor-space territory (which may be larger or smaller depending on the relative pecking order of the group, or the assertiveness of particular team leaders); the moving of office furniture; the re-laying of computer cabling; and all the other activities associated with the changes happen quickly. The flurry of activity lasts only a week or two, even less; it is the build up and aftermath that take longer.

With each change that occurred, I had to move from one floor to another, and to find a newly formed group of engineers willing to 'adopt' me and provide me with working space and computer facilities. It is fortunate that this never proved problematic, and the disruption caused by these changes was counter-balanced by the marked changes I observed in attitudes towards researchers generally. With each change that occurred, the company was becoming more ‘high-tech’ and computerised, along with more efficient (electronic) security measures being instigated. Without any changes to the rules regarding security, it became possible for the company to provide me with improved access to information and stores of text. The longer I worked on this study, it seems, the greater the opportunity became to:

1. communicate with large numbers of engineers, when I was given access to the company's intranet, three years into study.

2. examine virtually limitless amounts of text held in the company's electronic databases. This happened in the last two years of the study.

This greater access to data occurred when a significant part of the study had already been carried out and written up, on limited samples of data, more often than not collected on an ad hoc basis. In the first few years, I interviewed whoever would talk to me or had been instructed to talk to me, and the texts I examined were a precious few documents that were considered ‘safe’ for me to see. Every document was carefully considered before being handed over to me, and was just as carefully locked away every afternoon at the end of the working day. Such changes during an ESP project are not unusual, but I wondered if the examination of larger samples of data would invalidate earlier findings.

Nevertheless, and in the spirit of the ethnographic underpinning of the study, I decided to take advantage of the new opportunities to see if they confirmed, invalidated, or could in some way enhance work that had been done so far. Fortunately, later work proved complementary to that done earlier, although the task of writing up the work has proved problematic: some of the earlier writing up has been rendered irrelevant in the light of later work. Other early sections, however, have been melded with later writing, where that writing is related and serves either to confirm the earlier work or build on it. An advocate of systematicity and objectivity in analytical work, I had been concerned about making observations and judgements based on the early data I had managed to collect; in the case of engineers' attitudes and problems, these were based on interview data, and in the case of text, on the limited set of documents I had been given. It was satisfying to be able to build upon this work with data more systematically collected.

The organisational structure has changed the working roles of all employees, including the engineers. The impact the reorganisation has had on writing practices is particularly apparent, for example, in the way engineers now carry more responsibility at all stages of the writing process, from planning and drafting to producing the final version. The impact is also apparent in the emergence of collaborative writing, where it is commonplace for engineers to work as part of a team. Team-working has been cultivated as a natural corollary of the flattening organisational structure at RASE, 'team-working' being one of the catch-phrases of current business management jargon.

There has been significant interest this decade in what Bazerman and Paradis refer to as the 'textual construction of the professions', i.e. the study of texts in the workplace 'where textual dynamics are a central agency in the social construction of objects, concepts, and institutions' (1991:4). However, this interest has its roots in earlier enquiries made in the previous decade. These early investigations arose out of a need for more knowledge about occupational writing; they were a reaction to the dearth of information that was available in the 1960's and 1970's in the area of writing at work. At that time, it was an under-researched field which had yet to respond to needs of ESP/EOP teachers who were having to deal with the burgeoning growth in demand for specialist writing courses at tertiary level.

Coleman lambasts the limited extent of research into language at work then, criticising the predominance of studies into academic environments, and querying Fishman's suggestion (1985:115) that the research is becoming more cosmopolitan. He is presumably attacking UK-based research, since he acknowledges that investigations into non-academic language use have been carried out in the USA (1989:4-6). He also reveals the research in non-academic settings to be limited in terms of work type; the research that he could find concentrated on language use in medical and legal work environments. Robinson (1989:395-427) similarly describes how applied linguists have tended to focus on studying linguistic forms and their meaning potential in scientific or technical texts, often done with a view to gaining a better understanding of the language learning needs of scientific and technical students who need to use English as a second language. Until recently, much of this work has been concerned with study skills in academic disciplines (ibid:399), with the study of language use in a non-academic environment being a neglected area of study. This helps to explain some of the difficulties encountered in this study, in trying to uncover any research which has been done on language use in an engineering environment.

Some illuminating work has been carried out in the USA (some of which is referred to in Chapter 5 which deals with proposals), including Winsor's investigations into engineering students' attitudes to writing, and influences of the workplace and engineering work culture on the students' gradual socialisation 'into producing text that was acceptable to its members' (Winsor 1996:19). However, my search for reference to any language use at all, either spoken or written, language interpretation/reception or production has uncovered literature produced by engineers about their work and very particular types of writing, e.g. machine code and computer language, but little that has been done by fellow applied linguists or sociologists on engineers' writing in non-academic settings.

In the broader arena encompassing all types of working environment, Odell and Goswami, like Coleman, found information lacking in the 70s and early 80s. They describe early discussions they had on the sort of writing college students would have to do when they entered the world of work:

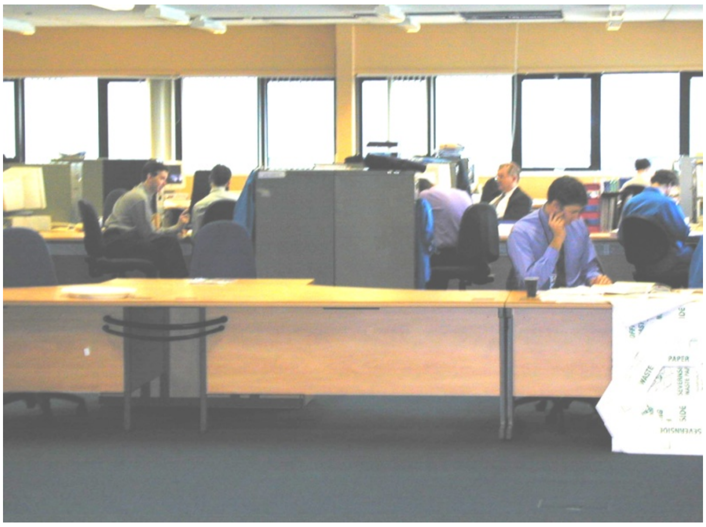
> We quickly realised that we didn't know enough even to speculate about the writing people had to do in business, government, and industry. ......we had no idea how many people, apart from those specifically hired as writers, had to do much writing as a routine part of their day-to-day work. And we had no personal knowledge about the forms this writing took, about the diverse rhetorical and conceptual demands it entailed, or about the kinds of sophistication these writers possessed (or lacked). (1985:vii)

They could afford to be candid about this ignorance, which they describe in the preface to their book, because they spent the next few years ridding themselves of it, and becoming catalysts for further research into the area. They were motivated to conduct a series of studies into writing in non-academic settings which in turn led to the compilation of their seminal book (Odell and Goswami 1985). Much of the innovativeness of the research and cutting-edge quality of the book endures to the present day, including as it does, for example, investigations into the relationship between social context and writing (Odell ibid.), in-company writing and editing practices (Paradis, Dobrin, and Miller ibid.), argument topics in engineering reports (Miller and Selzer ibid.) and a description of the ways ethnographic methods can be applied to research on writing (Doheny-Farina and Odell ibid.) providing useful ideas for this study, ideas which are investigated later. This early clutch of investigators have continued to research this area into the 1990's, as evidenced by the collection of work in Bazerman and Paradis (1991). Doheny-Farina, for example, picks up the thread of points raised by Paradis et al (1985) that writing may influence the social nature of the context in which it exists. He describes how a text can reflect and shape the organisational and social structure of a company (1991:306-335). This study, however, examines texts from a somewhat different perspective, examining how engineers attempt to portray and 'sell' their product through text, and trying to analyse the text in sympathy with their views.

1.7.4 Physical aspects of the working environment

Open-plan offices - sitting and working in teams

HISE engineers in Plymouth work in large open-plan offices, which take up almost the whole level of a building, and are not unlike capacious school assembly halls. They work in teams, with their desks arranged in clusters, and with a meeting table or two within each cluster. Each team marks out its territory with low level screens of chest height, which enclose desks, filing cabinets, fax machines, printers, model ships, engine parts, kettles, and any other equipment belonging to those in the cluster. Work talk and banter is easy among team members because of their close proximity to each other.



Photograph 1-1: Open to view and easy communication with others

While sitting at a desk, it is a simple matter to see where an engineer is, or what other teams are doing, by craning your neck. It is equally simple for members of different teams to converse with each other across a narrow divide. Movement from one cluster to another is unimpeded, and engineers frequently visit colleagues in other teams to consult with them.

The open-plan halls are linked together by vestibules offering such facilities as drinks machines, snacks dispensers, washrooms, noticeboards, and library. If their work is particularly sedentary, and does not require them to visit different parts of the site or take them off-site, it is usual for engineers to stretch their legs at intervals, by walking to and from these vestibules, strolling through the lengths of the open-office spaces, sometimes going from level to level, and surveying the scene on the way. The vestibules are natural places for employees come across each other, or to congregate for impromptu meetings or chats over the water-fountain.

Photograph 1-2: Engineers with their product (GPEOD)

Photograph 1-3: Impromptu discussions are common

A flat organisation influences the writing process

A significant proportion of RASE engineers used to work in the armed forces or in various departments of the Ministry of Defence (MoD), and have clear recollections of what it was like to work in a tightly structured, strictly hierarchical organisation. In their previous working lives, they had clearly delineated roles, knew exactly where they were ranked in the hierarchy, who they had to answer to, and who was answerable to them.

A fairly typical example is an engineer who worked as a ship's engineer in the Royal Navy. He remembers being conscious of his position relative to others placed higher or lower in the hierarchy, and of being required to write reports, since it had been decided by those 'higher up' that he was quite good at it. Any reports he wrote were solo efforts, and had to be presented to his superior officer, a Lieutenant Commander, who would examine it and, in the engineer's own words: 'cross the i's and dot the t's [sic] as he was wont, and then he would put his name to it and say 'yes, I agree', before it would then go off for the final signature from the captain himself.' Had his superior officer decided the report needed improving in any way, he would have sent it back to be changed, and the process would be repeated all over again. When the Lieutenant Commander was happy with the revised report, it was then sent to his superior officer, the Captain, who would read it, and, possibly finding something amiss with it, would send it back to the Lieutenant Commander, who would send it back yet again to the ship's engineer. As a result, the report could travel up and down the chain until the highest ranking officer was completely happy with it.

This type of writing process is in complete contrast to the way documents are presently produced at HISE, where the working environment has been deliberately arranged to facilitate closer working and writing practices. The open plan office, lack of physical (and hierarchical) barriers, and team working encourage members of a team to work more closely and to consult more frequently with each other than in organisations which are more hierarchically or atomistically structured. What this actually means is that any major writing project, for example, the need to prepare a proposal or produce a technical handbook, is a co-operative effort involving collaborative writing practices, so that the burden of the writing load is shared amongst the team. Distinctive aspects of working and writing practices at the company are discussed in the next chapter.

1.8 The engineers

1.8.1 Introduction to the engineers who contributed to this study

This section introduces the engineers who helped to inform this study, by reporting on their attitudes to their work as engineers, and perceptions of the writing problems they have. The information about the engineers was gathered mainly during two surveys:

1. an early investigation of engineers' attitudes to writing, based on interview data.

2. an email survey conducted later in the study

More than eighty HISE engineers contributed to this study in some way, either by being interviewed about their writing, or by allowing me to consult them, or by taking part in the email survey reported on in this chapter and Chapters 2 and 3. So far as working and writing practices are concerned, the engineers are fairly representative of the REMA industry as a whole, many of them having worked at other engineering companies or MoD departments around the country. Also lending credence to this claim is the frequent contact they have with engineers from other aerospace and engineering companies within this country, Europe, Japan and the United States. This inter-company contact includes a significant amount of discussion about documentation, including collaboration on how it should be written and collaborative writing practices. The engineers contributing to this study have been concerned with producing documentation for all stages of a project, starting with writing proposals in attempts to win in a bidding process, writing design specifications and requirements, and producing support documentation in the form of manuals, handbooks, and on-line helps.

This particular community of aerospace engineers works on both hardware and software systems, with the majority being practical engineers, concerned with the design, production, and maintenance of a product, whereas a minority are mainly concerned with theoretical modelling and research. A few of the informants are primarily concerned with management and commercial aspects. All, with the exception of five, are men.

As an overview, it is useful at this stage, to simplify the somewhat complex picture of the various types of engineer, by narrowing them down to five major categories, and to describe them by borrowing the spoken words provided by a support engineer to help describe the categories in 'lay-speak':

1. Mechanical – 'designs the casing'
2. Hardware/Electronic – 'designs the circuits and innards'
3. Software – 'designs the software that makes it work'
4. Systems – 'integrates all the above, and makes sure the whole thing works'
5. Support – 'looks after the system, providing help and maintenance when it is being used.'

It would be more accurate, in fact, to place the systems engineer at the top of the list, since he develops the functional concept of the product which is developed by the other engineering disciplines. However, this simplistic portrayal is expanded upon later, in Section 1.9 where a description of the engineers who contributed to this study is provided.

It is worth noting that the brief explanations used by the support engineer are product-centred, in that they relate to the product rather than to the customer, of whom there is no mention. This has been a common feature of most 'over-heard' engineers' discussion over the six years. In spite of company exhortations that engineers should be more 'customer-focused', their informal talk in day-to-day discussions reveals that in their working inclinations, engineers are still essentially product-centric, i.e. they are naturally pre-disposed to thinking about the product. In my opinion, this is perfectly understandable, and does not mean that the Customer is ill-served. This is far from the case, although it has led to some prevarication over terminology later in the study where I have to decide between using product-centred and customer-centred terminology ('product' versus 'solution', 'product-support' versus 'customer-support', and 'selling-point' versus 'benefit' are examples), and reach uneasy compromises in some cases. An early observation about design and support engineers

In the above list, it is possible, in fact, to see two broad categories of engineer, which for the sake of simplicity and practicality, I shall refer to as design and support engineers, i.e. the first four categories and final category, respectively. Both types helped to inform this study, bringing a different perspective and different views. Naturally, since this is a study into design documentation, many more design engineers have been consulted than support engineers, although the support engineer is the mainstay and primary source of reference for the Customer once the product starts to be used. I sat amongst support engineers during significant periods of this study, and learnt from them as well as from the design engineers about the product and documentation concerning it.

Design engineers have a tendency to be egocentric, i.e. overly focused on arcane features of design. Of course, not all design engineers are narrowly-focused, but as a general rule, this observation holds true. The very nature of their work, work practices and procedures encourages design engineers in this tendency. If it were not for the involvement of the support engineers in the early stages of design (in proposal writing), it could be argued that the design engineer would be less mindful of issues concerned with the use of the product. Several stories, which are possibly apocryphal, circulate about design blunders. One, which is cited by support engineers to show how the problems would have been averted had they been consulted, concerns an anti-tank weapon which was designed to be used in forests in cold regions. When it had been built and was being tested in the field, the user found he could not operate it with gloves on; nor could he see the controls in the dark. Although all engineers tell stories of this type, support engineers are particularly good at telling them. Their perception is that they have lower status in the company, and are consulted less than they should be in matters of design. An unexpected finding in this study is that certain texts reflect this impression, in their information content. This issue of design engineer versus support engineer in text is discussed in Chapter 7.

1.8.2 The email survey - engineers at HISE

The purpose of this section is to provide a summary of the engineer members of the discourse community, including information about their jobs, writing issues at work, their attitudes to and their perceptions of their own writing abilities. To begin with, let us consider the range of engineers who work at the company, and their thoughts about themselves and their work. The following is a report on the responses they made to a questionnaire sent via the company intranet. A copy of the complete questionnaire is provided in Appendix A, the first part of which explains to the engineers my motives for the survey.

The email questionnaire was sent out to a sample of around 120 engineers working at the company and was intended to both confirm and supplement findings gained from the earlier survey of interview data relating to engineers' writing problems and their attitudes towards writing generally. Oppenheim discusses descriptive survey design, where surveys cover large 'populations'(1992:38). In my study, I surveyed a sample of the members of this discourse community, who more specifically are not necessarily representative of the whole community, but are representative of the engineers concerned about the design, manufacture, and servicing of the product, and therefore of particular relevance to this study.

Response rates to written questionnaires are generally low, and I was concerned that the message should attract the engineers' interest, rather than the pressing of the 'delete' key. Oppenheim mentions that a postal questionnaire may easily produce a response rate below 40% (1992:81) He goes on to discuss how the response rate may be determined, with one of the main determinants being the respondent's motivation. Clearly a researcher stands to gain from respondents giving time and thought to the questionnaire, but if the respondents can see some gain for themselves, it is less of a one-sided transaction. I offered what Oppenheim calls rewards which are 'intrinsic to the subject of the survey' (ibid.:82) which would encourage the respondent to respond, by promising to keep them informed of the results of the survey, and offering to correspond with them about language questions. In spite of email questionnaire weariness, since HISE employees are often contacted for information in this way, the response rate was almost exactly 50%.

The different engineers who informed this study

Summary of responses to the question: What sort of engineer are you?

Since the sampling of the engineers had been random, it seemed logical to discover which areas of engineering respondents worked in, in case it should prove necessary, at a later stage to analyse correlations between batches of results. However, as they stand the responses to the questions proved intrinsically interesting, and show that, in this community of aerospace engineers, a range of engineering disciplines is represented. The question was intended to gather straightforward information about the engineers' qualifications and/or positions at RASE. However, since I was curious about how engineers viewed themselves professionally, it was expressed as an open-ended question. It was hoped it would elicit responses which would convey the engineers' perceptions of themselves as professionals.

Structure of the responses

All the responses included information about one or more of the following, with each response including reference to job designation and/or qualifications (No 1 and/or No 2):

1. Job designation
2. Qualification/engineering domain
3. Particular product the engineer is working on
4. Explanation, for example, if qualification does not obviously reflect present job
5. Joke

How engineers refer to themselves and the jobs that they do

The table in Appendix B shows the different categories by which the engineers identified themselves. In all the responses they refer either to their current work or positions, or to their qualified status, as exemplified by the following responses: ‘Software’, ‘Graduate Electronics Hons Engineer’, ‘As for my discipline, I’m a mechanical engineer’.

However, if an engineer's present job designation does not reflect his or her engineering background, the engineer provides information about original engineering experience or qualifications, for example:

> Quality Assurance with electronics background
>
> Support. Control engineering originally
>
> I am employed as a Systems Engineer but I am qualified as a Chartered Electrical Engineer
>
> Technical Director (ex-Systems Engineering)
>
> By formal training an electronics engineer. By career, a systems engineer.

Some engineers refer to the fact that their work involves different areas:

> I am a hardware engineer - although I get to have a go at systems, software, mechanical - whatever needs doing!
>
> Labelled as Systems Engineer ..... reality is sitting on the fence between AR [Applied Research] and Business.

Others mention the product they are working on:

> Electronic Engineer (Factron ATE)
>
> Systems Engineer in Navigation VC
>
> software engineer working in the YGO46 development team
>
> TERPROM (navigation) systems engineer

A few engineers begin their answers jokingly with ‘A brilliant one’, ‘About average!’, ‘A geriatric one’, ‘An ageing one’. One begins by describing himself as ‘practical’, and another states his belief that engineering is in the genes, these two particular responses reflecting a feature of replies to later questions which indicate that some engineers see themselves as belonging to a distinct ideological or engineering-oriented group in society, a notion that arises in responses by other engineers to other questions.

The categories of engineer

Electronics (25%) - By far the largest group comprises electronics engineers, four of whom refine their job descriptions by describing themselves as being concerned with design, systems design, or design and testing.

Software and systems (20% and 18.3%) - The second- and third-largest groups are software and systems engineers, comprising twelve and eleven respondents respectively. Systems and software appear to be straightforward categories, because few offered explanations apart from two engineers, who, seeing themselves as straddling the two categories, responded with 'software/systems analyst' or systems/software. There is clearly an inter-dependence between these two categories, where, put simply, the systems engineers are mainly concerned with design and drawing up requirements, and the software engineers with implementing those requirements.

Mechanical (8.3%) - A smaller proportion of the respondents are mechanical engineers, with one who described himself as 'lapsed', since his work is now more of a commercial nature.

Others - Production (5%), Support (5%), Mechanical design (3.3%), Manufacturing process (3.3%), Test equipment design (3.3%)

The smallest groups of respondents are connected with mechanical, production, support, mechanical design, manufacturing process, and test equipment design engineering. There were single responses for hardware, optical, electronics and control systems, and metallurgical and materials engineering.

Summary of responses to the question: Why did you decide to become an engineer?

Reasons for asking a question about career choice

I wanted information about this because I had collected anecdotal evidence from interviews indicating a belief that engineers generally chose their profession because they underperformed in communication skills and had inadequate L1 proficiency. While visiting two British universities with large engineering departments, I learned of the view generally held by lecturers in engineering that their undergraduates were deficient in EL skills, and, because of this, had chosen to follow a science and maths course of study at school as an avoidance strategy. I also wanted to see if any credence could be lent to stories I had been told which seemed to indicate the existence of a type of engineering lore, mentioned earlier. This lore is perpetuated by the engineers themselves, and has yielded a variety of horror stories about how badly engineers write, how these poor writing skills lose the industry millions of pounds, how inarticulate they are in oral interactions, and how they have been criticised or humiliated at school.

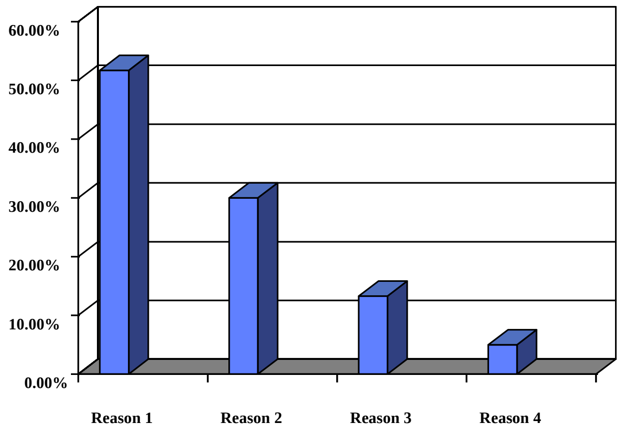
I shared some of these anecdotal findings with the engineers by including in the introduction to the email extract the provocative, but nonetheless truthful opinions I had heard about language proficiency, and attitudes to English. This question evoked old memories in some of the respondents, and motivated a significant proportion to write a few sentences, or paragraphs in answer to this question. In a few cases, it led to email conversations, or 'conversational threads' (a term coined by the intra-net software used by the engineers, Lotus Notes) in which language issues were explored and where engineers expressed their views or clarified points for me. The following 'conversation' is one example of this:

> Answer: I became an engineer because I was always curious about 'how things worked'. I did enjoy Maths more than English at school because I found English boring, therefore I didn't work as hard at English (and other Art subjects) than I did at Maths and the Sciences. I did not make a conscious decision to become an engineer because I didn't like English.
>
> Many thanks, *[name]*. I take your point about wanting to be an engineer because you were interested in how things worked rather than not liking English very much. Do you mind telling me, did you study mainly English Literature at school? or was it a mixture of English Literature and English Language? Hazel
>
> I studied a mixture of English Language and English Literature at school. As far as I can remember English Literature was an optional extra and I was advised to study it. In hindsight I wish I hadn't studied Literature because I had no interest in it at all and it was such a 'turn off' that I believe that my Language suffered as a consequence. Needless to say that I failed my Literature 'O' Level and probably only just scraped a C grade in Language. If I had just concentrated on Language I would have probably achieved a higher grade in this subject. My English teacher was awful too and I think that she was a major factor in my dislike of English. If she had made the subject more interesting I might have done better. Do you want me to go on? My school memories just have come flooding back!

Methodological considerations

All comments were recorded and categorised. Most of the comments referred to the reason for the engineers' choice of career, whereas others provided extra unsolicited information. Categorising responses to this question was simplified by the fact that most of the respondents provided a single reason for becoming engineers. A small minority, who provided two or more reasons were classed according to the first mentioned or most logical reason, where the nature of the whole response was considered. All the reasons the engineers provided can be seen to fall into four main categories. Three of these relate generally to a technological predisposition, a wish to do something practical, a liking for problem solving, and a preference for mathematical / scientific subjects. The fourth is concerned with financial considerations and the wish to earn a good salary.

Why they became engineers - the results



Key
Reason 1 - technologically inclined; positive or neutral towards Arts subjects
Reason 2 - performed better in the Sciences, less well in the Arts
Reason 3 - aspirations and/or family influences
Reason 4 - financial

Figure 1-2: Why did you decide to become an engineer?

Reason 1 (51.7% of the respondents) - Wanted to be technologically creative, and absence of negative feelings about English

This can be further sub-divided into two sub-categories:

1. No particular dislike of English (23.3%)
2. Preferred science, but also liked/equally good at English (28.3%)

The results show that more than half the respondents (51.7%) became engineers because they had a keen interest in how things work and a wish to work in a job which was practical and involved problem solving. Such motivation has made this by far the largest group as compared to the next category which comprises 30% of the respondents. A distinctive feature of engineers in this largest group is that they were either neutral or positive in their attitudes towards English and Arts subjects, but with an over-riding liking (and, in some cases, love) of science and/or mathematics, an interest, (and, in a few cases, a passion) for tinkering with machinery or making things, and feeling an affinity towards things technological. Here are some of the replies from respondents in this category:

> I enjoyed science (especially physics at school) and saw engineering as a useful example of applied science.
>
> Interest in making electronic gadgets
>
> I would agree that I fitted into the Maths stream. I was more interested in science than arts at school but I wouldn't say that I disliked languages particularly

> Very interested in science - I see engineering as one of the best ways to exploit this.
>
> The desire to ‘make something’, and the ability to mend televisions! It certainly wasn’t my Maths ability (average) or dislike of arts (I’ve got Latin, Geography, History and Art ‘O’ Levels).
>
> My natural bias is towards maths, I like to see something functional as a result of my work, I don’t dislike Arts subjects.

A significant proportion of engineers in this category (28.3% of the total) liked and/or were equally good at Arts and Science subjects, but nevertheless had an over-riding interest in things technical, problem solving, and tinkering with machinery. An engineer who epitomises this group explained how he enjoyed science subjects at school, had a hobby of making electronic gadgets, and wanted to join the Royal Navy. However, he also did well at English and foreign languages. Another engineer, in no uncertain terms, contradicted my suggestion of the stereotypical engineer who is inclined towards Maths and Science, but disinclined towards English and Arts subjects:

> In my case you could not be more wrong! ... I am certain I do not fit wholly into either ‘stream’ ..... As it happens I got high grades in both English subjects, Drama and German, but failed Geography and technology, and only just scraped by in Maths. I did, however, get high marks in both Science areas ...... I have always been interested in Technical things.

Several others expressed variations on this theme, for example:

> I chose engineering mainly because I like problem-solving. I did not dislike Arts subjects, but found them to be not as challenging as scientific subjects
>
> I enjoyed both maths/physics and English language/literature, but it was predominantly my love of science that swayed me. I also enjoyed practical subjects and wanted to escape from an office-based career [one of five female engineers who responded].
>
> I very much enjoyed English in school and the science subjects too. I was pretty good at all my subjects but it was much more fun to play rugby and experiment with electronics after school rather than to try and read Shakespeare plays.

Engineering is essentially creative

Several engineers explained that they wanted to do something that was useful to society, with a few believing they were predisposed to be engineers. A striking feature of the responses is an indication of the belief that an engineering job is essentially creative. Many became engineers because they wanted a creative occupation, and as can be inferred from the following verbatim extracts, there exists a kind of technological ideology which holds that engineering is essentially creative and will satisfy engineers' creative urges:

> I wanted to create something
>
> When leaving school I naively thought that engineering would offer a chance to be more creative!

> Although better at English than Mathematics I was fascinated by Amateur Radio and Electronics as a boy and I suppose that I have not really changed. I wanted to follow a career with a scientific bent from my early teen years, and after university decided on engineering. Encouraged by my father … I retained an interest in English language, both written and spoken.
>
> I have always wanted to make things. Engineering seemed to be the best route. .... I would describe it more as a science bias than a maths bias, my maths was not brilliant. I did quite well at English language but not at literature.

Reason 2 (30% of the respondents) - Performed better at Science (and Mathematics in several cases) and less well in English.

Nearly a third of the engineers conform to the stereotype described in the questionnaire, with responses which clearly indicate their better performance and competence in the sciences, and, in several cases, mathematics. This scientific inclination was a deciding factor in their choice of engineering as a career. All the engineers in this category clearly believed themselves to be poor (or underperformers) in Arts subjects, as exemplified by the following comment:

> Was inclined towards science subjects. Poor performer in geography, art, history (definitely!!)
>
> a) I became an engineer because it was the easiest way to express my creativity. b)I fit into the Maths stream c)I was not good at languages at school. The mechanics of both reading and writing never came naturally to me, consequently, it is much easier for me to do engineering type jobs which involve a lot less of this.
>
> I was very good at Maths at school and very bad at English, I don't know when but at a very early age I wanted to get into Electronics when I left school.
>
> I am a Maths stream person. I was good at Maths, Science and practical subjects at school. I always found spelling difficult and never performed well in English.

Reason 3 (13.3% of the respondents) - Aspirations, and/or family influences when young

Eight engineers mentioned childhood aspirations or relatives who acted as role models for them as being influential in their decision to become engineers. This was the reason given by these respondents, although it does not preclude them from belonging to other categories. One engineer, for example, explained when questioned further that he had been equally good at Arts and Science subjects at school, but had always wanted to join the Navy, and had therefore given this as his reason for becoming an engineer. Similarly, engineers in other categories would identify with sentiments expressed by those in this category; it is not unusual, for instance, for engineers to have fathers or older siblings who are engineers. Engineers in this category wrote:

> Becoming an engineer was an ambition, similar to the more traditional desire to become a train driver.
>
> I was told that girls couldn't be engineers and set out to prove them wrong!

> It was a natural progression. I'd wanted to join the Navy when I was a boy. I'd always liked fiddling with machinery and the Navy let me do this.
>
> My father was an engineer.
>
> My cousin was a role model and did influence my chosen [choice of] career.

Reason 4 - Financial (5%)

In this smallest category, only three engineers cited financial reasons for choosing engineering as a career:

> Nothing to do with English- wanted To earn lots of money (what a fool I was!!)
>
> It was a fairly mercenary [motive] to go with the subjects that (in theory anyway) would give better earning potential after university.
>
> Wanted male rates of pay ......

Section Postscripts

Postscript 1 - female respondents: Five women completed the questionnaire. One of them, reflecting a generally held view that women are better at language-related skills, suggested that female engineers were probably equally good at Arts and Science subjects, and furthermore, were probably more proficient writers. However, small though the female sample is, this belief is certainly not substantiated by the findings of this study, as evidenced by the following responses, all of which were provided by females:

> I did prefer maths, physics and art at school as opposed to subjects involving lots of writing, e.g. Biology, History and literature.
>
> Performed better in Maths and science subjects at school, and less well at writing and spelling.
>
> This may be more of a female trait - I enjoyed both maths/physics and English language/literature, but it was predominantly my love of science that swayed me. I also enjoyed practical subjects and wanted to escape from an office-based career.

Postscript 2 - the importance of developing language competence: Although not asked for this information, some engineers mentioned how they have changed in their attitudes towards English and language competence. Generally, they did not regard it as important or interesting at school, but through experience have come to see the importance of developing language competence in themselves, as an integral part of their personal and professional development:

> I often have to rewrite old instructions .... which are ambiguous, vague or not understandable. In this form they are ignored by the Operators and we wonder why work is not being done effectively. …. .... Every time I do a re-write, I recognise later on that I could have done a better job of it.
>
> [Expressing his indifference to English at school] English was kind of neutral at that time. More recently I have actually become interested in the use of language and have noted its deficiencies for such engineering tasks as system specification.
>
> I got much more interested in English [English language] as I got older.

> .... later in life I realised how important English is. No matter what career path anyone follows, English qualifications are needed …. people who cannot express themselves correctly will not progress in life.

Postscript 3 - Criticisms of the education system: Comments were also made, with some bitterness, about negative school experiences and indifferent teachers. One engineer described how he was not averse to Arts subjects, but that he was not encouraged by his teachers to pursue them. Similarly, another engineer who enjoyed learning French, but who did not particularly 'shine' at it, clearly recalls being told by his French teacher in a threatening tone:

> Now, you won't be doing French next year, Smith, will you Smith.

Others were overtly critical of teaching:

> With my children in that age group [8 to 12 years] I see creativity being rewarded more highly than correct English.
>
> I believe the means for teaching English in the past have been unimaginative and uninspiring.
>
> My English [Literature] teacher was awful too and I think that she was a major factor in my dislike of English. If she had made the subject more interesting I might have done better. Do you want me to go on? My school memories have just come flooding back!

Comments were also made about school influences, and shortcomings of the education system which forced some engineers to follow an almost exclusively scientific 'stream':

> Liked sciences and Arts at school (not so good/keen on English) but options not available to study arts as well as sciences . I therefore chose sciences.
>
> Had to select either Technical or Language based stream: chose technical because I was better at it. School forced me to choose between Maths/Science and Arts when it came to A Levels.

Final postscript - a note of regret: Three engineers hinted at some dissatisfaction with their choice of career, and two expressed it more plainly:

> …Personally I would have liked to have done a philosophy degree – but figured I can always go back and do that later.
>
> I often wish I hadn't. ….. I guess I ended up on a conveyor belt heading in that direction due to a science aptitude and interest in building things ......

1.9 Product - the focus of design documents

1.9.1 Introduction – providing a wider graphical context for writing

Up to now, we have considered attitudes and work practices in the company. In this section, we consider how these are all geared towards a successful outcome in the design and manufacture of products for customers. It was thought necessary, in the early stages of the study, to depict the results of my investigation into the writing context diagrammatically, to provide a pictorial backdrop in order to consider engineers' texts and their communicative function. This section charts my attempts to achieve this. It traces the thinking that led to graphic representations of human work interactions, writing, and design processes that provide the context for considering the written texts discussed in later chapters. It culminates in an attempt at a diagrammatic representation of all the key influences in text production in the design engineering workplace.

Attempts to represent diagrammatically the life-cycle of any product

Initial attempts

I started to write this section at the very beginning of my PhD studies, working on the assumption that it was important to build a holistic picture of product development within HISE in order to grasp how text functioned as part of that process. From that basis, I reasoned, the communicative function of particular texts could be better understood. It was easy to find published information on product development, since engineers seem fascinated by processes generally, and engineering text books reflect this interest. Early discussions with them revealed a description of product development closely matching those in the engineering books they showed me. My interest lay in the fact that theory did not seem to match up with observed practice. The descriptions and diagrams in the literature did not provide a satisfactory backdrop against which to contextualize my textual data, so that in the end I decided to devise my own diagram to represent the life-style of a product.

A wide choice exists of diagrammatic representations of the kind of product life-cycle, typified by Jones (1989:xii), shown below. Apart from being circular in some way, a striking feature of such diagrams (other such examples are provided in Texel and Williams (1997), and Underwood (1994:140) is their commonality with such diagrams in textbooks of other subjects. We would find similar drawings in Educational Technology or syllabus design textbooks, which would seem to indicate that a basic cyclic diagram may represent the life cycle of any 'product', be it a physical artefact or an educational course.

Without exception, each engineer consulted for this study has a clear view of how his work contributes to the overall development or use of a product produced at HISE. Every engineer is usually attached to a particular product or group of products, and has a good idea about why the product is required by the customer, and the nature of the various stages in the design and making of that product. If he has not been involved in the early stages, he can refer to the documentation, which plays a key role in recording the design, business, and contractual decisions taken, which engineers write during the life of a product, from its earliest conception as an abstract idea through to its use by the customer. This section, then, describes how RASE engineers see the product from the very earliest stages through to the very end, when it is no longer used, and is discarded by the customer, a cycle which may last for as long as twenty or thirty years in the case of some products, for example, a gun-firing system for a frigate, or the wing of an aircraft.

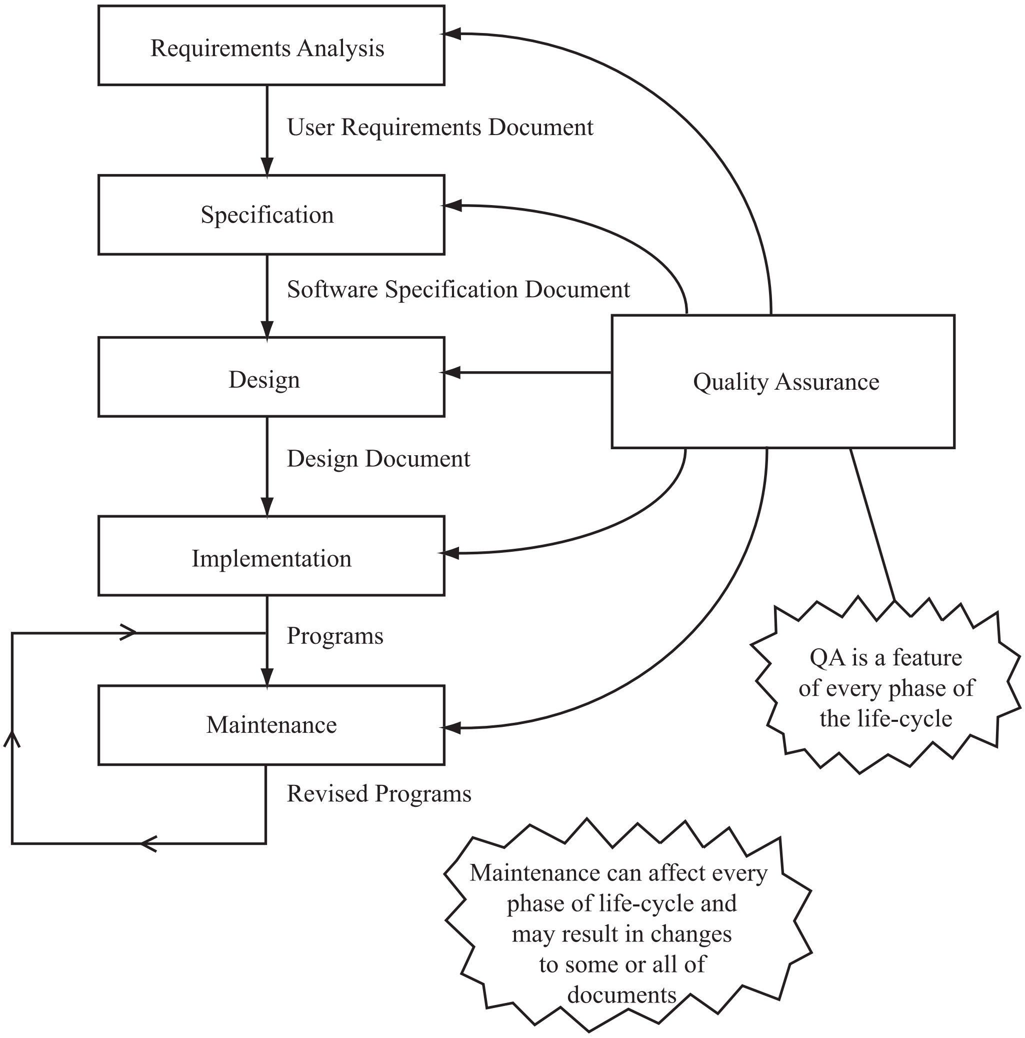


Figure 1-3: The Software Development Life-Cycle taken from Thomas, P. et al (1994:18) **(Notebook No 1, P25)**

Figure 1-3, taken from Thomas et al (1994:18), is useful in that that five stages in the development of a product (in this case, software) are shown, together with corresponding types of writing or documents. A further search through engineering and business texts yielded numerous other diagrammatic representations of production/commercial process, but no other source could be found that juxtaposes information engineering design processes and document generations in the way depicted by Thomas et al. However, the linear arrangement of the stages, with a clear beginning and end, did not match my perception of the design process I was observing around me. More appropriate seemed to be the circular diagrams, like the one below, by Jones, who identifies ‘seven distinctly different phases of a product life-cycle’ (1989:xii), portraying them diagrammatically thus:

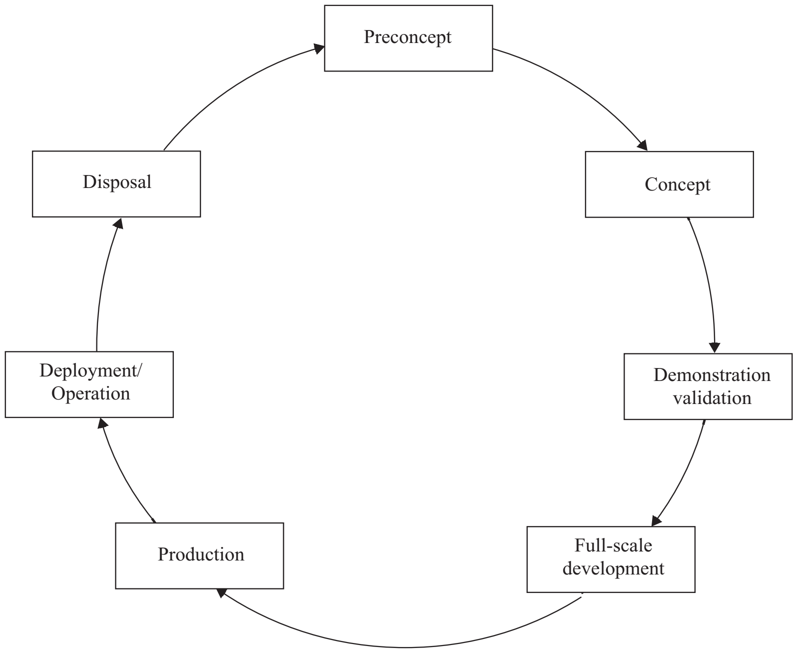


Figure 1-4: Product Life-Cycle taken from Jones (1989: xii)

Figure 1-4 is typical of the kind of graphic portrayal of the product-as-process to be found in engineering and business literature. This particular diagram is one of the better ones for my purposes because it shows the process as being cyclic and comprising stages which better matched the findings of this study.

It is wholly product-oriented, however, and labels used in the diagram express the cycle, not unnaturally, from a product perspective, so that ‘pre-concept’ means ‘pre-concept of the product’, ‘full-scale development’ means ‘full-scale development of the product’, ‘disposal’ means ‘disposal of the product’ and so on. I was looking for a more inclusive representation, i.e. a diagram which could account for human, textual, temporal and product dimensions. This seemed unachievable at the time, but, nevertheless, it was seen as important to the integrity of the ethnographic underpinning of the study to examine texts within a meaningful context, and that context had to include the ‘key players’ if it was to be of any use at all.

A diagram was therefore developed along similar lines to that provided by Jones, but which included consideration of the engineers’ and customer’s roles, as well as the product. It also attempts to take account of significant work processes engineers are involved in at different stages which demand certain types of documents to be produced. As can be seen, the product, as a concept or physical entity, is a key concern at every stage, whereas human participants change, as do the types of documents that are produced. The engineers which are one of the foci of this study, are involved only in the design of the product.

The diagram shows clearly the stages of product development which are their concern: these range from early thoughts about the product to the making of a formal proposal about the product to the Customer. The former may be captured in scribbles (literally) on the back of envelopes, day (log) book entries, technical notes, and Requests for Information (RFIs); the latter in the form of often lengthy text submitted formally to the Customer in bound volumes.

The following diagram (Fig 5), then, was an early attempt to provide the context for considering the design engineers' work and their texts.

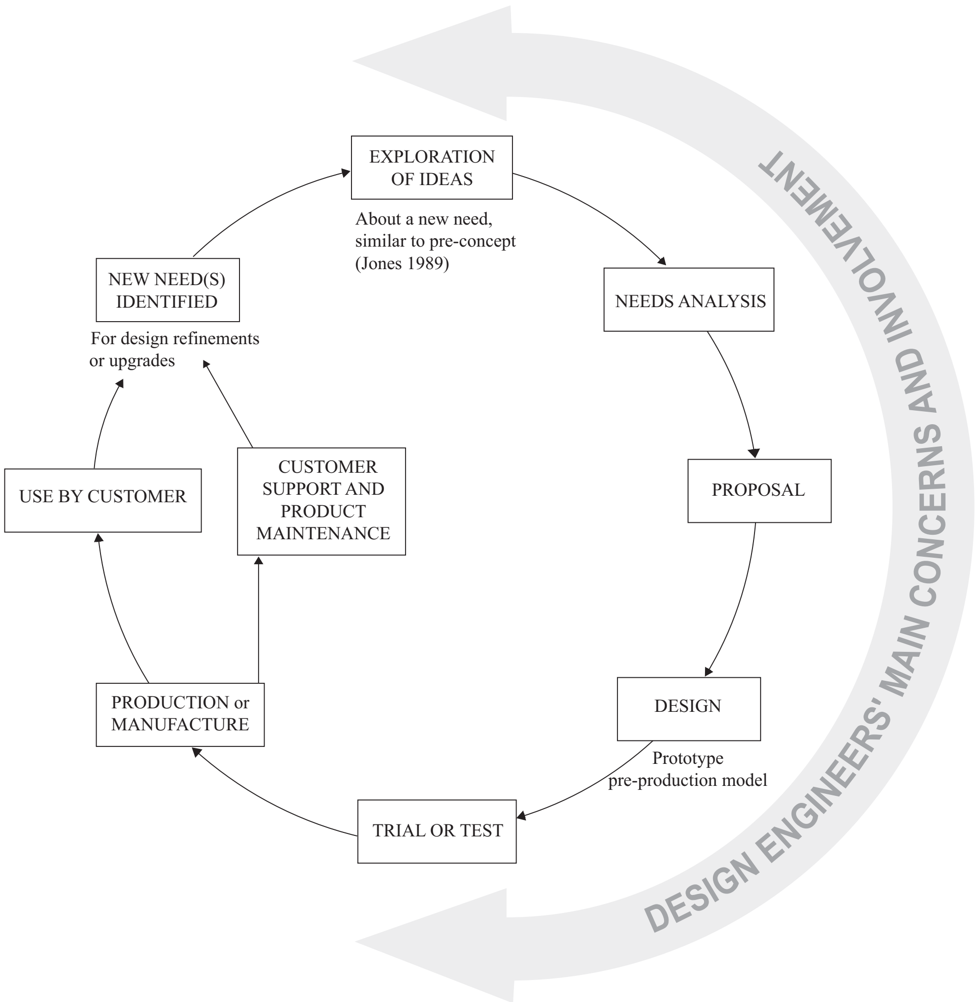


Figure 1-5: A cyclic representation of the design process

However, in diagrammatic terms, a more accurate representation of the product life-cycle is a spiral. A spiral conveys the dynamic and continual nature of the design process. It spirals outwards in an ever expanding growth, to reflect the accrual of knowledge and expertise which builds up, in a sort of compounding effect, as the product is designed, tested and used.

Thus, a product life-spiral, evolved out of Figure 1-5, in the form of the diagram below (Figure 1-6).

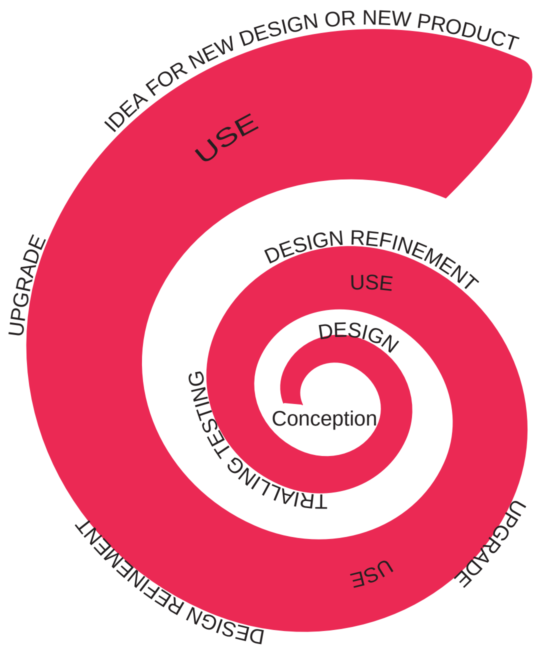


Figure 1-6: A product life-spiral

All the knowledge that accrues is captured in some way, most usually in orthographic form, and may include quick sketches and scribbled notes in an engineer's daybook. More recently, the knowledge has been, to use the engineers' term, 'captured' in electronic (as distinct from paper) format in word processed files and electronically held 'notes' and 'comments'. Whichever the format, however, this body of knowledge is held in text or diagrammatic form, and it is stored and saved as something precious, sometimes immeasurably precious, to the company and to the engineers. Figure 1-6 encapsulates well this body of knowledge, which I would refer to as design data or design information, and I found the spiral attractive for a while, for its depiction of the expansionist nature of this information. However, it still seemed inadequate for the purposes of this study, since it does not represent adequately the temporal dimension of product development. It is possible that this is too much to ask of any two-dimensional diagram since the full extent of any product's life time is difficult to gauge, until the product is deemed 'dead'.

As an example of this let us consider the gyroscope, for which HISE is renowned in the navigational field. One engineer, who was explaining a more recent gyroscope-based product to me, said this as a concluding observation:

> The momentum of the business stems from that original design. We are where we are today because of Elmer Sperry [who designed the original gyroscope]. (BPO 28.07.01).

The mechanical gyroscope he was referring to was originally conceived in the late 1800s, with a formal design proposed in 1902. The design for the gyroscope formed the basis of navigational equipment used by the British Royal Navy. Emerging out of this mechanical gyroscope, the silicon gyro was designed in the early 1990s, using silicon-chip technology, which looks set to form the basis of new navigational aids for aircraft, and much more recently, as a motion sensor for the Segway HT mentioned earlier. It can be seen, then, that the so-called life cycle of a product can extend across several decades, and more. In the case of gyroscopes, it has extended across the whole of the twentieth century and into the twenty-first. Long timescales are common in the engineering industry, particularly in the defence industry, and this extended temporal feature is a significant factor when considering engineers' writing (and working) practices and the potential longevity of design documentation.

The emergence of a final graphic representation

Therefore, yet another attempt was made, although this time the spiral was unravelled to better show the chronological ordering of:

- Key stages and events
- Main work processes
- The textual orientation (i.e. external or internal audience) of the writing produced at each stage

It is unlike the usual compartmentalised models of this kind propounded by Thomas et al (1994) and Jones (1989), and depicts the design process as being a continual one. It attempts to portray a temporal dimension to indicate the time the product is in use, and even potentially beyond that, if the technology is not superseded and made obsolete by design developments. Figure 1-7 below, then, is a stab at achieving this. It shows the stages of the 'life' of a product from an engineer's perspective, rather than from a finance, or marketing and sales perspective. Its overall function is to provide a useful context for considering and categorising the texts engineers write. It also serves as an accompaniment to my attempts to provide a meld of my applied linguist's perception and engineers' views of the life-cycle of a product, explained later in this chapter.

I see documentation produced by engineers about the product as falling into three main categories, coinciding with three macro-phases in the product life-cycle:

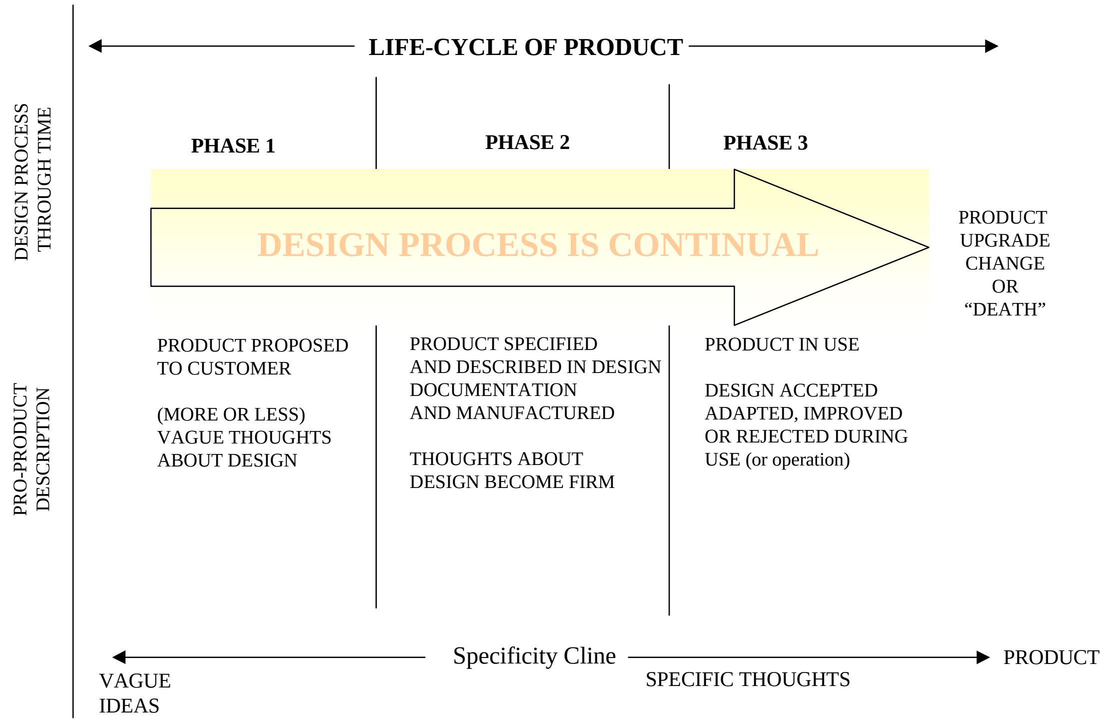


Figure 1-7: Simplified representation of the product life-cycle - three main phases

These phases are described in more detail later. However, for the sake of simplicity at this stage of the discussion, the phases are numbered and can be seen to coincide with distinct phases involving more or less interaction with the Customer. Where there is more interaction with the customer, in Phases 1 and 3, for example, the documentation is written for the Customer as the main audience, and with a clear view of the demands made by him. The documentation produced by engineers in Phase 2, however, when they work on detailing the design and manufacturing the product, is intended for an internal audience, comprising colleagues within the company or other collaborative companies. The Customer is rarely concerned about documentation produced during this central phase, which, in turn, has a fundamental effect on writing practices and text structure.

Figure 1-7 also shows a parallel process of design refinement, which I refer to as the specificity cline, in which engineers begin with (sometimes exceedingly) vague ideas which are shaped through text to produce a specific design, and then, ultimately, the product itself.

Differing degrees of effort expended by engineers at different stages of the life-cycle are implied in the diagram.

Broadly, the work invested by various engineers in the product life-cycle can be represented thus:

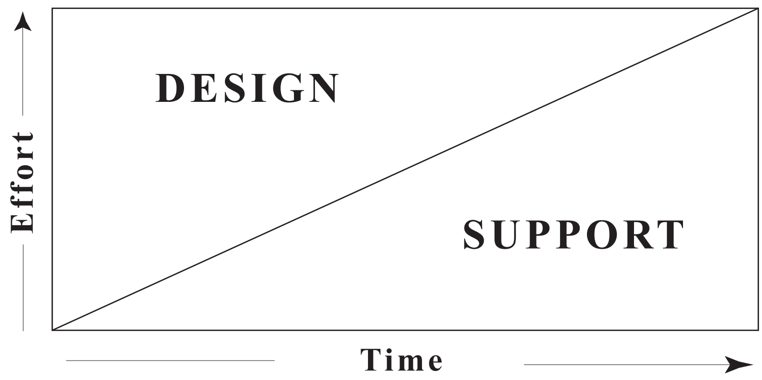


Figure 1-8: A balance of work on the product done by design and support engineers

Figure 1-8 shows the symbiotic balance that exists between design engineer and support engineers in their work on the product: design engineers are primarily involved in the early stages of the product life-cycle, their work tapering off as the product develops and as support engineers assume more responsibility. From my perspective, Figure 1-8 serves the purposes of this investigation, since it concerns these two main groups of engineers, particularly design engineers. However, to more accurately represent the work done by colleagues in production engineering, a design engineer suggested a modification to the diagram, to produce Figure 1-9 below. This more accurately accounts for the whole of the product life-cycle:

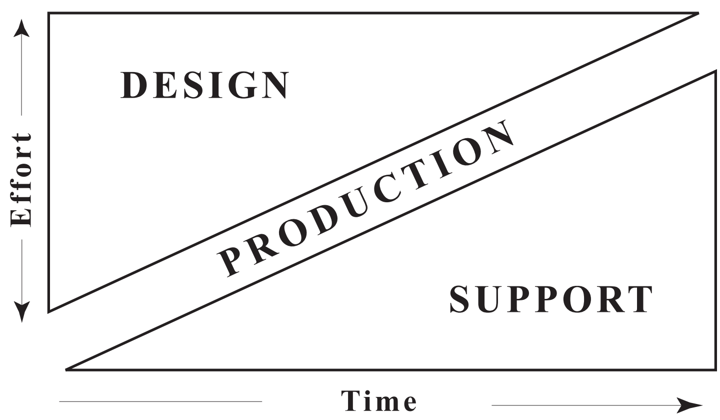


Figure 1-9: Work expended by different engineer categories

This is a fair representation from the HISE engineers' perspective, rather than from a financial, marketing and sales, production, or supplies/resourcing perspective, although I suspect these would throw up something very similar.

The final diagram and the stages it represents

Figure 1-10 below is the diagram I finally arrived at to serve as a visual context for the consideration of engineers' texts. It proved useful throughout the rest of the study as a reference point in a project which, against expectations, broadened in scope as it developed.

The significance of having such a textual-oriented view of the product is beginning to be appreciated by the engineers themselves. Although, he does not use the terms ‘text’ or ‘language’, it is this type of representation of the product that Kidd is referring to when he notes:

> .... the configuration, or information, life-cycle, is longer than the product life-cycle. It starts with the first definitive set of information, and ends with the retirement of the last information package. (Kidd 2001: 38)

Figure 1-10 depicts the key stages in the life-cycle of a product, together with the main participants and document categories. During the third round of company restructuring, in its own documentation about the product development process produced by the Change Team, HISE refers to ‘Phase Gates’ (Clarke and Hoad:1996), which are similar to my thresholds but more complex in their structure, incorporating a description of recommended work activities as a recommended ideal procedure for HISE staff. HISE (Plymouth) uses the term ‘Phase Gates’, an abstract concept, not unlike some kind of metaphorical hoop the engineers have to jump through in order to progress to the next phase. The Phase Gates, which were so often talked about in 1996 and 1997, prepared the way for the major changes that took place in work practices in late 1998, when the teams of engineers were broken up and reformed into ‘value chains’, a new name for what are in reality linear-like teams.

To my way of thinking, ‘gate’ is a misnomer, implying as it does a simple crossing from one phase to the next. However, at HISE there are gate-keepers to check that certain procedures have been followed, and that certain tasks have been achieved, before the engineers can progress, so that passing through the ‘gate’ could prove to be a fairly lengthy process in itself. This checking, or rather, ticking-off against a list of job items, will prove significant in this study, because it is inherent to an engineers’ work at various stages. The ticking-off, or signing-off of tasks influences the approach engineers take to their work, and, importantly, the way they structure their technical documents.

In my description, thresholds are like boundaries, the point of entry to the next stage, with no temporal significance. Thresholds, which do not take time to cross, are in marked contrast to stages, which can last for weeks, months, or years. Generally, decisions are reached at a threshold (or actions performed), which clearly push the engineer onto a new stage and into a different type of activity. The product would evolve into a new stage of development or use.

As Figure 1-10 shows, I have identified six thresholds and labelled them in terms of activity, i.e. what has to be done - either by the product makers (or producers, which is a more appropriate term for those who produce software) or by the customer/user. I also provide a brief description of each stage, mentioning whether the documents at each one are primarily for internal or external consumption. The usefulness of making a distinction between customer-oriented or engineer-oriented documents is not strikingly obvious at this stage, although it becomes more significant when considering the 'anxiety'-index of documents. This is a factor that became apparent later in the study, and has a bearing on the writing of proposals, specifications, and requirements. The main work activities of the participants in each stage are also mentioned, since there is an assumption that the topic focus of the documentation will reflect this. The following diagram, then shows the stages from the perspective of an engineer who is concerned with the design, production, and successful use of that product.

Thresholds and stages in the development of a product

The following is a list of the thresholds and a brief description of the stages they trigger:

Stage One: Needs Analysis and Proposals Stage

Threshold One - Recognition, identification, or description of the need for a product, as perceived by potential customer.

As Figure 1-10 shows, this leads on to a detailed exploration of the need, what may be called a needs analysis or use study. The distinguishing feature of this stage is that it is predominantly customer-oriented. Discussions take place with the customer, and documents are produced for the customer to see. This stage involves the production and interpretation of high level specifications. It is the customer who usually specifies, while the producer responds to the specifications by drawing up a proposal which the customer accepts or rejects. This proposal may be competitive, in the case of tendering a bid, or non-competitive. The proposals comprise both technical and customer support aspects; in other words, not only the design of the product, but a description of the help the customer would receive after he has taken delivery of it and is using it. This stage is not always instigated by the customer, as there are occasions when an engineer may take the initiative and point out to the customer that he needs a new or up-dated product.

Texts which typify this stage are a) high level specifications and requirements, b) proposals, and c) RFIs (responses to requests for information), more appropriately referred to as RRFIs.

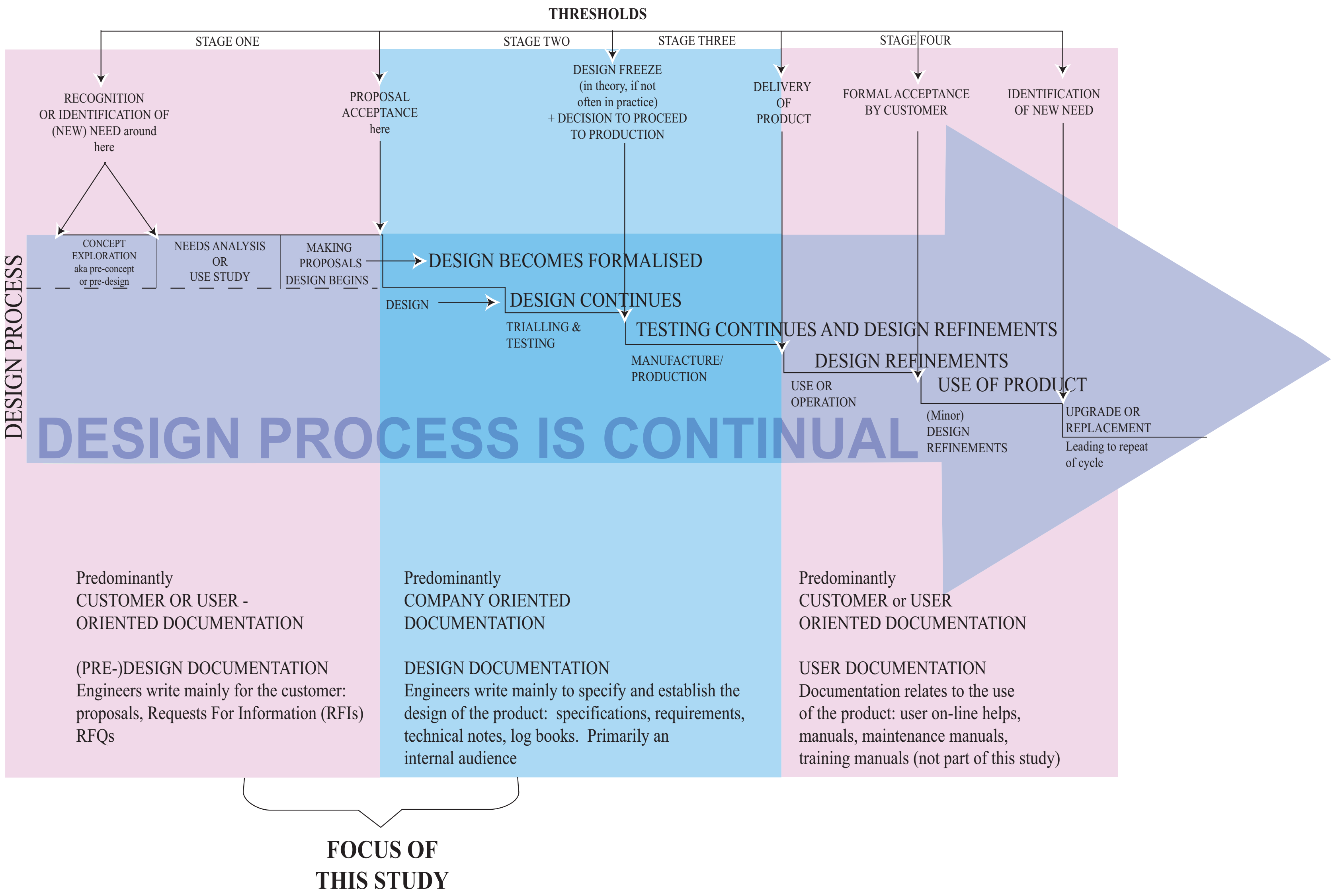


Figure 1-10: The Life-Cycle of a Product

Stage Two: Design and Testing
Threshold Two - Acceptance of a proposal that is made by the engineers to the customer

Usually this should mean one of two things: in the case of a competitive tendering exercise, the proposal is the winning submission, and in the case of a non-competitive bid, the customer gives the go-ahead for the engineer to move on to the next stage of product development. In both cases, the engineer can now design a proto-type or pre-production model, and test it. Trialling and testing is a key activity during this stage, playing an integral part in establishing the ultimate design of the product. A distinguishing feature of documentation at this stage is that it is produced mainly for the engineer's own use, and so can be described as being predominantly engineer-oriented. The main focus of documentation at this stage is on designing and testing.

The previous paragraph reflects the theory put about by textbooks, the ideal situation. It is also the line trotted out by the engineers, until they are challenged about its depiction of real-life practice. Then they will readily admit that in practice they rarely have the luxury of testing a proto-type. These days it is not uncommon for them to work with the customer in developing the product in the field while it is being used. Engineers also admit that both the engineers and the customer maintain a pretence, which starts when Threshold 1 is crossed, that the product has already been developed or is well on the way to being so, paying lip-service to the new procurement procedure brought in by the MoD in the early 1980s under Margaret Thatcher. It is not unusual for a similar fiction to be maintained with civil contracts. Apparently, this is a common phenomenon throughout the industry. More recently, procurement procedures have been introduced at the MoD to better reflect current design and production processes.

Texts at this stage centre on specifying refinements in design and engineers aim to 'pin down' as many aspects of the product as possible. Contractual specifications typify the engineers work here, which are ticked-off to the customer's satisfaction to mark the end of the stage.

Stage Three: Production
Threshold Three- Decision that the design is complete for the purposes of production.

This particular point in the process is called a 'design freeze' in HISE-speak. The idea behind this is that it should bring to a halt any more tweaking of the design or design refinements. One cannot help wondering if there is ever a design defrost. What has emerged, interestingly, is that there apparently is (and often), helping to confirm my impression that <u>design</u> is the major pre-occupation of the engineer, especially defining it in English, and controlling changes to it, again, in English.

The idea lying behind the design freeze is that there comes a time when the engineers must call a halt to any more changes or refinements to the product. Engineering theory will have it that all known needs should have been identified by this stage, and any problems should have been solved. Any change in instructions after the freeze would involve a formal review of the contract with all that that would involve in terms of revisions and cost. It is clear that a project can be dogged by unforeseen problems which may be caused by the customer changing his mind, or by the engineer failing to foresee design implications of the original specification. It is this stage which has the potential to be the engineers' worst nightmare: the product which was a figment of their imagination has to take on a form and substance, and, more importantly, has to work. It is at this stage when huge losses can be incurred by HISE, when the product may cost much more than was anticipated, as was the case with YGO46.

By crossing this threshold, the engineer can now see to the manufacture of the product, or in the case of software, to the production. Documents produced during the production stage are almost exclusively generated within HISE for internal consumption, and can be described as being predominantly engineer-oriented.

In the case of YGO46, mentioned later, practice does not match theory so far as design-oriented text is concerned at this stage. Further refinements to the specification were produced with the benefit of hindsight seven years after 'the freeze', expressed in two weighty documents.

Stage Four: Operation or Use of the Product
Threshold Four - Delivery of the product to a customer.

The main preoccupation during this stage is how well the product functions in the field, and, especially, how well the customer works with it.

It is believed that crossing this threshold leads the engineer to move into a distinct new stage in which the customer plays a key role. In an ideal world, armed with the original specification, the engineer spends a year or three developing the product, undisturbed by the customer who patiently waits on the side-lines. And, in fact, the ideal scenario is occasionally realised in actual practice, so that the following sequence may occur:

Production

↓

Delivery of first system(s)

↓

Customer witnesses trials

↓

Customer Acceptance (FWA)

↓

System in service and delivery of subsequent systems

However, Figure 1-10 attempts to accommodate the fact that, with certain products, the customer may be involved with the design and trialling of the product from the very beginning, and provide feedback to the engineer about it as part of a continuous process. I examined the documentation for a product, YGO46, for example, which was in service for six or seven years before it was finally (albeit reluctantly) ‘accepted’ by the Customer (the MoD). YGO46 proved to be a huge problem to both company and customer in terms of cost and use. Although such long-delayed acceptance is unusual, it is common for such products to be in use at various latitudes around the world for about a year before the Customer formally accepts them.

Distinctive activities in this stage are in-service customer support, product maintenance, and servicing. As a natural consequence of these, much of the documentation is customer-oriented. Texts in use or being developed at this stage are manuals, handbooks, and other textual assistance for the user, e.g. on-line helps. These are not a focus of this study, since they are texts more concerned with use than the design of the product.

Stage Four continued: Use of the Product

Threshold Five- Formal acceptance of the product by the customer, sometimes called the Fleet Weapons Acceptance (FWA).

Although the product will continue to be used, this threshold marks a part of the contract after the product has been used for an agreed period. It is the stage at which the customer formally states that the product has been produced and operates satisfactorily. The idea behind this acceptance is that it relieves the engineer of the burden of responsibility for any (unforeseen) problems that may arise subsequently, and any extra costs which may occur as a result. Clearly, a line has to be drawn at a certain point in the development of a product, so far as product support and maintenance is concerned; and there has to come a time when the customer can no longer expect to draw upon the engineer for help, maintenance and repairs, at least not without paying extra for this.

Although, this threshold is achieved, the customer continues to use the product, and through extended use and changing circumstances, the customer may have ideas about how the product could work even better. He may even identify new problems and new needs, or the engineer may diagnose such, leading to the next (optional) threshold. By its very nature, being in the domain of the customer, any texts produced at this stage are not directly relevant to this study.

Threshold Six (optional) - Identification of new need.

This leads into a new stage which signals a re-run of the whole process, as the engineer and customer work towards developing a refinement, up-grade, or totally new product (or 'solution', as the product is often referred to in HISE documents).

1.10 Conclusion

This chapter has attempted to provide an impressionistic thumbsketch of the engineer members of the discourse community and their working environment. It has also attempted to convey the fundamental importance of the product, because it is their major preoccupation, and central to the work that they do, the discussions that they have, and the design documentation that they write. The organisation of the physical and organisational aspects of the engineers' work has been contrived to facilitate almost total concentration on the product.

The full extent of the information yielded by the surveys has not been included in this study, because they were conducted in the earlier stages of the study with a view to examining specifications and requirements. As the study progressed, it became apparent that an examination of proposal documents was a necessary precursor to any study of specifications, with the result that much of the earlier work became redundant. Nonetheless, engineers' views on writing procedures and certain distinctive writing practices of theirs are reported on in the next chapter, parts of which draw upon survey findings. The next chapter, then, continues to describe the context in which engineers' texts, and more specifically proposals, will be examined.

CHAPTER TWO: ENGINEERS' WRITING AT WORK - ATTITUDES, PROCEDURES AND PRACTICES

2.1 Engineers' views - initial indications revealed by interview data

2.1.1 Introduction to the methodology

Rationale for early rounds of spoken data collecting

Since an essentially ethnographic approach was taken from the beginning of this study, it was considered important to identify and describe particular concerns held by engineers about writing at work, for the investigation to make any progress. A fundamental tenet on which this study is based is that the analysis of writing problems should be relevant to the HISE engineers themselves, since they provided the impetus for this study, and it was always intended that an engineer-oriented perspective should be a distinctive feature of this study. This being the case, and because I was unknown to most of the engineers in the early stages, I anticipated that a grape-shot approach to gathering information would be the best approach I could hope for, i.e. talking to as many engineers as possible. I had initial discussions with senior engineers and team leaders, which led to referrals from one engineer to another, and this in turn enabled me to follow trails of enquiry, which in the event seem to have proved coherent and logical, as the following sections of this chapter will explain.

How the data was collected

All the information for this initial analysis is from audio recordings of interviews, including discussions about particular texts, with one exception, which is a written record of a two-hour meeting. The recordings are from a larger collection, and span four years from August 1995, when I conducted needs analysis surveys of HISE engineers, to June 1998. Social researchers have various terms for referring to different interview styles I employed: according to Hague they were a mixture of semi-structured, unstructured or depth interviews (Hague 1993:21-27), and to Oppenheim, exploratory, depth, or free-style (1992:65).

This analysis includes a total number of twenty recordings, of which either a transcription, or a combination of transcription and notes, was made of each recording. In a few cases, the notes were shown and later discussed with the engineer concerned, either to discuss a point further or to confirm their accuracy. Each person whose interview has been included in this analysis has been allocated a Specialist Informant Number, together with information gained from each interview provided in Appendix C. Although data from twenty-one separate meeting are considered, nineteen engineers provide information for this particular analysis. This is because three interviews were with the same engineer, the then Head of

HISE research, who was acting as my industrial supervisor at the time, and who also was concerned about engineers' writing.

Those interviewed fall into three categories:

1. Engineers in positions of authority, concerned about the production of documentation at RASE, who perform some kind of managerial or leading role: team leaders, managers of projects, and/or senior research engineers, concerned with improving the writing of technical documentation (Appendix C: Specialist Informant Nos. 1/3/16, 2, 4, 11, 17, 18/19, 20)
2. Those considered by themselves or their managers to be inadequate writers. Members of this group either believed they needed to improve their writing skills, or had been advised by their managers to do so to help them to deal better with the demands of writing at work. (Appendix C: Specialist Informant Nos. 5, 6, 7, 9, 10, 13, 14, 15, 22).
3. Engineers who did not believe themselves to be bad writers, and who had not been earmarked as having writing problems by their managers. These engineers had either been advised to attend a special course in executive summary writing because of the particular writing demands of their work, or talked to me out of interest in documentation relating to their project (Appendix C: Specialist Informant Nos. 8, 12, 14, and 31).

Identifying and categorising categories of problem

At this early stage in the study, I decided not to set out to question or challenge engineers' views, but to accept them and use them as a basis for further investigation. My aim, after all was to identify exactly what the engineers perceived as being writing problems, as distinct from what my diagnosis was. This being the case, I examined the transcripts and notes for any relevant unambiguous comments, or clear propositions. ('Proposition' is used here in a less formal sense to refer to an assertion-like utterance concerning instances of problematic writing and associated problems.) All were annotated and listed for consideration. None was excluded from the analysis, although repetitions of the same proposition from the same engineer contribute to a single item in the numerical analysis. Once identified, each was allocated a Problem Number; a complete list of these is provided in Appendix D.

As mentioned above, some of the interviews include those conducted as part of a needs analysis for writing courses specially commissioned by the company in its drive to improve the quality of proposal writing, with, it was hoped, concomitant effective results in future bidding rounds. This is discussed in more detail in Chapter 5, which introduces proposals. In terms of writing ability and language awareness, there was a mixture of engineers who were ‘volunteered’ to attend the courses. In spite of attempts by the company to be diplomatic and to portray the courses as focusing on particular texts, e.g. executive summaries for proposals, some engineers clearly resented being picked, seeing themselves as having been labelled as poor writers. Others were humble or modest about their writing abilities. As a result, the observations tended to reflect this mix of interviewees, with the former tending to make more general observations, and the latter making more personal comments about their writing problems.

They expressed their ideas in different ways, some more directly and bluntly than others who were more oblique or circumlocutory, only those propositions that were transparent were recorded. The contrast between different engineers is clearly shown, not through their way of expressing ideas, but from the different perspectives they reveal. Sometimes it was necessary to paraphrase what was said in order to pinpoint the main idea being expressed, as illustrated, by the following spoken extract, which was provided by a senior engineer. It clearly identifies a problem, being about engineers’ reluctance to write and the quality of their writing. For this analysis, the problem was paraphrased as ‘They don’t like writing’ (Problem No. 107), and categorised under the general problem heading *EN1 General observation of inadequacy of engineers’ writing*:

> Oh yes, absolutely, oh yeah absolutely ….because of things that happen there is - they don’t call it a problem - this is an issue, an issue [sharp intake of breath] and people say like they’re engineers, they’re not going to write documentation unless you stand on their neck, um, and when they do write it, it’s a moveable feast....... (Specialist Informant No.16, Problem No.107)

Another example is provided by Specialist Informant No.14, who referred to the writing problems engineers have by saying:

> I think it’s a, you know, you’re dealing largely with engineers, and largely they’re not good at writing, are not aware of things, it’s a huge task. (Problem No. 96)

This was interpreted as a straightforward comment about engineers being poor writers, and since this was general observation, it was placed in the same problem category (EN1) as the previous example. In contrast, the same engineer, i.e. Specialist Informant No.14, made a more personal observation about his own writing and that of a colleague of his, called Pete, by saying:

> I’m sure that Pete doesn’t mind, well it doesn’t matter if he does, but as an example, Pete has a very archaic style of writing like ‘we have pleasure in’ and ‘we would point out that’ and all sorts of things that are really not modern usage at all, and I feel that my writing is bad like that as well, so I need to be more aware of that. So I want to get up-to-date, to present things as positively and as fluently and as clearly as possible, and improve my mediocre English. (Specialist Informant No 14)

Since this engineer had already made an observation about the inadequacy of engineers' writing, this latter comment was interpreted as expressing two propositions: the first that his own language use is old fashioned (Problem No 101 in Appendix D) and the second that he labels his own writing of English as mediocre (Problem No. 102, ibid.). The former is placed in the general category of **self-criticism** (EN2), and the latter categorised as a point about **inappropriate or inelegant writing style** (EN2.3).

Arriving at the problem categories

Trying to devise categories from qualitative data of the kind collected here is something akin to an exercise in reverse engineering, which is an activity HISE engineers need to perform. This could be seen as a reverse analogy, however, in that with reverse engineering, engineers are provided with a finished product, which may be a piece of software or hardware, and need to deconstruct it and work backwards, as it were, to establish a technical description of it, finally arriving at a language specification of it. On the other hand, in order to perceive pattern in qualitative data, one has to select from a mass of detail and information. Then, in order to devise a framework which accounts for each relevant point, there follows a time consuming process, which is in essence heuristic, which finally yields meaningful groupings, which, it is hoped, represent both the particular and general assertions made by the engineer interviewees. It is laudable to attempt to be systematic when analysing qualitative data, but the process of sifting and sorting through the data manually in this study and the email survey proved arduous and time consuming, to such an extent that I decided to use software for any future analyses involving sizeable amounts of data. This decision led to attempts to use NUD*ISTVivo and, to a lesser extent, Wordsmith, described in Chapters 8 and 9.

Three main notional categories were identified, concerning:

- writing procedures and practices at RASE
- engineers' writing abilities
- comments about English. 'English'-related comments form a heterogeneous category, which in fact comprising three small but distinct (sub)categories, grouped together for convenience by virtue of the label, 'English'.

Main findings or indications - the main problem categories

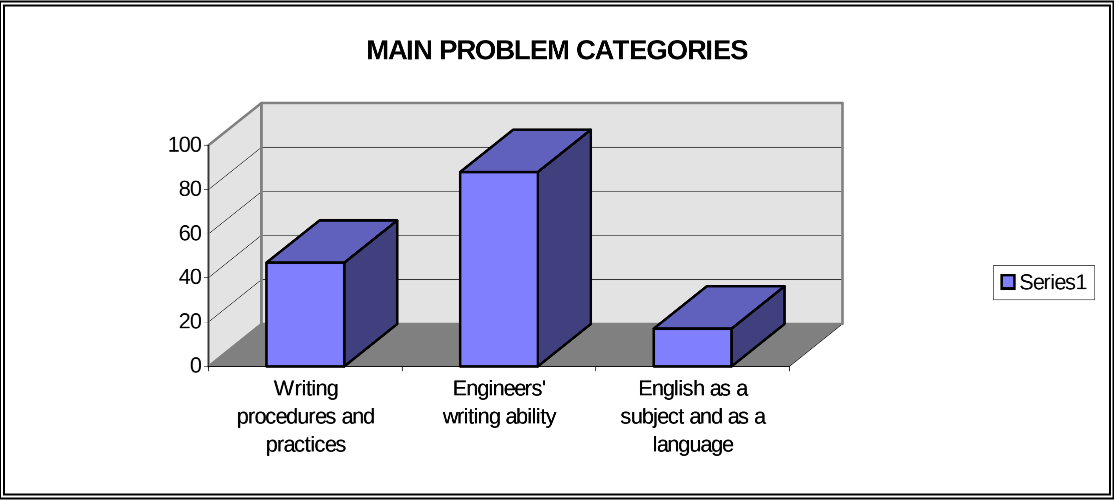


Figure 2-1: Main problem categories identified by engineers

Figure 2-1 shows the main categories of writing problem revealed by the data, i.e. those concerning engineers' writing ability (58%), writing procedures and practices (31%), and those relating to English (11%).

Engineers' writing ability – 'the problem is that engineers' can't write'

I hasten to add that this is not my view, but it is an opinion often mentioned by the engineers themselves. I remember being taken aback when I first heard this said, especially as such a judgement would be damning in my own field. However, it is such a commonly expressed opinion, that I become accustomed to it. I have also come to suspect, in the case of some of the more confident and successful engineers at least, that they are almost proud of the fact, or almost defiant about it.

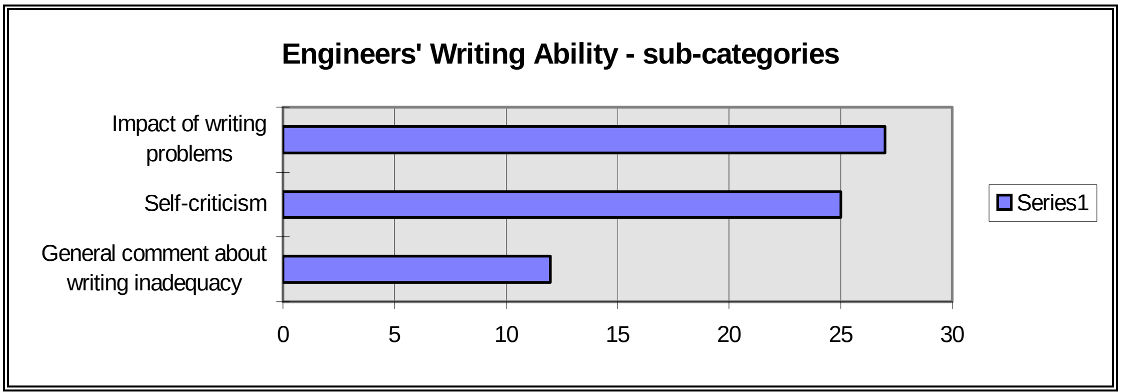


Figure 2-2: Engineers' comments about writing ability

Nevertheless, and such attitudes not withstanding, every engineer interviewed was concerned about writing, as evidenced by the findings. These reveal that by far the largest is the category ‘Engineers’ writing ability’ which also contains the most sub-categories. As Figure 2-2 above shows, these are grouped under the following:

1. General observations - comments which related to HISE engineers as a group
2. Self-criticism - comments engineers made about themselves
3. Impact of writing inadequacies - the effect or manifestations of the writing problems they had identified.

General observations of inadequacy of engineers’ writing - comments relating to RASE engineers as a group

As mentioned above, engineers are candid in their judgements about the writing abilities of members of their profession. They made bald assertions like ‘Engineers don’t know how to write’, and ‘Engineers are no good at writing, and are not aware of issues [surrounding writing]’. Most of the comments in this category were made by senior engineers who had a broader view of working practices at HISE. They talked about engineers’ reluctance to write, their dilatory efforts to record in writing their design ideas, or to keep records of their design work, and the problems concerning ‘standards of English’, i.e. grammar, spelling, fluency, and articulateness. These inadequacies, it is believed, hinder the writing of concise, clear, and unambiguous technical description which forms the core of a design engineer’s work in the form of specifications and requirements.

They also discussed the problems engineers have writing proposals, believing that ‘woolly language’ is often used when it really should be concise and clear. The collocates ‘clear’ and concise’ were commonly mentioned by engineers during discussions with me. Comments were also made about the need for better structuring of ideas within documents, and for a better selection of information content. As mentioned earlier, the management are concerned that documentation produced for an external readership should be grammatically accurate and coherent. One engineer talked about ‘bad’ grammar reflecting badly on the company, explaining that it ‘turns off the reader’, an unfortunate effect in the case of a proposal, the sole purpose of which is to win the company new business. It appears, then, that a curious incompatibility exists: these general comments reveal a belief that the company’s prosperity relies to some extent on good quality documentation and competent writing, but that those who are involved in producing it are not considered to be capable enough.

Self-criticism

The engineers who talked about their own writing fell into two clear groups:

1. the less confident - those who considered themselves to have problems (in four cases these were serious), and who felt powerless and frustrated by this, but who were unable to devise strategies for over coming them, and
2. the more confident - those who were more able to self-diagnose, and who assumed they could overcome the problems given the time, teaching, guidelines, and practice.

They mentioned the stress of writing, not being confident in their writing abilities, and being concerned about grammar and vocabulary. They were self-critical in that they described themselves as lacking in conciseness, being mediocre, and not having the 'right' words. Apart from mentioning the problems they had with grammar, spelling, punctuation and the like, they also worried about having mental blocks and spending too much time composing relatively short pieces of text. Skilled writers would claim that this is a necessary part of the writing process; however, an extreme example, reminiscent of the writing trials of L2 writers I studied in Singapore, was provided by an engineer who complained of spending five hours on a particularly difficult paragraph.

A few engineers revealed a yearning to be more articulate and elegant in their writing. Several mentioned they had noticed others' language performance, both in writing and in oral interactions, particularly in meetings, mentioning by name colleagues whose writing they admired, or colleagues they had noticed held the floor, or held people's attention in meetings. They said they wished they could write or talk in a similar way, regretting their lack of conciseness. As one interviewee put it:

> "I think what I'm maybe not so good at doing as I ought to be is saying things concisely, saying things in fewer rather than many words and I often find when I'm talking to people I can sense sometimes a you're saying too much, you're going too far, and yet I can see other people that can command attention by saying fewer words because what they say is straight to the point. I think that would be a nice thing to work on, to be able to say things concisely and accurately. Get your meaning across in fewer words."

Another lamented his over formal style when writing letters and faxes. His problem, he believes, is appearing to his audience as a distant and unfriendly stranger, whereas he is, in fact, writing to people whom he knows well and with whom he has been communicating over several years. He said he did not know how to be friendly in a letter. Judging by samples of his writing, it appears that he is indeed in the habit of expressing himself formally: he tends to passivize whenever a verb will allow, employs the frequent use of complex noun phrases, avoids the more informal phrasal verbs, and opens and closes his letters with formal ritualised salutations and complimentary closings.

Others talked about the 'drabness' of their writing, finding it difficult to write in a friendly or positive way without being 'smarmy', and difficulties in composing a rejection letter without making the reader feel slighted, and without appearing rude or indifferent. One engineer said he used to find writing so difficult that he tried to get others to do it for him. However, he has been thwarted in this in recent years because of changes in work practices at HISE which have brought about the depletion of secretarial assistance and seen the devolution of writing responsibilities to groups of engineers, so that the engineers themselves are now responsible for the production of much of the written output. Other engineers talked about resorting to copying from other documents as a strategy to help them complete a writing task, one referring to it as plagiarising and describing it as an exercise in damage limitation.

The email survey administered later enabled me to gain a rather more accurate picture of how engineers regarded their own writing abilities. The main findings of the survey reveal that more engineers rate themselves as being average and (well-) above average writers than those who hold more negative, or even pejorative, views about their own writing: just over 73% of the 60 respondents in the former category as against 20% in the latter. When asked to rate themselves as writers, the majority of the responses fell (almost neatly) into five main categories:

1. Highly positive (16.66%)- the engineer rates his/her writing as very good on the whole.
2. Positive (33.33%) - a generally positive self-rating of above average, competent.
3. Neutral/non-committal (23.33%)- an average self-rating.
4. Negative (10%)- a generally negative, or more negative than positive self-rating.
5. Very negative (10%) - clear self-denigration expressed by the engineer.

Three responses were impossible to place, one of which reveals an awareness on the part of the engineer of writing issues, as evidenced by his answer:

> I don't mind writing, and never have done - after all English is the International Engineering Language. My spelling is pretty crap, and my grammar has slipped since leaving school. I also tend to waffle a bit much in some areas, and miss detail in others. I'm sure this reply is a sound demonstration of this.

A more detailed account of the engineers' responses to this aspect of the email survey can be found in Appendix E.

Impact of writing inadequacies

As Figure 2-2 above shows, engineers had most to say about this within the category. Although it is not known precisely how, they believe that the impact of writing inadequacies is apparent in several respects, affecting the engineers themselves, the quality and effectiveness of the documentation, dealings with customers, and the financial health of the company. Although a minority sub-category, a few comments were made about how writing inadequacies have had an impact on engineers' self-image and promotion prospects. Only one mentioned that he felt he had felt humiliated or lost face in front of his peers because of his writing inadequacies, although this aspect arises in discussions about technical description in proposals (see Chapter 4) relating to engineers' awareness of the need to 'maintain face' in text. Two engineers mentioned they had been told in appraisals that poor writing skills were hampering their promotion prospects, and were candid in telling me that that was why they were talking to me: they disliked English, they disliked and avoided writing, but they realised they would have to do something about their writing ability if they were to make any progress professionally. They decided to be pragmatic, but it was nevertheless with undisguised reluctance that they approached me to discuss their problems. It is probable they would not have done so had they not been informed by the company of their need to improve 'their English'. It became apparent that most engineers did not see a distinction between L1 proficiency and the subjects of 'English' that they studied at school. English Language, English Literature, and their own EL skills were perceived as being part of the same phenomenon that they referred to as 'English'.

It is believed that the documents produced, especially proposals and technical specifications and requirements, could be more logically organised, and more clearly and concisely expressed. Particular mention was made by some engineers of the need to improve the selection and organisation of content, especially in the case of proposals which are composed around 'selling themes' or key attributes. Engineers also thought that the way themes are expressed could be improved through the use of more persuasive language. However, this survey has shown some disagreement exists between engineers about what is persuasive; there is no consensus on an acceptable writing style for proposals, with some advocating a more formal approach and traditional approach, and others a more colloquial informal one. The latter believe the company is too cautious in its attempts to sell its products. These comments were to prove useful in later stages of the study, when attention turned to proposals.

It is also believed that an inadequate mastery of the English language has caused difficulties in the production of technically-related documentation, especially requirements and specifications (Appendix J). These are not the focus of this thesis, but suffice it to say at this point that there are occasions when engineers are required to be suitably vague or precisely specific; their failure to be one or the other at appropriate times, for example, when writing a technical specification or when composing a persuasive section of a proposal, has led to problems for the company. So far as design documentation is concerned, it is believed that misunderstandings have arisen through poorly written documents which have proved (exceedingly) costly in time and money.

Writing practices and procedures at HISE

The second largest category, 'Writing procedures and practices', comprises seven sub-categories. The largest sub-category contains comments of general applicability, which are observations of the need for HISE to change or improve: 'Observations of the need for the company to promote changes or improvements'. This appears to suggest that engineers are prepared to change, and in fact would view favourably attempts made by the company to change writing practices. As Figure 2-3 below shows, the other six subcategories are more specific, and much smaller.

- engineers are writing mavericks and have their own individual writing practices
- (over) reliance on other people
- problems centred on writing tools
- time constraints
- need for models and prescription
- being subject to checking and imposed changes by senior colleagues

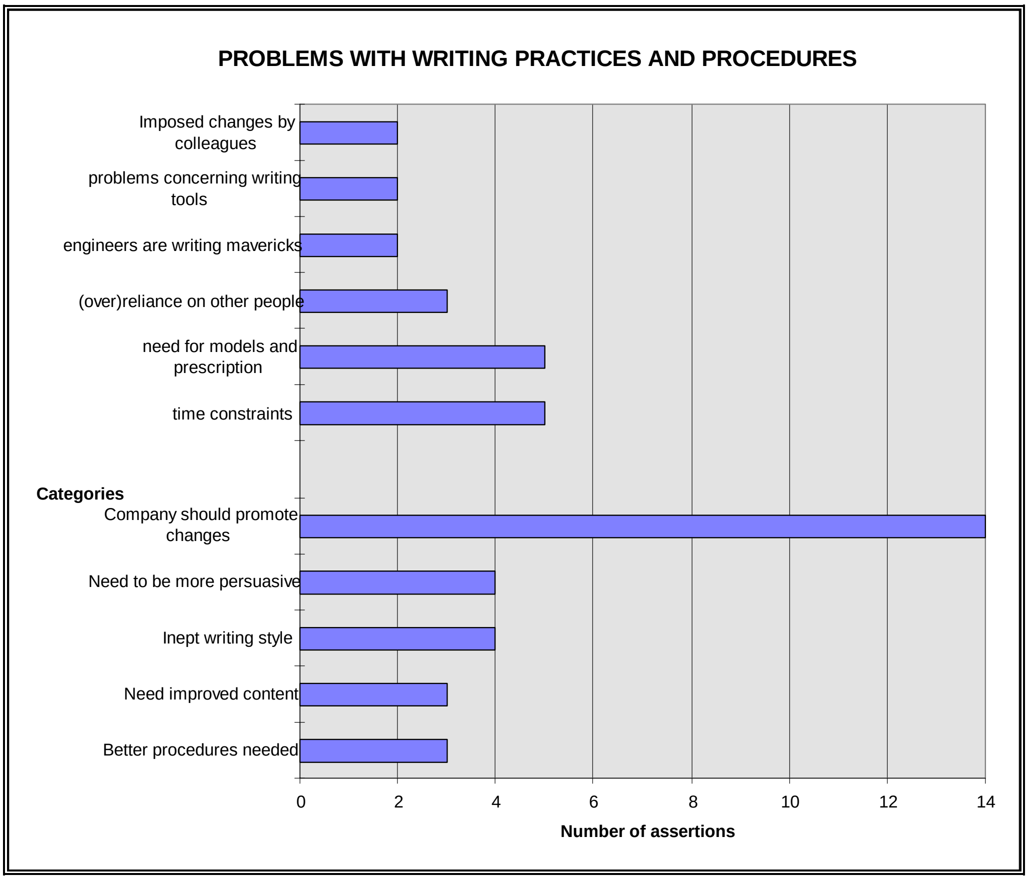


Figure 2-3: Problems with writing practices and procedures

The problem with 'English'

This was a surprise finding. Although the smallest category, it is probably more significant than the findings suggest, because the comments about 'English' were unsolicited and unplanned for during the interviews. It is possible that such negative comments arose because I was known to the interviewees as an English Language specialist, and they knew I was interested in the language perspective of the documents under discussion. So far as the comments about English as a subject are concerned, in all cases, the consistently negative comments were brought about by memories of school days, which, so far as English (as a subject at school) was concerned, had negative or unpleasant connotations. (It has already been mentioned that the engineers tended not to recognise the difference between EL proficiency, English as language code, or even between the subjects of English Language and English Literature).

The other problem with English, so engineers believe, is that it is totally inadequate for their purposes when they need to write requirements. Requirements, as mentioned above, are a major problem for engineers, and for the company. They are the most difficult of any kind of writing that an engineer has to compose, preoccupying the engineer more and requiring more of his time than any other kind of writing. It was again educational for me to learn of the engineers' strongly held belief that the English language, or what they refer to as 'natural English', is of little use to them.

The problem documents

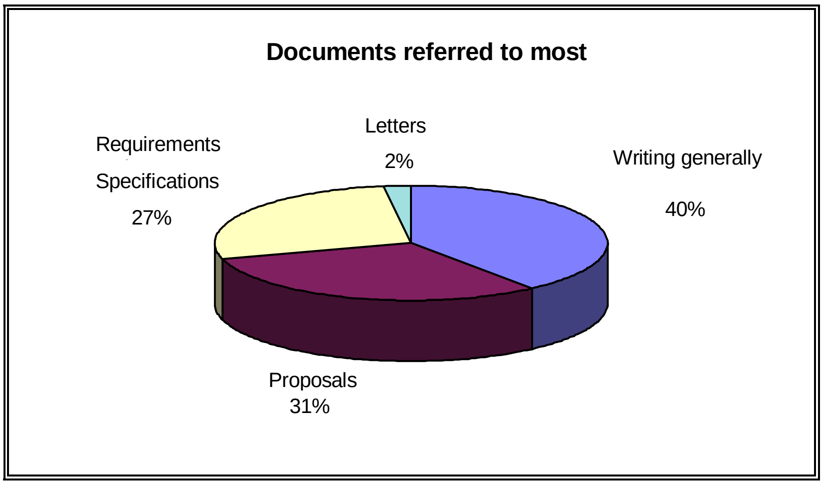


Figure 2-4: Documents referred to most

An unexpected bonus resulting from this examination of the early (mainly spoken) data, was some kind of indication of the kinds of documents which were troubling the engineers. Figure 2-4, above, confirmed initial impressions that engineers' are mainly preoccupied with two broad types: a) proposals and b) specifications and requirements. Forty per cent of the problems mentioned relate to general observations of writing issues which are non-text specific. However, the majority of the problems, a total of fifty-eight percent, concern proposals and specifications and requirements which account for 31% and 27 % of the problems mentioned respectively. The few references to letters were made by two engineers who had recently transferred to work on commercial aspects of the proposal. Of the rest, most of the engineers were working almost exclusively on engineering design; all were concerned about winning more business and saw writing proposals as playing a major role in helping them to do this. The highlighting of these documents in the early stages of the study was to prove influential in the direction that was eventually followed.

The amount of time engineers spend on writing

Finally, let us turn our attention to temporal matters. Reference has already been made to writing as a time-consuming activity. In my own work over the last two decades I have noticed the way engineers' work has changed, concomitant with developments in office technology. Engineers' preoccupation with documentation, and the importance of writing about the product has not changed very much in this time. However, what has clearly changed is the way that engineers appear to have taken on more responsibility for writing, as secretarial help has diminished and they have been given their own personal computers in the work place. This matter is raised later, when proposal writing processes are discussed in Chapter 5.

It is generally accepted that writing plays an important role in engineers' work, and that it can be extremely time-consuming. However, until the email survey was conducted, it was all conjecture, since there was a lack of information about actual amounts of time spent writing. Engineers were asked in the email survey to provide estimates in percentage terms, the aim being to gain some kind of idea of the extent of the writing done by engineers at RASE, in order to better consider the nature of the writing tasks (text/document types) performed. The types of writing tasks served as the focus of another question, the results of which are discussed in Chapter 3. If I knew the answer to this question about time duration, I reasoned, I would then have a more complete picture of the writing aspects of an engineer's job. I could hardly justify an investigation into writing problems if writing does not take up a significant amount of an engineer's time and is not an issue.

The results are impressive or stark, depending on your viewpoint: just over half the engineer respondents, 50.1% to be precise, spend between 30% - 60% of their time on writing at work, and a further 15% of the engineers spend more than 60% of their time on this. The graph below provides the gist of the answers to the email survey question on time spent on writing, which are described more fully in Appendix F. The breakdown is in twenty-percent time bands of the figures for every respondent to the questionnaire.

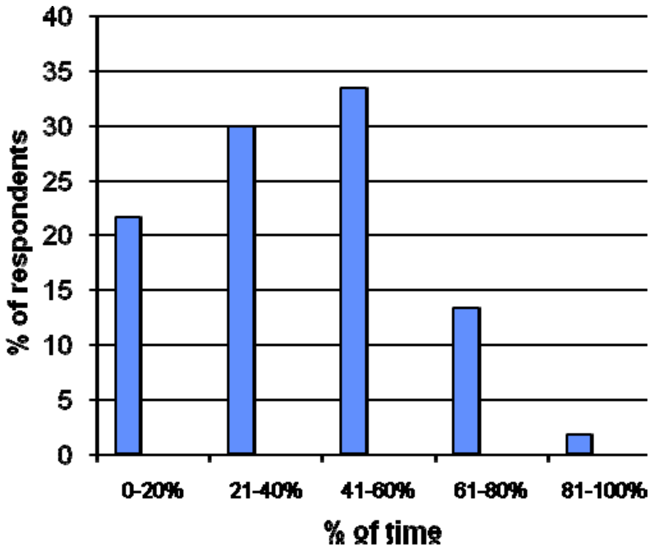


Figure 2-5: Time spent on writing

The picture emerging here contradicts the stereotypical image of engineers engrossed in tinkering with complex mechanisms or systems, designing, and making things. However, it does coincide with findings of another study carried out on scientists at MIT, showing their major output to be documentation rather than scientific experiments, and their working lives centred on writing scientific papers (Latour and Woolgar 1983). The figures lend credence to an idea that develops in this study about the importance attributed to certain documentation, and the emerging realisation that it is, in fact, a quasi-product, i.e. a substitute for the product, in that the product is negotiated and shaped through the documentation.

The graph below provides the gist of the answers to the email survey question on time spent on writing, which are described more fully in Appendix F.

2.2 Organisational structure and culture affect the writing process

In this section, I discuss the idea that writing practices at HISE reflect company organisation and culture, by describing the engineers' team writing approach to text construction. The discussion considers the significance of two metaphors in the hope that they will provide insights into the engineers' work culture and writing, and allow us to see, through their use of the metaphors, how they themselves view their writing tasks.

Working in groups, or team-working is a distinctive feature of work practices at HISE, which in turn affects writing practices. Descriptions of certain varieties of writing (and reading) practice arise later in this study, but in this section, engineers' attitudes and approaches to writing are explained against the backdrop of the prevailing work ethos permeating this discourse community. It is akin to a kind of engineering ideology which makes the culture of the community distinctive, and quite different from the academic culture I come from. The openness of the work areas, mentioned above, has removed physical and psychological barriers over much of the site. It is difficult to gain access onto the site, for security reasons, but once admittance has been gained, the accessibility of different company personnel, including top managers, and much of the physical space on site, is remarkable. Not all engineering companies are like this. There are working practices which have become fossilised in other companies, where, for example, engineers still communicate with other engineers in the same room by memorandum. This is a feature of a more accountable, less trusting work culture, that existed at HISE in the 1980's, but now the atmosphere and practices are markedly different.

In this section, I describe a particular approach to writing as an exemplar of typical writing practice, and to illustrate engineers' writing behaviour and attitudes towards writing. In so doing, I am suggesting that the present (flatter) organisation of the company, and the work culture it encourages, has enabled engineers to work more closely together and share the burden of the writing load with other members of the team. Metaphors are borrowed from the engineers' work talk (and writing) to illustrate the co-operative attitudes inherent in their working and writing practices: I explain the special role played by the strawman in collaborative writing activity, and compare it with another metaphor, kiteflying, to show the strong associations certain engineering texts have with risk-taking and anxiety. In my discussions with engineers, I encountered only surprise that I should find strawmen interesting. It did not take very long for me to discover that a straw man in an engineering environment is a very different beast from the academic straw man, that it is not made in order to be knocked down, but rather that it is a malleable creation which serves a constructive and often catalystic function in the writing process.

Ask academics about straw men, and they will usually speak dismissively of them, believing them to be artificial constructs based on spurious evidence, as one of my colleagues said when I asked him about them:

> 'Ah, that's when someone sets up a case and then demolishes it when there's really nothing to demolish.'

Straw men usually have negative connotations in academia, where the term is used somewhat pejoratively. They usually occur in the genre 'academic article', and are derided by journal editors who see them as being specially contrived constructions, created by authors in order to be knocked down, so that they can justify their own research and their own theories. In other words, academics may deliberately construct a straw man in order to destroy him, thereby trying to persuade the reader, in this case, the journal editor, of the need to publish their work. In doing so, they are trying to demonstrate the existence of a niche in their research area, albeit a contrived one, mimicking a well established writing strategy in academic articles, as shown by the work of Swales (1990:140-3).

There appears to be a fundamental difference between the academic's and the engineer's straw man. I see one as an illusion, with destructive connotations, whereas the other has substance and is essentially constructive.

One engineer, rather taken with my interest in the engineers' strawman, likened the academic's strawman to a Trojan Horse, because the intention is for the straw man to slip through without being detected. If it is successful in getting past the editors, it means the academic has convinced them that his writing is a valid piece of research. The engineer explained that the engineers' straw man, on the other hand, is intentionally sacrificial, because they do not expect him to survive intact. On the contrary, they fully expect parts of him to survive, and for him to serve as a catalyst for the production of something much better. Therefore, straw men are different in engineering writing, and are an accepted part of engineers' written work.

HISE engineers refer to straw men when talking about text, and find the term unremarkable, explaining it is commonly understood amongst engineers in different companies in the United Kingdom. It is not unusual to overhear references to straw men in snatches of conversation, for example: "….. can you come up with a straw man for us then, Patrick ….", and " ... any sign of that straw man yet, Dave?" They are also used in written communication, as this final sentence of a memorandum shows:

> Please complete the enclosed spreadsheet by the end of August and I will collate inputs and produce a strawman which we can discuss at our next session, date to be advised in due course.

Engineers recognise straw men as being a distinctive document which performs a particular role in the construction of text, and see it as basically a text which is intended for reshaping. In other words, it is composed in order to be changed, with the concomitant aim of involving members of the team in its metamorphosis.

Flying kites signals risk taking. I have overheard engineers' easy reference to kite flying when they talk about constructing straw men, although kite flying is mentioned infrequently. When I asked about the significance of kite flying to text construction, the engineers seemed somewhat nonplussed. After reflection, they explained that they use the term less often, and that they rarely flew kites. A possible reason for this is that flying a kite in text represents risk-taking and unilateral action, which most engineers will do their best to avoid. Put simply, a kite is a part of a text which is flagged, usually by the one who creates the straw man, as a part of the text which needs checking or special attention paid to it because it contains a new or unusual idea. Someone who is putting up a straw man to the rest of the team may, in the course of discussing it, say: "Chapter 3 is more or less as the customer requested ….. but I'm flying a kite in Section 3.7", meaning: "Section 3.7 wasn't planned for. I've put it in because I think it's needed, but I could be wrong, so have a look at it and see what you think". One technical author tried to explain how kites function in writing:

> "Say I was to write a straw man for something. I might say this bit about the technical solution: I'm really flying a kite there - it's part of the straw man but it's the risky bit, could be inaccurate and needs really good looking at by others, specialists. So suppose we had to produce a rapid proposal, a straw man, perhaps we could indicate in the straw man where we were flying kites…..... where we weren't sure of our ground".

Making the first version of a strawman

I have observed two approaches to the initial creation of straw men: construction by a group or by an individual. The former helps in deciding writing strategy, and the later serves to kick-start the writing process.

A group-initiated straw man

The following sentence illustrates how a straw man may begin. It appeared in a memorandum by a project leader to her team about the need to write a document as part of a proposal, a tender bid centred on an avionics system:

> The recommendation is that a straw man *ILS ARM&T plan should be prepared based on this assumption and including the requirements of Annex B of the ITT.
> [*ILS - Integrated Logistics Support, ARM&T - Availability, Reliability, Maintainability, and Testability, ITT- Invitation to Tender]

This memorandum led to a meeting of team members to decide on the information the strawman should contain. Engineers involved in this particular project believe that this straw man, which was to develop into a proposal for product support, made them think through what their commitments would be when supporting the product. The decisions they reached together as a group would be reflected in the proposal document. They see the straw man as having provided the team with an overall framework for proceeding, and a clear sense of direction. Their reliance on the strawman was reflected by the words of one engineer, spoken with sincerity, when I asked about the usefulness of the exercise: "How would we know which way we were going without the straw man?".

The first straw man produced by an individual

The straw man may be instigated and written by a single person who wants to get the ball rolling. He may be the team leader, or team member responsible for a particular part of a document. Take the executive summary, for instance, which summarises the main selling points of a bid to a potential customer within a proposal document. It is sometimes in the form of a cover letter to the chief executive of the company. A member of the team, for example, the engineer responsible for producing the executive summary, may quickly compose a draft, or, in HISE-speak, 'put a straw man together', and circulate it to the other team members asking them to respond to it. The purpose of circulating this straw man, or draft, would be to get a reaction from the other members of the team with the ultimate aim of arriving at decisions about key selling points, and eventually to flesh the straw man out.

There is a theory at the company that it is much easier to compose something for engineers to read and to comment on than it is to expect them to produce ideas in writing on a blank page. As one engineer put it: "you use a straw man to draw a response from people, or provoke them into responding". Another engineer said:

> "If you put something in front of them, it could easily be wrong, but it's so easy for them to react to it. You want to force them into doing something. That's the problem you have: nobody will do anything until you knock something into shape for them and give them some idea of what it could look like. They sit there struggling over how to start, and this is what kicks them off, and they say 'oh yes!'"

Evaluating the straw man - engineers' opinions

All the engineers I interviewed about straw men, about a dozen, believed in the value of using them to approach a writing task, citing the following main reasons:

1. They encourage team working in that several people meet and work together collaboratively to produce a document.
2. Straw men force decision-making within time constraints. In the decision making process, the straw man acts as a catalyst and has dynamic connotations for engineers. As one engineer put it:

   > "So we put up a straw man and we discuss an area. It's got some good stuff in it but it's not quite right, it doesn't quite suit. That forces them to make a decision because it can't go in like it is, we've got to make a decision what do we really want."

3. In proposal writing, for example, someone may compose a straw man with the key themes (selling points) as he sees them; he may wish to highlight the fact that the product is fully compliant as being the most important theme. However, on being examined by the team, the straw man may draw out other opinions about what the main theme should be. Being totally compliant may be considered less important than, say, the point that the product is already successfully being used by other customers, and has a proven track record. Alternatively, it may be argued that the after-sales support and maintenance should be highlighted, and so on.
4. The straw man is the documentary equivalent to the dry run. Engineers like to try out equipment to test its design before it is manufactured. This practising with a prototype is an integral part of an engineer's work which is taken for granted. They see straw men as being similar to dry runs; the shaping of the straw man is like modelling an argument.
5. The straw man saves time and effort - As a team leader put it:

> "If you have a group of people who turn up to a meeting to discuss a particular subject and a lot of people come along, some of them highly paid, if there's nothing on the table then you have to go through a brainstorming session and then you'd have to get something out before you can get a reasonable discussion going. ….. Now if we hadn't put up the straw man [talking about an Alignment Guide] and we went to the meeting, we would've spent all day trying to discuss it and really you end up with this sort of ping-pong effect for lots of the time."

6. Straw men have positive connotations - The prevailing attitude at HISE towards straw men is fundamentally positive. They are regarded as playing an integral part in the decision making process, encouraging problem-solving discussion, and helping engineers arrive at a solution. It is believed criticism must be constructive. In the use of straw men, there is no room for vindictiveness or personal attack. Here is how one engineer explained this particular point:

> An important point when you put a straw man up is that people mustn't be offended if other people criticise it, tear it apart, offer constructive criticism. You've got to take it in the light that other people have different opinions. It saves lots of time, because if you hadn't written it down [as a strawman], they wouldn't have thought about it, or some points would have been missed altogether.

Appendix G contains a case study of the drafting of a system manual, and includes a description of the different stages of the writing process; the writing behaviour of the team of engineers; the construction of the text; and the metalingual/discoursal comment that resulted, i.e. written annotations and spoken comment invoked by the strawman.

A final comment on strawmen

The straw man as a metaphor represents the ethos of the product and efforts of the team in conveying it to the customer. In the process, the straw man can be reshaped and rebuilt, incorporating any of the kites which manage to keep flying. A summary of a technical author's view brings this section on writing to an appropriate end, and serves to further illustrate how engineers view texts very much as they view the products they design, i.e. as objects that can be engineered:

> "A crashing kite need not bring down the straw man. To the engineer, a straw man represents a whole document, even if incomplete, whereas flying a kite is risk-taking in a particular section of it. The kite may be a single point or idea, and could be brought down by the other members of the team, and crash; however, in doing so it would not destroy the straw man, which is, to quote a worn but nevertheless apt cliché, very much greater than the sum of its parts."

2.3 The ethos of procedure underpinning engineers' work

2.3.1 General procedures - an overview

A typical working day for a HISE engineer sees a juxtaposing of activity which is spontaneous and unplanned with that which is prescribed and pre-ordained by company procedures. On the one hand, there is plentiful and varied human interaction, including face-to-face chat, telephone conversations, responses to unexpected problems, and ad hoc meetings, much as one would expect to find in any busy office. On the other hand, the engineers understand that their activities are governed by certain expectations of how things ought to be done. They assume that for every task they have to perform there is a particular way to perform it, a 'method', if you like. There is a tacit understanding, which is shared by all members of this discourse community, that these methods are expressed in the form of published procedures which are produced with the express purpose of guiding engineers through the various activities they have to carry out. It is an accepted part of the engineers' working ethos that for every task needing to be done, a procedure should exist to provide guidance on how it should be carried out, and that those responsible should try to anticipate procedures that will be needed. As a result, the company's published procedures are exceedingly varied in nature, providing, for example, guidelines on working with lasers, writing a product specification, claiming overtime, using chauffeur-driven cars, and obtaining a 'Hot Work Permit' (HISE Procedures).

Writing Procedures – attempts to control writing (and designing) behaviour

The hot work permit procedure is, however, quite short in comparison with those on writing specifications, which cover twenty or thirty pages. Again, these have been written with the intention of providing guidance in the writing of specification documents, which engineers find problematic to produce (see Appendix J). One of the memorable features of early conversations with engineers was how each automatically led me to what they commonly refer to as ‘the procedures’. When asked about writing requirements or proposals, for example, each referred me to the procedures, more accurately entitled ‘HISE Policies, Procedures and Instructions’, which are contained on more than two thousand pages held in sets of four thick lever arch files. In several cases, I was taken to the nearest set and watched as the engineer thumbed through to find the relevant section. More than thirty sets of these procedures exist scattered about the site. What struck me in the early stages of the study was that I had not encountered a single engineer who had actually used the procedures to help him with his writing.

A quick examination of each set soon reveals the sections which are referred to the most, for these are well-thumbed, for example, those concerning subsistence and allowances. A straw poll survey of the engineers confirmed this: when a group was asked how often they referred to the company specifications, only one had used them in recent weeks, and all had referred to them for administrative or financial reasons. One engineer, for example, had referred to them eighteen months previously to find out about tropical clothing allowances, another a year beforehand to get advice on how to go about buying a small piece of equipment, and another a few weeks beforehand to claim expenses incurred on a visit to a ship. Throughout the study, I have encountered a fair amount of cynicism when enquiring about company procedures, the more extreme views expressed by a few engineers who made comments like “If you want to get on, write procedures”, or “Those who can’t be engineers write procedures”.

In spite of this derisory comment, made during informal discussions, the fact remains that in more formal interview situations, and without exception, every engineer’s automatic reaction is to consult a set of procedures whenever I ask questions about particular documents (specifications, proposal writing, requirements, and various reports), writing and the writing process. This is because they generally believe that procedures should exist to guide them in their work. They also believe that procedures ought to attempt to account for any eventuality in everyday working practice. It follows, then, that if it is envisaged that a new activity will be performed, those supervising the implementation of the activity will spend much time drafting a procedural framework for it. The aim of developing this framework is to ensure standardised working practice and maintenance of quality, with the underlying expectation that the engineers would operate within it. On an abstract and theoretical level, then, there is an unquestioning acceptance of the need for prescription so far as working practices are concerned, and the belief that that if everyone follows procedures, life would be easier, and neater and tidier for everyone. To an outsider like me, it is a striking feature of this discourse community that they try to impose form on their own activities and behavioural aspects of their work, much in the same way as they do on the products they design.

A senior research engineer (TB Notes Jan 99) explained the importance of following procedures by providing a diagrammatic representation of the functional steps any HISE engineer should follow in the design process. He represented a commonly held view in the profession with these words:

> "It's important to know what you're doing, questioning whatever you do, and testing it at every step ...... people [engineers] say they do it anyway, but some of them fail to see the relationships between the different stages and it's all too easy for something to be missed out which may completely stymie the whole process."

This belief in procedures is rooted in the fear that major problems may arise out of an inaccurate or incomplete design, which would lead an inability to fulfil the terms of a contract, which in turn would lead to a dissatisfied customer (usually the MoD), and, as has already been mentioned in Chapter 1, financial losses running possibly into millions of pounds. As a result, the company has not stinted in dedicating staff time and investment in trying to identify the causes of problems and attempting to solve them, usually through changing procedures. It is considered unremarkable, for example, that another engineer in the Research Department (RO) should spend nine months designing a master plan to establish the way engineers should work (Engineering Methodologies) at the company. The rationale underpinning this project was that it was desirable to produce an abstract specification of a process or processes which would in turn give rise to different procedures depending on the particular tasks needing to be done.

The parent organisation, HISE, has similar concerns and has invested in projects dedicated to improving the quality and reliability of its design procedures. It has, for example, sponsored a long-term research programme at the Universities of Newcastle and York called the DCSC (Dependable Computing Systems Centre) which is dedicated to eliminating flaws in the early design stages of computer systems. Publicity about the centre includes reasons for its establishment, one of which is couched in the following terms:

> The research conducted at the DCSC is intended to reduce the cost of producing these systems and reduce the development lead-in time for systems for which there is an ever increasing customer and market integrity expectation. (DCSC 1996)

The reference to 'customer and market integrity expectation' is a reference to changes in the defence market, which include greater competition, radically different tendering procedures, and more demanding customers, who are not content to wait five or ten years for a crucial piece of equipment to be developed. The DCSC also make a reference to the need to reduce costs and development times, since these have proved a major cost bugbear on previous projects. A major fear of the company is that it may become embroiled in projects which over-run and incur extra unexpected costs. Anything which is unplanned or not anticipated is anathema to the engineer, who yearns (usually in vain) for predictable outcomes.

Unforeseen costs and losses have proved a strong motivation to the organisation to find solutions, which, it is believed, mainly lie in work practices. As part of HISE's search for improved procedures, a complex software package, called RTM (Requirements Traceability Management), has been developed for its engineers to use in systems design. They use RTM when designing software for their customers, because it helps an engineer in the total design of a product, assisting not only with the design and navigating the structure of his work, but also with the writing of specifications and test procedures. The interesting feature about RTM, so far as this study is concerned, is that it is intended to control engineers' work behaviour. It is essentially a management tool, which keeps track of changes that are made to a design, ensures that the necessary related changes are actually done, and ultimately ensures consistency of working practice. Any sacrifice to creativity the engineers have to make in order to control, or even constrain, their work behaviour is seen as a small price to pay for ensuring this consistency.

Procedures for writing and how engineers ignore them

The writing done by engineers receives the same treatment as any other task an engineer has to perform, with a plethora of procedures to help guide his writing, guidelines which attempt to cover all aspects of writing, ranging from the way a document should be formatted through to the length and style of the sentences. As is mentioned later in this section, procedural guidelines attempt to impose particular syntactic structures and restrict the lexicon from which writers may select words to compose their sentences.

That engineers take it for granted that procedures should exist to guide them in their writing is common at HISE and throughout the defence industry. Several engineers volunteered the opinion, that it was both desirable to establish uniform writing procedures, and that it was possible to devise standardised writing formats and styles, if only someone would take the time to plan them and write them out. A striking assumption of a number of them was that it was necessary to devise model texts in order to improve the documentation produced at the company. As two engineers wrote:

a) I come from an engineering background and I like to work to a defined structure

b) It would be good if we could come up with a template for writing executive summaries. It would save us from searching all the time for the best way of doing things, and ensure consistency of writing style. We're always reinventing the wheel.
(Engineers' workshop 1995).

This assumption gave rise to a project whose purpose was to design generic texts for just such a purpose (see Appendix U).

2.3.2 Writing guidelines

Simplified English - an example of writing procedures that receive little attention

In the early stages of this study, when I was enquiring about different the types of text being produced at the company, a member of the technical author team lent me the team's copy of guidelines on the preparation of handbooks that they had received from the European Association of Aerospace Manufacturers (AECMA), an organisation to which HISE belongs. Similar to the company's procedures, this is a hefty ring-bound tome, comprising four hundred or more pages. These guidelines, fully entitled 'A Guide for the Preparation of Aircraft Maintenance Documentation in the International Aerospace Maintenance Language', were compiled by a special AECMA project group which was set up by the AECMA Documentation Working Group. The Simplified English Project Group is not exclusively European, comprising fifteen members from Italy, West Germany, France, The Netherlands, and the United Kingdom (BAE SYSTEMS and Westland Helicopters), and no fewer than thirteen members from the United States of America, one of the reasons no doubt being a recognition of the expertise that exists in the United States, and the value that is placed there on the importance of producing effective handbooks and manuals. The project group, as claimed in the introduction, have 'researched the procedural texts in maintenance manuals' at the instigation of the aircraft industry, and proclaim their prescription for the problem identified by the industry:

> In the Aerospace Industry, the airlines identified the need for clear communication of complex maintenance data. Thus, in the late 1970's, the Association of European Airlines asked airframe manufacturers to investigate readability criteria for maintenance documentation within the civilian aircraft industry. ....This Simplified English is unique in the Aerospace Industry for a number of reasons: it chooses one word for a particular idea or action, defines the meaning that word shall have, and gives a set of rules to simplify the writing style. (AECMA 1989)

Clearly, the authors felt it necessary to encourage the production of maintenance manuals which reduce the risk of any misunderstanding on the part of maintenance crews across the world, most of whom would be speakers of languages other than English. As they explain with an unquestioning certainty:

> The user of a manual whose first language is not English may have difficulty with the complexity of English language. To help overcome such difficulties, we have made a set of rules to make the written message easier to understand. ......

Words were chosen for their simplicity and relationship with other languages. For example, ‘occur’ is apparently more international than ‘happen’ and was chosen for that reason. Their strategy follows a simple tripartite approach:

1. describe the grammar on which the writing should be based,

2. provide a limited vocabulary comprising a lexicon of about 1400 words, including inflections and variant forms/lemmas, and

3. lay down individual writing rules for each of the words in the lexicon.

Throughout the document the approach is prescriptive, brooking no arguments, and making plain the terms on which the user of the guide would have to take the prescription, as is explain in the introduction:

> In Simplified English, a word may have a restricted use. ‘To fall’ for example, is used to indicate the idea of gravity, and not the idea of a decrease in quantity. So the expression ‘the pressure falls’ is no longer available to the writer who follows the Simplified English rules. He must write ‘the pressure decreases’.

This confident and assertive style is reflective of the whole document. At no point is there ever any explanation of the criteria they used to decide upon the membership of their list of ‘simple’ words, nor is there any support provided for the claims they make about the ‘simplicity’ of their grammar. Furthermore, it would have been interesting to know on what basis they decided on the ‘international’ status of words. I am not being facetious in my last comment; so many experienced and expert technical writers clearly contributed to this project that it seems a pity that more of a rationale and justification for their guidelines has not been provided. Some of the claims may be contentious and appear to be based on hunches, like, for example, that their set of rules will make the message easier to understand. Others are intriguing, for example, the possibility of compiling an international set of words. Unfortunately, the quotations included so far in this section more or less reflect the extent of the justification provided in the brief introduction to the Simplified English guidelines. This lack is a noticeable shortcoming considering the intended reader of the document is the technical author, who is articulate in English and generally a skilled composer of technical texts of various kinds. The whole emphasis of the Simplified English is on the product and the reader; scant attention is paid to the writer or writing process, that is, how he is able to write within the constraints specified.

I could find no one at the company who had used these guidelines when writing manuals for aircraft maintenance; nor had any member of the technical author team, all of whom have been involved in writing projects involving writers from other companies in Europe and the USA, any knowledge of anyone who had used them. Here is another example in the domain of writing of procedures being ignored or disregarded. It is apparent that there is a clear wish within the engineering fraternity to control and constrain, as evidenced by the content and intent of the procedures. However, it seems that the act of producing the procedures somehow spells their death knell, the dynamism which goes into the writing of them ending with their publication, and with the procedures themselves falling into disuse.

ITSEC - another example of ignored writing procedures

The ITSEC document (ITSEC stands for Information Technology Security Evaluation Criteria) is another example of procedures referred to by a project leader when I was asking for information about writing technical specifications. They provide yet another example of engineers' belief that problems should be pre-empted or prevented by producing procedures and guidelines, including those for writing. In this case, the concerns centre on the need to develop 'harmonised criteria' across the engineering sector in the drawing up of security evaluation criteria for special software packages which handle classified data.

There are several copies of the document at , the project leader acknowledging that she had referred to certain sections of it concerning administrative procedures. However, of particular interest to this study are those sections governing the use of English in expressing the criteria, sections which no one at the company has followed. Unlike the authors of Simplified English, the authors of the ITSEC document are all British, being members of a British certification body sponsored by Her Majesty's Government. The forthright and prescriptive tone of the ITSEC document is similar to that used in Simplified English, as revealed by the following extract:

Para 0.12

> Within the criteria certain verbs are also used in a special way. *Shall* is used to express criteria which must be satisfied; *may* is used to express criteria which are not mandatory; and *will* is used to express actions to take place in the future. Similarly, the verbs *state, describe* and *explain* are used within criteria to require the provision of evidence of increasing levels of rigour. *State* means that relevant facts must be provided; *describe* means that the facts must be provided and their relevant characteristics enumerated; *explain* means that the facts must be provided, their relevant characteristics enumerated and justifications given.(ITSEC document)

I defy anyone to provide a justification for this advice on linguistic grounds, although the advice given, especially regarding modal auxiliary verbs, conforms with the understanding that engineers have of the meaning of these verbs in specification documents (see Appendix J). This ITSEC extract provides an indication of the kinds of problems engineers face in English, namely, confusions over different categories of technical description, and trying to devise their own rules of grammar to convey special meanings about product design.

Engineers usually disregard writing guidelines

In the final section to this chapter, it seems appropriate to provide the report I sent to the engineers who participated in the email survey on the responses to the question regarding use of writing guidelines: 'I suspect you seldom (or never) use the guidance available for writing. Am I right?' The report is presented below verbatim:

Report of responses to the question on the use of writing guidelines

Main finding: 92% of RASE engineers do not refer to any writing guidelines

The vast majority of engineers do not refer to any guidance for the writing they do at work. Punctuation marks, especially the oft-used question mark and exclamation mark, used in replies to this question can be expressive, as revealed in the following responses:

> What guidance????
>
> Yep!
>
> Yes, you are right!
>
> What guidance? - Does this answer your question?!!
>
> Yes. (The last time I used guidance for writing a report, I was asked to do something different)!
>
> I didn't know RASE had guidance for writing!

Two engineers base their writing on previously produced documents, e.g. reports, and another asks his colleagues to check the technical and grammatical accuracy of his writing if it is intended for external consumption. One engineer feels strongly that there should be less prescription, and argues for more freedom of expression and less constraint, echoing ideas I encountered in an earlier survey:

> ... one should be allowed to express oneself in one's own way. Most of us can write English, I hope. We did all go to school. We do not require to be told how to express our ideas. This is not 1984. ..... Sorry, this is a bit of a bugbear with me, as you may have guessed!

Four engineers in this category mention using grammar and spell checkers, although they are aware that these are not the guides referred to in the question.

A small minority (7%) have referred to guidelines

Only six engineers out of the sixty mention referring to writing guidelines of any kind: four have used RASE's procedures, policies, and instructions, and two the American Military standards.

Evaluative comment

This is not a surprising result so far as this study is concerned, as an earlier investigation revealed the existence of several writing guides and writing procedures, but failed to find anyone who had actually referred to them! Examples of the guidelines are Simplified English, a set of writing rules for engineers writing for readers who do not use English as their first language, ITSEC, RASE's Procedures, Policies, and Instructions, MoD writing guidelines, and American Defence Standards.

There has been a lively debate in recent years in technical writing circles ('The Journal for the Professional Communicator') about the usefulness of Simplified English, with the pro-camp led by a BAe engineer at Farnborough arguing for a strictly limited vocabulary and grammar, and a vociferous anti-brigade, highly critical of the constraints it places on the writer, and the way it prevents innovative writing.

2.4 Conclusion

It can be seen, then, that assumptions about the necessity of providing a procedural framework are not restricted to the engineers at , since such documentation abounds across the industry. There is also plentiful and costly evidence of the engineers' belief that there is a 'correct' way of doing something, with a hint of distrust on the part of engineers; there seems to exist a suspicion that fellow engineers may forget an essential 'step' or be slip-shod in their practices, and that this must be catered for or pre-empted. The underlying assumption I have consistently encountered is that it is both desirable and possible to account for, and delineate, anything concerning their work to a fine degree that I have not observed in other commercial organisations. Moreover, this belief in discovering the 'correct way' encompasses, of course, the writing done by engineers. It is curious, then, that the very documents that cause them concern seem resistant to the kind of control engineers would like to impose on them. These documents are, of course, proposals and executive summaries, and specifications and requirements. Although it is my long-term aim to investigate specifications and requirements, it is not possible to do them justice, or to understand them properly, without first examining the documents that lead to them, i.e. proposals. While some work has been done on specifications and requirements, it is proposals which serve as the focus of this thesis, as will be explained in the following chapters.

CHAPTER THREE - THE DOCUMENTS ENGINEERS WRITE

3.1 Introduction - early attempts to pinpoint engaging texts

Before the systematic examination of any text could begin, it was important to gain a broad view of the types of writing activity the engineers were engaged in, and the texts that resulted from them. From the start, there was a concern to identify the texts that most engaged engineers, and although my ideas were vague to begin with, I knew that there were texts that engineers valued, found interesting, and also found problematic at times. It was decided to begin the process by talking about texts generally, in order to identify these texts. There was no shortage of engineers willing to discuss them, and the first year or so of the study involved, among other things, collecting their opinions about writing and texts (which they refer to as documents), and trying to integrate their views into building up an overall picture of texts, depicted in Figure 1-10. In this early period, before I was given access to the company intranet, a range of opinions was sought and obtained, and, although engineers expressed individual and even idiosyncratic ideas, the views I gathered generally coincided. Put together, they provided a fairly coherent picture, with few exceptions.

3.1.1 Engineers' views

A distinctive feature of any discussion with engineers is the graphic illustration so often provided to accompany the words spoken. One of the earliest overall views of engineers' written texts was provided by a senior engineer with management responsibilities, regarded by other engineers as one of the company's 'boffins'. His diagram is reproduced below in Figure 3-1. So far as he is concerned, there are two broad categories: texts generated for external audiences, and those for internal audiences and purposes. His view is that the largest category is the internal one, which consists of three sub-categories: one comprising key technical data, which is a major category; one comprising ephemeral texts, admin-related texts of 'no lasting value'; and a third, which was added as an after-thought, containing documents produced for audit purposes. It was clear from the ensuing discussion, and the embellishments to the drawing that the 'key technical data' category is of greatest interest and concern to him as an engineer, notwithstanding his management role.

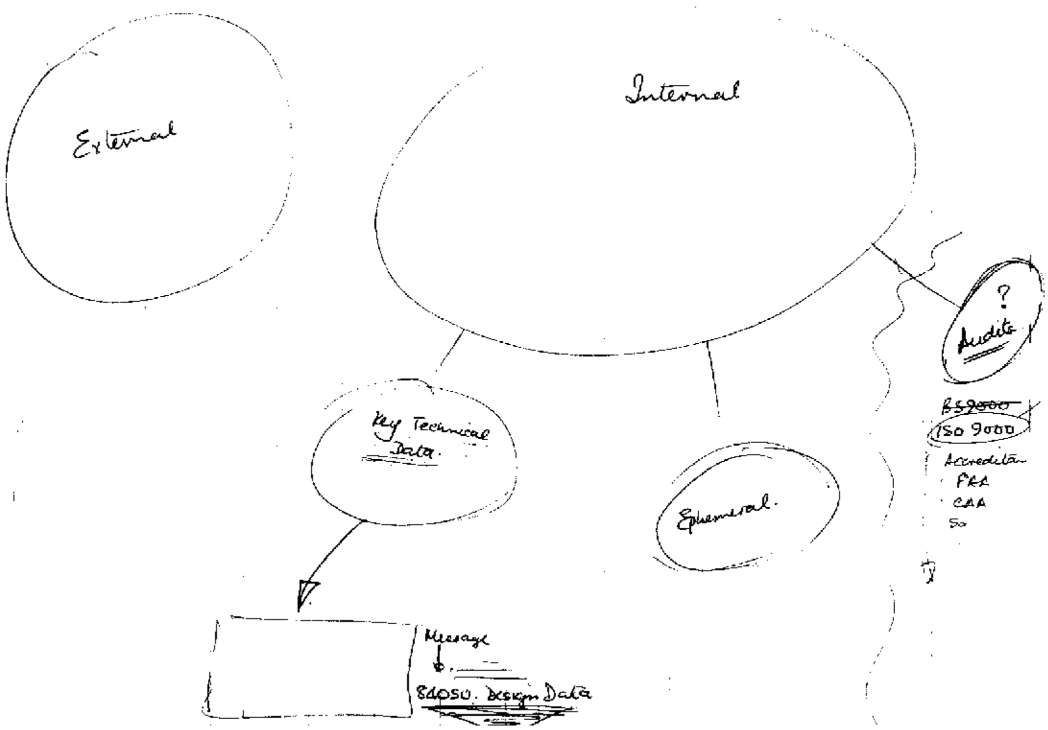


Figure 3-1: A senior engineer’s sketch of engineers' writing (DD 6.11.96)

I was struck by his reference to ephemeral texts, and inferred from his gloss of them that they were considered unimportant. To me, this was potentially useful information for approaching an investigation of engineers' texts, my reasoning being that the textual field could be conveniently narrowed by eliminating those text-types considered to be unimportant. Later, I used certain questions in the email survey to help identify these texts, with unexpected results, as will be explained.

3.2 The email survey

In earlier sections, I summarise the responses to questions about the engineers' work and aspects of their writing and working practices. However, when composing the questions for the questionnaire, a main aim was to identify those writing tasks that engineers were most concerned about, and those they considered unimportant. This section reports on the responses to Questions 4 to 8 of the email survey, by summarising the main findings. A full description of the responses to each of the questions is provided in Appendix I. When these questions were drafted I had, by then, collected anecdotal evidence that engineers were exasperated with certain writing tasks and questioned their value in certain cases. Examples of this sort of writing were SOFT reports, (SOFT being the acronym for ‘Strengths, Opportunities, Failures, Threats’), and any other writing required for internal administrative purposes. Added to that was my impression that ‘ephemeral’ texts, mentioned above, by virtue of having brief lives, had no lasting value, and were therefore valued less by engineers, unlike the way professionals in other fields regard some of the internal administrative writing they have to do (Davies et al 1999:298-301). I was therefore expecting engineers to respond to the question asking them about less important writing tasks by simply listing names of certain documents. It transpired, however, that I would be surprised by the way the majority of the engineers replied to it, which in turn caused me to question my own assumptions, and to revise my view of the engineers' attitudes to text.

The four questions reported on in this section were posed in an attempt to pinpoint those writing tasks that engineers are most concerned about. By taking a triangular approach, I reasoned, the responses to the questions (i.e. which documents do you write with other people, which take the most time, and which do you consider to be important/unimportant), would help to narrow down the categories and indicate the most significant text-types/documents. It was hoped the survey would yield data to confirm or modify the categories identified earlier in the project. For those who have investigated writing done in other (non-technical) work places (Davies et al 1996), a striking feature of these findings is that most of the writing done by HISE engineers is concerned with engineering design. Very little of their writing relates to administrative / bureaucratic matters. This surprising fact may be due to organisational changes that brought about fast, and marked, changes in writing habits, so that, for example, the dreaded ‘SOFT’ report did not feature at all in any of the replies, in spite of the fact that it features in earlier findings.

3.2.1 Major ‘text’ categories identified by engineers

According to the email survey responses, which were free responses to open questions, four major writing/text categories emerged:

1. Essentially technical and design-centred
2. Format-centred, i.e. not content specific
3. Intended for internal (HISE) audience, essentially concerned with personnel and administrative processes
4. Intended for external audience, essentially persuasive and/or ‘selling’

A comment of each now follows.

1. Essentially technical and design-focused

Reports form the largest category with 80% of RASE engineers writing a range of technical reports. Almost as many write design requirements and specifications (71.7%), mostly related to software design. A surprising result from my point of view is the significant number of engineers (46.6%) who write log book entries, since I had not encountered mention of these in any discussion, nor in any of the literature on technical writing. The high number of engineers involved in proposal writing (also 46.6%) is a reflection of the nature of the company's work activity in recent years, which could be described as being business-seeking, as well as dealing with in-service products.

Fewer engineers (11.7%) are concerned with manufacturing instructions and specifications, reflecting their involvement with the implementation of a design in the production process. The same number mentioned having to write plans, and revealed that they have to write a variety of them. Plans proved to be another surprise, much in the same way as the engineering log entries, and seem to be similar to log books in that they are almost a taken-for-granted aspect of engineers' work. Since plans are concerned with plotting or extrapolating work schemes, they are of little interest to this study. However, Technical Notes have proved of some interest since they are concerned with design. Intended for an internal audience, i.e. colleagues within the company, like logbooks, they are another document-type that was nearly overlooked. (A HISE definition of a Technical Note is provided in Appendix H.) Small numbers of engineers (10%) are concerned with writing technical notes, which record any technical ideas an engineer may have, and which are indexed and stored in the event they may prove useful to later design work. Even smaller numbers of engineers are involved in writing manuals and handbooks, patents, and procedures.

2. Format-centred, i.e. not content specific

Significant numbers of engineers mention the written communication mode or format, rather than the text-type or genre, i.e. memos, emails, and letters (75%, 38%, and 30% respectively). Only 15% mention faxes. Most, if not all, of the memos are in fact email messages, and, strictly speaking should be considered an email subcategory. Email, in fact, denotes the mode of transmission and possibly the format of messages, but not the message type. In this respect, faxes and letters are similar to emails, although within HISE, the term 'letter' seems to carry a special significance, similar to those 'letter-format documents' observed by Freed (1987:158) to be, in fact, formal proposals produced by an accounting firm. Information on letters that I have collected indicates that they usually require careful preparation, often of a technical and/or financial nature, and are usually a formal response to a query from a customer or supplier. HISE engineers are reaching the end of a transition stage at present, moving from sending paper-based messages to transmitting nearly all messages electronically. It follows, then, that the formal letter is on the wane, apart from those which may have contractual and/or legal significance in the future.

3. Intended for internal (HISE) audience, essentially concerned with work and administrative processes

Small numbers are concerned with what may be called facilitative writing. This is the kind of writing which serves the purpose of working processes and professional learning within the company. Presentations are the largest group, concerning 8% of engineers. These are a special case, because they make different writing demands on engineers from the other texts: there can surely be no other writing task which requires engineers to script-write what they are going to say in front of a live audience of colleagues.

4. Intended for external audience, essentially persuasive and/or 'selling'

The distinctive feature of texts in this category is that they are intended for audiences without HISE, who could be regarded as customers or potential customers. Fifteen percent of the engineers write executive summaries which are a special section of the proposals examined in Chapters 4 and 5. It is an overtly persuasive part of the proposal that engineers find particularly problematic.

Only one engineer writes web pages, and two engineers prepare brochures and other publicity material. Both web pages and brochures require particular writing skills which are very different from those required for writing the design-focused texts in the first category.

3.2.2 Collaborative writing

Engineers responded to the question about this with short concise answers, or lists of document-types, which yielded six main categories of response in rank order:

1. Those who write (virtually) on their own (35%)
2. Proposals (33%)
3. Software design/requirements/ specifications (25%)
4. Reports (23%)
5. Manuals and handbooks (5%)
6. Presentations (5%)

Those who write nothing or very little with other people (35% of respondents) formed the largest category, with a total of 21 engineers claiming to write more or less on their own. Their views on this vary as revealed by these responses to the question ‘What do you write with other people?’:

> No, but prefer to,

and another, who answered:

> As few documents as possible (writing by committee is a hassle).

Within this category, thirteen engineers write nothing (or virtually nothing) with others, and eight write so little that they consider it hardly worth mentioning.

Writing proposals demands the most collaborative writing effort, involving twenty engineers, or 33% of the total, 25% write software design documents (specifications and requirements) collaboratively, and 23% write reports. One engineer explained the proposal writing process thus:

> We tend to write proposals as a group but not doing the same bits together (we do individual parts which are brought together as a whole).

His explanation provides a simple outline of what is, in fact, a complicated process, which is both time-consuming and costly to the company. An examination of this process, and an analysis of the writing done by the engineers is provided in the next two chapters. Details of other responses to this question can be found in Appendix I.

With few exceptions, responses to the question about time-consuming documents were short and concise, with a few providing some kind of explanation. Some examples of the longer replies illustrate their preoccupation with requirements:

- Probably the specs, as they are laborious to produce, and require frequent changes.
- Specification writing and responding to customer & supplier questions and comments.
- Technical reports, as they are generally linked to applied research projects. These can take several weeks to complete as they evolve with the research. Requirements also take a long time as they will change several times during the review process.

Major categories of documents that are the most time consuming to write are as follows:

1. reports (22.1%)

2. software design/requirements/specifications (18.9%)

3. engineers' log books (9.5%)

4. memos and emails (9.5%)

5. proposals (9.5%)

6. letters/responding to customers' queries (5.3%)

It is useful to note the overlap of these responses with those for the previous question, which asked engineers what they wrote with other people, i.e. proposals, software design/ requirements/specifications, and reports.

When asked to list the documents they considered to be important, it was revealed that the most highly regarded are, unsurprisingly, those which are essentially technical and design-centred. If we pay particular attention to those texts which have a clear purpose or content (which excludes the Format-centred categories), and consider those categories mentioned by five or more engineers, it emerges that there is a limited set of texts:

- reports
- requirements/specifications/software design
- proposals
- engineering log book entries
- executive summaries
- presentations

If we then examine specific documents mentioned by engineers within the largest (design) category, the following emerge as being the most important:

1. requirements/specifications/software design

2. technical reports

3. proposals and bid documents

4. engineers' log books

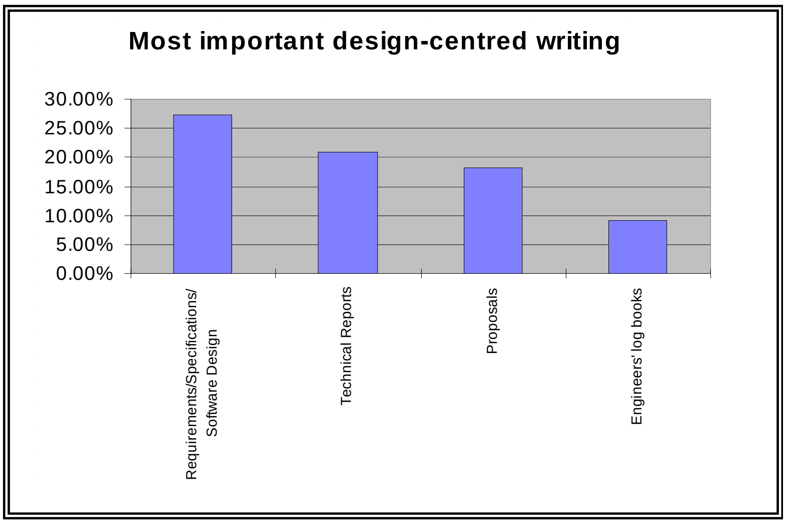


Figure 3-2: Most important design – centred writing

3.2.3 Summary of responses to the questions about 'important' and 'unimportant' texts

It appears that most engineers are in the fortunate position at work of being required to write only those documents that they value. Only one engineer out of the sixty respondents did not attach much importance to writing. Of the rest, twenty-two engineers (36.6%) named particular documents that they considered important, usually simply naming one or more:

- Reports
- Responses to customer queries.
- Requirements, proposals, reports

However, a striking aspect of the findings is the fact that, when asked which documents were mot important to them, thirty-three (55%) expressed the belief that all the writing they do is important. Eleven simply wrote 'All' as an answer, whereas others felt the need to explain themselves:

> This doesn't answer your question, but I consider them all important. If they weren't important, they wouldn't need doing, and I'd find something more important to do. In some way, they are opportunities to put your mark on something permanent, and a way of getting known about the company. This can of course, backfire in a big way!

> From my point of view, everything I ever do is important. It is just a question of which is most important - and that varies on a daily basis.

> They all have their importance, some not at the time that one wrote them, e.g. engineering log book entries.

> ?at the risk of being flippant - all of them - they are all part of the job

A majority (66.66%) do not write anything they consider to be unimportant. This contrasts with findings of other surveys (Davies and Forey 1995; Davies, Forey and Hyatt 1999), and may be the result of fundamental changes to working practices that had been implemented around the time the questionnaire was administered. The company had undergone yet another reorganisation, and work practices had changed so that certain administrative type documents, SOFT reports and the like, were no longer required, as this answer reveals:

> Nothing. There was a time in the past when we had to write what I call Processed Junk, e.g. soft reports. But they've done away with that now.

These changes in the workplace have had knock-on effects on the writing engineers have to produce. They have clearly reduced the range of writing engineers are required to do, and, it can be argued, the fact that engineers believe the writing they do to be relevant and important may be an indication that streamlining and improvements to the engineers' work practices have taken place, i.e. they only write what is important and useful to their work, and, it logically follows, the writing is more focused (on the product).

3.3 Inferences to be drawn from the engineers' responses

First inference engineers value highly the writing that they do

Some engineers clearly take care over their writing, seeing it as having a clear purpose and reflecting on them professionally. They seemed to find it odd to be asked to identify unimportant writing, as exemplified by these responses:

> Strange question! [when asked to explain, the engineer wrote:] I'm not trying to pull the 'Added Value' aspect of my work, but I do regard almost everything I do as important and try to give each item as much attention as it needs – even a memo deserves that. Added to which I want to maintain the standard of my work.

> None. Writing is a medium for explanation, description or reviewing etc. I feel it is important that I can express myself well otherwise my efforts may be disregarded or overlooked.

> No, we need it all. Everything I write is necessary really. Even the progress reports are important. I quite like writing them. It's useful to think about what we've done and to put it in words.

Second inference – most engineers wouldn't consider writing anything considered to be unimportant

I gained the impression that several respondents were surprised I should have thought they would spend time writing anything that was not important. Some replies seem to imply that they would not countenance doing any writing that was not important, that they would reject the task if they thought as much, and would cock a snook at anyone who would dare to try:

> Who would do things that are unimportant?

> At work I don't intentionally write anything if there's no reason for it. I can't remember having written anything for which there wasn't a reason.

> None, or I wouldn't do them.

> None of the items I consider unimportant. I try and only write things when they are important. This is my way of reducing how much I have to do.

There is possibly a third inference, i.e. that some engineers do not question what they are asked to write. Other engineers seemed to imply that if it is required or asked for, it must be important:

> I only write what I'm required to and it is usually relevant to my work.

> All company functions are important.

3.4 Conclusion

I felt somewhat foolish to have asked engineers the question about texts they regarded as unimportant, and their (occasionally indignant) responses motivated me to take issue with the 'boffin' who first coined the 'ephemeral' category of texts. The ensuing discussion revealed the breakdown in understanding that can occur when an Arts-oriented person, whose job imposes some writing tasks which are bureaucratically inspired, tries to communicate with a scientist, who is self-determined, with few writing demands made of him, and who has a maverick attitude towards writing. The fact that ephemeral texts do not have long-lasting value does not mean they are unimportant: the word 'unimportant' is too value-loaded and emotive for engineers' liking. It means, quite simply, that, unlike design documentation, which endures, ephemeral documents are relevant only for the time they serve any useful purpose. Often the purpose is served within short periods of time, possibly days, or even minutes.

With the benefit of hindsight, it is possible there were more efficient ways of pinpointing problematic texts, and perhaps more reliance should have been placed on the results of earlier investigations. However, the email survey proved educative, providing copious information about a range of writing issues, and, ultimately, indicating the texts that should be examined in this study.

CHAPTER FOUR - PROPOSAL WRITING PRELIMINARIES

4.1 Introduction

In Chapter Three, three main document categories were identified as being of particular interest to design engineers at HISE:

1. proposals (and executive summaries),
2. specifications (and requirements),
3. and engineers' logbooks.

This is not to say that engineers are uninterested in other documents, e.g. engineers' manuals, technical notes, technical reports, as the previous chapter explains, but that these three documents claim most of their writing time and, in the case of proposals and specifications and requirements, cause the most concern. This concern could, without exaggeration, be referred to as anxiety, because these documents may incur huge problems and expense if they are not effectively written.

Proposal writing has become one of the most important writing activities in the last five years at HISE, if not the most important. Engineers have significantly broadened their writing horizons out of the necessity of having to look for new business. The heavy reliance on the MoD contracts up to the 1990s has been a cause of concern, and led to calls for diversification, and this decade has seen a marketing shift in response to the need to bid for civil contracts. However, engineers will claim that clarion calls for a change in direction on the part of the management, who would like to see more civil/commercial contracts won, have not changed the fact that the traditional relationship endures, and that the MoD remains a major customer.

The last four years have seen a channelling of engineers' efforts into writing proposals. A simple indication of this is the greater proportion of the company's training budget on commissioning courses in proposal writing for their engineers across all departments. Engineers themselves claim a greater proportion of their time is now spent on proposal writing. This is certainly a new departure for them, forcing a change to their traditional writing habits, and making writing demands of a different kind upon them. It has also brought about a sea-change in their attitudes to writing, since proposal writing makes rhetorical demands that they used to regard as peripheral to their work, e.g. persuasive texts, side by side with the technical description they relate more closely to. Another causal factor in this attitudinal change is the move towards team working and team writing, which demands the engineer bring a broader perspective to his writing. This latter point means, in practical terms, that engineers who are responsible for preparing a bid need to take into account all aspects of the product they are offering, including not only the design, where lies their main interest (nay, passion), but also other aspects like manufacturing, servicing, and contractual legalities.

A flattening of the hierarchical structure within the company, with the phasing out of typists and other such support staff, has helped to bring about dramatic changes in engineers' writing practice. This decade has seen engineers involved in every stage of the proposal writing process, from the very early decisions about design and selling points through to the final proofs of the (usually weighty) documents.

This chapter investigates proposals, and in particular, those parts of the proposal which design engineers are required to write, or help to write, since the writing of proposals is usually a team-writing exercise. Ultimately, it is hoped this work may be of use to the engineers in their quest for writing models, proposal writing guidelines, boilerplates, content checklists, and the like, that they believe will make their job easier. Therefore the investigation begins by describing proposals at a macro level, providing an outline description of proposals, before examining the discourse structure of particular sections.

It will be shown how the proposal, by its very purpose and linguistic construction, is distinctive from other types of writing concerned with engineering design; it alone in the whole suite of design documentation is persuasive, and overtly so. This chapter discusses what the Customer needs to be persuaded about, and how the engineers try to achieve this, which paves the way for observations and suggestions made later about the proposal writing process and how they could be more effectively written.

First, it might be useful to clarify terms briefly. In this sort of study, in which 'a posteriori' categories have been identified, it is useful and sensible to draw upon the nomenclature of the discourse community. This view is put forward by Swales who asserts that 'eliciting the community's category labels plays a central role' (Swales 1990:39). Sometimes, when most of a proposal is concerned with technical aspects, the whole proposal is referred to a 'the technical proposal'. At other times, the technical proposal may be sub-section of the whole proposal, although it is always considered to be the most significant section, by engineers and non-engineers alike. For the purposes of this discussion, when the term 'technical proposal' is used, it refers to both types, since, no matter how long or short they are, from the perspective of the company and the engineers, the functions they perform are the same.

From necessity, through paucity of actual texts to analyse in the early stages, this study initially identified discourse functions from ethnographic evidence, i.e. interview data, and observation and questioning of engineers while they worked, some of which is discussed in the previous chapter. Pragmatic aspects of the texts, in particular, their discourse functions, were identified (discussed later in this chapter), and from them and the texts available, extrapolations made and hypotheses drawn about the discourse structure and linguistic characteristics of the texts. In this early stage of the analysis, attempts were made to identify a useful analytical perspective. These were informed by reading about the work done by others in the fields of engineering and applied linguistics, and, because of the 'selling' nature of proposals, in the field of business and management.

4.2 Analytical approach followed

4.2.1 An overview of the analytical approach taken

A description of the different sets of data drawn upon for this study is provided in Chapter 1, and reference made to the surprise granting of access to the company's 'bank' of proposals in the summer of 2000. The sudden availability of this collection, and at such a stage of the study, was seen as being both an opportunity and a possible concern, because work had already been done on a few proposals, with preliminary conclusions having been drawn about their textual characteristics; it was possible after all that examination of a considerably larger collection could invalidate earlier findings. Nevertheless, since proposal writing was of major concern to engineers, the enlarged collection provided opportunities for analysis that had not existed previously, widening the scope of the study, and enabling me to do the following:

- check on the validity of earlier findings
- make more substantial claims about Information Components (ICs)
- compile corpora for computer analysis
- identify significant text patterns
- describe these patterns, and test them against other documents (post-PhD).

There was, therefore, little choice but to continue (with some trepidation), and attempt to build on work that had already been done. I decided to work on the assumption that information that had already been gained had integrity and usefulness to the study. I hoped that the findings that had been made from interview data, for example, would inform and support further study, rather than contradict it. My decision to use findings from preliminary analyses to inform the later more comprehensive study radically changed their role from being the actual findings, to forming the starting point for further study. In the event, this earlier work proved to be a significant part of the investigation, because it flagged up those parts of the proposal which proved to be the most problematic and of the greatest concern to the engineers. These are the parts whose composition are the direct responsibility of the design engineers, i.e. describing the product, or the 'solution' as it is referred to in proposals, and explaining how well it matches the customer's requirements.

Earlier Analysis

The earlier pre-2001 work was carried out by examining paper-based copies of four documents, by hand. This was an exercise of discovery with few, if any, preconceived ideas about the texts, during which I relied upon linguistic clues in the text, hunches and intuition informed by past experience with ST (Science and Technology) texts, to make hand-written annotations and other mark-ups during a trawl through the texts. This was a bottom-up approach, and a not so quick 'quick and dirty' analysis, to use Swales' term. The results of this examination provided insights and information about discourse patterns, other linguistic features, and a socio-linguistic perspective, which eventually led to the identification of ICs mentioned later in this chapter.

Later analysis - more data and the need for computer-based analysis

It was clear that a more systematic approach, preferably computer-assisted, was necessary when copious data was made available in 2000, comprising ninety-five proposals, and more, with a word-total exceeding half a million words. It was thought that any useful analysis of even a selection would prove an insurmountable task without some computer assistance.

It was decided to follow a three-pronged approach:

First, a manual [quick and dirty] approach - direct contact with the text with hand-written mark-ups: To make a small selection of proposals, in order to conduct a manual impressionistic analysis, i.e. observations recorded as hand-written annotations. The aim at this stage was to identify linguistic features ranging from information topics to use of lexis for a more comprehensive treatment later. The proposals were chosen for their representativeness, and for the fact that they could be examined by others (i.e. readers of this thesis) without contravening confidentiality arrangements with HISE.

Second, an extension of the manual examination through a computerised interface: To supplement this first examination with a more systematic one using a computer tool, NVivo, which is a qualitative data analytical software package with a facility for examining text.

NVivo replicates the 'quick and dirty' approach, but helps the researcher manage the sheer quantity of data and paper in order to perceive patterns or significant textual features. In the case of this study, I used NVivo to tag text segments in the identification of Information Components (ICs) in proposal texts. More information about ICs, and using NVivo is provided in Chapters 6 and 7.

Third, the identification of textual patterns: As a result of this examination, to make observations about significant features of the texts relating to their information structure and IC identification.

A manual [quick and dirty] approach with hand-written annotations

Anyone who has worked with text in this way may relate to my experience, and recall the enthusiasm of tackling a document in the early stages of a text examination. By the time the twelfth or thirteenth page is reached, however, the enthusiasm has waned considerably, and been replaced by other more negative emotions to affect the smooth progress of the analysis: the thought of another twenty or thirty pages to go, followed by the prospect of examining a further half dozen such documents is demotivating indeed. The sheer volume of information gained from this early examination is difficult for any researcher to make much sense of. Nevertheless, such analysis is important in an investigative study like this, because, by its very nature, the researcher needs to interact with the texts, make guesses about them, question the writers of the texts, and formulate early, if tentative, conclusions. The observations below show the kind of early information gleaned from this analytical approach, ranging from inferences drawn about discourse structure, through observations about clause combinations and words and phrases, to noting overtly persuasive writing.

1. **Discourse structure:** certain paragraphs seem to relate to selling points (or benefits) in the executive summary, e.g. three phases of the project mentioned in the executive summary are expanded upon in the proposal, the Silicon IMU as the proposed solution is a key benefit in the executive summary, and described at length in the proposal.

2. **Clausal patterns:** an observation that sentences describing the proposed product in one of the sections are structured according to the following pattern:

First clause		Second clause
↓	+	↓
Design feature		Reason for this feature
e.g. Three Silicon VSG sensor heads are mounted orthogonally		e.g. to give roll, pitch and yaw rate information.

3. **Word and phrase level features:** vague language in which hedging disguised in vague engineer-like language might be detected, e.g. 'The accelerometer currently envisaged' may be interpreted as 'but I may change my mind'; or 'Initial mechanical design concepts' may be seen as a noun phrase with suitably impressive pre-head modification serving as a smokescreen for the conveyance of vague thoughts, or the posting of a tentative idea (EP3018). Engineers generally regard any kind of vague language to be anathma, and to be avoided, and, in fact, it is regarded almost as taboo, especially when describing the product. Nevertheless, a few have admitted that it can be useful in the early stages of product design. This study has revealed it to be indispensable, especially at the proposal writing stage.

   Persuasive Language: 'technical-speak' versus 'sales-speak'

   A clear difference was noted between writing segments which were overtly persuasive, and those which were not. When trawling through proposal documents, I was struck by the contrast between text which was couched in engineers' sales-speak (sometimes referred to as marketing-speak) and that which appeared more objective and technical. The use of 'successfully' in the following two examples is a case in point. In both, 'successfully' functions as an adjunct/adverbial, but in Example 1 it is used to emphasise and extol the virtues of the thermal imager, in a writing style that most engineers feel uncomfortable about, whereas Example 2 is a straightforward scientific statement of fact, explaining the algorithms used to engage the auto-track:

   > Example 1: The NERO 6340 series of Thermal Imagers are designed and manufactured for use under the severest of operating conditions and have been successfully proven in shipborne and main battle tank applications.
   >
   > Example 2: When the processing circuits successfully differentiate an acquired target image from the background, then autotrack is engaged. [EP3015]

The issue of persuasion, the language associated with it, and engineers' difficulties with it, are discussed further in later in this chapter.

4.3 A review of the literature on proposals

4.3.1 Up to 1980

It would be paying a disservice to the considerable and informed literature that exists in the area of EST, to report, without some qualification, that a dearth of information exists on proposal writing. The fact remains, however, that this is a neglected aspect of engineers' writing, and always has been. If we consider the substantial work on EST that took place in the middle decades of the last century, mainly in America, more attention appears to have been paid to proposal writing before the 1980s than afterwards (Souther 1954, Marder 1960, Hicks 1961, Weisman 1962, Pauley 1973, Souther and White 1977, Fear 1977, Houp and Pearsall 1980). Much of the work of this time arose out of the distinctive applied analytical practices and close working relationship between academia and industry, as exemplified by the work of those at the University of Washington (Souther and White 1977).

Even so, before the 1980s, proposal writing was still not often mentioned. Technical report writing was the major concern around this time, and these books were written primarily as text books to be used on ESP/EST courses for L1 students in tertiary institutions, and for in-company courses. Across all the works, the emphasis is generally on the writing of manuals, feasibility studies and the like, technical articles and/or papers, and letter/memo writing. Hicks, for example, in acknowledging that engineers write a range of documents, makes fleeting references to proposals, but uses the term to refer to proposals made in technical reports (1961:141), or more informally to mean a suggestion.

In fact, ‘report writing’ is generally used as a cover-all term to function as a near synonym for ‘technical writing’, and in the two books in which proposals are explained, proposal writing is subsumed under report writing: Pauley categorises them as a type of formal report (1973:163), and Houp and Pearsall designate proposal writing as one of the applications of technical reporting, stating that proposals are a kind of technical report, and dealing with them in a section which includes progress reports, feasibility reports, and correspondence (1980:v, 267).

Accordingly, Houp and Pearsall deal with proposals as sort of quasi-reports, and anyone who has researched or taught report writing will be familiar with their prescription: ‘Introduction-Body-Solution-Attachments’, often quoted as an outline structure for reports. They suggest writers should follow this outline plan in proposal writing (1980:344), adding, as a rider, that such an outline applies to small-scale proposals written by one person, and implying that what they refer to as ‘mammoth’ proposals would be structured differently:

> You should understand, however, that the paperwork for mammoth proposals (investigations in the millions or billions of dollars) may fill a five-foot shelf.
> (Houp and Pearsall, 1990:345)

This is all they have to say about large proposals, since their chapter on proposal writing concentrates on the writing of unsolicited ‘short-form letter proposals'. This seems curious, considering that the main problems engineers have concern the competitive solicited proposals, and not the unsolicited ones. This is mere surmise, but it is possible that little information existed (or exists) on competitive proposals, since they are considered by companies in competition to be highly sensitive, and have not been made available for study. Furthermore, the pre-eminence of report-writing as the major type of rhetorical discourse associated with technical writing, and the need to appeal to a mass readership/market, may have determined Houp and Pearsall's disinclination to tackle the competitive bid (or proposal). After all, the unsolicited proposal fits, nearly, into a report paradigm, although I am tempted to draw analogies with attempts to fit a square peg into a round hole: the solicited proposal most certainly does not fit, and, possibly for this and the previously stated reason, receives scant attention from Houp and Pearsall.

Most of the information they provide relates to a brief contextual story explaining how proposals arise; they depict proposals as typical investigative projects (1980:342) which are written in response to a perceived need on the part of the Customer. They make special mention of an 'RFP', standing for 'Request for Proposal', because it is commonly issued by a potential Customer. Another acronym in use these days is 'RFI', standing for 'Request for Information', which engineers also use to refer to the document they write as a response to the RFI. I have overhead, for example, engineers say: 'Have you finished writing that RFI yet?'. An RFI issued by a Customer is a more informal casual enquiry , which may, nonetheless, eventually lead to a business contract or being invited to submit a more formal proposal. An RFP is a more formal and firmer request for a proposal.

Houp and Pearsall also discuss the sort of information which could be included in a proposal. This they list as separate topics, with the advice that only those 'items' that are pertinent should be included. The full list is as follows:

• Reference to earlier association	• Time and work schedule
• Subject and purpose	• Facilities available
• Definition of the problem	• Previous experience
• Immediate background of the problem	• Personnel and their qualifications
• Need for solution of the problem	• References
• Benefits that will come from solution	• Likelihood of success
• Feasibility of solution	• Products of the project
• Scope	• Cost and method of payment
• Methods to be used	• Descriptive and advertising literature
• Task breakdown	• Urge to action

Table 4-1: Houp and Pearsall's list of items for inclusion in proposals

They suggest to the reader/proposal writer that these 'items' be used, or combined, as headings, and imply that the order of appearance of the items should be followed in the proposal. Any advice they give is generally expressed, and relates more to writing purpose and strategy than to specific language or textual features. As an illustration of this, here is how they discuss 'Definition of the Problem':

> Depending upon the scale of the proposal, you should spend from a paragraph to several pages in defining, locating, and describing the problem you propose to solve. By this means you may 'shock' your intended client into sudden and full awareness that a problem really does exist. However, you should guard against overstatement and overdramatization, because the techniques can boomerang. (Houp and Pearsall, 1980:347)

Much of Houp and Pearsall's chapter is devoted to explaining each 'item' in this way, offering advice and using narratives for analogies to be drawn, or case-study-type explanations, to help the reader. If asked about how one would actually compose defining, locating, or describing text, they would probably point to an earlier chapter on technical exposition, which deals with such writing topics as exemplification, definition, classification, comparison and contrast, and so on. The essentially persuasive intent of proposals is only once, and briefly, made explicit when they state:

> ....we can safely assert that a proposal is designed to discharge two salesmanship functions:
>
> 1. To get a proposal accepted.
> 2. To get you (or your company) accepted to perform work.
>
> (Houp and Pearsall, 1980:344)

Since engineers need to develop expertise in writing persuasive proposals, they clearly need explicit advice on how to do this, for today, as in the 1980s, engineers remain ambivalent about writing persuasively, regarding it as a kind of writing they would rather not be associated with. This issue is explored later in this chapter.

Pauley draws a different distinction between proposals to that drawn by Houp and Pearsall. Rather than seeing proposals as either solicited or unsolicited (Houp's and Pearsall's distinction) Pauley sees a dichotomy between what he calls 'interfirm' and 'intrafirm' proposals, the difference being, in his interpretation, that interfirm proposals are competitive and submitted as part of a bidding process, whereas intrafirm proposals are unsolicited proposals made within a company, usually from an employee in a subordinate position to someone in a management position.

Of the little information that is available on proposals, Pauley's work on interfirm proposals most accurately reflects the current situation at HISE. Unfortunately, his treatment of them is scant; of the 29 pages in the chapter on proposals, only 3 ½ are devoted to interfirm proposals, and the rest of the chapter to intrafirm proposals, 19 pages of which contain sample proposals. It strikes me as curious that another work should begin a chapter by discussing competitive proposals, and emphasise their importance, only to deal with them cursorily before moving on to intrafirm proposals. Yet again, the interfirm proposal is given prominence by being placed at the start of the chapter, and the drama associated with such proposals is described. Expectations of a more detailed treatment of the interfirm proposal are dashed, however, as most of the rest of the chapter is contrived into conformity with a report-writing theme, with the bulk of the chapter concentrating on non-competitive proposals written for an internal audience within a company.

Nonetheless, Pauley attempts to provide a framework of some use to proposal writers generally, which would be applicable to both inter- (i.e. competitive) and intrafirm (non-competitive) proposals. On the surface, this appears to be an uneasy compromise, but beyond the desultory early sections, which include title page, table of contents, purpose, and scope, he provides an outline (see Figure 4-1 below), two aspects of which current proposal writers may recognise. First, as can be seen in the sections of what Pauley refers to as the 'body of the report', a combative phrase is used to label a part of the technical section: 'Plan of the Attack'. Such a label reflects the strategic approach needing to be taken in the writing of the technical part of the proposal, and Pauley probably chose the words 'plan of attack' to convey this. These days, though, engineers would take issue with such an aggressive sounding label, because they see the aim of the technical part of the proposal as being complementary to the reader's needs, and as being a proposed solution to the Customer's problems; they want to persuade and win the Customer over to their side.

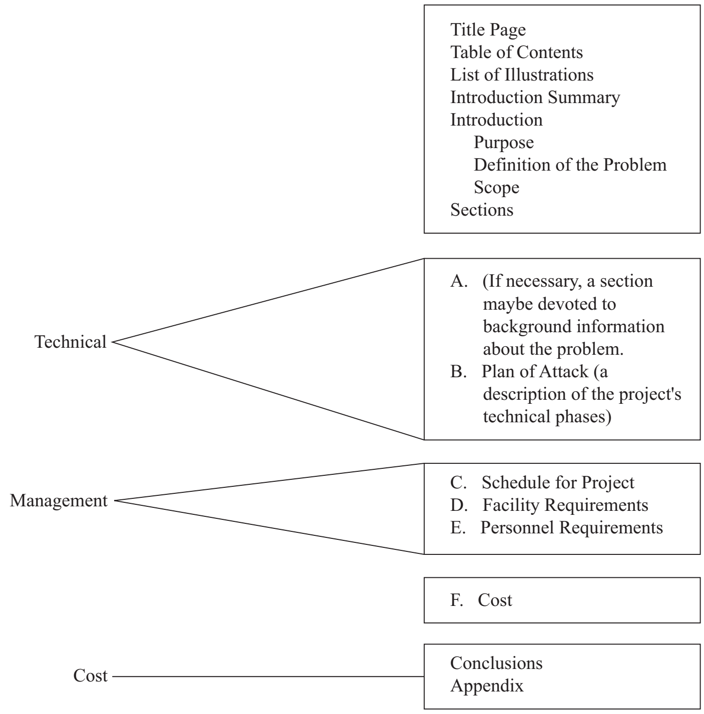


Figure 4-1: Outline for an intrafirm proposal (Pauley 1973:166)

The second aspect relates to his identification of three major subsections in the 'body', which he highlights to the left of his outline: Technical, Management, and Cost. This tripartite division continues to the present day as major and distinct parts of the proposal, which are sometimes submitted as separate volumes (see Chapter 5 for more information on the structure of modern solicited proposals).

Pauley provides an interesting, if somewhat superficial, overview of the interfirm proposal, using as contextual illustration the Pentagon's invitation to companies to bid for work on the B-1 supersonic bomber (ibid:163), providing a concise gloss of the function of the main parts of the proposal, as can be seen by the following:

> *Technical.* A proposal's technical section begins by stating the problem to be solved. This seems unnecessary, but the firm must clearly demonstrate that it understands what the solicitor expects. Then, the firm describes its approach to the problem and presents a design for the product if one is needed. Sometimes, the firm offers alternative methods for solving the problem and invites the solicitor to select one. (Pauley, 1973: 165)

However, as is the case with Houp and Pearsall's work, this is the limited extent of the information provided. It is unsurprising that engineers, as well as those that teach them, and those who help them to write proposals, the technical authors, should mention the lack of guidance that exists for proposal writing, and the difficulties that such writing poses. It is also not surprising that those who have to read the proposals should express the wish for better organised and more relevant reading material.

4.3.2 Post-1980

However, if proposals were not pre-eminent in these sterling works, they have been positively neglected in more recent decades. This is curious, considering how important they have become in engineers' work, in terms of frequency and consumption of engineers' effort and time at work, as well as being their potential source of future employment and means of retaining their jobs. A trawl through more recent work in the field of applied linguistics or ESP yields little specifically on proposals. A search through numerous writing guides and books on communication skills of the self-help 'close-that-sale' or 'write-that-winning-proposal' variety, yields poor pickings, with few references to proposal writing of any use to this study. Such publications, including those intended specifically for engineers and technical authors, generally pay scant attention to proposals, and are not representative of the importance attributed to proposals by engineers at work today.

There are, however, a few notable exceptions, for example, Freed and Roberts (1987, 1989), whose work is discussed later. There are also those books which are well-regarded and referred to by technical authors and university engineering lecturers. Used by the latter is a text book for engineering students on developing communication skills, which has a chapter devoted to proposal writing, albeit brief: a little over four pages in length (Ellis, 1997:166-170). Also, in the non-academic professional field, technical authors and engineers have found the ideas put forward by Stross (1992) and Covey (1997) useful, and these ideas have helped to inform this study. There has been the odd false lead, which, in view of the information dearth, proved disappointing. For example, Ellis (ibid:170) mentions a book with the promising title: 'Writing winning Proposals' (Silver 1992), of which the British Library can find no trace.

Ellis puts forward an informed and common-sense view of proposal writing in a bullet point format, which is popular with engineers. He starts by defining the proposal as being essentially 'a selling document', citing the MoD as a major customer (Ellis 1997:166), in much the same way as Pauley mentions the Pentagon in the opening section to his chapter on proposals as being a significant instigator of invitations to tender, mentioned earlier. Clearly, governments continue to be a major source of business for engineering designs. In Ellis's and Stross's work, little attention is paid to textual and/or language aspects, their main concern being the human motivation behind proposal writing and concomitant aspects of writing strategy needing to be adopted. In both cases this involves a discussion of the sort of information that needs to be included in order to follow the strategy. Their guidelines are usually generally stated, or have general applicability, with the understanding that persuasion as the primary purpose underpins their discussion of proposals. This sort of treatment can be seen to be sociologically determined, with the primary emphasis on interaction (Brown and Yule 1983: 228), since readers are asked to first consider relationships between proposal writers and Customers, and to use this to inform their writing strategy. Ellis, for example, provides a list of bulleted topics to be included in a proposal, which includes costs, quality control systems, and ability to keep to deadlines. He follows the list with advice which emphasises the interactional aspect:

> There will be many other questions, but unless the organization receives reassuring news on these then it is not much point going further with the relationship. Naturally a proposal has the best chance of 'winning' if it closely matches the customer's needs .... If for any reasons the proposal that you write (either individually or as part of a team) is *not compliant* then the reasons for this must be clearly spelled out. You must be able to persuade the reader that your reasons are acceptable and can be justified. (Ellis, 1997:166-7)

Note his informal and direct style of writing, which engineers seem to find appealing, and the mention of issues that they can relate to, e.g. cost, compliance, delivery deadlines, i.e. the sort of business issues connected with the product. This is an approach to writing commonly found in popular self-help books.

Although the target readership may find much that is relevant in such books, and although the books claim to be dealing with the writing of proposals, the fact is that it is usually business-related aspects which are being dealt with, rather than language. For example, Ellis suggests performing a type of SWOT analysis, where the writers answer questions relating to their commercial strengths, weaknesses, opportunities, and threats, in order to decide on future business, and in the case of proposals, the writing strategy to be followed. Like Stross, he mentions the role of ‘themes’ in proposal writing, a term commonly used throughout the industry, and by the engineers in this study, to refer to selling features of a proposal. Ellis’s short section on themes is reproduced below, because it supports a few of my findings on this aspect, and sums up rather well an engineers' perspective, which is commonsensical, though rather general in applicability. Engineers would recognise some pet phrases in the extract, which appear in proposals examined in this study, e.g. ‘ensure low risk’, ‘engineering excellence’, ‘committed to quality’, ‘track record’:

> We want our readers to be aware of certain broad themes as they read our document. These are the keys that will help to unlock any doubts and establish our credibility as to why we should be selected. As they are key themes we must make certain that they are appropriate for our purpose and that they are repeated with conviction. Such themes could include:
>
> - Our approach is evolutionary; we build successfully on previous work and by doing so we ensure low risk.
> - Our engineering excellence is proven; we have an experienced systems team enhanced by subject specialists.

- We are committed to quality. You are welcome to inspect our procedures.
- We are a small flexible operation and can react with speed to situations; our track record demonstrates this ability.
- We consistently meet deadlines.(Ellis, 1997: 169)

However, the engineers consulted in this study would take issue with the usage adopted by Ellis and Stross, because they see themes as super-ordinate/over-arching selling points, functioning in proposals much like mission statements in management practice, or learning aims as a focus for learning objectives. As an illustration, one of them explained a theme in writing thus, a written explanation reproduced verbatim:

> The Seahunter mid-life update might be an example. We proposed a very expensive LongueMadison thermal imager as central to our solution. The theme was 'only the best is good enough'. In the trade off between cost and performance , we went for performance and meeting the stringent specification fully.
>
> The system is an enhancement to protection against fast, sea-skimming, anti-ship missiles. If the system doesn't do the job – you lose your ship.
>
> The customer didn't go for it – he would rather lose the ship, but save a few bob! Of course the customer isn't sitting on the ship – the end user is!
>
> [The story of the Seahunter Mid-life Update continues: the customer discovered that the company that won the bid could not actually deliver an effective system, and the proposal originally submitted by HISE is being reconsidered.]

In a similar vein to Ellis, Stross (ibid.) discusses proposal writing in terms of themes, structuring his advice as bulleted points. Although his work clearly lacks academic rigour, I include a rather fuller account of his work in this study (see Table 4-2 below) than might be expected, for two reasons:

1. a significant number of engineers involved in proposal writing have attended his training sessions and found his advice useful, and one of the aims of this study is to include such information.

2. Stross has attempted to address a fundamental problem engineers have in proposal writing, similar to one that I have identified in this study, which concerns the information content of proposals. Engineers need help in deciding what to write about.

Garden-variety themes:

The total resources of the firm will be brought to bear on this programme to ensure its successful completion.
Our past performance is the credible base for the proposed performance.
We are high performance, low risk.
We have exclusively served the Navy for 30 years.
We built it before; we can do it again.
Our proposal is 100% responsive to the government's requirements.
We are low cost, low risk with production data available to prove it.
Our state-of-the-art leadership assures lowest technical and cost risk.
We were the contractor on your last programme which successfully served as the basis for this one.
To us, this is not just another contract, it is the only one we have served on for 37 years.
In toto, our firm has over 10,000 person-years of experience in this field.

Configuration themes:

- This aircraft design will fully serve the common mission needs of both the Air Force and the Navy.
- 44% of our proposed design in common with prior product.
- Commonality with A-6 engine -- engine now in production.
- Reliable systems achieved through design with back-up and quality assurance.
- Our design features lowest acquisition cost and lowest maintenance cost.
- Our proposed approach will reduce the number of government personnel required overseas.
- We have verified our design through extensive testing.
- Our design has proven long life in operational use.
- We will modify available government-furnished equipment from previous contract.
- We have a proven and fully-tested design approach.
- We are so sure of equipment reliability that we'll assume the risk of maintenance and a fixed price.
- Alternative design approaches have been identified if problems arise.
- Trade-off studies demonstrate superiority of proposed design.
- We feature low development risk in our approach.
- Fewer components.
- Use off-the-shelf components.
- Our approach offers low cost, high reliability.
- Unique design.

Competitive themes:

- As the incumbent contractor, we have our first team on the project now; there will be no disruption of morale or performance.
- We have world-wide capability to service this product.
- We have unique in-house IR&D directly related to the technical solution.
- Only firm with design experience under nuclear environment.
- We are the only minority-owned firm capable of doing this job on time, within budget.
- Our local office will facilitate coordination of the project and promote communication between contractor and government personnel.
- Our project team features a single-line chain-of-command straight from the government technical representative through to our field personnel.
- We would draw upon our existing manpower permitting a rapid programme start.
- We have no overrun history.
- We have more experience in working with your agency than any other single firm.
- Two years of IR&D directly applicable to 95% of this requirement.
- Our team represents every Congressional district.
- No additional facilities will be required for this programme.
- Leading experts in the nation.

[Here are examples of Stross's throw-away themes, which he believes will not achieve success for a proposal, if they are used solely:]

Throw-away themes:

- Our proposed project director has full authority to command the full resources of the firm for this contract.
- We have top management's backing on this project.

We will use our existing management team

Table 4-2: A small selection of Stross's themes (each reproduced, more-or-less, verbatim)

We may baulk at Stross's vocabulary choices and style of writing, but he attempts to devise comprehensive lists of themes, and to categorise them, a feature that engineers find attractive, because they are provided with writing ideas, or topics, in a form akin to check lists which they can pick and choose from, much as they might choose dishes from a menu. Also, it needs to be added, this is an approach which I discovered independently of Ellis and Stross to be valuable in this study (see Chapters Five and Six). Stross sees four categories of theme: three major and one minor. The major categories he refers to as ‘common garden variety’ themes, themes ‘unique to the bidder’s configuration’ (called ‘discriminators’ at HISE), and ‘competitive’ themes; the minor category comprises ‘lesser throw-away’ themes. These categories do not withstand examination, which reveals them to lack robustness. Nonetheless, Stross makes a creditable attempt to identify a notion that I refer to as the 'what' factor, or information content, i.e., what it is that engineers need to write about in order to persuade a potential Customer to select their solution. This notion is explored further in Chapter 6.

When I encountered Stross’s work, I was struck by the association of two of his categories, albeit rough, with the major categories of Information Components (ICs) devised in this study: most of his ‘garden-variety’ themes relate to personnel and company-related topics; his configuration themes more or less relate to product or design matters; items in his ‘competitive’ category seem to be a mixture of the previous two. But the rationale underlying his ‘throw-away’ themes is difficult to determine; perhaps they should be re-allocated, or, true to their label, be discarded.

It is of some interest to note that, in contrast with the themes identified by Stross, Ellis's list relates only to company or personnel-related features of the proposal, although no significance can be attributed to this, considering the brevity of his treatment of proposals. He provides proposal writers with what he refers to as ‘techniques’ for preparing ‘such a major document as a proposal’, and suggests they follow the project management outline reproduced below:

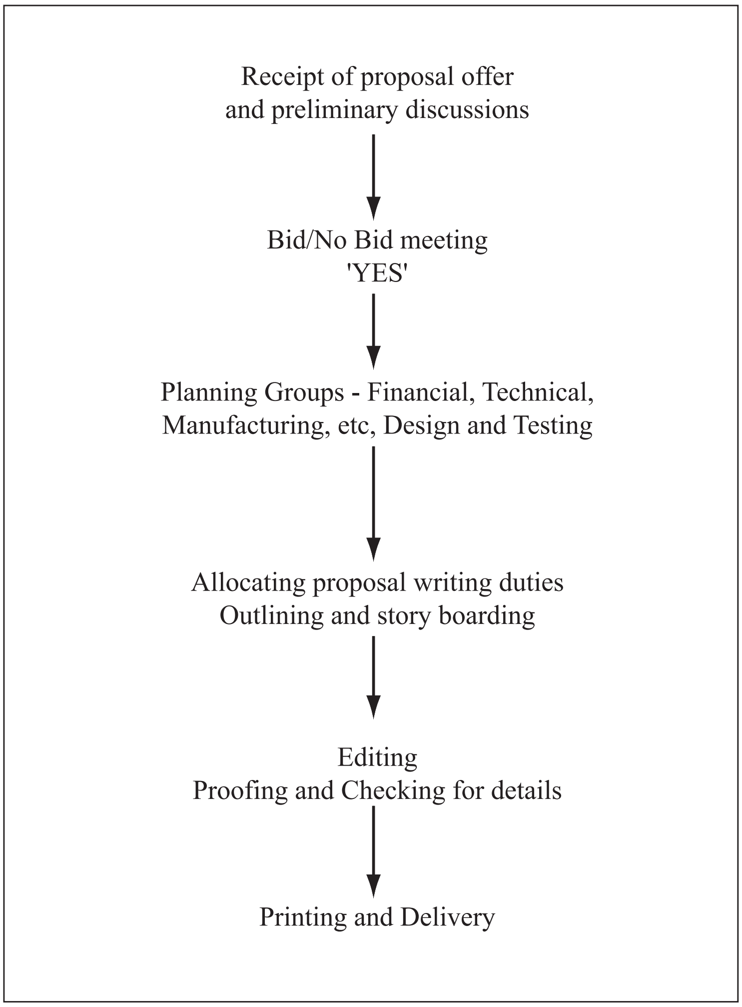


Figure 4-2: A project management outline for writing proposals (Ellis 1997:168)

Ellis emphasises that proposals need to persuade, and, as part of this procedural framework, suggests that, in order to persuade the Customer, a question-posing approach be followed. The questions are intended serve as a focus for writing, by helping proposal writers establish broad topic areas to write about:

> Why us?
>
> What have we got going for us to help win this bid?
>
> Where do we score? How can we play on our assets?
>
> How much will the customer know about us?
>
> Do we need to correct any misinformation that our would-be customer may have?
>
> Why not us?
>
> What are our deficits? How can we circumvent these? How can we turn a seeming deficit into a strength or opportunity (i.e. we are a small organization, but we can be flexible and rapid in meeting your requirements; we don't have any cumbersome bureaucracy to slow us down!).
>
> Why another?

> Who are our likely competitors? Can we assess their relative strengths against us? How can we gear our proposal so as to minimize their relative strengths and maximize ours? (Ellis 1997:168)

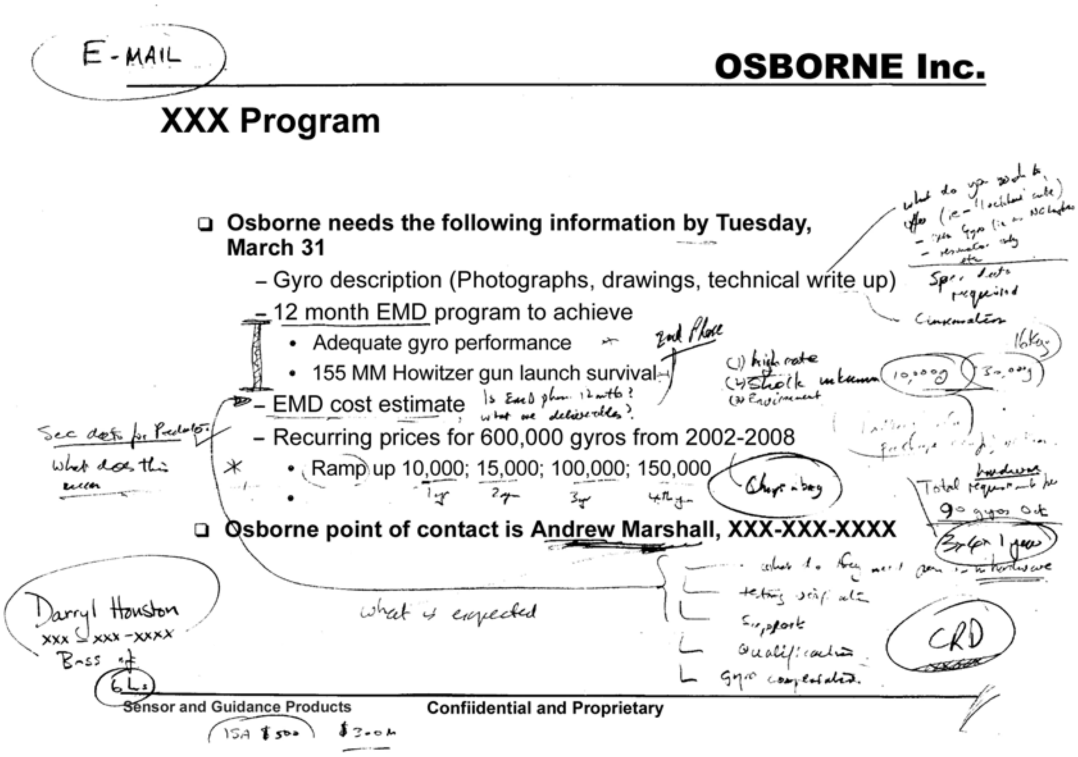
The questions, which any proposal team would find relevant, are included here to show their essentially general, context-setting, and purpose-establishing nature. Once the questions are answered, however, there still remains the problem of structuring and writing the proposal document, and it is the more specific advice for this which is all too obviously lacking from this book and others previously reviewed. Should the reader wish to discover more about writing, he is referred to 'writing techniques' in an earlier chapter on report writing, which deals with such topics as readership, terms of reference, overcoming writer's block, outlining, project planning, and data collection. This approach is no different from the ones adopted by Pauley (1973) and Souther and White (1977), discussed earlier. All this is eminently sensible and relevant to the situation engineers find themselves in. However, I started to examine proposals because they were identified as problematic for engineers and the companies they work for; it seems that in the fields of applied linguistics and business, the literature on proposals generally fails to address the more difficult questions concerning information content, discourse structure, and linguistic aspects.

4.4 The Customer Requirement - catalyst for proposal writing

Proposals are written in response to an identified need of the 'Customer', which is a term of convenience used here to refer to the recipient, or recipients, of the documentation, i.e. the target readers. In most cases, the Customer is the individual, or group of individuals, who has responsibility for reading and short-listing the proposals, and ultimately, for choosing the winning proposal. The Customer may be another similar organisation, e.g. Lockheed, Aerospatiale, Honeywell, for whom HISE may be bidding as potential subcontractor for a larger project, or it may be a department within the MoD in the United Kingdom or another country. A clear distinction exists between the terms 'Customer' and 'User', since the two perform different functions with regard to proposals. The User may be the operator of the equipment, be he an able seaman or fighter pilot, but the Customer is the person who vets the document, and, in the MoD or a commercial company, this would more likely be the head of a procurement team reporting back to an admiral and/or his aides, or the chief executive, respectively.

The Customer's need usually will have been identified in a document called the Customer Requirement, or, simply, the Requirement. In the case of the Requirement, 'Customer' is actually a rather diffuse term, encompassing both the originator and/or writer of the Requirement document and the ultimate user of the product described in it. The Requirement document is most commonly the trigger for the writing of a proposal, although, as mentioned earlier, there are others, for example, a request made in conversation, by letter, by fax, or by an email message, as mentioned below. Alternatively, HISE support engineers may identify a need for the Customer: in the case of existing equipment which has become outmoded or even obsolete, the engineers may propose an upgrade or new product to the Customer, that he may not have thought of himself. The proposal ep3020, which is discussed with other proposals in Chapter 7, is an example of just such a proposal.

On occasion, the Requirement may be expressed orally, rather than in writing, or may begin with a hastily drafted fax or email, an example of which is reproduced below as Figure 4-3. This message, which arrived unexpectedly, asks for information about a product's performance and cost, the product in this case being the silicon gyro. The sender needed the information in order to complete his team's own larger proposal to a third party, because he wished to bid for a contract which would include, as a small part, a silicon-gyro, or IMU (inertial measurement unit). The message kick-started a cycle of events involving the engineers working on the silicon gyro team, which correspond closely to the product life-cycle stages, described in Chapter 1. The lead engineer immediately started to draft his response, beginning with preliminary scribbles on the email printout, which formed the basis of a responding email. This eventually led to the production of a formal proposal document.


E-MAIL

OSBORNE Inc.

XXX Program

- **Osborne needs the following information by Tuesday, March 31**
  - Gyro description (Photographs, drawings, technical write up)
  - 12 month EMD program to achieve
    - Adequate gyro performance
    - 155 MM Howitzer gun launch survival
  - EMD cost estimate
  - Recurring prices for 600,000 gyros from 2002-2008
    - Ramp up 10,000; 15,000; 100,000; 150,000
    -
- **Osborne point of contact is Andrew Marshall, XXX-XXX-XXXX**

Darryl Houston
XXX - XXX -XXXX

what is expected

CRD

Sensor and Guidance Products — Confiidential and Proprietary

Figure 4-3: One example of a catalyst for proposal writing - an unexpected email printout, with the recipient's annotations and doodles (Spring 1997)

As he was becoming accustomed to such requests for information about this new IMU, the engineer subsequently decided that an off-the-shelf proposal, a generic document, needed to be designed (see Appendix L) to save him and his team time and to enable them to be well-prepared in the event of future requests being made.

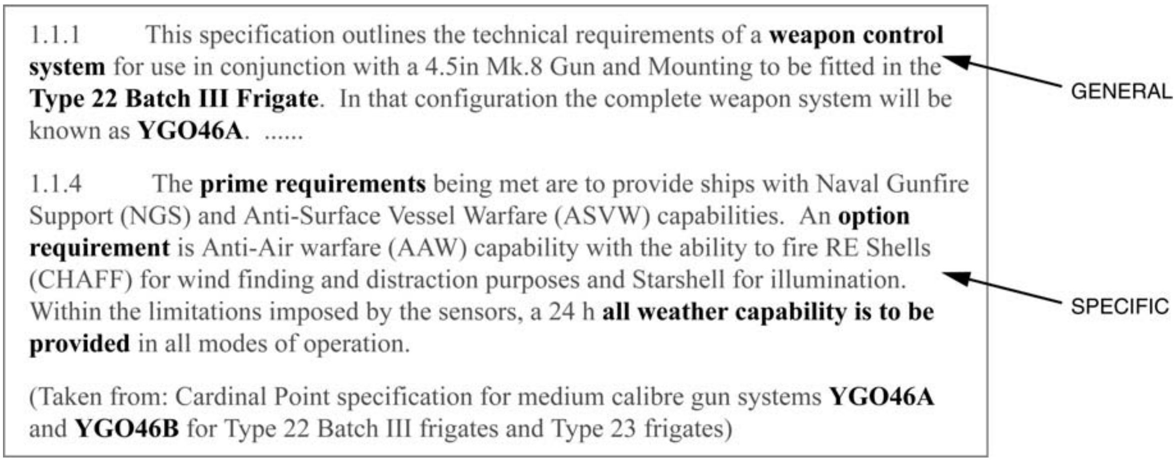
The Requirement is not an argumentative or persuasive text. It doesn't have to be, since those responsible for it know that others will compete to provide what is being specified. It is the readers of the Requirement, the engineers involved in the bid, who will need to persuade the writer of the Requirement to accept their offer. The extract below, for example, is taken from a Requirement, the YGO46 Requirement, in which the Customer states exactly what he wants, and is trying to influence the design process by specifying how the products, two medium calibre gun systems, should function, perform, and be constructed. He is calling the shots, so to speak, and saying 'this is what it should do, what it should look like, how it should be used, etc.'

Unlike Figure 4-3 above, which is a brief email, this Requirement is a more substantial bound document, comprising c.7400 words and covering 28 pages. It reflects the Customer's ideas for a gunfire control system, is detailed, and, indeed, imposes many constraints upon the design engineers, while at the same time placing the onus on the engineers to create a system which will perform in the way specified. It is a difficult task, described by one engineer as 'easier said than done'. He went on to explain that it may be perfectly possible to fulfil the customer's wish that the system be capable of registering six targets simultaneously, and at the same time, perform two full computations on two of them, but that it was difficult to design a system to these specifications, and, at the same time, to achieve this performance accurately and efficiently, at sea, in any weather conditions, and in any climate and/or at any latitude, which is what the Customer wanted.

The main purpose of any Requirement is to provide as accurate and precise description as possible, so that the engineers bidding for the contract can produce the system the Customer wants. Typically, the Customer's description may move from the general to the specific, as shown in the extracts below. First, in the Introduction are points which refer to the system as a whole, and which provide a context for the lengthy itemised description that follows. Points 1.1.1 and 1.1.4, for example, categorise the YGO46 product (it is a weapon control system), specify where it will be used (on Type 22 Frigates), and specify nomenclature by stating the name it should be given, and how it should be referred to (YGO46). Twenty years after this Requirement was written, the name 'YGO46' is still used in conversation and written communication at HISE (although engineers describe it as being a mature product, well into its service life, and overshadowed by forthcoming Type 45 fire control technology).

The overarching YGO46 requirement is subdivided into prime and optional requirements, and as Figure 4-4 shows, section 1.1.4 specifies:

1. **two prime requirements,** i.e. that ships should be provided with NGS and ASVW capabilities,
2. **an optional requirement,** i.e. an anti-air warfare capability with the ability to fire RE shells, and
3. **an obligatory requirement** for an all-weather capability.


1.1.1 This specification outlines the technical requirements of a **weapon control system** for use in conjunction with a 4.5in Mk.8 Gun and Mounting to be fitted in the **Type 22 Batch III Frigate**. In that configuration the complete weapon system will be known as **YGO46A**. ......

1.1.4 The **prime requirements** being met are to provide ships with Naval Gunfire Support (NGS) and Anti-Surface Vessel Warfare (ASVW) capabilities. An **option requirement** is Anti-Air warfare (AAW) capability with the ability to fire RE Shells (CHAFF) for wind finding and distraction purposes and Starshell for illumination. Within the limitations imposed by the sensors, a 24 h **all weather capability is to be provided** in all modes of operation.

(Taken from: Cardinal Point specification for medium calibre gun systems **YGO46A** and **YGO46B** for Type 22 Batch III frigates and Type 23 frigates)

Figure 4-4: Extract from a Customer Requirement document

It is significant that the design should be expressed in terms of compulsory and optional features, and a striking feature of engineers' interpretation of these texts is the close attention they pay to this aspect of the Requirement. I was to see a painstaking observance of the different categories of requirements written by design engineers in their written response. It struck me as odd that the design should be deconstructed in this textual way, and the early part of my investigation involved an attempt to understand the rationale behind this approach to engineering design. Suffice it to say at this stage that the Requirement is the starting point and main reference point for everything the engineers write in proposals, and, subsequently, if the proposal should win, the Specification Requirement/ Contractual Specifications.

In the YGO46 Requirement, specification spans both structural and stylistic aspects of the proposal to be drawn up. As well as specifying the names and terminology to be used, including associated acronyms (Chapter 5 discusses the use of acronyms in proposals), the Requirement attempts to influence the structure of the proposal by specifying the details that have to be included about the system as a whole:

1. the technical characteristics required of the equipment, and a list of the equipment that has to be incorporated into the system.

2. the different functions of the system, for example, that the navigation function should provide latitude and longitudinal information about the ship's position, or that the gun should be able to register six targets simultaneously.

3. the roles of the system, for example, as a tool in anti-aircraft warfare, or that it should interface with other systems.

4. the ways it should work with other equipment.

It then specifies each part of the system, for example, the gun controller's console, fire control equipment, sensor, and optical sights. It states the main function of each (with few exceptions), and then specifies how it should operate, under headings which include, among others:

1. Performance - i.e. how accurately the system should operate, and within which ranges, in different sea and manoeuvring conditions.

2. Environment - e.g. the temperatures the system should be able to function.

3. Technical characteristics of the gun - design and construction: sixteen separate requirements, some of which are general, and others, specific.

4. Computation of gun orders - input parameters.

It also specifies that information should be included about the following:

1. Theoretical studies – a demand for theoretical calculations as support for performance predictions.

2. ARM – a section concerned with the post-production phase, when the system is in use. ARM stands for availability, reliability, maintainability.

3. Documentation – specifies the documents which should be produced to accompany the system: in all, seventeen sets of documents.

4. Packaging – how the system should be prepared for delivery.

5. A compliance matrix, as an essential part of the proposal structure.

A striking feature of the Requirement is the distinctive use of verb forms, in particular modal verbs. The Customer's expectation in the YGO46 Requirement seems clear and brooks no argument, as the following examples seem to demonstrate:

1. is (also) required
2. should be minimized
3. are to provide
4. is/is to be provided/made/displayed
5. should be met
6. are to be detailed
7. will comprise
8. are (subject to)
9. is specified
10. must be/are to be (capable of) calculating/being inputted [sic]/performing
11. will be applied/indicated/input
12. must be (possible) to register and to perform
13. is to have/be/be made (of)
14. is/are required to offset/compute
15. (It is desirable) to be able to fire

Such verbs help engineers to distinguish between compulsory or optional requirements (see Appendix J, which contains a description of modal verb usage in specifications and requirements).

The two examples of a Requirement cited above show how different the Customer Requirement can be. However, whether the Customer produces a formal detailed Requirement or not, the fact remains that there is a need the design engineer must cater for, and this presents the engineer with a design problem to which a solution must be found. The solution is described to the Customer in the proposal document, and, ultimately, the efficacy of the solution is judged by its performance in the field. Again, it is the design engineers' responsibility to provide information to the Customer about this.

4.5 The readers of proposals

It is necessary to consider the relative roles of the proposal and its executive summary when considering the audience of a proposal, because the discourse functions of the proposal and executive summary relate directly to the readers and their reasons for reading the document. Taking a broad, long-term view, the readership can be seen as being both prospective and retrospective, although, when the proposal is submitted, the prospective category of reader is the engineers' main concern.

4.5.1 Prospective readers

These are the target readers for the proposal, who are those representing the Customer, who may be a government department or another large company, and can be seen to comprise two main categories: chief readers who make decisions about proposal selection, and who usually read only the executive summary; and team readers, who scrutinise and vet parts of the proposal.

The readers work in reading groups or teams, each team representing a specialist aspect of the project, e.g. engineering, finance, law. HISE engineers are aware that these specialist readers probably only read discrete parts of the proposal, and so use the executive summary as a kind of orientational text; it is copied and presented at the beginning of each of the separate parts/volumes in larger proposals. In this way, the summary provides the readers who only read particular sections with an overview of the whole project, so that they can consider the detail of the technical design, say, within the context of the overall proposed solution. Ideally, the executive summary serves a metalinguistic function by providing the specialist readers with a reading perspective, and enabling them to rise above the detail, to see 'the wood for the trees'. It also has the potential for priming those who consider the proposal, by helping to cultivate a particular mind-set in the readers, and predisposing them to the benefits (selling points) of the proposal. By highlighting the most significant benefits, the executive summary can help the reader to perceive the positive aspects of the different sections of the proposal.

4.5.2 Chief readers

These teams of readers are usually headed by a smaller group, or a team leader or senior executive, who, for the purposes of this study, will be referred to as the chief readers. They directly represent the Customer, and it is with them that the responsibility lies to select proposals for the short-list, and ultimately to choose the winning bid. Clearly, it is crucial for the proposal to clear the first hurdle of the bid process and succeed in being selected for the short-list. Chief readers may not always have engineering or other technical qualifications, and are just as likely to have commercial/ procurement expertise. It is unusual for chief readers to read any other document apart from the executive summary, although they may call upon the observations and views of the specialist team readers to inform their own opinions. During the reading process, the chief readers rate the executive summaries according to selection/reading criteria, and decide which proposals should be rejected or retained for further consideration. It can be seen, therefore, that the executive summary plays a key role / is crucial in the bid selection process.

4.5.3 Retrospective readers

If the proposal fails, the engineers experience feelings of dejection, but quickly dust themselves off, metaphorically, shrug their shoulders, and resume work on other projects.

If the proposal wins, however, the design process enters another phase in which the engineers have to revisit the technical proposal. They need to review what was promised, and to specify in more detail how it should be designed, produced, and used. At least, this is the theory. In practice, some engineers claim, design is always 'done from new' for the following reasons (all of which serve to confirm the complex design process described in Chapter 1):

1. The Requirement may have been a draft document, in which case, a 'firm' Requirement would need to be produced, and then responded to by the design engineers.

2. If the Requirement was firm, a new design team may be brought in to interpret it afresh, or, as an engineer put it, 'for real'.

3. By the time the company learns it has won the bid, nine months, or even one or two years, may have passed, by which time new technological developments may demand a rethink of the product.

4.6 Proposal writers: aspiring engineer writers and frustrated technical authors

Let us now briefly consider how proposals are written, by turning to the engineers responsible for producing the design, who are central to this study and who are not technical authors, and to the technical authors, who are engineers (usually), who are not responsible for the design, but who are responsible for producing the final proposal document. In spite of the fact that the technical authors are no longer organised as a distinct writing team, they nevertheless play a pivotal role in proposal writing, co-ordinating the numerous contributors to the proposal document, collating the various (far from homogenous) textual contributions they receive from engineers, and compiling (or at least attempting to compile) a substantial document which is professionally presented, and reads coherently.

Chapter One describes the organisational changes that have taken place in the company over the last six years. Recent working practices have been influenced by the fact that engineers are now grouped into product teams, called 'value chains', with the main focus being on the customer and his needs in terms of product design, or, in the case of a customer who has bought a product, in providing help and servicing during the use of the product. Secretaries have almost disappeared, and, instead, engineers have their own computers, providing word-processing facilities and other like software. With new more independent methods of team working, a combined focus on both product and customer, having to respond to customer queries themselves (rather than a secretary doing it), and the need to do their own typing/word-processing, it is hardly surprising that the engineers should produce their own drafts of text, or take the initiative in producing documentation. Rather than produce a sketch outline for the technical author to interpret, it is probably easier and more convenient for them to commit their thoughts to the screen and to devise their own textual version of the solution, i.e. the technical description of the proposal.

The technical authors, who are used to taking responsibility for document production, have seen radical changes to the work they have been required to do in recent years. They find they are called on less frequently to draft documents from scratch these days, which is what they prefer to do, and where they see their expertise lies. Instead, they now find themselves more often dealing with cosmetic aspects of writing: formatting text, integrating graphics, 'tidying-up' sentences, and generally checking and editing the work of the design engineers. They see this as limiting their professional practice, restricting opportunities to use their document producing skills, and an erosion of their status, as, in their opinion, some of their colleagues fail to understand the true role of the technical author.

During this study, I have observed the impact on the technical authors' work of the company restructuring, and the diminution of their roles as the Technical Publications team was broken up. Any ESP department in a polytechnic or university striving to gain or maintain departmental status would identify with them. The technical publications team was a service provider to the engineers, and it was almost inevitable that the authors should find their influence dissipate when it was disbanded. The team had built up expertise in compiling and producing whole documents, especially proposals. In a manner of speaking, they were 'textographers', to extend and borrow Swales' coining (1996:194), with expertise in working with text.

Engineers, on the other hand, generally lack textual skills. Technical authors have expressed the opinion that design engineers cannot write as well as they can design, and that by writing their own technical descriptions, and other types of writing, they are using time better spent on work they have been trained, and paid, to do. The authors believe that much of the time and effort they spend rewriting and editing engineers' compositions is a poor use of their time, and ultimately affects the quality of the finished document. They are sometimes exasperated with the texts they are given to work with, finding them structurally illogical, often grammatically incorrect, and stylistically inelegant. By the very nature of their jobs, technical authors offer other engineers a documentation and writing service, and, unfortunately for them, usually find themselves having to be reactive rather than proactive, too often responding to requests, rather than being involved at the outset of document production.

A tension clearly exists over authorship and ownership of text, with the engineers who are concerned with design also concerned about any text that is produced about the design for other people to read. In other words, they are proprietary about any text relating to their product intended for an external audience. I argue about text substituting for product in design documentation (in the next chapter), where the text actually is treated as being the product for certain intents and purposes until the actual product is produced. It is therefore understandable that engineers should feel responsible for, and have a 'mother hen'-kind of attitude towards, any text that describes their product.

This, then, is the story about the writers lying behind the texts about to be analysed.

4.7 Early Observations - groundwork and scene setting

4.7.1 Text analysis: four YGO46 'proposal' texts

This section describes the text analysis undertaken in the early stages of the study, and includes some early observations drawn about proposal writing from a small set of documents. As has been explained, for a significant period of this study, access to documentation was limited. Before I was given access to most of the company's document databases, the direction taken by the early study of proposals was influenced by the results gained from interview data, discussed in Chapter One, and the examination of any documents I could collect, or get sight of. Eventually I managed to compile two small but coherent sets of documents relating to two products.

One set of texts concerns the product named 'YGO46', and some time was spent examining both the texts and the engineers connected with YGO46. Appendix R contains an extract from these early notes made on YGO46, which reveal the wide, and, it must be said, at times rather directionless, nature of the enquiry at the very start of this study. The other set concerns the silicon gyroscope, a product that the Plymouth site has gained expertise in developing. This latter set comprises:

Text 1. Vibrating structure gyroscope - Principles of Operation, Jan 1994

Text 2. Micro-machined silicon puts new spin on gyroscopes, c.1997

Text 3. Generic proposal for the silicon rate sensor, June 1998

Text 4. RASE Technical Proposal for UK Bomb Enhancement Programme (UBEP), August 1998

Similar to the YGO46 texts, Texts 1 and 2 were provided at an early stage for analysis, and examination of them raised questions which were to prove influential for this study; I was involved with engineers and technical authors in the development of Text 3, the generic proposal; and Text 4 is an actual proposal which incorporates many of the sections and features of the generic proposal. Texts 1, 2, 3 can be seen in their entirety in Appendices V, K and U, respectively.

In any discussion of documents produced about a product, there are particular aspects about the product, aspects of the product story if you like, which have a bearing upon the way the documents are written. The silicon gyroscope is distinctive, in that it is a product not obviously associated by the general public with the defence industry. Furthermore, it has distinctive design features and applications, and, since such considerations affect the nature of the proposals that have been written about it, a brief description of the product as a preliminary to this discussion would be useful at this point.

An overview of the silicon-gyro

In the struggles and disappointments of the company in the last eight years, with several failed bids, loss of business, and shedding of staff, the silicon-gyro has proved to be one of the company's more notable successes. As its reputation for versatility has grown relatively recently (c.1997 to the present day) it has brought to the Plymouth site profit, kudos, and plaudits across the corporation. This recognition from colleagues across HISE, and those in other companies, is valued by the engineers in Plymouth. Peer opinion matters to them, i.e. others' view of their professional knowledge, and engineering expertise and ingenuity.

The full name of this product is 'silicon vibrating structure gyro', referred to as SVSG in the documentation, and as 'gyro', 'gyroscope', or 'silicon-gyro' in work talk. It is a sensing device which measures the rate of motion of different types of objects. It is basically a measuring system which is capable of working with another mechanism to stabilise, re-orientate, or redirect. It is highly versatile and can be used for a range of purposes on sea, land and in the air, although it was originally devised to meet the demands of the automotive industry. It can be used, for example, to measure the roll, heave, and pitch of a ship, the tilt of a train as it goes into a bend, or to improve the steering and stability of moving cars.

It is the latest in the development of what the HISE literature refers to as 'the HISE family of vibrating structure rate sensors'. The development of these started in the 1980s with the development of ceramic cylinder-type resonators for a military (high *g*) mortar application. They were then extended into a range of commercial sensors for a wide variety of applications with concomitant design changes. The original ceramic cylinder was superseded first by a planar metal resonator and eventually by a planar vibrating ring manufactured from a single crystal silicon wafer, which was made possible by the development of micro-machining techniques. This in turn led to dramatic improvements in terms of cost, performance and size. The final result today is a much smaller cheaper sensor with, it is claimed, improved environmental performance and a wide variety of applications. A proud boast in the company's literature is that it has been tested to high vibration levels with no degradation in performance, and can meet shock environments/conditions in excess of 10,000g without damage.

In its earlier stages of development, and when the VSG (vibrating structure gyroscope) became more established as a product and began to be noticed, engineers found they were being asked to explain it and to provide written descriptions of it, because people did not really know what it was, or how it worked. Text 1 is typical of the kind of document that design engineers produced, and still produce, in an attempt to explain the gyro to enquirers representing potential customers, like, for example, the MoD. I have anecdotal evidence that engineers write these descriptions with enthusiasm and dedication, spending long hours laboriously writing out (or more recently, word-processing) the explanations and reworking them until they are satisfied. They also like to draw diagrams and other illustrations, again spending much time laboriously designing these and integrating them with the text. Eventually, the time comes for the document to be handed over to the technical author or illustrator, either because the draft needs to be polished, or because they have got stuck and are unable to complete the document in time. When this happens they guard their favourite phrases and sentences jealously, with disputes/discussion about phraseology being quite common.

When this study began, the silicon gyro was considered by many of the engineers as a 'new boy on the block', and a different kind of product to the larger more traditional systems that occupied, and still occupy, large teams of engineers. In the final stages of this study, at the time of writing-up, some of the traditional products are being deemed near obsolete, and their associated teams of engineers disbanded. The silicon gyro, on the other hand, has expanded to occupy whole floors of office space, in order to accommodate eighty engineers who have been recently taken on to deal with new design applications.

The above four texts reflect the developments that have taken place in the design of the gyro. Their textual production corresponds with developments that have taken place in the product, as well as changes in attitude on the part of the engineering team towards text production, showing a growing awareness of the need to be more active in marketing the gyros, to 'educate' the reader about them, and to produce more persuasive text about the gyro.

The following diagram, Figure 4-5, illustrates how the four texts have marked the main developments in the gyro products:

1. Awareness of need to provide a product description of some kind for unsolicited proposals or prospective customers, as exemplified by Text 1, which is a rather crude ill-structured document, compared with the ones that follow.

2. An (as it transpired, vain) attempt to make text more persuasive, or ‘selling’, as revealed by Text 2, which resembles a press release.

3. The devising of a generic, off-the-shelf proposal, mentioned earlier: Text 3 is a proto-type generic text which follows a planned structure, incorporating knowledge of target audience and purpose.

4. Submission of a formal solicited proposal, i.e. Text 4, which is a well-structured, and professionally written and presented document.

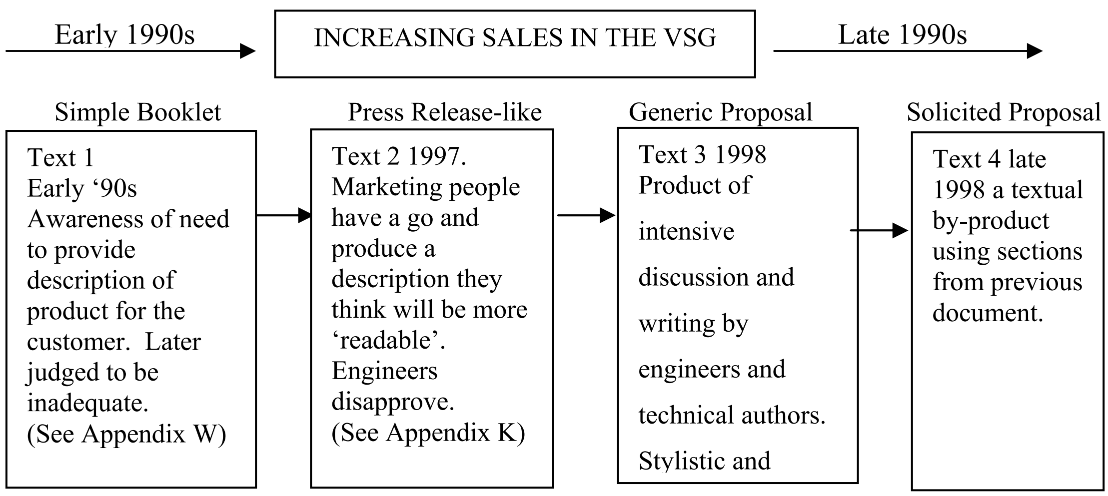


Figure 4-5: Main developments in documentation for gyroscopes

The developments in gyro documentation saw an increasing involvement of design engineers in the actual writing and presentation of those texts.

4.7.2 Observations gained from an examination of Text 1 - Vibrating structure gyroscope - Principles of Operation, Jan 1994

This is a short document (Appendix V) given to me as an example of an attempt at writing a technical description of the VSG suitable for inclusion in a selling-type document, or proposal. It comprises four typed pages, followed by six pages of diagrams, mostly scientific. No diagrams are integrated into the text. The ten pages are bound as a booklet with a card cover. The cover is plain with text, date, company name and RASE logo, but no other picture or diagram. There is no table of contents, proprietary page, security classification, or other information usually associated with RASE/ HISE documentation.

Overview of Text 1 – vibrating structure gyroscopes

This begins with a large heading in bold and underlined:

<u>VIBRATING STRUCTURE GYROSCOPES</u>

Figure 4-6 below shows that Text 1 comprises three main sections. A more detailed breakdown of each, including first-impression comments, is provided after the diagram.

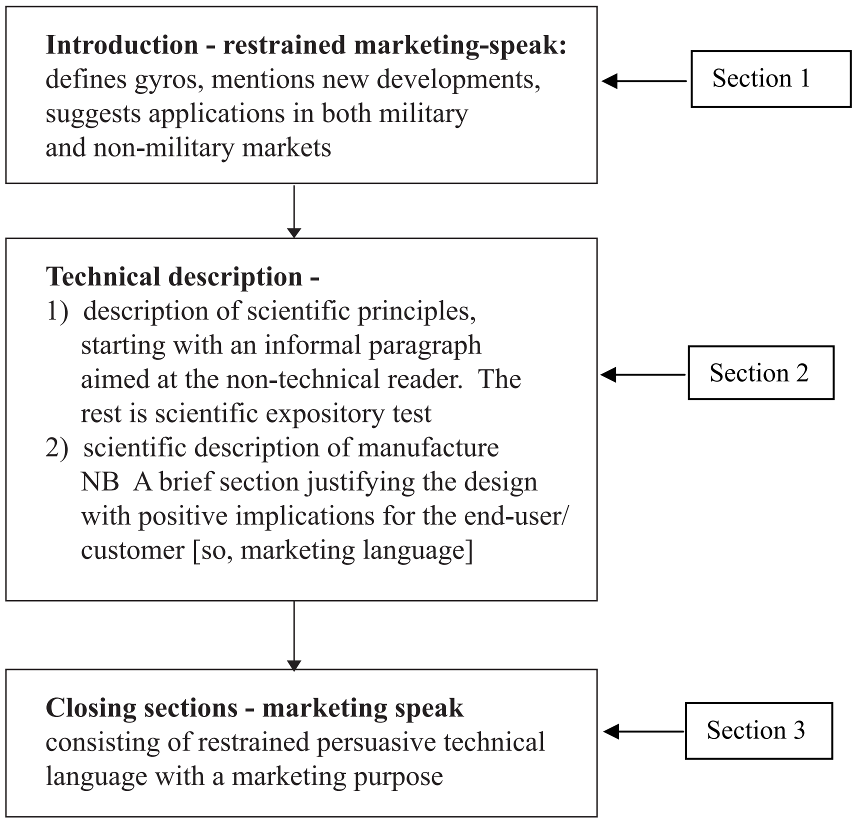


Figure 4-6: To show main discourse shape: a tripartite structure

This is ostensibly a description of scientific principles, has face validity as a technical/scientific document, and is accepted by engineers as being such a document. Sections 2 and 3, the longest sections and forming 70% of the document, comprise mainly scientific information and data, including equations, the interpretation of which requires scientific knowledge.

Breakdown of the three main sections of Text 1 - Vibrating Structure Gyroscope

There are five sections, followed by six pages of diagrams:

Section 1 - Introduction:

		Comment on language
Para 1- 2 sentences	definition of gyroscopes definition of VSGs	language of definitions
Para 2 - 4 sentences	Brief story of the development of gyroscopes at RASE, and heralding the change from the old spinning-wheel type to solid state gyroscopes.	restrained marketing speak contains evaluative lexis and other stance markers
Para 3 – 1 sentence	Announcement: First mention of the familiar phrase "family of vibrating structure gyroscopes" and their applicability to both military and commercial markets.	more marketing speak
Para 4 – 1 sentence	States briefly the aim of the document: describes the principles on which these devices work.	This clearly <u>not</u> the only aim of the paper.

Section 2 - Principles of the vibrating structure gyroscope

		Comment on language
Section 2.1	2 paragraphs, the first explaining in "lay-speak" what the coriolis effect is, and the second, mathematical	Two paragraphs of completely different language juxta-posed. One intended for any non-science person [somewhat patronising tone], and the second which can only be understood by a scientist or mathematician.
Section 2.2	comprises 3 sub-sections of scientific language describing oscillation/ vibration	I know from my interviews that this is what fascinates the VSG engineers. However, few non-science folk would understand it, or relate to it.

Section 3 - Development of RASE Vibrating Structure Gyroscope

		Comment on language
Section 3	Mostly scientific formulae, or what are described as "basic equations". Introduced by reasons for the design.	On the face of it, appears to be a justification + scientific description of the structure. In fact, it is a sort-of boast in quasi- technical language [marketing-speak] in the first half, followed by scientific language in the second complete with equations.

Section 4 - Main features of the VSG

		Comment on language
Section 4	A list of 5 selling points, each a distinct advantage of the VSG portrayed as NPs: No moving parts, simple construction, short run-up time, low power requirements, low noise. Each is followed by supporting [technical] information.	The kind of marketing/sales-speak an engineer produces. Definitely persuasive technical writing as evidenced by the number of negators; i.e. the engineer is aware of features the customer wants to avoid, and what he is looking for, e.g. simplicity, robustness, long-life etc. This vocab. has been used in interviews.

Section 5 - Product range

		Comment on language
Section 5	Lists the four categories of VSGs by their technical names, each followed by a brief gloss containing a "selling" feature	Information with marketing/ selling purposes. Positive evaluative lexis. Points to further information being available in form of "data sheets".

The diagrams - the last six pages:

Diagrams are an integral feature of most technical proposals. They are all presented as a group at the end of this particular document, although this is not a good example of the presentation of proposals generally, as will be seen in the next chapter. Engineers seem more comfortable with diagrammatic representations like these and have favourites which are used repeatedly in different proposals. Figs. 3-5, for example, are included whenever the silicon gyro is one of the features of the solution.

1. Fig 1 - diagram to show simple oscillators, and how oscillation occurs and is detected along particular axes.

2. Fig 2 - diagram to show balanced oscillators

3. Fig 3 - diagrams of the hemispherical and cylindrical shells used in the vibrating structure gyroscopes (VSGs)

4. Fig 4 - shows the coriolis effect, central to the design of the VSG

5. Fig 5 - system diagram for the VSG [the integrated circuitry for the VSG]

6. Fig 6 - diagram to show single axis assembly [a cross-section of the whole VSG]

However, although this was given to me as an example of technical description, intended to be read by a potential customer, this is does not adequately convey the function of the document. Summing up the piece as a technical description, does not adequately explain why it was written in the first place. The document is plainly intended to do more than put forward a technical description of VSG's, especially since it contains different types of writing, for example:

1. **formal scientific writing**, including the language of definitions, scientific and/or technical descriptions and explanations, with equations/formulae. Here are some examples, reproduced (and punctuated) verbatim:

    1. Gyroscopes are instruments which are used to measure angular motion. The Vibrating Structure Gyroscopes described in this paper are simply devices which provide a voltage proportional to the rate of turn applied to the gyroscopes [sic] sensitive axis. [definitions]
    2. The cylinder is manufactured as a single part, it is closed at one end which has a stem for mounting purposes. In order to provide the means of driving and detecting the vibration electrodes are printed on the cylinder. These are equally spaced around the circumference of the cylinder. [technical description]
    3. Mathematically the coriolis force (Fc) is equal to twice the mass (m) times the vector cross product of the angular rotation frequency (ω) and the linear velocity of the mass (v). i.e. $Fc = 2m (\underline{\omega} \times \underline{v})$ [expressing formulae]
    4. The simplest example of this coriolis force is to imagine watering your garden with a hose pipe: as you turn the water expelled from the pipe appears to move in a curve. [Taken from Section 2.1. There appears to be some concession in this extract to the possibility that the reader may not have much technical knowledge; hence the use of analogy and the curiously personal and almost patronising tone; this is the only section to include second person pronouns.]

2. **sales and marketing language** appropriate to such a text, i.e. expressed in language the design engineers in the team believe would be acceptable to engineers in other companies

who would read the document, i.e. restrained, technical, and giving the appearance of being objective, expressed in formal language through the use of long complex noun phrases (in these extracts most are heavily pre-modified), the passive voice, longer formal/Latinate words (rather than phrasal constructions), and phrases associated with formal language, e.g. 'this is due to', 'it is felt that', and 'according to'. Here are two examples:

1. It is felt that in the future most conventional motor driven, spinning-wheel gyroscopes will have been supplanted by solid state devices. This is due to their simplified construction, improved reliability and shock handling capability.
2. Short Run-Up Time - The sensor has no conventional spinning wheel and, as a result, achieves ready state within a very short period. This period is governed only by the capture time of the phase locked loop used to excite the resonant structure, and is in order of 300ms. This time can be adjusted according to requirements. [Cited as one of the main features of the VSG:]

4.7.3 Some early observations and reactions to the document

In spite of its brevity, this document has proved to be revealing, and, together with other findings arising out of interview data and other text analysis, helped in forming some vague conclusions and early hypotheses. It begs the question: why write a technical description in a marketing-type document? It could be argued that it is expository text, but why was it composed?

The engineers believe it is important to include such technical descriptions in proposals, but I query that their motives are purely educational, or simply informational. Instead, I suggest they are displaying their credentials, their knowledge and expertise through this type of text. The description itself is significant, because it is what they are selling, i.e. it is the product, and so therefore, the document would be almost worthless without it. The main aim of Text 1, however, is determined by the opening and closing sections, which contain 'selling' persuasive text (Sections 1, 4, 5). The image of themselves that the engineers wish to project to those they are targeting (other engineers and colleagues in engineering companies) is portrayed by the style of these three sections, and 'proved' by the relatively substantial technical sections 2 and 3. They appear to be selling their products through displaying their knowledge and expertise via text. A concession seems to have been made for the possibility that the reader may not have the technical background: hence the curiously personal style with patronising overtones in Section 2.1.

Thoughts like these provided the direction of later work, when more texts were made available for analysis.

4.7.4 Broad aims identified

1 Marketing and sales

Broadly, the main aim of this document was identified as being concerned with marketing and selling the product, even though it was not written by the marketing or sales departments. The intention was to help broaden the market for SVSGs by signalling its applicability to a variety of non-military uses. The next logical observation, that it was intended to persuade the reader, led to further observations which were to underpin a major part of this study.

2 Persuasion

This is the primary aim of the document. The opening and closing sections reflect the main aim of the document which is to be a 'selling' persuasive text (Sections 1, 4, and 5). The engineers attempt to persuade the customer by various means, for example, by including information about their expertise and a description of the product. An expansion of my thoughts about these aspects now follows.

The expertise of those making the proposal.

At this stage of the study, I observed in Text 1 a manifestation of inferences I had been drawing from interview data: it seemed that proposals needed to 'give face' to the engineers making the proposal, and to project professional expertise and high standards of professional practice. It was clear that engineers wish to convey to the reader this quality about themselves and the company that they feel strongly (even passionately) about, but which they find hard to explain.

They want the readers to have a high opinion of them as professionals, and of HISE. As one team leader expressed it: 'We need to show them why we're good at it'. They attempt to achieve this by including information on design, testing, laboratory and manufacturing facilities, and expertise at HISE. They may also mention future prospects, i.e. promising future developments which show the customer that HISE is active in research and development and that the product is dynamic and evolving.

This involves all levels of document production, ranging from choice of lexis, topic content, grammatical structures, through to formatting and presentational factors like choice of cover, pictures, colour, and so on. As this study progressed, it was discovered that engineers attempt to convey this impression through sections of proposals which realise particular Information Components (ICs), which are discussed in the following chapters.

Description of the product

The description is what they are selling, and the product documentation lacks substance, and is of less value, without it. It was at this stage when the germ of the idea began that the product description in a proposal is a quasi-product. As a result of these thoughts, general ideas began to form about the purpose of such a description, and what it should achieve if it is part of the technical proposal. I thought that any description about the product:

- **defines the product, and defines terms**

- **explains what it is and what it does**. Text for this may be explanatory, informative, or even educative, containing information on how it works, naming main parts (shape, size, similes relating parts to everyday objects), and what they do. Text 1 tried to make the reader aware of changes that had taken place in VSG technology. It also describes how the VSG works, although, in Text 1, the writer seems to be aiming the description at both the non-technical as well as technical reader, possibly with in the idea that this will help the reader understand how it can be used in different ways. However, as I mention above, through the description, the engineer also 'displays' [my coining] his knowledge, or 'struts his stuff', possibly because it is expected of him within the engineering writing culture, or because it is his misapprehension that he believes it to be.

- **shows the extent to which the product gives the customer what he wants**/fulfils the customer's requirements or criteria.

- **gives an idea about degree of compliance**: The proposal needs to convince the customer that the product would be best for the customer's purpose, even if it does not quite fit the bill, or, to use engineers' words, is not 100% compliant. So, an early conclusion was that proposals need to explain convincingly what is being proposed, and why, and the extent to which HISE proposes to give the customer what he wants

- **attempts to convince the customer** that the HISE product is what is best in terms of design, function and quality.

- **forms the basis of the blueprint of the design** (usually). This is more of a temporal point being made here. As a response to an enquiry by a potential customer, or as a solicited bid, the technical description, of the sort found in Text 1, is sent to customers who are thinking of buying an existing product, or who are thinking about commissioning the design and production of a bespoke or new product. Thus, such text may be used at the earliest design, or rather, pre-design, stage, or during the life-cycle of a product.

4.8 Persuasion

4.8.1 Engineers versus marketing colleagues

Engineers are unhappy about needing to persuade in proposals. They feel uncomfortable about it, and generally view themselves as being inept as persuasive writers. Winsor reports similar observations:

> As a profession, engineers frown on persuasiveness and find it suspect (Winsor 1996:12). ...The primacy and purity of data are an ethical as well as a functional concern. Thus engineers may believe they let the facts speak for themselves and abstain from any obvious persuasion because that is a useful fiction in the world of engineering. (ibid. 99)

In the technical proposal, for example, they prefer to write in a style they believe to be objective and devoid of any emotive slant. On the one hand there are those engineers who acknowledge that the main aim of a proposal is to persuade, but who do not want to be associated with the persuasive aspects of text, or, rather, their perceptions of what a persuasive text actually is. There is a prevailing attitude that salesmen write persuasive language, and that overtly 'selling' language is somewhat offensive to them. One design engineer, for example, described an instance when he and the marketing member of the team did not see eye to eye about a technical description intended for a proposal. His recounting of the event demonstrates the cultural/attitudinal divide that exists even between those working in the same proposal writing team. He was confident in his opinion that he should write about the solution using restrained factual language, about which no hint of a selling motive could be inferred. With a degree of hyperbole, he related the disagreement in the following words:

> "The Customer said he wanted it green, and so I wrote: 'It will be green.' But Michael [responsible for marketing] wanted it to say: 'You asked for green and you shall have it. You will have a beautiful shade of green. We love green at HISE. We have a whole range of greens for you to choose from', and I thought: 'I can't write that!' "

Restrained persuasion

On the other hand, there are those engineers who will admit to composing text with the aim of persuading the reader. On one occasion I observed another engineer, a support engineer, spend around two hours trying to compose a few 'right sounding' sentences. Making slow progress, he approached his colleagues for their renditions, but when their offerings were not what he wanted, he asked me for help. At first, his task seemed a simple one: he was composing a brief written response to a few of the many numbered requirements in the Customer Requirement, in particular, two which read as follows:

> 5.1.5 Maintenance at Test Environment shall be supported by the Contractor.
>
> 5.1.6 The implementation of any upgrades will be undertaken on an opportunity basis to minimise the impact on the operational programme of the warship and

Test Environments.
[ILS requirement: BP]

He explained that he was trying to write a sentence as part of a list of goals, or stated intentions in the proposal, and that he wanted it to convey a sincere desire to please the Customer. He wanted to impress the reader with HISE'S dedication to providing a quick and efficient service, which would support the Customer at times of risk during the testing phase of the product. He wished to 'reach out' to the reader and to impress him with the sincerity of the proposal solution, and wondered how one could convey sincerity in writing. At the same time, he wished to convey the fact that HISE would not only provide upgrades when they became necessary, but would be so efficient and aware of the Customer's needs, that problems would be anticipated before they occurred, and engineers would suggest improvements and upgrades before the Customer realised they were necessary. As it seemed a tall order to make of a few sentences, I asked him to explain, and this was his verbatim response:

> "If the Customer asks you if you will do something, you don't just say 'Yes, I'll do it', not if you want him to have confidence in you. You want to say to him, 'Yes, honest, I really will do it, I'm interested in doing it, and not only that, I'll ring you up to find out if you want me to do it. I want him to have confidence in us, and make him feel good."

It transpired that he was looking for 'right' words, and that he believed this to be a problem because he had a vocabulary deficit. However, he knew the nature of the (emotional) response he wished to invoke in the reader, and also had some vague ideas about the language he was prepared to use in order to achieve it. Although unable to articulate his views on language, he had a clear idea of a preferred style, wanting to convey the company's professionalism and commitment to a rapid response without it sounding too 'slick' or glib. In spite of the emotive spoken language he used to express what he wanted, like the previous engineer, he was not prepared to sacrifice received stylistic norms. For example, of the ideas bandied about, he rejected 'rapid response' as being too clichéd, and 'speedy response' as 'sounding like a plumber's ad'. I agreed to compose a few 'strawman' sentences for him to consider, and emailed some to him. Here is part of his final response to those numbered requirements, of which the only words of mine that I recognise are 'proactive support':

> Identify and develop a maintenance concept which limits maintenance at sea, thus ensuring the least effect on the operational availability of the warship.
>
> To provide a proactive support policy for the Neptune 45 at the test environments to prevent delays to the programme.
>
> To implement any upgrades to the Neptune 45, in an effective manner, as dictated to by the operational programme of the warship and test environments.
> (Taken from 'ILS Goals': EP3145)

This is typical of the writing style considered by engineers to be acceptable persuasive language in a technical proposal. Although not bulleted, these are listed as separate items, each focusing on particular aspects of the maintenance provision considered by the engineers to be of most concern to the Customer. Each bullet relates to a specific item of information, i.e.:

1. Minimise inconvenience to the Customer by reducing the maintenance that will have to be done at sea.
2. Anticipate problems in order to pre-empt them.
3. Conform with the ships' working schedule, so as to avoid interrupting planned operations.

Possibly because they are listed in this way as parallel structures, more or less, the sentence adjuncts are in final position. I have incidentally noticed engineers' avoidance of the use of adjuncts, generally, when describing the product (or solution), and the almost total absence of them in sentence-initial position. Negatively coloured or minimising words are employed to convey positive attributes modestly, for example, '<u>limits</u> maintenance', 'the <u>least</u> effect', and the most positively loaded words in the piece are: 'maintenance concept', 'operational availability of the warship', 'proactive support policy', 'upgrades' and 'effective manner'. Any more effusive expressions would not pass muster.

Persuasive text for a generic proposal

There was an urgent need for suitable material to help expand the market for the SVSG. As it was improved and developed further, and its usefulness and versatility became apparent, together with an awareness of the potential for growing the business in this area, there was a perceived need for some kind of description to be available for sending to potential customers, or to respond to RFIs (Requests for Information). There was a hunch amongst the engineers and marketing people at HISE that there was potentially a huge market for the new generation of VSGs, if only people knew more about the product. Engineers believed there existed a lack of understanding (much of it requiring scientific understanding) of the VSGs, what they were, how they worked, and their applications in a variety of contexts/machines. They also realised that some of those potential customers in other companies who may be interested in the VSGs for incorporating into their own products probably lacked this scientific/technical understanding.

It was dissatisfaction with attempts to produce proposals with a clearer 'selling' message that motivated an engineer team leader for the SVSG to set up a task force to develop a generic proposal. The sales team had produced a description of the product, for inclusion in proposals as the product description, and for use in publicity material, with the aim of making it more appealing to a wider audience. I imagine the salesmen were rather pleased with the text, which is an easy read for the non-technical reader. This is Text 2, mentioned above. For a public relations-type exercise it is a creditable composition. However, the authors were probably unaware of, and would have been surprised at, the reaction this text caused amongst the design engineers. In a meeting on the generic proposal, the team leader expressed disapproval of Text 1, and was concerned to replace it, because, to quote his words, 'It's not up to the job, and it won't do'. He and his engineers expressed some embarrassment that the text had already been included in a few proposals, and described it as 'too snazzy' and 'brash'. They expressed dislike of what they considered to be the overt sales pitch of the piece. The whole of the offending text, 'Micro-machined silicon puts new spin on gyroscopes', is included in Appendix K, but a few extracts from it are included below as exemplars of features the engineers found distasteful.

First, they objected to the title, dismissing it as similar to a tabloid headline. They described the style as being too 'chatty', but were unable to be more specific about particular 'chatty' features of the text. Through elicitation, it appeared they objected to certain lexical choices, the structure of the sentences, and punctuation. For example, this sentence was anathema to them, because they would never include sentences beginning with 'but' in a proposal:

> But the market never stands still, and today, new requirements are driving the technology for the next generation of the gyroscopes.

They also would have preferred some other verb to 'driving'. However, their strongest objection was to the phrase 'an astonishing order of magnitude', and in particular the use of 'astonishing' in this sentence:

> Now in production, this new gyroscope will be delivered at a price an astonishing order of magnitude less than was achievable from older generation designs.

They naturally objected to the hyberbolic 'miracle' in this sentence:

> The electronics in the single ASIC controller is also a miracle of modern levels of Very Large Scale Integration (VLSI).

They also considered the way they were portrayed in this sentence as overly dramatic:

> To address these needs, gyroscope designers have no alternative but to embrace new manufacturing technologies.

Judging by their comments, they generally avoid using adjectival intensifiers or lexical adverbs, which occur in the text, e.g. 'Silicon has some very useful material properties for a sensor', 'The gyroscope has also been carefully designed .....'. They also found the sentence structures inappropriate, in particular, the frequent use of sentence initial adverbials/adjuncts, like ‘Now in production’ above, and the use of dashes, which are used three times on the first page:

> In the development of these micromachined gyroscopes, techniques and technologies previously employed in the design of earlier systems can be effectively employed - and then cost reduced.

In this respect, they would concur with Quirk et al, who advise cautious use of the dash because of its dramatic (and one would infer, distracting) effect and the informal impression it conveys (1972:1075).

Text 2 is, in fact, a well-written attempt to describe an innovative and ingenious product in an interesting way, and with a few stylistic changes, could have been converted into a more acceptable section for inclusion in technical proposals. However, the original motivation for writing the piece, with the notion of a one-size-fits-all text which is intended for disparate audiences, is problematic, and, furthermore, if a text concerns a description of the product and reads like a press release, it is unsuitable for inclusion in a formal proposal. Such was their distaste for its writing style, the engineers rejected it out of hand, and decided to write their own version from scratch.

The proprietary attitude of the HISE engineers towards their product was striking in those early discussions. New methods of team working had meant that the engineer was now more involved in marketing and selling the product, and, as a corollary of this, in describing the product for the customer in proposals. In the case of the SVSG, the engineers were noticeably proud of the engineering and overall design of their product, and the fact that they had succeeded in designing an innovative product with the dimensions of a pencil-tip. It may look unremarkable, or even unattractive to the uninitiated, but to the engineers it is a work of art. This is why a picture of what appears to be an antiquated space ship from the first Star Wars film (in fact, the SVSG) is juxtaposed with a pencil tip on the front cover of each proposal they send out (see Figure 5-3 in Chapter 5). The team leader insists on retaining this photograph in spite of entreaties from his marketing colleagues to replace it with, to them, a visually more attractive picture. The significance of visuals as persuasive features in proposals is explored in the next chapter.

In retrospect, the SVSG proved to be a good product to focus on, during a period in the study when I was attempting to examine all documentation and writing produced in relation to a particular product (range). This reflected in microcosm the text generated for much larger and/or more complex systems, which traditionally form the bedrock of all HISE business.

Also, by taking such a product focus, it is/was possible to see the various types of proposal spin-offs, i.e. the different types of proposal that may result from one product. I became involved with a small team of SVSG engineers in an attempt to develop a generic proposal around the time when they had decided that Text 2 was inappropriate for describing their product in proposals. The lead engineer had anticipated that there would be an increase in enquiries about the SVSG, and that there would be a concomitant need for what he referred to as an off-the-shelf proposal. He could see numerous textual permutations for the proposal, which he envisaged would be a sort of generic document that engineers could take and quickly modify, to tailor it to specific aspects of enquiries being made about the product. The proposal would serve as an RFI, or response to a request for information, which may be informally made, over the telephone, for example, or more formally requested, in a meeting, or by letter or email. The generic document could also form the basis of a more tailored solicited proposal, or be submitted as an unsolicited one.

The very idea of having such a textual convenience arose because of the nature of the SVSG product, which, compared to other products, has a design which is more or less static and unchanging. Other ‘products’ offered by HISE, are, in fact, systems, possibly comprising numerous components, of which one may be the SVSG. In the case of a proposal for a system incorporating the SVSG, certain parts of the generic proposal, it was reasoned, could be incorporated into the main proposal document.

After lengthy discussions and examination of texts, I drafted a strawman outline for a generic proposal for the SVSG for the engineers to use (Appendix L). At the time, I regarded the analysis as an opportunity to practise rather rusty analytical skills, and to learn more about the attitudes of the engineers working around me; it was an applied linguistic exercise, in effect, and little more than that, since the importance of proposal writing had not become apparent at the time. However, the insights it provided into engineers’ attempts to persuade in text have proved invaluable to this project, in ways not anticipated at the time.

The work also proved useful to the engineers, since a generic proposal was eventually produced, and this has since been used to produce later proposals featuring the SVSG. Since work on the generic proposal is not central to this study, it will not be discussed further, but, in the event, it has proved influential/useful in that it has informed this study, and served as a starting point for the wider-ranging examination of proposals that followed, when access was gained to more data. The efforts of the engineers and the technical authors can be seen in the generic proposal that emerged (Appendix U). (A separate issue, i.e. the usefulness or otherwise of using a generic proposal as a basis for proposal writing is an interesting one, possibly to be discussed on another occasion.)

4.8.2 Engineers' ambivalence towards overtly persuasive language

These are but three examples of exchanges I had with engineers about the persuasive aspects of proposal writing throughout this project. From the earliest discussions, I had noticed that engineers try hard to be persuasive, without being too obvious about it. They are not alone. There are others in the scientific field who have the same burden of having to write proposals to ensure the continuation of their professional practice and livelihoods. Myers mentions some of the constraints placed upon biologist researchers in their attempts to bid for funding. In a parallel situation to the stylistic/cultural conflicts facing engineers in their proposal writing, he notes that a similar paradox exists for the biologists:

> There is a paradox in the rhetorical strategy of the proposal, because the proposal format, with its standard questions about background and goals and budget, and the style, with its passives and impersonality, do not allow for most types of rhetorical appeals; one must persuade without seeming to persuade. (Myers 1990: 42)

It seems the engineers are correct in believing that an informal writing style, or an overt 'sales pitch' is generally disapproved of in the engineering field. Readers of proposals at the MoD stated that they too react negatively to such a style of writing. The engineers are faced with a problem, however: how can they write persuasively in a style acceptable to their peers? All have been taught by their science and university teachers never to write in other than a formal objective and impersonal style. This is confirmed by Kirkman, who refers to the 'traditional' writing style produced by engineers, describing much of it as 'heavily unreadable':

> .... when I suggest that passive, impersonal, turgid expression is a millstone that the technical content need not carry, I am told that papers written in any other style would be unacceptable: 'It would be thrown straight back'; 'My boss wouldn't have it'; 'You must make your work sound impressive'. .... Always there is anxiety that other engineers and scientists would not accept a departure from 'traditional style'. (Kirkman 1992:2)

My work with engineers at HISE and other organisations, including academic institutions, has revealed this attitude to be ingrained in the engineering community. However, during this project, I have observed the gradual change in HISE engineers' attitude towards being persuasive in text; the realisation that they need to write to persuade is a recent one, only emerging during the last five years or so. Even now, as the above discussion reveals, there is disagreement about how the proposal should be persuasive, with ambivalent attitudes prevailing towards the notion. Some associate persuasiveness with the style of writing exemplified by Text 1, mentioned above, and make uneasy attempts to imitate with gauche results. This enthusiastic self-endorsement, for example, would engender a sceptical response from the Customer, and, according to interviews with those who read proposals in the MoD, the use of 'excellent' (twice in a short paragraph) and the claim about a successful working relationship would evoke in the reader the opposite effect to that intended by the writers:

> HISE Avionics believes this program is an excellent match for its advanced IMU product and business plans in terms of performance, price and quantity. Equally, we believe that the excellent working relationship built up between our two companies, even before the merger, during the initial bid phase has demonstrated that working together can be successful.

Since engineers are not traditionally associated with such rhetoric, little help is available in the literature, either within engineering or applied linguistics. EST writers (Fear 1977, Hicks 1961, Kirkman 1992, Pauley 1973, and others) seem to assume that engineers write mainly factual, information conveying, non-argumentative texts. They tend to deal with text-types more traditionally associated with engineers, for example, engineering reports and engineering specifications. As a result, their central concern is to encourage clear and accurate factual writing, perpetuating the notion that this is what engineers usually write, and that they need to concentrate on specific aspects, like writing clearly, concisely and objectively. Kirkman, for example, writes:

> It is surely axiomatic that the aim of technical writing is to transmit information accurately, quickly and economically from one person to another(ibid.).

He later discusses briefly a potentially more persuasive writing activity, i.e. correspondence, but even so portrays it as essentially factual:

> The aim is usually to transmit the information exactly, or to make a precise enquiry. ....accordingly, writing should be direct and specific. (Kirkman 1992:128)

As has been discussed earlier in this chapter, advice about persuasive information to be included can be found, and is expressed as different selling points or themes (Stross 1990). However, the language used to express the themes, including such phrases as ‘ensure low risk’, ‘engineering excellence’, ‘committed to quality’, are regarded as stylistically undesirable and unsubstantiated ‘sales talk’ by engineer proposal writers and readers alike. As has been mentioned, writing guidelines issued by organisations like the European Space Agency, the American Military, and HISE’S own in-company guides concentrate on formatting rather than language expression. The dearth of information about proposals in EST writing has already been noted, and as a natural corollary, the persuasive kind of language engineers need to produce in proposals is also a neglected area. The mantra that engineers should always be clear, correct and concise persists, and it is still considered anathema for engineers to be anything other than objective. How, then, should this be reconciled with the need to persuade in proposals?

4.8.3 Attempting to pin down the notion 'persuasion'

It would be a mistake to equate persuasion simply with 'sales talk', or with language that is subjective or hyperbolic. The prevailing attitude in the engineering community tends to reflect a rather black and white dichotomy of linguistic expression which designates language as being either objective/factual or subjective/emotional. As has been discussed, there is a tendency for EST literature to perpetuate this idea. However, it is useful to consider linguistic expression in terms of clines or continuums. This is not a recent view to take: Houp and Pearsall discuss persuasive strategy in terms of a continuum, stating 'all information ranges along a continuum from complete objectivity to complete subjectivity'. They depict this diagrammatically thus:

Objectivity	Area of Reasonable Argument	Subjectivity

(Houp and Pearsall 1980:141)

They assert the central importance of the central 'Area of Reasonable Argument' in communication by stating:

> Many of our communications fall in this zone of the continuum, between pure objectivity and pure subjectivity. In this zone argument is permissible – in fact inevitable. And when we argue, we have at our command all other modes: exposition, description and narration. (ibid.: 142-143)

However, categorical assertions about the existence of 'pure' objectivity or subjectivity would be absent from more recent views of discourse. These days, writers are seen to have a wider range of strategies and devices at their disposal, both linguistic and extra-linguistic, beyond the modes of exposition, description and narration mentioned by Houp and Pearsall. Martin (1985) represents more recent (and to the engineers, contentious) views, sweeping aside any notion that factual writing is 'factual', putting forward the idea that factual writing requires creativity and imagination to be successful:

> There is a naive view in our culture that it is possible to distinguish form from content, and that factual writing deals with content and can be judged simply in terms of how truthful or close to the facts it is. ....factual writing requires all the creativity and imagination we can muster if it is to succeed. .... Exposition counts, even if it has nothing to do with truth. (Martin 1985: 49)

Possibly, one of the problems facing engineers is the confusion that results from the meanings associated with persuasion. As a term, 'persuasion' (or 'persuade') has rather wide colloquial applications, associated with the idea that it is an intentional act with illocutionary force. It is deemed successful if it results in the desired behaviour of the message recipient. Colloquially, 'persuasion' has potentially negative connotations, because of its association with social and behavioural manipulation which is not benign. These associations have their roots in the views perpetuated by the likes of Packard (1957) who portrays a gullible society unsuspectingly persuaded into a pattern of consumer behaviour at the behest of clever advertising, and unscrupulous corporations. Bolinger is one of the few linguists to explore aspects of persuasion, investigating persuasive acts which have negative connotations, for example: evasion, instilling fear, persuading through deception, euphemism and dysphemism. He discusses the lexical choices made to commit these acts, and is possibly the first to coin the term 'suasion', although he does not define it (Bolinger 1980: 110-111, 119-122).

It could be said, that since it may be considered as a kind of manipulation, presumably covert and possibly not in the message receiver's best interests, 'persuasion' is negatively coloured for engineers in proposal writing (and reading) contexts. Readers of proposals may suspect manipulative intent that is one-sided, i.e. the proposal writer stands to benefit from winning in the bid process, and may adjust the 'facts' in order to win. Engineers generally regard non-technical English with suspicion (they refer to it as 'natural' English), because it allows, in their view, vagueness, 'truth-bending', and inaccuracies (see Appendix J for a discussion of this). It is possible, therefore, that, in acknowledging the need for proposals to persuade, the writing task is rendered more difficult because of the problematic association with potential dishonesty and malign intent. It is indeed a conundrum that faces the engineer, since he has to convince the reader of the proposal's benefits to the Customer, while both reader and writer are aware that the proposing company also stands to benefit, and furthermore, from the Customer's viewpoint, may even benefit to a greater extent.

4.8.4 Informative persuasion – substantiation

Since this study aims to be of some use to engineers, it was thought necessary to tease out a focused view of persuasion in proposals which might have the potential to be developed by the engineers or by applied linguists. Repeatedly, it seemed the major concern of engineers and linguists working in EST lay in the selection of information to be used as 'ammunition' for convincing the Customer; they had to decide on the facts to be included in order to persuade the Customer of the efficacy of the proposed solution. The 'what' factor of texts is fundamental to any decision on organisation and writing style. In this respect, proposal writing is little different to writing an academic assignment; the highest ranked problem for students is the gathering and selecting of information to be included in an assignment. This is logical when one considers that the whole point of writing an assignment is that it provides students with the opportunity to display their subject knowledge and to be judged by their displays.

The pre-eminence of subject (or information) content in persuasive discourse seems to be confirmed by the some of the more recent work in the field of EST. For example, in her research into the nature of persuasive strategies in medical texts, Segal remarks on her observation that a different paradigm is beginning to be articulated in the rhetoric of medicine. Her case study report is particularly interesting, because it includes a description of the structure of the review article:

> Parts are not organized with persuasive introduction and discussion sections flanking a more descriptive middle; rather, they are arranged according to topics, with headings and sub-headings directing reader attention to particular areas of professional interest. Review articles, however, are not less persuasive because of this seemingly arhetorical organization. (Segal 1993: 94)

Similar observations were made in this study of distinctive writing practices and organisation of text segments, when engineers set out to be persuasive in proposals. These eventually led to the decision to devise analytical categories based on information topic, as I shall now show.

The iterative process of devising categories, described in Chapter 6, revealed instances of attempts by the engineers to persuade by impressing the reader in different ways. Few of them are strikingly obvious. An examination of the following extract from an executive summary, for example, shows instances of engineers trying to impress covertly:

> **Development Experience in Naval Electro Optical Tracking Systems**
> The Neptune 1 Electro-optical gun fire control system was developed in the 1970s, Sea Neptune 1 systems were fitted to the Royal Navy TURRET class patrol vessels and exported to customers in the Middle and Far East. Using this experience in naval Electro-optical tracking, OSBORNE INDUSTRIES developed the high performance General Purpose Electro-Optical Director (HPOD), which was selected by the Royal Navy in 1985. The resulting Neptune 22 system (designated YGO46 in the Royal Navy) provides Electro-optical surveillance, tracking and gun fire control.(Extract from EP3007e)
> [This extract is considered later, in a discussion about category refinement]

Engineers are uncomfortable with the idea that they may be regarded as boastful, and so they try to impress in this less obvious way; e.g. through the listing of ‘facts’ about their work. The only evidence of overt persuasive or ‘selling’ language lies in two words ‘high performance’ within the pre-modification of the noun phrase, ‘the high performance General Purpose Electro-Optical Director’. At least three examples of impressive instances may be gleaned from this extract:

1. the Royal Navy, a prestigious customer by any company’s standard, is mentioned three times;

2. the reference to ‘customers’ in other countries (i.e. other navies) is intended to impress;

3. the positive reinforcement of the idea, implied in 'development experience' in the title: that HISE is an established and committed company with a long-term research and development culture contributing to a successful product.

If viewed from this 'suasion' perspective, certain inferences can be drawn:

1. The tracking system design has been developed over more than three decades.

2. It is in use by several navies for surveillance, tracking, and gun-fire control, and has been for years (unspecified).

3. The company has expertise in this type of product.

4. The product has shown 'proven performance'.

Chapter 6 discusses how these inferences were further developed and refined, and, in turn, converted into categories to be used in analysing the information content of proposals and executive summaries. The four refinements above, for example, were seen to convey particular persuasive information pertaining to distinctive informational aspects of the proposal. These are as follows, with the distinctive information (to become possible category labels) shown in square brackets in bold:

1. commitment to refining design over a long period, in this case thirty years [**company's commitment to the product**];

2. evidence of improving the design, and developing new generations of the system [**expertise of personnel/ effective product**];

3. evidence of the system being used by substantial customers, e.g. the British Royal Navy, and other countries' navies [**proven performance**].

4. present customers are satisfied by the system [**proven performance** again]. This is an inference which can be drawn, because, after all, if the Royal Navy had not been happy with it, would they be using it still?

Another interpretation of the engineers' attempts to impress emerged out of a discussion about my assumptions with an engineer, which revealed that an ulterior purpose underlies the ostensible historical perspective of the product offered by the extract. The title: 'Development Experience in Naval Electro Optical Tracking Systems' implies that the extract outlines historical events or landmarks, and these can, in fact, be seen as appearing in chronological order:

- The Neptune…. gun fire control system was developed in the 1970s
- Neptune systems were fitted to Royal Navy TURRET class patrol vessels
- (Neptune systems) were exported to customers in the Middle and Far East, etc.

However, after some discussion it was agreed that this was not a straightforward historical outline. Instead, an inference concerning the 'track record' or reputation of the company can be drawn from the extract, and this was confirmed by the engineer, who drew an odd analogy as an illustration:

> "Well, they're talking about our pedigree, aren't they? ….You could be running a stud farm and end up with a horse that's really ropey, but you could go back and trace its lineage and that's its pedigree."

The term 'pedigree' is often used by engineers, although it usually carries more positive connotations than that of a 'ropey horse', to convey a picture of a committed, experienced and expert engineering company. It struck me as being a potentially useful category for labelling certain parts of proposals which relate to the company's (or the engineers') reputation, as it later actually became.

4.9 Discourse function – persuasion through topic elements

The search for a useful analytical perspective in the early stages of the study, encompassed readings which were not restricted to those specifically concerned with technical writing. So far as this section is concerned, where the discourse functions of the proposal are examined, the most useful ideas were drawn from the wider area loosely known as ESP (English for Specific Purposes) or LSP (Language for Specific Purposes). The work of Batten and Cornu (1984), for example, was attractive, because they consider texts within their wider context, and also because they draw upon this context in an attempt to be more specific in their analysis; their attempt to relate reading needs to textual purpose was seen as a good starting point for this analysis. Their reasons for investigating the texts, i.e. with the aim of helping LSP teachers select reading texts with a view to devising teaching materials, may differ from those of this study. However, their work has parallels with this one in that they too attempt to identify distinguishing features of an LSP text, and acknowledge the important role played by contextual aspects, for example, who will be using the texts and for what reasons (in this case LSP teachers in devising teaching/learning materials); as well as the authors of the texts, their purpose, and the intended audience of the texts. They make the point that in the case of LSP texts, the writer has a clear idea of his reader, the target audience.

By comparison, this attempt to identify distinguishing features of engineers' texts, and the contextual aspects surrounding the investigation, is of a more specific nature than the more general scope of Batten and Cornu's work. Specific information is known, for example, about the physical context, i.e. the place where the texts are written and read. Furthermore, the writers are known. They are not amorphous faceless 'authors', about which little or nothing is known, but alive and kicking writers who are in the act of composing text at the time of writing this section. The proposals they write are written for a specific purpose and often with an idea of how they will be read and scrutinised by the Customer.

Batten and Cornu may have different ultimate aims for their analysis, but their approach to describing text function was thought to be a useful starting point, especially as their ideological stance towards text analysis is sympathetic with that taken in this study. For example, they examine the structure of an LSP text from the perspective of the reader who, they argue, is not simply a recipient of meaning, but actually an active participant who has to 'organise and evaluate the information he receives while he is reading the text' (1984:190). In their discussion of non-fiction texts, they discuss differences with fiction texts, emphasising the importance of audience awareness on the part of the writer, and how he must relate to a specific audience. The points they make about the reader, however, needs to be seen in a historical context, since they may appear unremarkable today. Batten and Cornu's work reflects innovative thinking in terms of text analysis in the 1980's, although their reference to recipes, lonely hearts columns, and instructions adds a rather dated shadow over their work today. More recent work has been more context focused, and with the realisation that texts are physically and culturally anchored, has shown a concomitant move towards analysing the discourses within institutions or organisations (Bazerman and Paradis 1991; Swales 1996; Stubbs 1996; Davies, Forey and Hyatt 1999, et al).

At the time they wrote the paper, there was quite some interest in the differences in reader reaction to fiction and non-fiction texts, and it is their work in developing this which is useful here. The relevance of their discussion is their idea, drawing upon Searle's work (1969) about reader action, or, better still, reader reaction to LSP texts. They argue that, because the reader must arrive at the same gist as the author intended, the LSP text has a function 'to make the reader do', whereas a reader must feel in order 'to do justice to a fiction text'(1984:192); a possible extrapolation of their ideas is that reading an LSP text has a functional purpose fulfilled by systematic reading procedures, which would certainly apply in the case of proposals. The relevance to proposals continues in their identification of three distinctive features of non-fiction texts:

1. The gist of a text is explicit. It follows that for all readers the function of a given non-fiction text and consequently what is rendered by it, i.e. the gist, must be the same. For example, they claim, when reading an instruction for use, the reader does not question it.

In the case of proposals, it has been shown that identified functions are not only recognised by the reader, but are often specified in the Customer Requirement.

2. The function intended by the writer is unique. By 'unique' Batten and Cornu mean that an expository text cannot be given more than one function, presumably for the purposes of their materials writing project. They also indicate that this second feature is a direct consequence of the first. This study recognises that a text can be multi-functional, although it is clear a single over-riding function of a proposal is to ‘persuade’. Other more specific functions can be identified, as will be shown.

3. There is a congruence between the writer's aim and the reader's experience of the real world. In other words, the original reader is familiar with the concepts present in the text, and knows what they refer to. The specialist readers of proposals are usually engineers with the same professional expertise as the proposal writers.

Having determined what it is that a reader should *do,* Batten and Cornu distinguish four main functions the texts should perform: the writer may want the reader to understand, to go further, to use, or to be convinced. They provide this information in a table, reproduced below:

The function of non-fiction texts

Functions	**Gist for the original reader**	**What the reader does**
To understand		
1 Didactic manuals and school books	new	learn
2 Communicative radio news bulletins, newspapers, reports, curriculum vitaes, personal letters, lonely hearts columns	new	discover
Instructions for use recipes, answer to lonely hearts column	not new	do
To go further scientific articles	new	1 understand 2 evaluate
To convince		
1 To believe political speeches, editorials	not new	1 understand 2 evaluate
2 To act advertisements, letters of application	not new	1 discover 2 do/not do

Table 4-3: The function of non-fiction texts (taken from Baten and Cornu 1994:195)

The usefulness of Batten and Cornu’s work is in examining their attempts to categorise the textual functions of non-fiction texts. Their categories may be too general to be of much use (e.g. to understand), or inappropriate to proposals (instructions for use). Nevertheless they have formed their categories to help differentiate between texts and to make it possible to order texts in ‘in relation to text-types from a text function point of view’ (ibid:196). However, a curious feature of their categories is the way they are expressed, and their some-what nebulous purposes vis-à-vis the reader. Two clearly relate to textual purpose, for example, ‘instructions for use’, and ‘to convince’ (incidentally, the reason for expressing the former as an NP, and the latter as a VP is not apparent); a third, ‘to go further’, could relate to both text and reader; and the fourth, ‘to understand’, clearly refers to reader behaviour, and the effect on the reader in terms of reader cognition intended by the writer of the non-fiction text. Although it is useful to consider their approach, this study aims to identify rather less fuzzy categories in order to provide an analytical framework which might be useful to engineers writing proposals in the future.

Swales and Feak work within a more clearly defined context in their attempts to provide guidance to student writers, introducing at an early stage a broad perspective of academic writing as a backdrop, what they refer to as ‘considerations’, for the student writers to ponder on their ‘positioning’ (1994:8). They identify six considerations for graduate academic writers: audience, purpose, organisation, style, flow, presentation, an approach broadly followed in this study. In the holistic discourse analyst tradition, they follow these considerations with questions to help the graduate writer perceive the distinctive features of the writing culture he is a member of.

Although, engineers work within a radically different writing culture, and are not concerned about using references or re-evaluating the work of authorities in the field, for example, they would nonetheless be interested in a few of the questions posed (Swales and Feak 1994:32). It has been seen, for example that they take time and trouble to express enthusiasm and commitment whilst writing in a formal register/style. Many of them have discussed related issues in their own writing, and are intrigued by the notion that proposal writing is strategic. Just as academic writing has a clear writing culture and conventions, so too does proposal writing.

The symbiotic relationship that exists between proposal writer and reader (or customer) determines the distinctive functions of the proposal. The very fact that the engineer needs to show how closely his proposed design the solution fulfils the Customer’s requirement, which will usually have been stated before the writing begins, is an example of this. It is useful to borrow Batten and Cornu’s approach and to state the functions in terms of desired reader behaviour, what Searle (citing Austin’s work) would refer to as illocutionary acts or [desired] perlocutionary effects (1969:24-5), and attempt to match these with specific topic areas.

4.9.1 Macro discourse functions

In view of the observations made on proposals and discourse in this chapter, it is possible to suggest a hierarchy of discourse functions relating to proposal documents. At the highest level, the proposal is a:

1) **Response to a (potential) customer** At the highest level, the proposal is a response to a textual stimulus, usually written, which can be an expression of need expressed in a formally stated Requirement, and/or an enquiry for information.

2) **Description of the 'solution' (to use the engineers' term) or product**

   This is the largest and most significant function of the proposal. Again, it needs to be performed with a view to persuading the Customer:

   a) define the product, and define terms

   b) explain what it is and what it is capable of doing

   c) show the extent to which the product gives the customer what he wants/fulfils the customer's requirements or criteria

3) **Means of persuasion -** In fact, proposal writing involves the engineer in a complex problem-solving exercise in which the solution he suggests must convince the Customer that it will solve his problem. Ultimately, however, the aim of proposal writers is to persuade the reader to place the proposal on the short list, and finally to choose it as the winning proposal out of all the bids that are submitted.

From the engineers' standpoint the proposal needs to persuade the reader in eight key topic areas, to be referred to, for purposes of convenience at this stage as 'topic elements', although 'discourse topics' would also suffice:

1. **Compliance – different aspects, e.g. degree of compliance:** The proposal needs to show how closely the proposed 'solution', referred to here as 'the product' (see discussion of terms in Chapter 1) matches the Customer's requirement. Ideally, it should meet all the criteria set, and it needs to convince the customer that the product would be best for the customer's purposes, even if it does not quite fit the bill (or in engineer-speak is not 100% compliant). So it needs to explain convincingly what is being proposed, and why. Compliance is a crucial topic for two reasons: first, it may be the most important selection criterion and over-riding factor in the Customer's selection process; second, it may have financial implications, determining the release of staged payments in the event of the

proposal winning in the bid process. This financial consideration underlies the processes of design and proposal writing, so that certain aspects of proposal discourse reveal evidence of what can be referred to, for want of a better term, monetary manipulation. This is manifest, firstly and less obviously, in the organisation of the discourse, and secondly, and overtly, in direct reference to financial aspects in the proposal.

2. **Physical features of product/solution,** e.g. physical construction and appearance: If a piece of hardware is being proposed, the proposal provides a description of the equipment, i.e. what it is made of, how it is made, and its appearance, through text, supported by photographs and diagrams galore. Appendix U provides an example of this textual-graphical description of physical features.
   If a piece of software is being described, e.g. terrain profile matching software, in other words, a kind of 'abstract' product, with textual (or conceptual) rather than physical substance, the proposal includes details of the casing/cabinet/console that contains the electronic data (sometimes nothing more than a mundane plastic cartridge) with pictures of that instead!

3. **Performance of the product-** what the equipment is capable of doing, information about how it has performed in tests, how it has performed with other customers who have bought it.

4. **Company expertise, facilities and systems -** Since the Customer may not know much about HISE as a company, he needs to be persuaded about the suitability of HISE for being awarded the contract. Whether he lives outside or within the United Kingdom, he may need to be given information about the structure of the company, its personnel, manufacturing facilities, testing facilities, and so on, if he is to be convinced of the value of the solution proposed.

5. **Post-production aspects- e.g. installation, application, use** – The user's perspective needs to be reflected, and the proposal may need to show how easy it is to use the product, how many people are needed for it to function, how safe it is, how easy it is to maintain, and how easy it is to install. Also, it needs to be known what spare parts are available, and how often it will need checking and maintenance.

6. **Documentation associated with the product**, otherwise referred to as documentation support. - The proposal may need to describe the support to be provided in the form of service, training, and user manuals.

7. **Training and maintenance support** – The bid may need to include information about engineer advisors/trainers, maintenance and trouble-shooting engineers, equipment spares, and service facilities. Sometimes, potential for upgrades is mentioned.

8. **Price / financial aspects** – A proportion of technical proposals make a reference to price, sometimes implicitly, although engineers argue about the benefit of stating this more explicitly. Much depends on whether the proposal is an all-in-one, or split up into separate sections.

These then, are the eight main discourse topics which were first identified as being potentially part of any technical proposal, the first four being obligatory, and the last four optional. For the purposes of the analysis that evolves, it may be useful to mention briefly at this point a distinction between 'discourse topics' and 'discourse functions'. As will be seen, having an over-riding pragmatic aim, this study is not overly concerned with teasing out the differences between these notions, except where it achieves a means to an end. The former refers to aspects of the text which are topic- or object-oriented, which, in the event, proves a major concern. The latter is used in a general sense in this study to refer to the manifestation of 'writer intention' or 'writer motive' in text. As the analysis progresses specific discourse topics are identified, referred to as Information Components (ICs). Put simply, whereas a discourse topic may, in theory, occur in different parts of the proposal, it may be conveyed in text performing distinctly different discourse functions. ICs are discussed further in Chapter Six.

Up to now, the highest level discourse functions have been identified, together with macro-discourse topics, as shown in Figure 4-7.

Further (discourse) analysis of proposals reveals the usefulness of viewing these eight topic areas from the perspective of persuasion as the main illocutionary function: as this study will reveal, engineers attempt to persuade through practising what may be best described as strategic writing, in which the macro-persuasive strategies (which overlap) aimed at are:

1. **assurance and reassurance** – to make the reader feel safe and secure over a variety of topic elements, ranging from product description to quality assurance procedures.

2. **'face building' and corporate image-building** – to impress the reader about the engineers' knowledge and expertise, and about the company's facilities and connections.

3. **instruction** – aimed at educating the reader about technical/scientific matters.

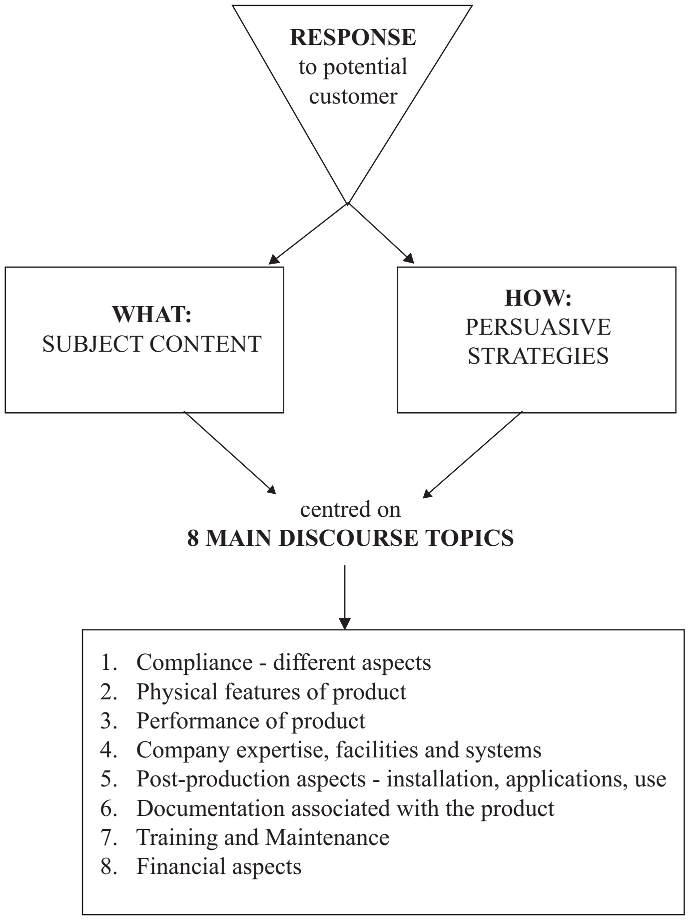


Figure 4-7: Macro-level discourse functions and discourse topics of technical proposals

This view of proposal writing being strategic and reflecting engineers' writing motives seems similar to that taken by Swales and Feak (1994) in their treatment of the teaching of academic writing for graduate students. It is their application for practical purposes of linguistic theory developed earlier (Swales 1981,1990) that is interesting here. A recurring point made throughout their work is that academic writing is rhetorical, and, furthermore, that they see rhetorical writing as strategic writing:

> All of us, as academic writers and whatever our backgrounds, are engaged with thinking about our readers' likely expectations and reactions, with deciding on what to say - and what not to say - about our data, and with organising our texts in ways that meet local conventions and yet create a space for ourselves. (1994:3)

It follows, then, that when engineers are engaged in proposal writing, they are similar to other writers, like the post-graduate academic writer, where they want to achieve an outcome, and persuade the reader into a certain type of behaviour; hence the suitability of the terms 'strategic writing' and 'writer motive'. It is the combined aspects of motive and persuasion in proposal writing which distinguishes it from other types writing produced by the engineer when designing a product (see Appendix J). Figure 4-8 below shows the ways in which the eight discourse topics listed above are manifest linguistically in proposal documents as part of the engineers' attempts to influence the behaviour of the Customer through assurance and/or reassurance, instruction, and 'face-' or image- building:

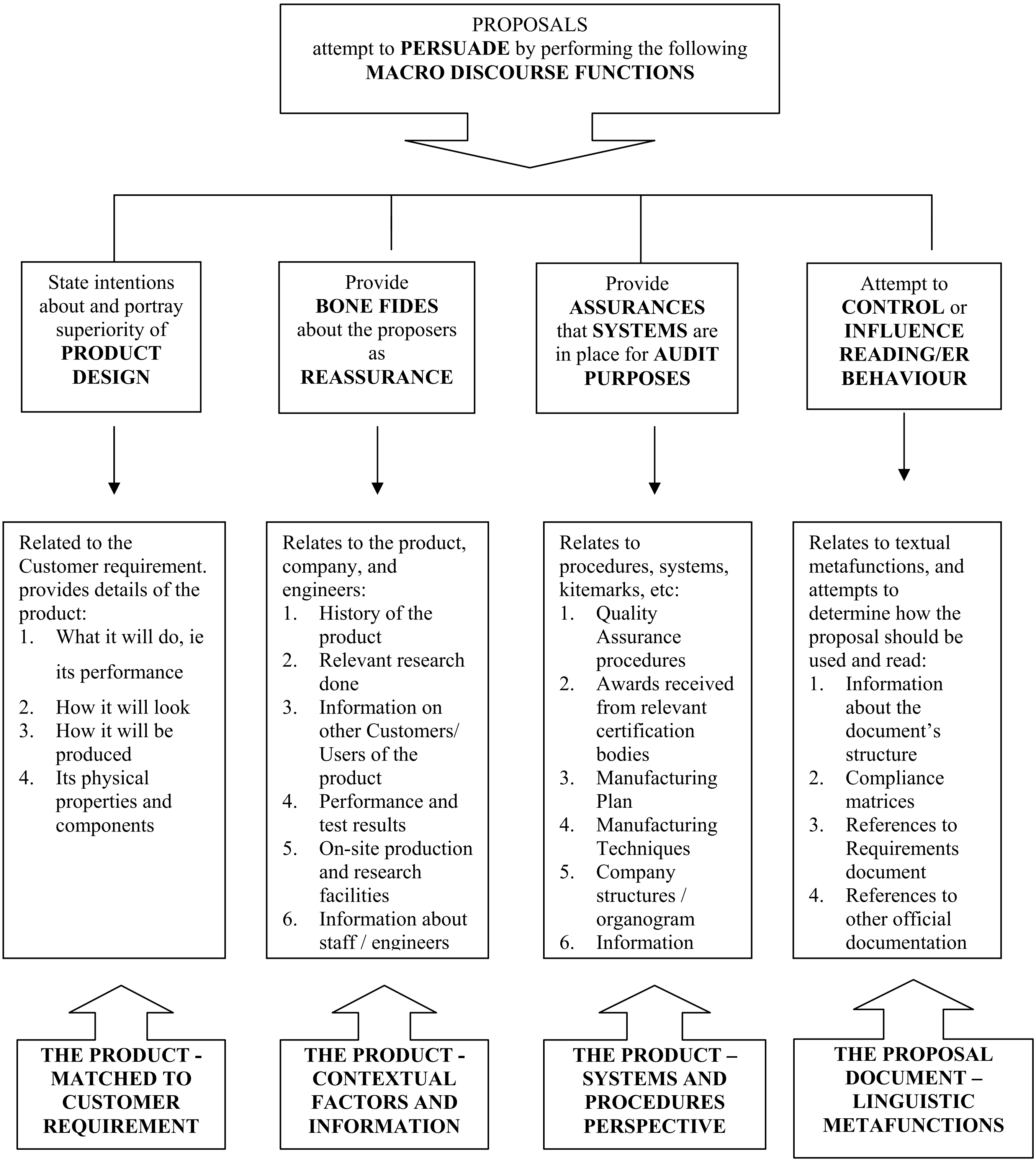


Figure 4-8: Diagrammatic representation of engineers' persuasion strategies in proposals

4.10 Conclusion

This section has described early work and reading done on proposals which served as a basis for the more focused analysis that followed. It has emerged so far that proposals are produced and interpreted by teams of writers and readers. It has also emerged that proposals are essentially persuasive documents whose success or failure hinges on acceptance or rejection by the Customer. Finally, broad topic areas have been identified which relate to the 1) design, cost, performance, and maintenance of the product; 2) facilities, expertise offered by the company, and industrial standards achieved; 3) documentation relating to external auditing agencies, and 4) metalinguistic aspects. These provide the starting point of further work into the information structure of proposals, discussed in the next three chapters. Figure 4-8 was produced at a time when the relative significance of these categories to the study was not overly apparent. It is fortuitous that 3) was seen as separate at that time since it transpires that audit related topics, being essentially bureaucratic, are peripheral in the consideration of discourse function. The study therefore concentrates on Nos. 1, 2, and 4.

The next chapter charts work done when the company's store of documents was unexpectedly made available for this study, and the attempt to devise an analytical approach of use to engineers. It serves as an introduction to proposals by discussing the overall structure of proposals, and the different sections they comprise. It describes particular sections, the analysis of which proved revelatory, and informed the more focused analysis that follows in later chapters.

CHAPTER FIVE - HOW PROPOSALS ARE STRUCTURED

5.1 Introduction to technical proposals and executive summaries

Anyone who has composed a document with the purpose of bidding for funds or competing for business, will understand the intent underlying engineering proposals. An engineering proposal is a formal and complex document, which is written by a team of engineers, together with their commercial and marketing colleagues in highly confidential working conditions, as part of a tendering process. Usually, the proposal is competitive, and is submitted to the Customer with the aim of being short-listed, and, ultimately, selected as the winning proposal. Occasionally, the proposal may be non-competitive, when the Customer has a need for a product or service, and asks for suggestions from the company.

RFIs (Requests for Information) are examples of other documents produced in response to queries from potential customers. Engineers refer to such responses as RFIs, although more logically they should be called RRFIs, i.e. Responses to Requests For Information. RFIs are usually shorter documents, or may be in the form of a letter, and are written in the knowledge that they may lead to future business for the company, if the potential customer is impressed enough, and persuaded, to invite a formal proposal as a result of reading it.

The bid team writes any proposal with the aim of persuading the Customer to place it on a short-list, and, ultimately, to be the one selected for the prize, which, in this case, could be the winning of a business contract for HISE. The 'business', so far as the engineer is concerned, relies upon the design, production, and delivery of an engineered product, which, put simply, could be hardware or software, or a combination of both. Bids can be large or small, ranging from those worth tens of thousands to those worth hundreds of millions of pounds to the company, as in the more recent case of, for example, the Joint Strike Fighter.

Since a proposal is written as part of the bid process, it has serious and formal connotations, and, as such, is no different from any other proposal, be it a proposal made at a meeting, for example, or a marriage proposal: after due consideration, it may be accepted or rejected. There is happiness and celebration for the proposal team, if it is the former, and a sense of failure and dejection, if the latter. As one bid leader put it:

> "You put everything in to it. It's like going for a job interview: you've got to psyche yourself into the job, so that you actually visualise yourself doing it. It's a hell of a let down, then, if you don't get it. It's a serial process: when you submit a proposal you can see the project taking off and start to look beyond it to other spin-off projects. If you win, you have a party. If you lose, it's dreadful, because other plans fall by the wayside."

Over the six years of this study, I observed proposals being written by individuals and teams, and, in the late stages, I was working among a group of engineers who compiled a proposal for a gun system for the British Royal Navy. This was a particularly large proposal, in terms of the size of the actual document, and the amount of time and effort expended on it. It was also a particularly important proposal, because, if successful, it would secure work for the engineers and those on the factory floor for a decade or more. If unsuccessful, the engineers knew that they would probably be disbanded, and that most of them could lose their jobs. The words quoted above were said by the leader of this bid team as they were about to make a team presentation to the Customer, in the final stages of the bid process, after having worked on the proposal for over a year. In the event, they lost, and the dejection felt by the team was palpable. At the time of writing this particular section, they were steeling themselves for redeployment or redundancy; such are the human consequences of losing in the tendering process.

The executive summary is distinct from the proposal, and recognised as such by the engineers, who refer to it as a separate document. So far as the engineer and Customer are concerned, the executive summary is part of the proposal, and in their databases is subsumed under the main document category ‘proposal’. It is, however, a variety of written abstract performing very similar functions to the business report abstract. It is submitted to the Customer as a subsection within the main proposal document, but is usually composed as a distinctly separate document, is referred to by the bid team (including engineers) in discussions as a separate document, and, by its discourse structure, can be regarded as a distinctive genre (see Swales 1990:54-6, Couture 1986:82).

5.2 Approaches to text

Most engineers would consider it a simple question to be asked about the structure of a proposal, and would reel off on their fingers the main section headings to be found in most of the proposals held in the company’s database. Similarly, they would have no doubt about the ultimate purpose of the proposals, and would probably say these words, or something very similar: ‘Proposals are persuading documents. They have to persuade the customer that ours is the best solution.’ They say this with certainty, although, when questioned, are unable to explain how they try to be persuasive in what they write, except in general terms. When questioned further about proposal writing, engineers and managers alike are dissatisfied with the proposals they write and ask for proposal writing models and guidelines (see Chapter 4). The linguist, on the other hand, wishes to discern the discourse structure of proposals, and identify concomitant discourse functions, which may, or may not, conform with the engineers’ ideas about structure. The linguist would also aim to take the notion of ‘persuasiveness’, and identify those features of the proposal which are persuasive, be they organisational; visual; propositional, i.e. what is stated, similar to Searle’s use of the term (1969:29), and akin to information content; or stylistic. The starting point for this section, then, is that, whatever the stimulus, and without exception, the proposal sets out to persuade. It is written in order to convince the Customer of the efficacy of the proposed ‘solution’, a term used to refer to what is being proposed, be it a product with physical properties, a set of documents, a piece of software, or a procedure.

In his, albeit brief, reference to technical language, Halliday mentions the ‘often professed ideal of “plain, simple English”’, similar to the ‘clear, correct, concise’ mantra engineers like to quote to me. He remarks on how deceptive such a phrase is: ‘the concept of “plain and simple” is itself very far from being plain and simple’, going on to mention the tendency for any kind of technical language to become even more complicated when attempts are made to simplify it ‘by removing metaphors’. He juxtaposes this with the explanation that written language is more lexically dense than spoken language which is grammatically intricate (1994:350), with the possible implication being that written language, and certainly technical language, has a tendency to be clausally simple. I drew such an inference because my early observations of engineers’ texts indicated that sentences/clauses had ostensibly simple structures (i.e. SVCs and SVO), but contained structurally complicated noun phrases (NPs) at S and O and Cs positions. However, interesting though a study of a text’s lexical density or NP structure may be, and an attractive prospect for a linguistic study which needed limiting in some way, it seemed rather too narrow a focus for the analysis, and not in keeping with the aims and holistic spirit of the study.

Certain analytical principles should underpin any textual examination intended to be systematic and comprehensive, and the approach taken in this study has similar intentions to those suggested by Crystal, who is interested in developing the idea of a stylistic profile. Although stylistic features are not central to this study, I am interested in ideas about portraying textual features. Crystal states that there needs to be a place for any stylistically significant feature to be mentioned or displayed, on a spreadsheet, for example (Crystal 1991:224), and as will be shown, an attempt is made to provide graphic representation of informational features in this chapter and Chapters 6 and 7. He raises the problem of identifying those features which should be given a 'separate identity' and the criteria he and his colleagues based their decisions on, which have parallels with my own. They used their clinical experience, or knowledge gained in the field to make decisions; I used my knowledge in working amongst and with engineers on document design, together with information gathered from surveying and interviewing engineers over a period of five years. They used information gained from research into child language acquisition, and I from information in the field of engineering and linguistic studies of technical language, the latter a pauce field, as has already been discussed. My wish to take account of the writers' views, and their working and writing practices, however, has entailed the taking of a different slant from that suggested by Crystal, which is concerned only with stylistic features of a body of texts per se. This study is concerned, then, with inter- as well as intra-textual relationships, including writing practice, writing purpose, discourse structure, altogether a more holistic examination. Nevertheless an attempt has been made to be as consistent and systematic as possible, and to make some sense out of the textual data so that it relates to the work objectives and aspirations of the engineers. If they write proposals in order to persuade the reader, how do they try to achieve their purpose? The following questions need to be answered: what would be a useful description of the proposals' discourse structure; and what sort of language and linguistic devices do engineers use to achieve their purpose?

In retrospect, it is possible this chapter should be renamed ‘Search for the Analytical Holy Grail’. In their synthesis of research carried out in L1 contexts, Grabe and Kaplan recognise four research strands, which they describe as ‘distinct but interacting’, and representing ‘a somewhat confusing array of extant research’ (1996:18). I recall talks given by colleagues and fellow post-graduate students over the years who have described their frustration with a variety of language descriptions and models, whatever their basis or approach, ranging through transformational-generative, notional, functional, systemic, Swalesian-type genre and move analysis, or macro/micro-text analyses. Most often these have been dismissed out of hand along with claims that they were found not to work with undoctored authentic data, and, having tried to apply certain models myself, I can understand their disillusionment. Nonetheless, attempts to provide empirically derived analytic models with practical applications to authentic texts are beginning to bear fruit. The work of Davies and Greene (1984), for example, discussed in the next chapter, is an example of the early pioneering work in this mould.

The liberating aspect in a study of this kind is that it can encourage in the research student a ‘sweety-shop’ kind of attitude, with the student picking and choosing from a cornucopia of analytical models and approaches developed by others within the field.

This study started out as an attempt to be of some use to engineer writers, with both the text descriptions and analytical approaches designed with them in mind. I am not alone in having this aspiration of being useful to a target discourse community, and am following in the path well trodden by other applied linguists who have worked to this end. Ultimately, we aspire to be of some use to language users who have to produce language for real life instrumental purposes, where the results of the language production could have serious financial, professional or social consequences. The intent underpinning this study, then, is similar to that of others (Dudley-Evans 1986, 1994; Devitt 1991; Myers 1990; Bhatia 1993; Davies, Forey, and Hyatt 1999, et al), whose work has clearly stated objectives. Myers, for example, expresses the wish that his work be of use to the scientific community, suggesting it could be useful to biologists/scientists ‘by pointing out which features of their texts might have rhetorical significance’ (1990:xiii). Devitt examines the texts written by tax accountants, explaining that it is her wish to explore ‘all of the text-types within a community … not only how single texts function but also how texts interact’ (1991:336).

The ethnographic perspective of this study has had the effect of both constraining and liberating the analysis, which, in turn, have each had positive and negative effects. On the one hand knowledge of the writers, writing and working processes, the readers, and the purposes of proposals has served to inform and illuminate, providing a clear backdrop for an analytical approach to be developed. This knowledge has inspired ideas about what the analysis should achieve, in terms of practical outcomes, i.e. discourse structure, information content, and models or observations for writing future proposals. It has also provided insights, and completed the 'picture' in which the documents are set. On the other hand, the study needed to move from this sociological / sociolinguistic perspective to one which was more textually-oriented, to develop an analytical approach. However, there was no one analytical model that could be followed in order to achieve the pragmatically-oriented analytical goals suggested in Chapter 1. The question facing me was 'how to bridge that gap' between stated purpose and analytical approach, a situation somewhat reminiscent of that faced by those in the late 70s and early 80s who wished to design functional syllabuses.

In those decades, inspired by functional notions about providing more relevant courses for language learners, Wilkins (1976), and then Munby (1978), attempted to identify language functions for ELT syllabus design. Foreknowledge of Munby's work helped to influence the approach taken in this research: Munby devised an exhaustive and painstakingly detailed list of language functions which, it transpired, course designers found difficult to translate into teachable syllabuses. The task in this study is to devise an analytical approach which can be 'applied' in a linguistic sense, but which could also be applied in an engineering environment by the writers themselves. Practical goals established early in the study should have the effect of producing an analysis which ultimately engineers could make use of in their own writing work. Munby knew his analysis was intended to inform syllabus design, but he seems to have excluded from his study and resulting taxonomy consideration of the whole pedagogical context, i.e. that, ultimately, the syllabuses would need to be implemented by teachers in the classroom.

The previous chapter provides an overview of the linguistic macro-functions, in an attempt to convey a clear sense of language use, an approach advocated by Halliday who has been a prime motivator in recent trends to follow a functional approach to analysis. Although the approach taken in this study is not strictly Hallidayan, it has been influenced by Halliday's linguistic ideology, which has been an underlying influence throughout. With a degree of license, it is possible to draw parallels between Halliday's analogies, intended for grammatical description, and this study of proposals. In introducing his functional approach to grammar, Halliday explains that asking how meanings are expressed places the forms of language in a different perspective, so that they are a means to an end, rather than an end in themselves. (Taking a similar stance, I attempt to identify the persuasive elements in proposals, with a view to examining how they are expressed.) The technical term for this kind of grammar is ‘synesis’, and Halliday believes his approach is more that of synesis than of syntax (1994:xiv). Taking one of many of his dictums, ‘every text unfolds in some context of use’ (ibid.:xiii), this section explores the ‘unfolding’ of the text, in this case, the proposal, through different layers of analysis. The journey through to achieving any kind of synesis, however, involves interim levels of analysis, and it is these levels which are the focus of this section.

There were initial problems with trying to identify levels of analysis which would prove useful to the study of proposals, with questions about whether proposals were a particular text-type or genre; if they were written in a particular register; how the concept of ‘register’ related to that of ‘genre’*;* at which stage it would be relevant to carry-out a syntactic or stylistic examination; and questions which revisited others, querying, for example, if the study of stylistic features should come first because this would help to establish text-typologies; and whether it would be useful to establish at the outset the ‘shape’ of proposal documents. Inevitably, this circular questioning led to a sampling kind of analytical practice, referred to by Swales as ‘quick and dirty’, until an analytical framework evolved.

Terminology, and others’ use of it, was to prove an early preoccupation. Swales and Feak's work (1994) proved attractive in the early stages of this study, when I was bandying about just such terms, vacillating between discussing documents, to text types, to writing tasks, and writing types, discussed in the first chapter. This is inevitable in the exploratory phases of such a study, when one is busy collecting data, and building up corpora. It is necessary to think on the hoof when you need the vocabulary to talk about engineers’ writing with the engineers themselves, but have not yet developed the metalanguage for doing so.

Since I have been an advocate of a holistic approach to any kind of text analysis, this investigation of the texts has been grounded in sociological as well as linguistic considerations, taking account of the main factors and participants in the text-making and text-interpreting process. In a similar vein, Halliday argues for the benefits of analysing text in such a way that it can be related to the non-linguistic universe of its situation and cultural environment (1994:xvii). I can see both similarities and contrasts between his description of language as being evolving rather than designed and the engineer's texts, which are concerned about design and are also evolving. In his explanation of language as being an evolved system, he writes: “…there are rarely any sharp lines in language since it is an evolved system, not a designed one” (ibid.:xix). It strikes me as a curious that the texts I am looking at have design at their very centre, and, furthermore that the engineer writers try to establish sharp lines (via writing procedures and templates) in an attempt to control the work that they do.

The work of Dudley-Evans and Hopkins (1988) is of interest to this study. They emphasise the need to know more about the textual product: ‘But learners also need more information than we currently provide on *what it is* [their italics] they are expected to produce’ (1988:113). As well as acknowledging the need for a more narrowly focused examination of the texts, they call for a delicate and comprehensive descriptive framework that includes 'only categories that have meaning for the texts under study rather than for language use in general' (1998:114). They list three aspects of textual feature that an adequate description should include:

1. The content of the speaker/writer message.
2. The internal logical organisation of what is being presented, and the implicit/explicit patterning introduced by the speaker/writer.
3. The ways in which the speaker/writer takes account of his audience.
(Hopkins and Dudley-Evans 1998:114)

The description in this study evolved through a heuristic approach and has much in common with the kind of analysis advocated by Hopkins and Dudley-Evans, who seem to share the same analytical ethos underpinning the approach I followed in this work: they claim that text analysis must be flexible to accommodate shifting emphases affected by varying functions within a text, and to 'name/label/code in a way that is meaningful in the context of a *particular discourse*' (ibid.). My interest in their examination of Swales' work lies in their discussion of his 'quick and dirty' analysis of article introductions, their observation of the labels he uses which are 'vaguely descriptive of general content', and that these labels indicate moves which fall into three groups, because they are 'primarily interactional (e.g., question raising), primarily logical (e.g., gap indication) or primarily transactional (e.g. ascribing key characteristics)' (1998:116). Like Swales, they are both concerned with academic discourse, and with analysing this for pedagogic reasons, seeking links between discourse theory and teaching ESP or EAP. The texts they examine have single authors who are producing texts, i.e. MSc dissertations, primarily for purposes of academic assessment. This study, on the other hand, is concerned with analysing non-academic written discourse which is produced under radically different conditions in the commercial/engineering sector. The texts in this study are multi-authored and produced for different reasons. They can be exceedingly long, and occasionally can be longer than a science dissertation, i.e., exceed 15000 words. It would be reasonable to assume that their greater length and complexity would confound any attempt at a move-type analysis, which would only serve to confirm the findings of Hopkins and Dudley-Evans that Swales' move analysis cannot seem to handle longer texts.

They clearly see the structure of discourse as being concerned with transactional, interactional and logical features. The transactional function roughly equates with Halliday's ideational function or Brown and Yule's transactional function; the interactional function concerns how the writer takes account of his audience; and the logical features relate to the patterns and ordering of the information content. They observed that while it has been quite easy to analyse opening and closing sections of texts, 'one of the greatest problems' has been 'the very long informing sections that so often occur in the middle of articles, dissertations and lectures' (1998:120), and call for much more work to be done on these sections.

They suggest a change of direction in text analysis, away from describing groups of texts on the basis of similarity to differentiating between texts on the basis of their differences. This exhortation is probably an acknowledgement of the fact that much recent work has tended to concentrate on genre analysis which is based on similarities of text structure. Hopkins and Dudley-Evans saw a clear need for 'a system that will be more attuned to a fairly narrow focus', suggesting that we use our experience of communities of specialists to do so (1988:114).

My approach to text has been influenced by Dudley-Evans, who has long been concerned with any text analysis which informs pedagogical applications, particularly classroom practice (1986, 1994). An underlying theme in his work has been a quest for devising the most effective ways of helping L2 students tackle the writing tasks demanded by their subject specialisms. Like others who were inspired by Swales' work on article introductions (Swales 1981), he saw the potential for EAP teaching of Swales' 'move' analysis. In a critique of Swales' work, Dudley-Evans observes that, initially, he had more success with shorter introductory sections than with more extended pieces of writing, confirming observations of earlier analysis (Hopkins and Dudley-Evans 1988). He shows how Swales', now early, claim that article introductions are a single genre has been shown to be over-optimistic, but points out that the model nevertheless could be adapted for use with other types of text, and had 'considerable potential' for analysing other academic texts, as he himself demonstrated by adapting the model for the introductions of MSc dissertations written by English L1 students (1994:134). The model proved less useful for the discussion sections, however, where Dudley-Evans reports finding a much less predictable structure (ibid.: 144). Paltridge also comments on this problem with longer texts, citing Hasan as having pointed this out in her discussion of literary text analysis (Hasan 1989:54 cited in Paltridge 1997:3)

The notion of textual 'moves' has always appealed to me, but I have had limited success with them, finding, like Dudley-Evans, the 'move' analysis to be effective with shorter spoken or written texts belonging to the more predictable genres. These are genres produced usually by one or two people, e.g.: a job application letter (Bhatia 1993:62), a resume, or a 'cold call', for example, an unsolicited telephone call made by a window salesperson. They tend to be transactional rather than interactional in emphasis (Brown and Yule 1983:2), and may be placed anywhere along the predictability continuum (Nunan 1991: 4287). It follows then that the more unpredictable ones present problems when they are submitted to submit to a detailed move analysis. One would also expect the discussion section of a dissertation to be placed towards the more unpredictable end of the cline, since the subject content, the writer's abilities and writing proficiency, and the issues being discussed would differ with each dissertation.

Bearing this in mind, it is understandable that Dudley-Evans found it more difficult to detect patterns in longer tracts, in his case, the discussion section of dissertations, although his analysis eventually yielded the identification of nine separate moves, which he and St John gloss as follows:

> The moves are essentially options open to the writer who will build his or her argument through the careful choice and ordering of these moves into cycles. (Dudley-Evans and St John 1998:90)

The physical form of each move is worth noting for this study: each 'move' is, in fact, a separate text segment, ranging in size from, minimally, an independent clause, to several sentences. From a certain perspective, and expressed rather simply, the 'moves' in the discussion section can be seen to be textual building blocks which can be mixed and matched. Furthermore, particular moves can be used several times, and in certain combinations to construct the whole section. Dudley-Evans' portrayal of 'moves' seems to allow this building block analogy, since amongst the moves, he detected several move-cycles with each cycle made up of 'statement of result/findings' + 'reference to previous research' +'claim' (Dudley-Evans 1994:225).

The names given to the 'moves' are supra-labels, summing up the discourse function of each move by giving an indication of its information content, for example: Statement of aims, Work carried out, Finding, Reference to previous research, Explanation, Information move, Claim, Statement of result. With few exceptions, i.e. 'Information move' and possibly 'Explanation', all could be used as sub-headings in any discussion section of a dissertation. I am certain that MSc dissertation writers would find it useful to know about these, and, furthermore, that they are the elements of 'an overarching three-part framework' comprising the whole discussion, i.e. Introduction, Evaluation and Conclusion (Dudley-Evans 1994:224). Whether further move analysis could yield much more useful information for dissertation writers in the School of Biological Sciences at the University of Birmingham is doubtful, considering the individual nature of each dissertation in terms of topic content and research question.

This section explores the broad perspective of proposals in the search for a near-definitive description of their text shape or rhetorical structure. First, it takes into account an aspect which underpins all proposal writing, i.e. communicative intent, or more specifically, engineer writing motives which have a bearing on all proposals and their formats. It provides a taxonomy of intents/motives, all of which are subsumed under the general discourse function of 'persuasion'. It describes the text shape of proposals, and the different text segments which serve as vehicles for persuasive elements. Finally, it describes presentational aspects of proposals, providing a breakdown of their conventional formats and structures.

Investigating text shape – 'rhetorical shape'

In the early stages of the study, I was taken by the work of Swales and Feak, and the notion they put forward of text shape (Swales and Feak 1994:157). The issue of 'text shape', i.e. defining what it is, and then describing the 'shape' of a document, has been an underlying linguistic issue and a practical writing issue for the engineers. In their desire for model texts and writing guidelines, they want a clear description of what should be written (topic headings), in what order (logical sequencing), and in what manner (language style). Swales and Feak seem to refer to text shape in a similar way to that taken in this study, building upon the rather vague usage of the term by colleagues concerned about L1 academic writing (Creme and Lea 1997, Fairbairn and Winch 1996) who discuss the structuring of academic essays with their students. In an essay-writing context, text shape is seen to have malleable connotations, referring to the way a student writer is expected gather ideas together, organise them logically, and then present them in connected sections of prose to form continuous running text in the form of an academic essay or assignment. In such a case, the 'shape' of the assignment refers to the organising of ideas, the subsequent rearrangement of them, and reworking of the text into an assignment suitable for presentation to those who will judge its merits by subjecting it to scrutiny and assessment. Students find the malleable plasticine metaphor an attractive one, because it conveys the impression that they can directly change the shape of the assignment as they see fit. Teachers describing assignment writing in this way may offer the nub of such a description as being that the shape of the text, in this case the academic assignment, is akin to the rhetorical structure, in other words:

text shape = rhetorical structure

In their textbook on academic writing, Swales and Feak use similar terminology, discussing writing in terms of 'writing tasks', 'text-types' (in this case, 'general-specific'), and 'text shape' (1994:33). Having explored the nature of writing in a post-graduate academic context they suggest common types of text (referred in this study as 'text-types') which, using their words, are 'under-lying structures' in academic writing, i.e. general-specific texts and problem-solution texts. They imply some kind of dynamism at work in these texts by explaining that their structure 'involves general-to-specific movement' and 'problem-to-solution movement' (ibid:33 and 57). In the case of general-specific texts (GS), for example, they liken the shape of these texts to physical objects and see their structure as comprising language structures which perform distinct functions, e.g. definitions of different types, generalisations, purpose statements. They are able to show the structure of such a text and its shape in diagrammatic form:

GS texts usually begin with *one* of the following:

a) a short or extended definition
b) a contrastive or comparative definition, or
c) a generalisation or purpose statement.

As their name implies, GS texts move from broad statements to narrower ones. However, they often widen out again in the final sentence. The shape is similar to that of a glass or cup.

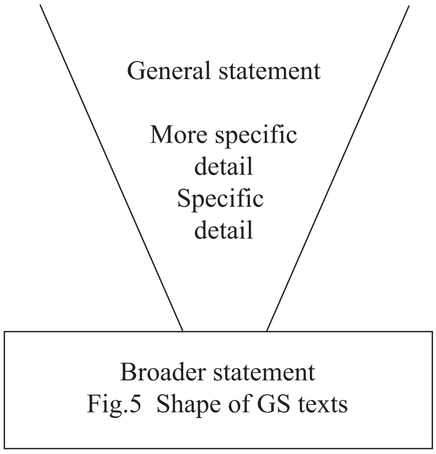


Fig.5 Shape of GS texts

(Swales and Feak 1994:33)

However, they don't explain why they relate physical width and narrowness to language generalisations and detail respectively, although, on reflection, this seems to be a generally accepted correspondence: when communicating ideas orally/through spoken language, one intuitively indicates general statements with broad sweeps of the arms, and more specific detailed points with a bringing together of the hands. Also, being a text book for graduate students, it is probably unnecessary to provide such a (theoretical) explanation.

Macro structure of proposals

Having identified the macro-functions, and explained some of the conceptual difficulties encountered in establishing an approach to analysing proposals, the next logical step is to attempt a description of the discourse structure of proposals. As mentioned in Chapter 4, formatting and topic constraints are imposed by the Customer, although the engineers attempt to be creative in the presentation of their 'solution'.

Paltridge attempts to provide a paradigm through which to view writing produced in a research setting. His is indeed an ambitious work, in which he searches for a framework for:

> a description of genres based on an examination of how it is that members of a particular discourse community assign a particular genre label to a particular discourse event. (Paltridge 1997:2)

His exhaustive examination of various models and approaches leads him to an interesting conclusion, in which he cites Biber's contention about genre categories:

> [They are] assigned on the basis of use rather than of form ..... [and genres] are defined and distinguished on the basis of systematic nonlinguistic criteria, and they are valid in those terms. (Biber 1989:39, cited by Paltridge 1997:107)

This would tend to support my analysis of proposals and executive summaries, which found it necessary to move beyond a 'move' analysis, and to rely on a grounded approach to the texts. Paltridge's comprehensive examination of genres, and application of Fillmore's frame semantic model, explains the possibility of analysing genres through various 'frame' perspectives, e.g. frame semantics, interactional and cognitive frames, categorical-type [my term] frames, referred to as 'frames and the notion of prototype' by Paltridge, among others (Paltridge ibid.:47-62). Of particular interest is his discovery of the significance of the so-called 'content' of text, revealed in his search for 'patterning of ... particular structural elements' and his useful discussion of Hasan's work into semantic attributes (Hasan 1984a: 83, cited in Paltridge ibid.: 70-73). Explaining how these attributes have been recognised in 'structural elements' that Hasan has identified, Paltridge then explains his approach:

> As with Hasan's analyses, an examination was carried out of the semantic attributes in the texts to the point where each 'content domain' in the texts under analysis was accounted for. (Paltridge 1997:73)

Like Paltridge and most other linguists, I was concerned to discover some textual/analytical framework against which to account for the overall structure of the proposal document, and, found a 'grounded' approach to yield significant 'units' of information with which to analyse proposal text. The development of these is discussed in more detail in the next chapter.

In order to view these units within an overall textual construct, I toyed with the idea of a 'master' genre, when I discovered the proposal to be a textual compilation of sections and components; it is both a master genre and a master document. In a similar vein, I considered the term 'matrix', since a matrix is a structure or a kind of textual environment, or, put another way, an 'array of elements, ... used to facilitate the solution of problems...' (Collins English Dictionary and Thesaurus:1993). Having particular relevance to the field of mathematics, the idea of a matrix is also applicable to a document in which the engineers propose their 'solution' to the Customer.

Having been taught by him in the 1980s, my thoughts about matrices may have been inspired by Hoey, who develops ideas that gestated throughout the 1980s about textual colonies and the hierarchical organisation of texts into 'a matrix perspective of text' in his recent book on written discourse (Hoey 2001:93-118). Like Dudley-Evans, Hoey has an appreciation of the difficulties of writers 'losing their sense of the overall picture' in the case of longer texts (ibid.: 52). His model is a modification of Pike's use of a matrix to represent the structure of an event, or 'happening', as Hoey puts it (Pike 1981, cited in Hoey 2001:93). His analyses are mainly concerned with narratives, but his portrayal of the matrix perspective seems apt indeed for this study. His concern about the route followed in the 'telling' of a narrative, whether it passes across or down the rows of a matrix is less central to this work than the idea of a document comprising segments (or 'cells'). The attractiveness of the matrix concept to this work is partly due to the fact that the proposal may be accessed at different points by different readers, who may read only those parts that are relevant to their reading roles. It is with from a matrix perspective that the Information Components are developed, and from which a description of the various proposal sections is now offered.

5.3 A preliminary overview of physical and visual aspects

5.3.1 Macro/Outline structures of the proposal – a typical format and structure

There are more than two hundred engineers working at HISE in Plymouth, and although most of them may influence proposal preparation in some way or other, through the design work that they do, for example, rather fewer are directly involved in the writing of proposals, and even fewer still in writing the executive summary. In the email survey conducted at the start of the study (see Chapter 3), 47% of the engineers were involved in writing proposals, and 15% in writing executive summaries. The type of proposal determines who should be involved in writing it. For example, a relatively small non-competitive bid worth twenty or thirty thousand pounds, say, may involve one engineer who is responsible for the particular product (or country involved) with the assistance of a technical author, and written inputs from one or two other specialist engineers. On the other hand, a larger competitive bid, worth ten million pounds (or more), could involve a project team comprising eight to a dozen engineers who will work on the solution/engineering design and on writing parts of the technical proposal; others in the commercial and legal departments would produce other sections of the proposal.

It is mentioned earlier that engineers are well aware that the ultimate purpose of the proposal is to persuade the Customer. In answer to the question: 'Persuade about what?', the answer that 'Our solution is the best' is too simplistic and somewhat glib, obscuring what is, in fact, a complicated attempt to be convincing and persuasive at a variety of levels. The proposal has to include information which is not only about the design of the product, but about a variety of activities, some associated with its manufacture/production and use, and others associated with commercial, legal, and contractual matters.

It may not have to be long in some cases. Small proposals may be only 4000 words long, or less, and be bound as one document. On the other hand, others may comprise several volumes amounting to hundreds of thousands of words. Engineers would describe such a large proposal as consisting of a 'set' of documents, only one set of which would be their primary concern, i.e. the Technical Proposal.

Figure 5-1 below is an extract from just such a large proposal (EP3049). In view of its size and complexity, the technical author responsible for compiling it included this ‘routemap’ for the benefit of the readers. Having in mind both those who would be in overall charge of the reading process, and those who would read particular sections of it, he included a copy of the ‘routemap’ in each of the four volumes that made up the whole proposal. Similarly, as can be seen in Figure 26, each volume contains a copy of the executive summary, to provide the specialist readers of each volume with an overview of the main benefits of the proposal.

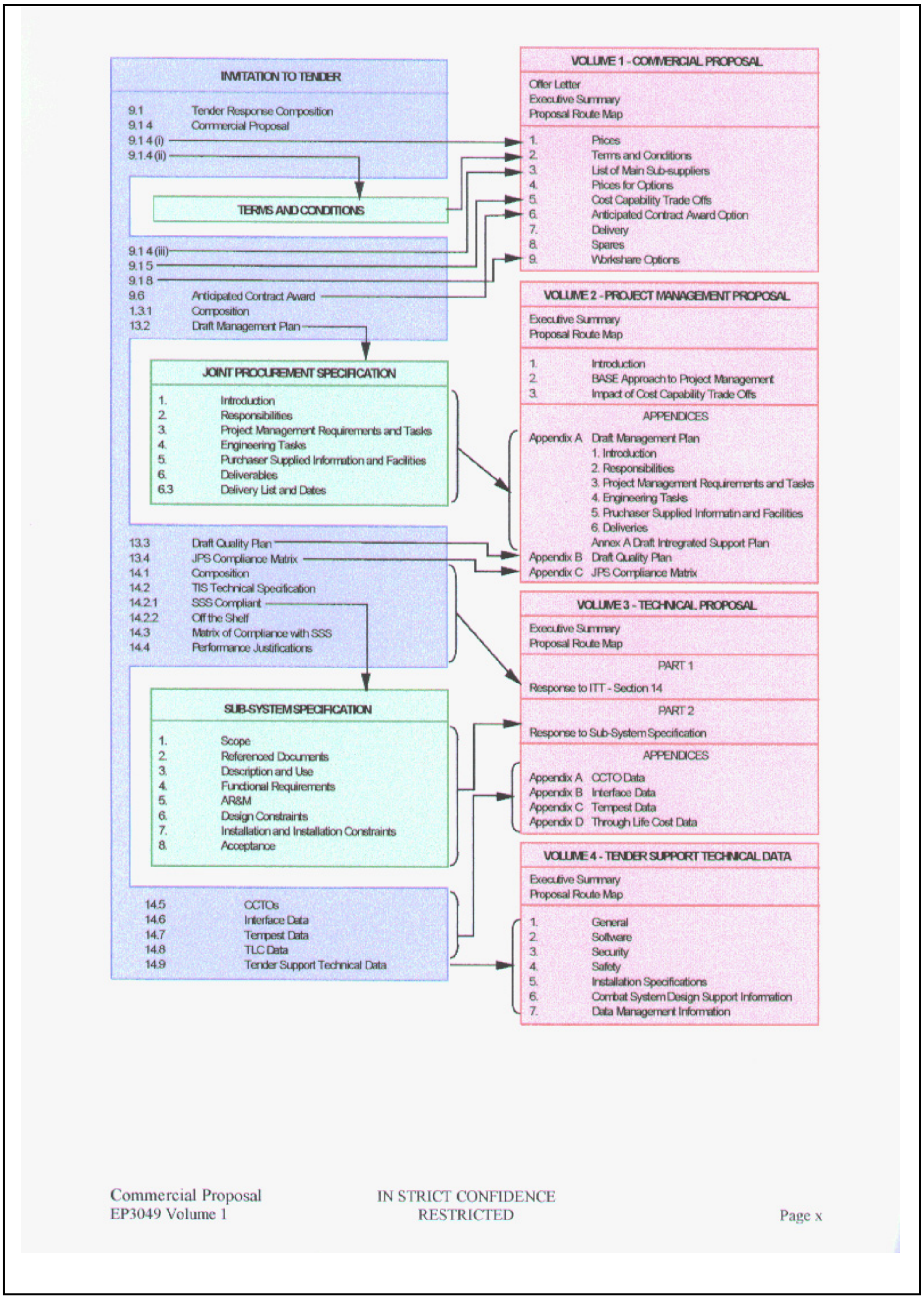


Figure 5-1: A ‘route map’ of a large proposal

Since engineers may contribute only a section, the sheer size of such a proposal may escape them. In the case of EP3049, for example, only the technical authors and bid leader saw the final document when it had been printed and bound. Two engineers who contributed significantly to the sections on the design mentioned that they had not seen the final result, and did not know what it looked like. The following table and photograph provide both a visual and simple textual impression. To give an idea of the 'textual' extent of a large proposal, Table 5-1 lists each part of the proposal, and the number of pages and words it contains. As can be seen, the proposal comprises a total of 156, 686 words and 782 pages. Following the table, Photograph 5-1 provides a pictorial impression of the size (and weight) of a large submission: a technical publications employee has been photographed carrying the four EP3049 volumes that were submitted to the Customer.

DESCRIPTION			No. of Words in Section	No. of Pages in Section
VOLUME 1 – COMMERCIAL PROPOSAL				
EP3049 Volume 1			5,496	57
		Total	**5,496**	**57**
EXECUTIVE SUMMARY		(included electronically in only Volumes 3 and 4)	1,661	8
		Total	**1,661**	**8**
VOLUME 2 – PROJECT MANAGEMENT PROPOSAL				
EP3049 Volume 2		Section 1	2,728	17
		Section 2	3,791	16
		Section 3	2,395	16
		Appendix A	37,976	144
		Appendix B	12,207	50
		Appendix C	664	5
		Total	**59,761**	**248**
VOLUME 3 – TECHNICAL PROPOSAL				
EP3049 Volume 3	Part 1		8,892	41
	Part 2	Section 1	440	4
		Section 2	42	3
		Section 3	5,293	31
		Section 4	9,209	35
		Section 5	4,653	36
		Section 6	9,505	39
		Section 7	5,117	25
		Section 8	2,083	11
		Section 9	234	3
		Appendix A	3,685	21
		Appendix B	224	3
		Appendix C	8,368	44
		Appendix D	870	9
		Total	**58,615**	**305**
VOLUME 4 – TENDER SUPPORT TECHNICAL DATA				
EP3049 Volume 4		Section 1	53	3
		Section 2	240	3
		Section 3	987	5
		Section 4	173	3
		Section 5	303	4
		Section 6	5,996	27
		Section 7	5,773	18
		Installation Specification	17,628	101
		Total	**31,153**	**164**
OVERALL TOTALS (excl. Commercial Response)			**156,686 words**	**782 pages**

Table 5-1: **The 'textual' extent of a fairly large proposal**

There exists a variety of sections and section headings, and a combination of different names given to separate volumes of different proposals. However, typically, a proposal can been seen to comprise four key sections, or volumes, depending on the size of the potential business. Other sections may also be included, as shown below, but the core elements of any proposal are these:

Photograph 5-1: Paula from Tech Pubs at HISE carrying a proposal

Section or Volume name	Informational content
Executive Summary (concerns the engineer, and consistently problematic)	provides a synthesis of the main 'selling' points of the bid.
Technical Section (concerns the engineer, and usually problematic)	includes the company's technical response to the Customer's Requirement, technical description of the product, compliance matrices, and other information relating the maintenance of the product, and measures for ensuring its successful performance when in use.
Management Section (not of direct concern to the engineer, involves other writers)	concerns mainly financial and legal aspects of the proposal
Commercial Section (not of direct concern to the engineer, involves other writers)	concerns the administration of the programme, production plans, information about the company and personnel, and details the Commercial Terms and Conditions, and selling prices.

Table 5-2: Overview of proposal structure

The macro-structure of the proposal is/has been influenced by the knowledge of what happens when the proposal is delivered to the so-called 'Customer' (as discussed in the previous chapter), who is more likely to be a collection of teams of specialist readers, each team being responsible for one of the four sections. It is this knowledge about the reader which is influential in the way a proposal is structured: if it is thought that the proposal will be automatically split into sections and distributed to different readers with different reading responsibilities, the proposal is structured to facilitate the reading interests of the different readers.

Engineers claim to want a template, or definitive document shape, to help guide them in the writing proposals, whilst contradicting this through their actual writing behaviour, and the emerging structures of the proposals they write. Table 5-2, above, shows the main sections to be found in most proposals, although there are individual variations in structure depending on the decisions taken by each writing team. The fact is that engineers are influenced, and rightly so, by the proposal's essentially persuasive intent, so that they merge or omit sections, or may present sections in a different order to suit their purposes, as shown in the following examples in Table 5-3 below:

Proposal	**Macro/Main structural divisions**
Request for Information RP5020 for the UK Bomb Enhancement Programme [ep3074]	A set of 3 separately bound documents: Volume 1 – Executive Summary Volume 2 – Technical Proposal Volume 3 – Commercial Proposal
Proposal for a Radome for the Synthetic Aperture Radar for the Kastar Programme [ep3042]	One bound document comprising two main sections (referred to as volumes in the proposal): Volume 1 Management and Commercial Proposal Volume 2 Technical Proposal
Close Range Air Defence System for the xxxxx Navy [ep2813]	A document set comprising the following, all separately bound: 1 Technical Proposal 2 Commercial Proposal 3 Draft Interface Specification [named as a separate section, but, in fact, part of the technical proposal] Draft System Specification [named as a separate section, but, in fact, part of the technical proposal]

Table 5-3: The outline structure of a random selection of proposals

The technical authors have responded to the engineers' request, recognising the need for flexibility of individual proposal responses, and designed a proposal writing template for the engineers which allows for greater freedom of organisation and composition, resisting the demand for an overly prescriptive plan. The authors had hoped that the use of this template would make their own jobs easier at the final writing stage, when the written contributions of (sometimes various) engineers are fitted together to form a sequence of sections. It transpires, however, that the hope was a vain one, because of working arrangements, as is explained in the previous chapter.

The next section considers the discourse function and structure of the two sections about which design engineers are most concerned: the executive summary, and the technical proposal. The technical proposal will be discussed first, as a reflection of the writing process, during which the technical proposal is written before the executive summary (because the technical proposal is written before the executive summary). In fact, the executive summary is usually one of the very last sections to be composed, in spite of the fact that it is the first to appear in the finished document, and also, in spite of the engineers' wish to write it first. They never do. The delay in writing the executive summary (explained later) is a logical outcome of the complexities of the proposal writing process.

Swales and Feak (1994:157) describe the overall rhetorical shape of the research paper, discussed earlier, seeing it as comprising four different sections (Introduction, Methods and materials, Results, and Discussion), each section having a different purpose and distinctive linguistic structure. The labels, or headings for these sections, that they use would be easily recognised by any graduate student. The proposal is similar to the research paper in that it comprises a collection of sections, each of which is distinctive in terms of purpose and structure, and each of which contributes to the construction of the whole proposal. In much the same way, the labels for these sections would be easily recognised by any engineer. I have drawn up what for now I shall call *sections* of the proposal, all of which have distinct functions, in terms of reading practice and writer-intention, underpinned by writing regulations and administrative requirements. This is a holistic description, taking into account the engineers' views of what should be in a proposal, and actual examination of proposals. The main sections, which are listed below, are now described in order to pave the way for the analysis of those sections which particularly concern them. Other distinct sections, e.g. the table of contents and illustrations, circulation lists, change forms (which record changes made to the document after it is produced), are not included in this discussion, since they tend to be automatically generated as part of the presentation of the document, and, as such, are paid scant attention by the engineers writing the proposal.

Placing description in perspective – simplified overview of the structure of the proposal

Although not all parts of the proposal are given detailed examination in this study, a tabular breakdown of all the sections and discourse functions of the generic structure of the proposal is provided in Table 5-4 below.

	Distinct/Main Sections OF THE PROPOSAL	DISCOURSE Functions / Aims
1	Front cover of folder and/or title page	Names /Refers [Referential and/or nominative function] - names the proposal, the company, and the key personnel who are responsible and/or accountable for the bid. Aims to: a) help reader with organising the reading of it, administration, and storage b) impress the reader by its attractive appearance and visuals c) provide reader with an idea of the nature of the product
2	Copyright page/Proprietary Statement	Asserts (and establishes) legal copyright of contents of the proposal based on HISE'S proprietary statement
3	Executive Summary [sometimes in letter form]	Ultimately, sets out to persuade the reader to place the proposal on the shortlist, by providing one or more of the following: • overview of the main selling points (called 'themes') of the proposal • description of the product • information about HISE, intended to impress
4	Table of contents	Is made use of by the reader or reading team to: 1) gain an overview of the document structure, in order to 2) split the document up to be read by different members of the reading team, and the more conventional use, which in this case is less important, 3) help the reader navigate and read the document
5	Glossary	1) Provides assistance to the reader so that s/he can read the text and (numerous acronyms) with understanding and ease. 2) Helps the writer avoid repeating names or phrases in order to produce more readable prose.
6	Technical Proposal	Impresses the reader (or attempts to) by explaining the product from different engineering perspectives, e.g.: • describing key aspects of the design • degree of compliance • physical and functional characteristics • comparison and contrast with other like products • manufacturing aspects • testing and research • HISE 's expertise/ track record
7	Commercial Proposal/aspects of the proposal	Persuades the reader of the financial and commercial benefits of the proposal, by giving a breakdown of: • costs – a key, and often **the** key consideration, including a cost/payment plan • legal and commercial terms and conditions
8	Management Proposal/aspects of the proposal	Aims to convince the reader that the product (or project) can be delivered in the specified time and within the stated budget by detailing, for example: • production plans • delivery schedules • HISE'S organisation and management structures • research and development facilities • project engineers' CVs
9	Appendices	Data to support the technical argument, e.g. test results, mathematical modelling

Table 5-4: An overview of the generic structure of the engineering proposal

The Technical, Commercial, and Management sections tend to be the most substantial, sometimes meriting separate volumes in themselves. The executive summary may be one of the shortest sections, unusually reaching ten pages in length, but more usually comprising one or two. However, as is discussed later, the summary may be considered one of the key parts of the proposal, if not the most decisive section, because it is sometimes the part on which the decision whether or not to short-list the proposal is based.

5.4 Significant parts of the proposal – an overview of each section

Figure 5-2 below shows in simple visual terms distinct sections of the proposal:

- **the title page**
- **proprietary statement**
- the table of contents
- **glossary**
- **executive summary**
- **technical (section of the) proposal**
- commercial aspects of the proposal
- management aspects of the proposal
- appendices (these may contain technical description of the product)

Those with labels highlighted in bold are now discussed, with a view to providing background information for the more detailed examination in later chapters.

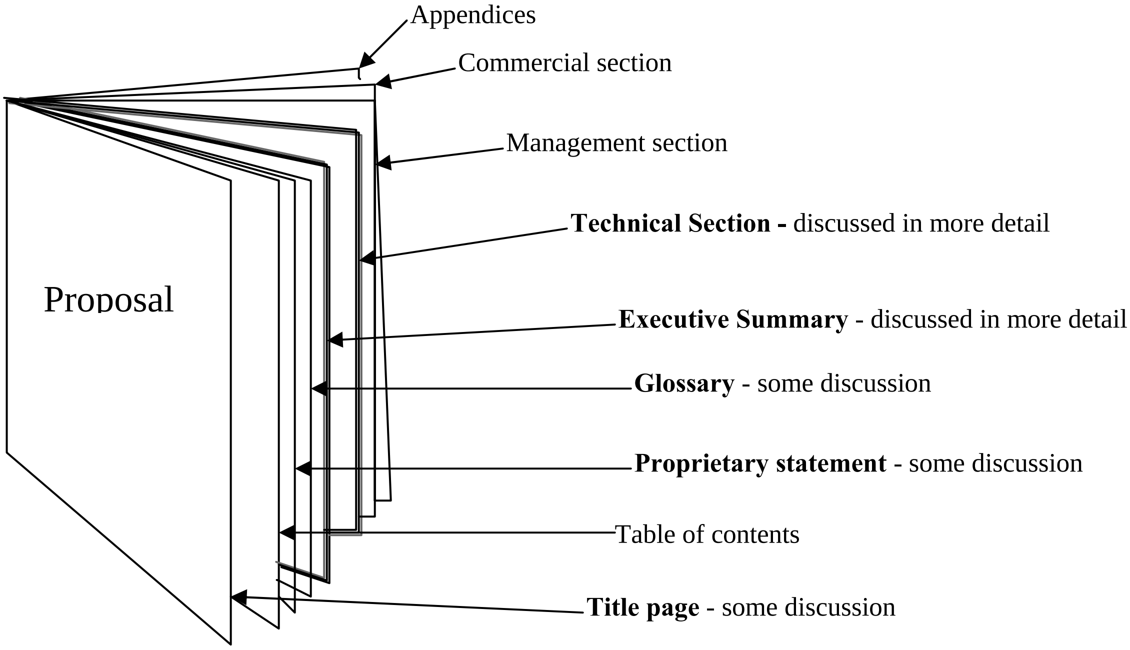


Figure 5-2: Pictorial representation of proposal structure

Certain parts of the proposal may not, at first sight, appear to be obvious inclusions in this part of the discussion, i.e. the title page, glossary, and proprietary statement. However, they are discussed here for three main reasons:

1. they may be regarded as distinct sections because they have distinct visual features, perform distinct and different functions which relate to the whole of the proposal, and, moreover, provide useful contextual information for the purposes of this study.

2. they are integral parts of every proposal, and are always placed at the very front, together with the table of contents. The 'fronting' of these parts has an early utility and impact on the reader.

3. they provide important information to the reader regarding the nature of the proposal, influencing the attitude with which the reader should begin reading the proposal, the way he should read it, and how he should regard the ownership of the information it contains.

Certain proposal sections receive scant attention

The table of contents, management section, commercial section, and appendices receive scant treatment in this study, because they have little bearing on the central aim of this study, which is to examine the writing produced by design engineers which they regard as special and/or problematic (see Chapters 2 and 3). The table of contents is automatically generated by the word-processor, and compiled by the technical author at the final stages of writing, with little attention paid to it by the engineers themselves. The management and commercial sections are usually written by other colleagues in the Commercial or Sales department of the company, many of whom have been engineers, or have an engineering background. Finally, the appendices of an engineering proposal are no different from appendices to be found in any document, being optional, and their inclusion predicated upon need. In large bid projects, the appendices may be placed in separately bound volumes, and contain supportive information, for example, test results, query lists (comprising lists of specific questions requiring answers), or compliance matrices. Whether lengthy or brief, appendices containing technical information have been considered in the examination of the technical writing produced by engineers (Chapters 6 and 7), because it is their textual content rather than their appendix format that is significant to this study.

5.5 Front cover and/or title page

Referential and administrative function

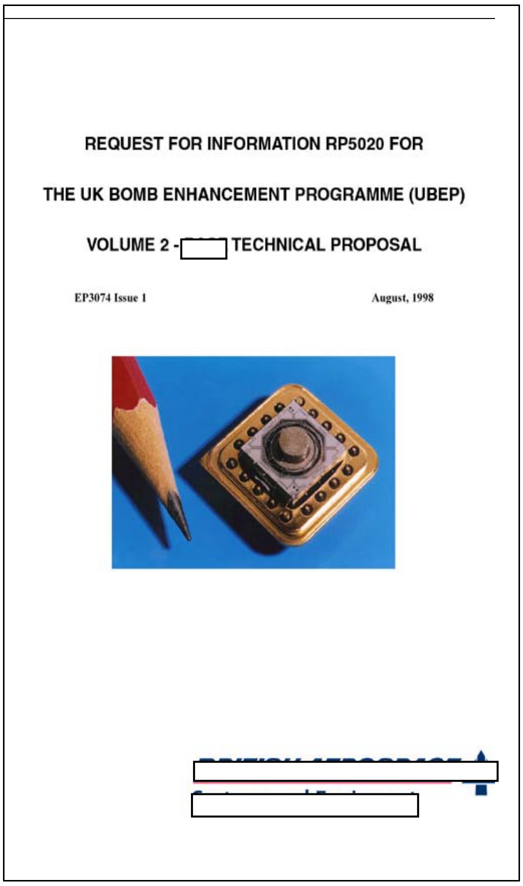
Usually the cover specifies the proposal (name and proposal reference number), a bid reference number (issued by the Customer), the date of printing, the company name (usually the prime contractor), and the key personnel involved in compiling the bid. Discussion of particular proposal covers later in this section reveals other information which may be included, e.g. subcontractor and logos, among others.

The most obvious function of the cover is referential and/or nominative, in that it provides the reader at a glance with the reference number and name of the product and/or project. In an organisation where vast stores of documents are held, and where the documentation has legal standing, this consideration may be taken for granted, but is nevertheless key to the smooth operation of working and writing practices of the engineers. The name and number of the proposal helps the recipient Customer with administration, and with organising the reading of it, which is an important consideration when several sets of proposals are submitted at the same time for several different projects. The name and number are also necessary for the administrative purposes of HISE, i.e. storage and filing, by aiding future location and reference, especially if it is the winning bid. As mentioned earlier, the technical proposal may form the basis of the design development of the product, and it is therefore necessary to make the document clearly positioned and easily traceable in the vast collection of documentation which will accumulate about the product.

The names of those responsible for the contents of the proposal, usually engineers, are placed on the title page or cover for three inter-linking reasons: reference, traceability, and accountability. These engineers would be considered accountable for the contents, and to whom enquiries about the proposal (or product) should be addressed. Such enquiries might arise at some distant time in the future, possibly ten or fifteen years after the proposal is submitted, when engineers involved in the design of the product may no longer be working for the company. In such cases, knowledge about the product held in such documents is passed on to inheritor engineers as a kind of design-knowledge legacy. It is not uncommon for situations to arise where engineers need to know who 'holds' knowledge about particular products, since they may be the repositories of experience and wisdom. They are able to answer questions about decisions that were taken about the design, or particular problems which may have arisen during the development and use of the product.

The use of visuals

From the late 1990's the majority of the proposals have been produced with visuals on the cover, and, in the case of the example below, such visuals are chosen with care by the engineers leading the project.


REQUEST FOR INFORMATION RP5020 FOR

THE UK BOMB ENHANCEMENT PROGRAMME (UBEP)

VOLUME 2 - TECHNICAL PROPOSAL

EP3074 Issue 1 August, 1998

Figure 5-3: The front cover of proposal ep3074

In the case of proposal ep3074 above, the engineer in charge of the project had firm views about the picture he wanted to see on the front cover, rejecting others submitted to him by colleagues in the Sales Department, who were not engineers. The salesmen thought the picture, (in)famously referred to as ‘the pencil picture’, to be rather crude and mundane. The engineer, on the other hand, was adamant in believing this particular picture summed up the essence of the ingenuity of product offered in the proposal. He wanted to bring to the reader the realisation that the idea of the gyroscope as a spinning object was outdated, and that its construction no longer comprised moving parts. One of the outstanding features of the design was miniaturisation, i.e. an electrical component engineered to be no bigger than the tip of a pencil, with soldered leads to enable it to be connected to other components, and manufactured like a micro-chip. He believed the picture conveyed this, and had no doubt that the intended reader of the proposal, his counterparts in another company would see the significance of the juxta-position of the component with a pencil tip, as would the non-specialist readers. For the latter, he had especially included an explanation of the product in an appendix of the proposal to ‘educate’ them (see Appendix U which provides a proposal containing such an explanation).

Interviews with engineers about proposal writing revealed the significance of visuals to proposal writing. Similarly, opportunities to observe meetings between engineers about structuring proposals afforded a view of their beliefs about how these should be used to make the proposal more effective, and ultimately to persuade the reader(s) of the superiority, as the engineers seemed to believe sincerely, of their product. Early observations about this concern to impress readers through the use of visuals prompted a search for any work that had been done in this area. Kress and van Leeuwan's attempts to analyse visual communication (presumably, as distinct from orthography) appear to confirm observations made in this research of engineers' use of pictures and other graphic representation (Kress and van Leeuwen 1996). Their goals appear similar to the ones for this study, in that they claim to be providing a description which can be used for both practical and critical purposes.

Clearly adherents of a Hallidayan approach (Halliday 1978 and 1985), Kress and van Leeuwen claim their book is about signmaking (1996:5) and covers signifiers, what they refer to as 'forms'(they give as examples: colour, perspective, and line), and signifieds, which they gloss as the way in which these forms are used to signify meanings. They discuss the 'grammar' of visual images in a Hallidayan sense, in terms of 'participants' (or 'subjects and objects of verbs', for those, brought up on Quirk and Greenbaum), stating that interactive participants can be identified in the interpretation of images. Their summing up of those involved in choosing images, and those who will interpret the images, encapsulates the situation in this study with regard to images used in proposals:

> Interactive participants are therefore real people who produce and make sense of images in the context of social institutions which, to different degrees and in different ways, regulate what may be 'said' with images, and how it should be said, and how images should be interpreted. (ibid:119)

They also seem to confirm my opinion that the pictures used in proposals, or 'visuals', to use their term, clearly seem to represent the ideological standpoint of the engineers. They wish to project a certain image of themselves and the culture of their company, and to convey in their selection of graphs, pictures, etc., the way in which they would like to be seen. It was apparent from the start that there was a mis-match between perception and fact: the writing in proposals was clearly a representation of stance, although the engineers like to believe that they are writing objectively and unemotionally. This opinion that they hold about themselves is confirmed by observations such as those made by Kress and van Leeuwen who comment on the fact that:

> the apparently neutral, purely informative discourses of newspaper reporting, government publications, social science reports, and so on, may in fact convey ideological attitudes just as much as discourses which more explicitly editorialize or propagandize…. (ibid.: 12)

The pictures used on proposal covers have the purpose of communicating the ethos of the company, or providing pictorial contexts in which the product would be used. The picture of the silicon gyro used on the cover above would be regarded by Kress and van Leeuwen as having high modality, since it has as one of its purposes that of communicating 'scientific ideas or technological complexities to …. non-initiates' (ibid:169). They cite Myers' work (1990) into visual representations of scientific images for the non-specialist, mentioning how these tend to be 'lavish, full-colour, and "hyper-real"', in contrast with the rather sparse drawings to be found in specialist scientific publications.

The examples of recent proposal covers, shown below in Figures 5-4 to 5-6, depict the product (or 'solution') proposed in visuals which aim to convey some kind of dynamic context for the product, in the form of a dramatic pictorial narrative, not unlike the portrayal of the mating behaviour of garter snakes in vivid pictures, described by Myers (1990:160,167).

Figure 5-4: Cover of proposal 3137 for a product specifically designed for Type-45 destroyers

Figure 5-5: Cover of proposal 3149 for a product specifically designed for the Tornado

Proposal covers used to comprise plain, monochromatic pages, with orthographic symbols, usually the title, as the focal point, accompanied on occasion by some kind of simple visual or graphic. They have evolved, concomitantly with developments in desk-top publishing software, into the covers shown in Figures 5-4 t to 5-6, depicting colourful images integrated into an overall complex graphic design. The idea is to implement a deliberate strategy to impress the readers, who would be involved in scrutinising the bids submitted by different companies. A technical author put it thus:

> “We went from no images to these covers. We try to imagine three or four bids lying on the table, and aim to make ours noticeable and identifiable as our bid. We want to make it stand out and identifiable as our bid.”

He explained that their motive for designing distinctive and attractive covers was probably the same as that for the design of a work of fiction about to be published. They wanted the design to make an impact on the reader, so that he would remark on the design, pick the proposal up, and be predisposed into thinking that it looked interesting. Of course, the old adage ‘never judge a book by its cover’ still holds true, and the story lying between the covers could prove disappointing. This may apply to the proposal, where, no matter how good the proposal submitted, the bid may not win, or the initial expectation inspired by the cover may not be fulfilled in the content of the proposal. Whilst acknowledging that they do not know what their competitors submit, another aim of the cover design is to make the proposal easily recognisable amongst all the other proposals and documentation the readers need to sift through during the short-listing process. The bid may not ultimately win, but if the image conveyed by the visual image on the cover endures in the readers’ minds and renders the bid documents easily recognisable, the aim lying behind the visuals will have been fulfilled.

It is more common than not that engineers feel passionate about their designs and products. They attempt to convey an idea of the design on the proposal cover and, it should be added, in diagrams and pictures integrated in with the text, although this can be difficult in the case of a product which may appear to be nothing more than an unremarkable box; consist of several bits of equipment fitted in different parts of a ship or aircraft; or be a piece of software, and therefore ‘invisible’ and difficult to depict in a visual representation which would be interesting to the reader. In such cases, the proposal cover may have a similar design to that shown in Figure 5-5, which is a cover for ep 3149, a proposal for an inertial navigation system using global positioning by satellite intended for the Tornado aircraft. This complex system comprises various integrated items of software and hardware and would be difficult to depict visually for a proposal cover. Instead, pictures of the aircraft, for which the product has been bespoke-designed, form the focus of the cover, with intimations of circuit-boards and other technical ‘bits’ providing a diffused background.

Similarly, the cover for ep3137,in Figure 5-4, shows the ship for which the product has been designed, the product being a large electro-optical tracking system. The story behind this proposal is a complicated one and worth retelling for the insights it provides into the design of the cover that emerged. The proposal itself has involved all the intricacies of inter-corporate relationships in the soliciting and submitting of bids, and it has ultimately been considerations of a political nature that have had a bearing on the design of the cover. In the case of this proposal, the Customer is the British MoD, who selected HISE as the prime contractor responsible for the whole ship, so that HISE is (overseeing and) managing all the bids submitted in order for the vessel and its fittings and sophisticated equipment to be completed and assembled, ultimately to produce a ship in its entirety. However, the situation is an interesting one, in that HISE is in the curious position, so far as this piece of equipment is concerned, of being both the prime contractor and subcontractor in the bidding process. In turn, HISE are submitting this proposal with the assistance of a sub-contractor (MAGI).

The cover has been designed to achieve several objectives. First, it should downplay the fact that, as one engineer put it, ‘we are bidding into ourselves’; the MoD would wish to be seen as objective and beyond reproach in the selection process, and, therefore, HISE would not wish to flaunt themselves on the cover, and be disadvantaged by the fact that they are de facto prime contractors and could be seen to be favoured in some way. For this reason, the T45 ministry logo is larger and more eye-catching, and the HISE logo is not prominently displayed, being, instead, juxta-posed with that of its subcontractor, MAGI. An even more eye-catching logo, in colours not usually used on proposal covers (bright orange, yellow and red), is placed in a prominent position on the cover to represent the new series of Sea Neptune destroyer, and to encapsulate the special working relationship between the Ministry and its collaborating ‘partners’. This logo shows the sea archer fish, which attacks its prey with jets of water, and which provided the original concept for the design of earlier versions of fire control systems produced by HISE.

The final example of a proposal cover, shown in Figure 5-6, is included as an exemplar of a more generic type of product, in this case a gyroscope. As can be seen, the cover shows a picture which encourages the idea of there being a wide range of applications for the gyroscope in a variety of craft. The picture is similar to ones used in brochures, advertising and posters, and helps to perpetuate the corporate image HISE wish to project.

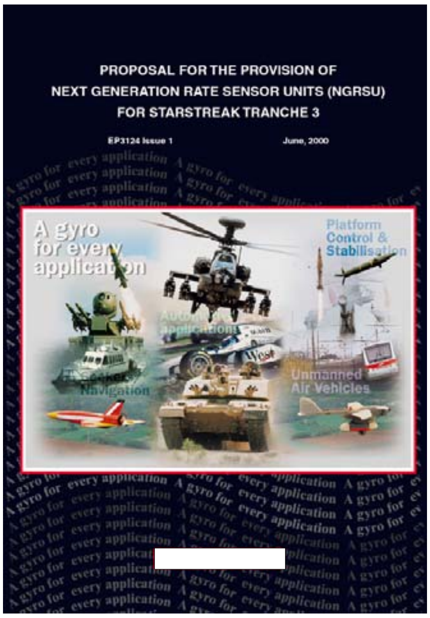


Figure 5-6: Cover of proposal ep3124 for a product with a wider range of applications

There is general agreement amongst HISE engineers that the image conveyed is macho-oriented, evoking images reminiscent of the army comic books, or ‘Two-penny Bloods’ as they used to be called, read by young adolescent boys, and (much) older. Recurring themes are bravery, manliness, patriotism, camaraderie, fighting, shooting, explosions, and killing. Engineers readily acknowledge that the visuals used on proposal covers draw upon these themes to convey, as one engineer put it: ‘smoke and flames and tanks and things’, and another: ‘toys for the boys’, ‘boys’ in the latter quote referring to ex-service personnel working in the British MoD.

5.6 RASE Proprietary statement - laying claim to design rights

This establishes the company’s legal copyright for the contents of the proposal. The positioning of this on the first page after the title page is similar to copyright claims of the kind usually found in published books, although its length (c.150 words) and prominence are quite different. Copyright statements in books are rarely more than 50 words long, appear in a minute typeface, and may be found inserted unobtrusively at the bottom of a page, or amidst information about the book’s publishers, ISBN, key words, etc. In HISE’S proposals, the proprietary statement is usually allocated a whole page, and is the responsibility of the legal experts in the commercial department. It is the only part of the proposal that engineers believe is off-limits to them; they do not write it and are not allowed to change it.

Its inclusion and prominent display demonstrates the strongly felt need by the company to protect its property, in this case the description of an engineering design (or ‘solution’, as the engineers express it), and to establish ownership of the design, or design idea. The significance of the proprietary statement to this study is this: it reflects an observation of mine that the ‘product’ exists even before the proposal has been submitted, and certainly at the time of writing a proposal. Initially the product is manifest as writing, and is judged as it is expressed in text as a quasi-product; it is an idea expressed as text, and the design is developed and established in textual rather than actual terms. As such, the text can be seen to represent the product, and in fact becomes the de facto product until it rolls off the production-line and is delivered to the Customer. The development of the product, and the expression of its design in text until its conversion from a ‘textual’ into a physical product is shown graphically in Figure 1-10.

Others have made similar observations. In her study of tax acountants’ texts within a ‘single professional community’, Devitt sees the texts as:

> ‘a tax accountant’s product, constituting and defining the accountant’s work. ..... In return for their fees, its [the accounting firm’s] clients receive texts – whether a tax return, a letter to the Internal Revenue Service (IRS), an opinion letter, or a verbal text over the phone ...’(Devitt 1991: 336,338)

Devitt mentions Faigley and Miller as having suggested that texts may serve as an accounting firm's product (Faigley and Miller 1982: 564, cited in Devitt 1991: 338). Within the field of engineering, observations about the text substituting for the product have also been made:

> In many industries, such as aerospace or the automotive sector, there will be a considerable period when the product does not exist in a physical form. In the concept phase, for example, the product will be represented solely as a set of functional requirements. (Kidd 2001: 37)

Figure 5-7 below provides an example of a proprietary statement for a proposal (ep3024) which claims ownership of the design.

REM SYSTEMS AND EQUIPMENT

PROPRIETARY

Publication Number: **EP3024 Issue: 1**

Entitled: **PROPOSAL FOR YAW RATE AND ACCELERATION SENSORS FOR FRASER AUTOMOTIVE GmbH**

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Figure 5-7: Claiming ownership of the design - a proprietary statement for a proposal

5.7 Glossary – a plethora of acronyms

Acronyms proliferate in corporate language and are frequently the butt of ridicule, grumbling, and complaint, sometimes causing problems of understanding for the organisation's own employees, let alone outsiders. Nevertheless, they are commonly used in any large organisation, and are a distinctive feature of HISE'S proposals. The situation surrounding the use of acronyms has also been observed by Jones, who mentions/states that this is where 'confusion abounds', and that even with a given list of abbreviations, no one organisation will use all the definitions in 'the same manner'. Furthermore, they may be used without adequate definition of exactly 'what is being communicated'. He advises that it is essential to define clearly each acronym and abbreviation every time it is used (1995:1.14-15).

Writing conventions surrounding acronyms

A list of acronyms or (abbreviations) is usually allocated at least a whole page, no matter what its length, and typically appears after the table of contents and before the executive summary. Here is an example of a shorter list, taken from a proposal for the use of an inertial measurement unit in a bomb enhancement proposal (ep3074):

GLOSSARY

ALARM	Air Launched Anti Radar Missile
ASIC	Application Specific Integrated Circuit
RASE	REM Aerospace Systems and Equipment
BIT	Built In Test
GDU	Guidance and Control Unit
GMRDS-DD	GEC Bazalgette Radar Defence Systems-Dynamic Division
GPS	Global Positioning System
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
MoD	Ministry of Defence
OEM	Own Equipment Manufacturer
PCB	Printed Circuit Board
RFI	Request For Information
MPP	Makemoto Precision Products Ltd
SiGyros	Silicon Gyroscopes
UBEP	UK Bomb Enhancement Programme
UK	United Kingdom
VLSI	Very Large Scale Integration
VSG	Vibrating Structure Gyro

Figure 5-8: A glossary for a proposal – an example of presentation and content

The first mention of an acronym in proposal text, similar to writing conventions in most formal business writing, occurs in brackets immediately after the word group it represents, for example: ‘Silicon Vibrating Structure Gyroscope (SVSG)’. Thereafter, the acronym is used instead of the word group, as shown in the following extract, where the relevant sections are underlined for reading convenience:

> The Silicon Vibrating Structure Gyroscope (SVSG) is based on a planar resonating ring design. RASE has extensive patent coverage encompassing all aspects of the design and implementation. In particular, US Patent 5226321 relates to the use of the planar ring design with US Patent application 970337.5, specifically covering the SVSG implementation including the drive and pick-off transducer mechanisation. (ep3074, P.1)

These are writing conventions encouraged by the technical authors at HISE , although the engineers may not always be aware of them or follow them consistently. In lengthy documents, or documents which they believe will be read in sections by separate people, the authors repeat the practice of first using the expression in full followed by acronym in brackets in each new section for the convenience of the different teams of readers.

There is someone at HISE whose job it is to keep track of acronym usage. A list of acronyms has been compiled and is stored in a dedicated acronyms binder, copies of which are located around the site. It is updated at regular intervals, because the development of new products, or the incorporation of new technology into products, e.g. Silicon VSG, spawns collections of new terms. The total number of acronyms used in all types of HISE documentation is currently around 4000. A list of all the acronyms used in proposals compiled for this study yields a total of 1768, which means an average of c.18.5 glossary entries per proposal. Some acronyms have multiple entries because of different referents or other (slight) differences. In one proposal, for example, 'IP' may refer to 'Industrial Participation', and in another proposal, it may refer to 'Initial Point'; 'AMS' may refer to 'Alenia Marconi Systems' or 'Aircraft Management System'; and 'MFC' may refer to 'Microsoft Fountain Class' or 'Multi-Function Console'. Of the 1768 acronyms found in the collection of proposals, 818 are individual, in that they refer to distinctly different referents. This total of 818 includes certain cases where an acronym is counted twice (or, occasionally, even three times), if it refers to two (or three) separate referents. So, if we consider another example,'ALARM', which may refer to either 'Air Launched Radiation Missile' or 'Air-Launched Anti-Radar Missile', it is considered as two separate acronyms.

The acronyms seem to have been coined for two main reasons. First, when a certain acronym is used so often in engineers’ speech for verbal economy, it being accepted that its referent is clear to interlocutors, it is automatically used to replace the orthographic form of the words in writing, e.g. the oft-used ‘COTS’ (Commercial off the shelf), or ‘RASE’ (REM Aerospace Systems and Equipment). Second, acronyms are used for stylistic reasons, in an attempt to improve the language used in proposals and avoid repetitions of long expressions in the text, which would render it inelegant, and prevent it from being read easily. Some fixed expressions are so long and unwieldy that acronyms can be useful in shortening sentences which would otherwise be too long. It is possible that skilled use of acronyms can improve the readability of the text, and facilitate fast fluent reading, a necessary consideration in view of the reading load of those scrutinising proposal submissions. Of course, over-use, or unskilled use of acronyms could have the opposite effect, by impeding the reading process and irritating the reader.

A skim through the list of acronyms reveals a varied list, with the potential for subcategorisation and more detailed study for another research occasion, possibly. It might be interesting, for example, to conduct a systematic examination of acronym usage and acronym structures with a view to devising an overall description. For the purposes of this study, however, a thumb-sketch impression must suffice. Such an overview indicates that a significant proportion refers to:

1. **organisations**, for example: RNLF - Royal Netherlands Air Force, RSC Raytheon Systems Company, SAGEM - Société d'Applications Générales d'Electricité et de Mécanique, MBDF Matra BAe Dynamics – France, NATO North Atlantic Treaty Organisation, among many others.

2. **whole systems: objects, products, vehicles, or equipment**, for example: AEU - Antenna Electronics Unit, ALARM - Air Launched Anti-Radar Missile, MBT - main battle tank, RPV - remotely piloted vehicle, COPICS - Communication Oriented Production Information and Control System.

2. **technical, scientific, or mathematical terms**, for example: CMT Cadmium Mercury Telluride, RMS - root mean squared, SNR - signal to noise ratio, BCD - Binary Coded Decimal.

They are also used to reflect how the product may be used by the user, for example: 'HU' - head up, and 'HD' - head down. They may consist of positional adjectives (high, low), and parts of the body (head, eye), parts of the product (line replaceable unit, least significant bit, most significant bit), and so on.

Technical authors, who are responsible for compiling proposals, and helping to write sections of them, are usually the ones who decide whether or not the use of particular acronyms/ abbreviations will affect the readability of the text. Clearly, as one put it, they do not want to 'turn off' the reader they are trying to convince that theirs is the best proposal by peppering the text with unfamiliar acronyms. They are aware that there are proposals, e.g. those designs centred on thermal imaging or silicon gyroscopes, which need to be explained for readers, because there are occasions when the team considering the proposal may not have specialist knowledge. In such cases, it is stylistically more appropriate to avoid using too many acronyms. However, where it is known that the readership is au fait with the terminology, there is an understanding the readers will actually expect acronyms to be used. In fact, some engineers believe, rightly or wrongly, that the use of acronyms will impress the reader (because they, themselves, find them impressive), and, furthermore, that the reader expects to see them in the text, since their presence symbolises exclusivity. It can be seen, then, that acronyms are part of the written (and spoken) language of the engineering community, and that their use is a form of showing-off, or professional display.

Against this backdrop of their engineer colleagues' beliefs, the technical authors are aware of how injudicious usage can ill-affect the readability of proposals. However, often they have little choice but to use acronyms specified by the Customer, who will have used them in the Requirement. This means that, in tailoring their solution in the form of a proposal, they are responding to text (the Requirement) produced by the customer which will usually include acronyms. They feel obliged to use them, not wanting to be seen to reject the Customer's terminology, even though they may object to using them for stylistic reasons. The engineers and technical authors also believe that using the acronyms used by the customer demonstrates they have membership of a kind of club, i.e. a club of special 'knowers' or specialists in the field of aerospace engineering.

Executive summary

5.7.1 Early identification of the executive summary as being problematic

The executive summary had been flagged as being a problem before this study began. Of all the writing tasks performed by design engineers, it was the first to be identified by HISE managers as being problematic. The executive summary is submitted as part of the whole proposal, and yet is a separate and distinctive document. Its main purpose is to 'sell' the whole proposal to the most senior decision makers, i.e. those who decide which of the tenders should be shortlisted. In the early 1990s, the company became aware that changes in the defence industry would bring about an increasing need to reduce reliance on government contracts, and for engineers to be more actively involved in seeking new business. There was a perception then that proposal writing would start to take up a significant proportion of engineers' work time. In 1995, and as a consequence of the perceived need for engineers to be given support, I was asked to work with engineers on developing proposal writing skills in a series of two-day workshops. Their team leader decided the executive summary should serve as the focus of the workshops, for various reasons, among them being:

1. Time constraints - HISE wished as many engineers to attend in as short a time as possible.

2. Writing difficulty - The executive summary had been identified as being consistently difficult to write, for reasons which are discussed below.

3. Good representation of the proposal - Since it is supposed to encapsulate the whole proposal, i.e., provide a summary of the main benefits it is offering the Customer, the executive summary served as a text through which the whole proposal could be considered in microcosm.

4. Convenient length - It is usually a short text of around two sides of A4, and is, therefore, a convenient text to use for both teaching purposes, and writing practice. More recently, however, executive summaries written for large proposals have been significantly longer, one reaching sixteen pages and c. 3000 words in length (ep3098).

In the later stages of the study, observations of engineers' writing behaviour and examination of most recently produced executive summaries reveal that the problems faced by engineers in 2002 are little different to those faced by engineers writing proposals in the mid 1990s. Then, they suspected that the executive summary was probably a more important element of the proposal than they had given it credit for, or the limited time they set aside for writing it would seem to indicate. By virtue of its name, they thought it might be read by the chief executive, whom they believed to be one of the key decision makers in selecting the winning bid. However, they were unsure about how the proposal was read, or how many people were involved in the selection process. It was known that several readers were usually involved in large projects, for which lengthy proposals were written, comprising several volumes and addenda. However, in all the projects the engineers prepared bids for, they had only vague ideas about how wide the readership of the executive summary was, or the purpose it served.

All these gaps in their knowledge made it difficult for them to identify the function of the executive summary, and this situation was not helped by the fact that, at times, the executive summary seemed to be an optional element, and at others, obligatory: sometimes the Customer specified that one should be submitted, and sometimes did not. They used to discuss at length whether or not it was a good idea to submit an executive summary, even if one had not been asked for, such discussions revealing the extent to which they were stabbing in the dark. Some thought the executive summary was submitted as a courtesy convention, a demonstration of politeness to the chief executive, who, by dint of his position, would be the official recipient of the tender documents. A popular suggestion was that the executive summary (or similar equivalent, in the form of a cover letter, for example) should be submitted with the proposal/tender documents as a matter of polite bidding behaviour. However, it was not known how active a role the chief executive played in the tendering process. In view of the arcane nature of the bid process, the engineers were clearly trying to construct a post-proposal writing scenario, and trying to make sense of the anecdotes and gossip that a secretive event inevitably generates.

A minority suggested that the chief executive's minions would consider the submissions on his behalf, and that he would usually follow their recommendations, in which case the executive summary would not be as important as the main documents. However, this suggestion was generally rejected by those who had some, albeit patchy, knowledge of the bidding process from the Customer's viewpoint: several engineers had worked for other engineering organisations in the past or were ex-service personnel, with some (anecdotal) knowledge about procurement; and a minority had been involved in considering bids submitted to HISE. These early discussions revealed that, although knowledge about the specific purpose of the executive summary remained hazy, there was general acceptance that it was an important part of the proposal for the following reasons:

- it had a tradition of being regarded as having status in their industry,
- it was accorded importance by their managers, and
- it was important to relay to the chief executive or decision-maker(s) the main selling points of the proposal in summary form.

When reflecting on their writing practice, engineers acknowledged that, in the pressure to produce the proposal documents in time, the executive summary is usually left until last, being squeezed in and hurriedly written in the final stages of the proposal writing process. As a result, it was not (and still is not) always written to their satisfaction. The upshot of the discussions was, first, a general agreement that executive summaries merited more careful attention and less erratic treatment, and, second, a request that I devise writing guidelines or an executive summary writing template which would do the following:

1 provide a checklist of different selling points that could be highlighted in the summary. I interpreted this as a need for guidance about information content.

2 prescribe an effective layout for an effective summary.

3 provide advice about writing style.

This request for a writing template brought about a change in my attitude towards model texts, since at that time I was not a strong adherent of their use in teaching. I had encountered many situations with L2 students who were required to structure various rhetorical texts, but found rhetorical writing difficult, and were always asking for model texts to copy. This time, however, the situation was somewhat different and merited consideration. The engineers were accustomed to using document templates, and it was clear they were serious about their need for such writing assistance, at work in a non-pedagogic setting, as distinct from in the classroom. Those early writing workshops caused me to wonder if the design of a kind of 'template' was possible, and encouraged my pursuit of the description which emerges in this and the following chapters. It is not a template as such that results, but more a systematic description of the information content of proposals, as will be seen.

5.7.2 An examination of the structure and format of executive summaries

First a note about the executive summary data: all the examples are taken from the corpus of 29 executive summaries from which the statistical data for this study are drawn. Occasionally and rarely, comments are made which have been inspired by a smaller collection of executive summaries gathered in the early stages of the study (c. 1995). Since these are not available in electronic format, they were not added to the corpus; their relative old age, compared with those held on the electronic database mitigated against taking time to scan them and add them to it.

Nothing has been found in the literature about executive summaries, let alone those written as accompaniments to proposals, apart from Covey (1997). He provides advice to those (non-linguists) in commerce and industry about how to write and present a wide range of genres, and, understandably, is more concerned with presentational features, like font styles and page formatting, than linguistic structure, and suggests a range of format styles for the executive summary. This publication is admired by the engineers and technical authors who refer to it, and it appears to be a good example of books of that kind. Covey provides four exemplars (model texts) with sound, commonsensical side annotations indicating key aspects of the summary, for example, the need to keep paragraphs ‘short and focused’, to end every sub-heading with a section number which should cross-reference to corresponding sections in the proposal, and so on. He uses the terms ‘benefit’ and ‘theme’, mentioning that the summary should list ‘three major benefits covered in the proposal’, but seems to assume the reader knows all about these, since no explanation is provided of them (1997:405-408).

This almost total lack of information about executive summaries is surprising, considering the pivotal role they play in the selection process, and the amount of effort (and cost) that is invested in proposal writing, not only in aerospace engineering, but in the tendering process generally across the whole industrial sector. It is possible, of course, that the dearth of information about the inner-workings of the tendering process, mentioned earlier, and the restricted access that has so far been afforded to researchers, have contributed to the neglect of this genre. Considering how little is known about executive summaries, then, this section attempts to provide some kind of idea of how the summary looks on the page, and how the discourse functions (which lead to the information components identified later) are presented in executive summary text. In doing so, this section also attempts to provide a fair representation of the range of executive summaries that exists, because, as has already been explained, there are different categories of proposal, the main ones based on whether the proposal is competitive or non-competitive, solicited or unsolicited, and whether HISE is the prime contractor or a sub-contractor. As a corollary of this variation, there exists a variety of summaries in terms of presentation/format, structure, and information content, a selection of which are now shown.

The executive summaries now presented provide an idea of the range of different modes of presentation used to persuade the chief readers to agree to the proposal. An attempt has been made to provide representative sample to portray, in this small selection, a mixture of proposal types and proposal writers.

Four executive summaries or extracts are provided below:

1. Ep3056 - Proposal For Type 840 Programme Dynamically Tuned Gyro, Issue 1 February, 1998

2. Ep3024 – Proposal For Yaw Rate And Acceleration Sensors For Fraser Automotive Gmbh, August 1997

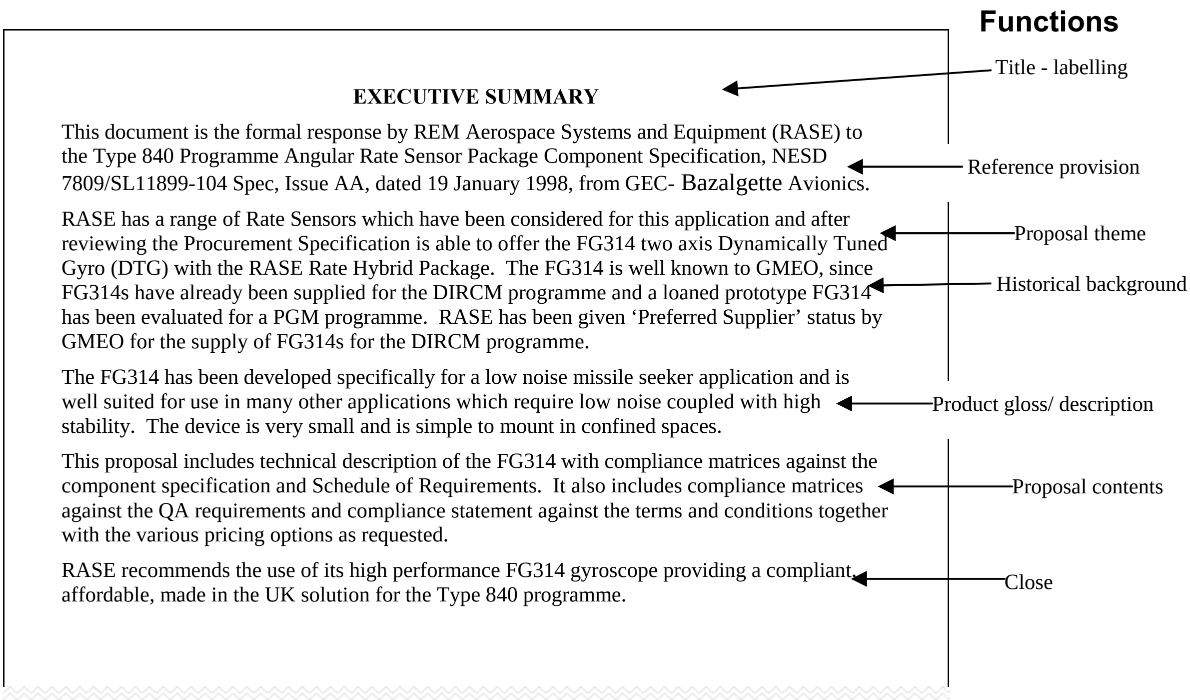
3. Ep3049 - Target Indication System For HORIZON, Issue 1 March, 1998

4. Ep3098 Seahunter Mid-Life Update Electro-Optic Sub System PART 1 Technical July 1999

They range from a short monochromatic summary presented in a traditional plain format (Figure 5-9), to a sixteen-page summary arranged in columns using colour, pictures, and other embellishments (Figure 5-12). They show a development from a more conservative and traditional style, to one incorporating the latest features of desk-top publishing and electronic formats. The latter, and the most recent, has seen a closer contact develop between the Customer and the engineers, together with growing awareness on the part of engineers that they need to put more effort into 'selling' their products. Work practices have been changing in response to the demand for engineers to make oral face-to-face presentations to the Customer team after the proposal has been submitted. The following examples, then, show developments in presentational differences which reflect the changes that have taken place (and still are) in the proposal writing process. Each example is accompanied by information about the summary, including some simple statistics, to give an idea of its physical proportions, format, presentation, and the extent to which it is representative, among other items of information.

Example 1 –This is a whole executive summary (ep3056, Feb 1998), much resembling the business abstracts I have encountered in earlier studies. It is short (211 words), concise, occupies half a page, and comprises plain unembellished text, with no sub-headings, visuals, or other presentational enhancements. It is by no means the shortest executive summary in the corpus, since four others are even shorter; the shortest summary comprises around 153 words. Ten out of the collection of twenty-nine summaries are presented in this plain format.

In the right-hand margin are early observations made about the functions performed by different parts of the text, which were to inform later analysis carried out on a sample of executive summaries and proposals, described in the next two chapters.



EXECUTIVE SUMMARY

This document is the formal response by REM Aerospace Systems and Equipment (RASE) to the Type 840 Programme Angular Rate Sensor Package Component Specification, NESD 7809/SL11899-104 Spec, Issue AA, dated 19 January 1998, from GEC- Bazalgette Avionics.

RASE has a range of Rate Sensors which have been considered for this application and after reviewing the Procurement Specification is able to offer the FG314 two axis Dynamically Tuned Gyro (DTG) with the RASE Rate Hybrid Package. The FG314 is well known to GMEO, since FG314s have already been supplied for the DIRCM programme and a loaned prototype FG314 has been evaluated for a PGM programme. RASE has been given 'Preferred Supplier' status by GMEO for the supply of FG314s for the DIRCM programme.

The FG314 has been developed specifically for a low noise missile seeker application and is well suited for use in many other applications which require low noise coupled with high stability. The device is very small and is simple to mount in confined spaces.

This proposal includes technical description of the FG314 with compliance matrices against the component specification and Schedule of Requirements. It also includes compliance matrices against the QA requirements and compliance statement against the terms and conditions together with the various pricing options as requested.

RASE recommends the use of its high performance FG314 gyroscope providing a compliant, affordable, made in the UK solution for the Type 840 programme.

Figure 5-9: Executive summary, example 1 – traditional plain format

Example 2 – This is a whole page executive summary (ep3024, Aug 1997)(375 words), reproduced without annotation on this page to show its appearance and structure. Benefits/ selling points are organised under, and highlighted by, sub-headings, which are emphasised in the text through the use of capital letters in an emboldened font. This style of presentation is the most common format used, with seventeen out of the twenty-nine summaries having this appearance. So far as length is concerned, this one is fairly representative, with six of the summaries being a page long, and nine being between one and two pages in length. Only two are several pages long. This executive summary is reproduced in Figure 5-14, with annotations and colour shading, to show its discourse structure.

EXECUTIVE SUMMARY

This proposal provides details of the REM Aerospace Systems and Equipment (RASE) and Makemoto Precision Products (MPP) Silicon Vibrating Structure Gyro, and Silicon 2 axis accelerometer for provision of Stand-Alone Sensors for the Fraser Automotive program.

AN ESTABLISHED AEROSPACE COMPANY

RASE is a recognised centre of excellence in the Motion Sensing, Navigation, Data Control, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world class electronic and electro-mechanical equipment, RASE's products form an integral part of many of the world's finest platforms and systems supplied directly or in close co-operation with other leading prime contractors.

A LEADING EUROPEAN SUPPLIER OF INERTIAL PRODUCTS

RASE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe. Current gyro throughput is in excess of 500 per month. This proposal for the use of a Vibrating Structure Gyro (VSG) is based on over 10 years of VSG development and over 5,000 VSG sales. The new technology Silicon VSG is an evolutionary step in the VSG development progression and demonstrates a high level of innovation, setting the benchmark for others to follow.

SILICON PROCESSING EXPERIENCE

From a background as an established volume supplier of heat exchanger products with production rates of 1 m units per year MPP has now established a reputation within Japan for the design and manufacture of automated Si wafer processing and handling equipments. To enhance this capability MPP has recently acquired TTS the world leading manufacturer of Si deep trench etching equipment which provides a key process in the manufacture of Silicon Micromachined Products.

STRONG PARTNERSHIP

The marriage of Inertial Sensor technology from RASE and the manufacturing technology from MPP provides a strong foundation for the supply of Yaw Rate and Acceleration Sensors to Fraser Automotive GmbH.

RASE/MPP SOLUTION FOR FRASER AUTOMOTIVE GmbH

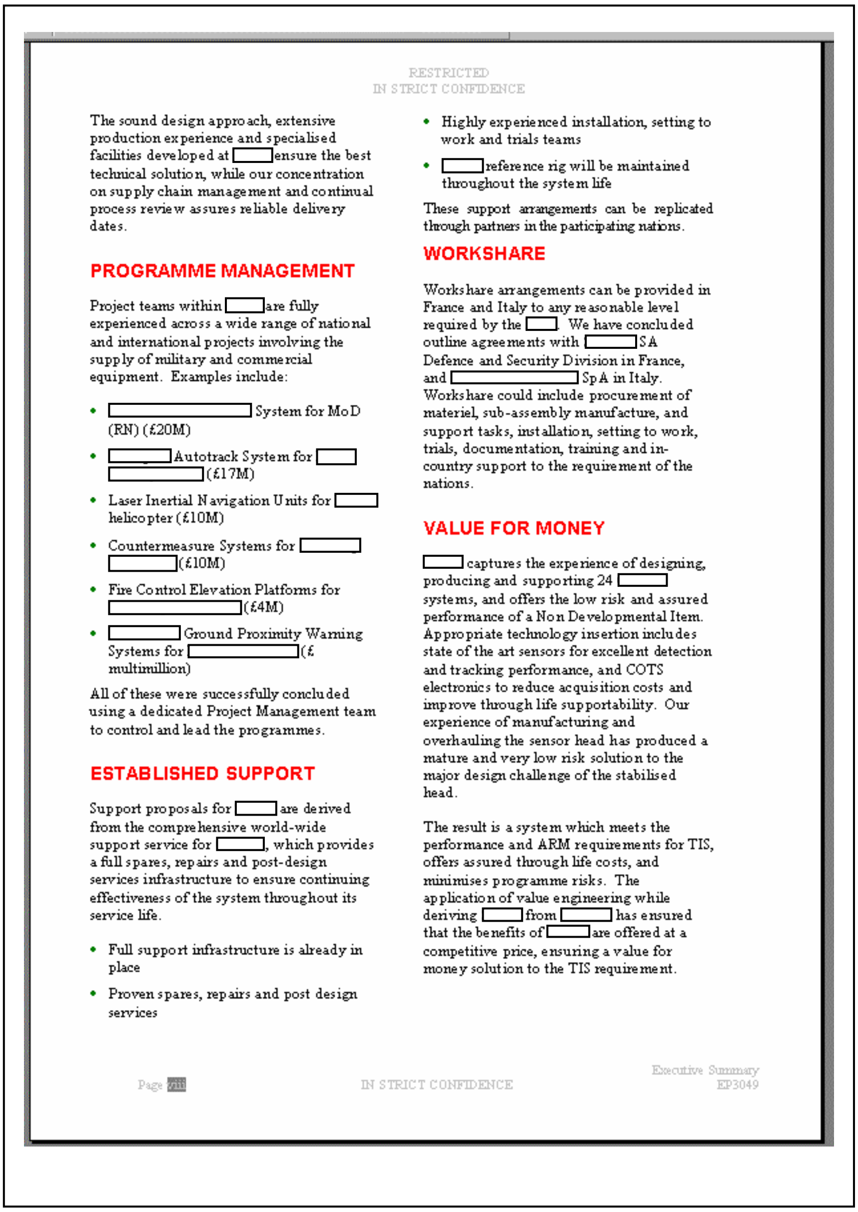
For the Fraser Automotive GmbH requirements RASE/MPP proposes the following solutions:

- Yaw Rate Sensor formed from a deep trench etched Silicon Vibrating Ring
- Two axis accelerometer micromachined in Silicon

ENHANCED ACCELEROMETER SOLUTION

RASE/MPP are discussing the availability of competitive single axis accelerometers with a number of potential vendors. This may provide a more attractive solution for Fraser Automotive GmbH.

Figure 5-10: Executive summary, example 2 – most commonly used format



The sound design approach, extensive production experience and specialised facilities developed at [redacted] ensure the best technical solution, while our concentration on supply chain management and continual process review assures reliable delivery dates.

PROGRAMME MANAGEMENT

Project teams within [redacted] are fully experienced across a wide range of national and international projects involving the supply of military and commercial equipment. Examples include:

- [redacted] System for MoD (RN) (£20M)
- [redacted] Autotrack System for [redacted] (£17M)
- Laser Inertial Navigation Units for [redacted] helicopter (£10M)
- Countermeasure Systems for [redacted] (£10M)
- Fire Control Elevation Platforms for [redacted] (£4M)
- [redacted] Ground Proximity Warning Systems for [redacted] (£ multimillion)

All of these were successfully concluded using a dedicated Project Management team to control and lead the programmes.

ESTABLISHED SUPPORT

Support proposals for [redacted] are derived from the comprehensive world-wide support service for [redacted], which provides a full spares, repairs and post-design services infrastructure to ensure continuing effectiveness of the system throughout its service life.

- Full support infrastructure is already in place
- Proven spares, repairs and post design services
- Highly experienced installation, setting to work and trials teams
- [redacted] reference rig will be maintained throughout the system life

These support arrangements can be replicated through partners in the participating nations.

WORKSHARE

Workshare arrangements can be provided in France and Italy to any reasonable level required by the [redacted]. We have concluded outline agreements with [redacted] SA Defence and Security Division in France, and [redacted] SpA in Italy. Workshare could include procurement of materiel, sub-assembly manufacture, and support tasks, installation, setting to work, trials, documentation, training and in-country support to the requirement of the nations.

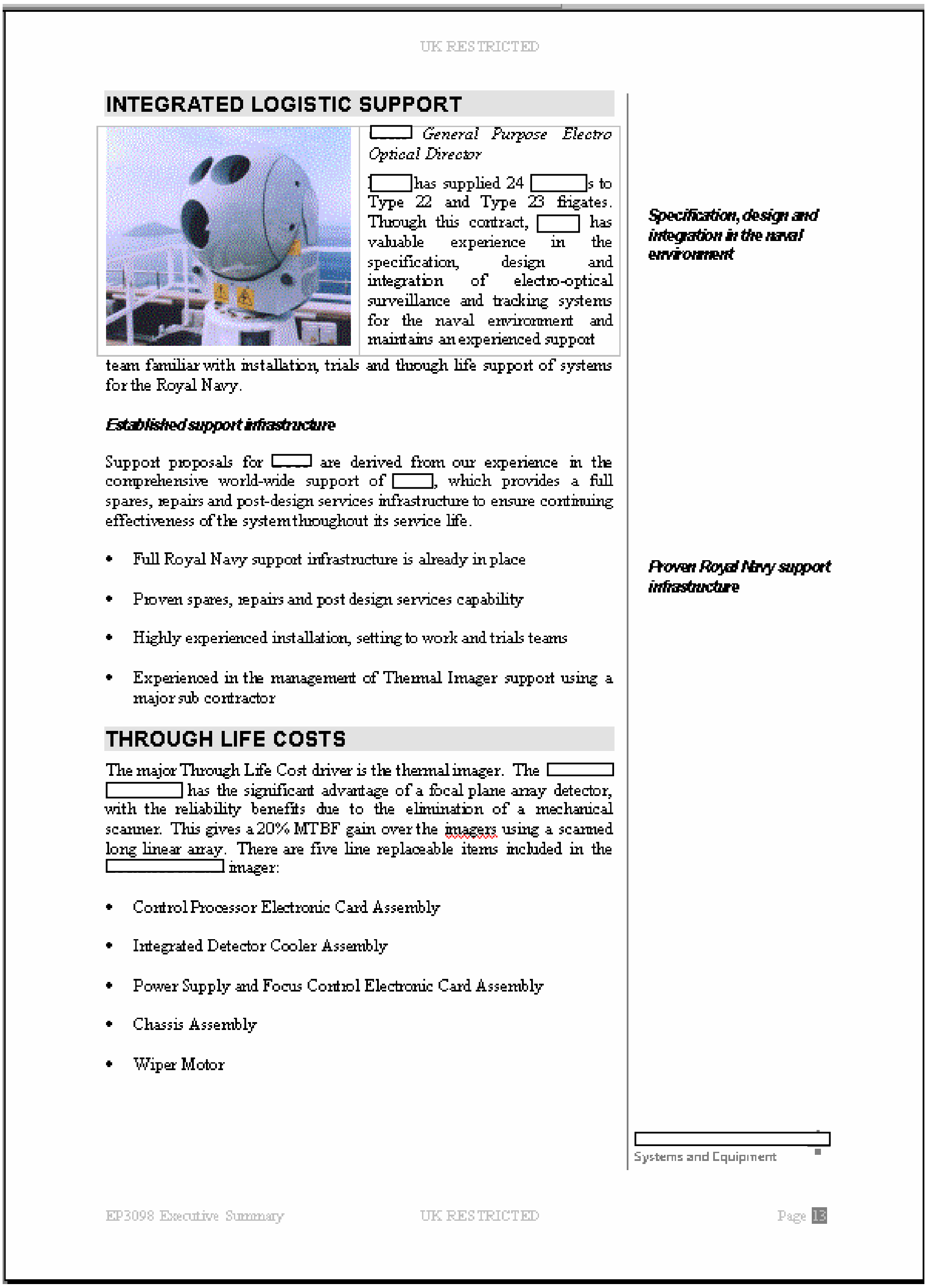
VALUE FOR MONEY

[redacted] captures the experience of designing, producing and supporting 24 [redacted] systems, and offers the low risk and assured performance of a Non Developmental Item. Appropriate technology insertion includes state of the art sensors for excellent detection and tracking performance, and COTS electronics to reduce acquisition costs and improve through life supportability. Our experience of manufacturing and overhauling the sensor head has produced a mature and very low risk solution to the major design challenge of the stabilised head.

The result is a system which meets the performance and ARM requirements for TIS, offers assured through life costs, and minimises programme risks. The application of value engineering while deriving [redacted] from [redacted] has ensured that the benefits of [redacted] are offered at a competitive price, ensuring a value for money solution to the TIS requirement.

Figure 5-11: Executive summary, example 3 – mimicking newspaper layout (ep3049, March 1988)

The third example (Figure 5-11) shows how attempts have been made to present the selling points (or benefits) in a more reader-friendly format. Figure 5-11 shows the whole of the last page of an executive summary comprising a total of 1662 words and eleven pages. In this extract it can be seen how selling points are organised under coloured headings and arranged in two columns like a newspaper article, in a conscious attempt to impress the reader with, to use a technical author's words, 'a more snazzy and readable layout'. It has already been mentioned that the preferred term for these selling points is 'benefits', and that the engineers have tried to express these using an overtly persuasive style. However, the immediate 'benefit' of 'PROGRAMME MANAGEMENT' to the Customer, for example, is not apparent, but as later analysis will show, the nub of the message is not what it seems. The analytical approach which emerges in Chapters 6 would reveal this segment to contain not information about programme management, its ostensible purpose, but instead to contain information intended to impress the reader about the company's track record with the product in question. The term, 'pedigree', which has been unconsciously coined by the engineers, has been used as a label for this particular selling point (or 'component') which is discussed later with the others.



UK RESTRICTED

INTEGRATED LOGISTIC SUPPORT

[redacted] *General Purpose Electro Optical Director*

[redacted] has supplied 24 [redacted]s to Type 22 and Type 23 frigates. Through this contract, [redacted] has valuable experience in the specification, design and integration of electro-optical surveillance and tracking systems for the naval environment and maintains an experienced support team familiar with installation, trials and through life support of systems for the Royal Navy.

Specification, design and integration in the naval environment

Established support infrastructure

Support proposals for [redacted] are derived from our experience in the comprehensive world-wide support of [redacted], which provides a full spares, repairs and post-design services infrastructure to ensure continuing effectiveness of the system throughout its service life.

- Full Royal Navy support infrastructure is already in place
- Proven spares, repairs and post design services capability
- Highly experienced installation, setting to work and trials teams
- Experienced in the management of Thermal Imager support using a major sub contractor

Proven Royal Navy support infrastructure

THROUGH LIFE COSTS

The major Through Life Cost driver is the thermal imager. The [redacted] has the significant advantage of a focal plane array detector, with the reliability benefits due to the elimination of a mechanical scanner. This gives a 20% MTBF gain over the imagers using a scanned long linear array. There are five line replaceable items included in the [redacted] imager:

- Control Processor Electronic Card Assembly
- Integrated Detector Cooler Assembly
- Power Supply and Focus Control Electronic Card Assembly
- Chassis Assembly
- Wiper Motor

[redacted]
Systems and Equipment

EP3098 Executive Summary UK RESTRICTED Page 13

Figure 5-12: Executive summary, example 4 - a 'glossy-like' presentation **(ep3098e July 1999)**

Example 4: In the style of a glossy magazine

This executive summary is part of a large proposal, and is the longest in the corpus, comprising 24 pages and 2988 words. The recent realisation that the Chief Readers may rely solely on the executive summary to make a decision has motivated the project team to provide more information about the proposal in the summary, and to present it in, what the engineers perceive to be, a more 'reader-friendly' format. It is common, with large proposals like this, to put more effort into the executive summaries, and, as a result, these longer summaries use pictures and other graphical representation liberally to portray test and statistical information in order to interest the readers, and, ultimately, to impress them. The extract above shows the usual use of headings to specify particular benefits, incorporated into a split-page layout. In this particular case, the main body text appears on the left, whilst 'side-text' or 'sidelines' are placed in the right-hand column. Much like advertising slogans, these sidelines attempt to encapsulate in a few words (which the engineers hope will be memorable) the selling point/benefit that they juxtapose.

5.7.3 Discourse functions of the executive summary

Information content of the executive summary - persuasion through selling points

To use the engineers' words: the purpose of the executive summary is 'to highlight the key benefits of choosing the HISE solution'. Essentially, the executive summary is a persuasive abstract, in that it summarises the key selling features, or 'benefits', which is the company's preferred term. As mentioned in Chapter 4 , these are, in essence, information topics or main selling points around which the proposal is constructed. Usually these topics relate to features of the product which the engineers believe would be attractive or advantageous to the Customer. Proposals can be long documents, comprising several volumes , and so the executive summary provides engineers with the opportunity of crystallising their proposal, and highlighting to the readers its benefits, which would otherwise be lost in the detail of the main proposal documents. During brainstorming sessions at the proposal writing workshops, a list of the most important selling features for an executive summary was compiled in consultation with the engineers, using a (then) current proposal writing project as a case study. Each proposal clearly has different writing requirements, but, nevertheless, it was found to be possible to identify the features, which were given in the form of a checklist for the engineers to use as a sort of aide memoire to help them with writing future executive summaries.

Subsequent examination of a collection of 29 executive summaries revealed a collection of selling points, which may be regarded as generic. In theory, every executive summary could mention these, with the most important highlighted first. However, since proposals may differ, and, certainly, every competitive proposal is distinctive (usually unique), the selection of these selling points varies from bid to bid. An executive summary may mention several, or only one or two, as will be shown. They usually appear in executive summaries in the bid team's view of the order of importance, the most important mentioned first.

In Table 5-5 below the right-hand column lists the benefits/selling points which may be used in an executive summary. (It will be seen later in the study that these same points may be found in the main proposal, although they would probably be described at greater length.) The benefits are grouped into four functional categories to show how they are clustered around four main notions, three of which are concerned with selling and conveying particular types information (topic areas), and one (metalingual) which is concerned with reading process. The first three categories relate to the following information topics, which are portrayed in the executive summary as positively as the engineers own views about 'sales-speak' will allow:

1. **the 'product' or 'technical solution'**, which is naturally the major concern of design engineers.

2. **the company or organisation**, which, in this case, is now HISE (used to be REMA), and information about other partnership companies contributing to the bid.

3. **product support**, otherwise referred to as Integrated Logistical Support (ILS), Customer Support, or After-Sales Support. This is significant in most projects, especially those which may last a few years, or even extend over one or two decades, although later examination of proposals shows this aspect to be under-represented in the text.

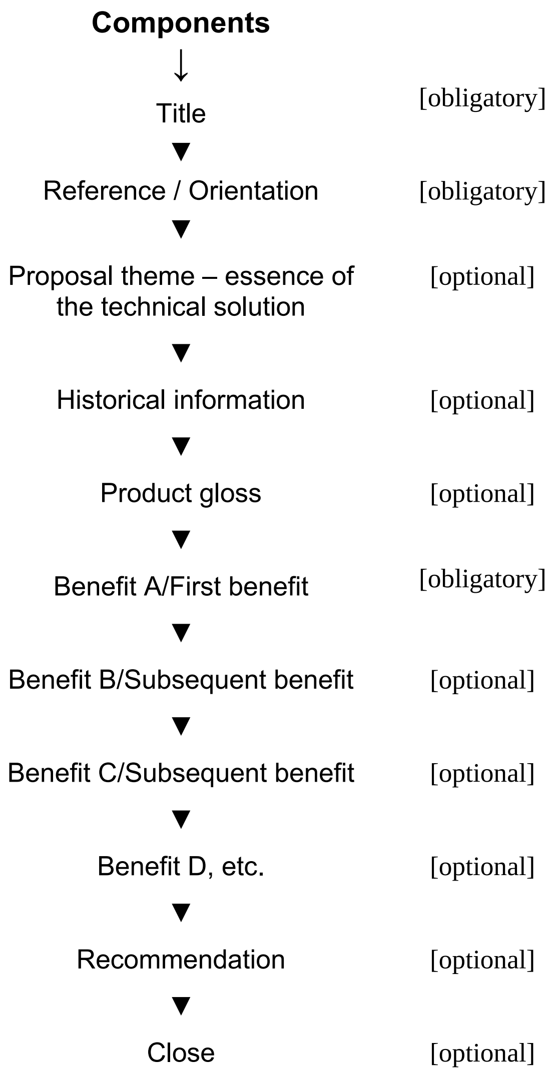
The final functional category, the metalinguistic, relates to attempts to influence how the whole proposal should be read in terms of both reading behaviour and reader attitude, and because it relates to usually substantial stretches of written discourse, I prefer to refer to this category as 'meta-discoursal'.

Table 5-5 shows the main discourse function categories identified in executive summaries, and the benefits (or topics) they contain. The first three functional categories reflect text that conveys information to the Customer and convinces him about aspects of the product, company, or after-sales (product) support. The metadiscoursal category is distinctive in that it lists metalinguistic-type functions, and not selling points or benefits.

Functional category	Discourse functions: benefits or selling points, and meta-lingual
Product focus	• product (or solution) gloss • financial considerations: price, costings, or potential savings through, for example, safety improvements, or low maintenance • degree of compliance technically and commercially. If totally compliant, this is usually fronted/emphasised. • special design features • state-of-the-art design, engineering, and (possibly) production methods • tailored aspects, or ability to tailor • off-the-shelf but adaptable nature of the product (or solution) • proven performance, if already in use, with examples/other organisations cited • low risk / low nature of the risk involved
Attributes of the company or organisation	• lineage (usually conveyed through historical recount) • impressive or substantial aspects of HISE as a company, collaborating partners, sub-contractors, etc. • commitment • size • track record • joint venture links with another French/American/ Italian etc company (political benefits) • range of strengths offered by co-operative/collaborative effort • research and development facilities • experience and expertise of engineers (and other personnel) • production facilities • sustainability (ability to resource and develop the product in the long term) • strengths of HISE vis a vis competitors' weaknesses [a moot function]
Product support	• post-delivery support • long term benefits available after delivery • maintenance and after-sales support • product development and enhancement • training • documentation
Metadiscoursal	• provide overview of proposal document structure to facilitate jigsaw reading • encourage reading prospection/ anticipation • indicate proposal sections where certain points are described in more detail

Table 5-5: Four main discourse function categories found in executive summaries

Having identified the main selling points in executive summaries, it is now possible to consider how they are organised and realised in text. First, it may be useful to consider a typical (or generic) structure of an executive summary, before looking at an actual example of a whole summary. The generic structure is portrayed in two ways: diagrammatically (Figure 5-13 below), and as a table (Table 5-6). The former provides an outline structure as a simplified linear diagram showing the distinct sections, which for now will be referred to as components. These were identified in the early stages of the study, and served as a precursor to the more detailed examination of executive summaries and proposals, and further refinement of the components into topic-focused discourse categories (information components) discussed in the next two chapters. The generic structure in Figure 5-13 is fleshed out in Table 5-5, which places each component into a functional category, specifies its discourse function, and shows examples of each.



Description versus prescription- A comment about actual textual content and the ideal:

It can be seen that only three components are obligatory, judging by the data. However, in view of its purpose, it could be argued that all executive summaries should include a description which encapsulates the proposal theme. Furthermore, where compliance is

Figure 5-13: Outline generic structure of the executive summary

Functional category	Discourse function	**Example extract(s)** taken from executive summaries in the corpus	Comment
Title	Labelling (Obligatory)	**Executive Summary / Executive Brief**	In the form of a main heading usually. Clearly demarcates executive summary from rest of proposal
Orientational/ Referential	Reference provision - locates /orientates reader (obligatory)	This proposal provides details of the REM Aerospace Systems and Equipment (RASE) and Makemoto Precision Products (MPP) Silicon Vibrating Structure Gyro, for the Richters AG.(ep3037e)	This would be regarded by engineers as an introduction, or some kind of opening. Usually a sentence-long paragraph
	Courtesy/supplication marker (optional)	In response to Alenia Bazalgette Systems invitation to tender for an Electro-Optic Sub System for the Seahunter Mid Life Update, RASE are delighted to offer their Seahunter Electro-Optic Sub System (SEOSS).(ep3098)	
Proposal 'theme'	Essence/summation of the solution (optional)	The refurbishment is designed to restore the system to full operational performance standard, and to make it supportable for a further eight years. (ep3016)	**NB Components** may be realised in paragraphs, sentences, or clauses; i.e. a sentence may contain more than one information component, as in the following example: The system architecture is based around standard PC hardware and commercial off-the-shelf software, which ensures a highly cost effective and low-risk solution.(ep3129)
	Highlighting main selling point(s)/benefit(s) through fronting [early mention] (optional)	The proposal provides a firm price and programme for the refurbishment of 22 off Sea Hunter TAGU's for the xxxxxx Air Force.(ep3001) HISE Avionics believes this program is an excellent match for its advanced MEMS SiIMU product and business plans in terms of performance, price and quantity. Equally, we believe that the excellent working relationship built up between our two companies, even before the merger, during the initial bid phase has demonstrated that working together can be successful.(ep xxx)	
Historical background	Temporal contextualisation for the product or solution (optional)	**Development Experience in Naval Electro Optical Tracking Systems** The Sea Neptune 1 electro-optical gun fire control system was developed in the 1970s and was fitted to the Royal Navy TURRET class patrol vessels and exported to customers in the Middle and Far East. …..……[See Appendix M for full component.] …….. A further contract was received from the MoD in 1993 to integrate both the electro-optical sub-system and the fire control sub system with the ship's combat system highway. …	
Product gloss/ description	Significant aspects of product design/ description glossed. (optional)	The FG314 has been developed specifically for a low noise missile seeker application and is well suited for use in many other applications which require low noise coupled with high stability. The device is very small and is simple to mount in confined spaces.(3055e)	
Selling point/benefit 1	Explanation to Customer about one of the selling points	**Lowest risk -** VSG technology has been demonstrated and is more than just a research programme (in excess of 7,000 units delivered). It is well-established in Military and	Emphasising the selling point : Low Risk.

Functional category	Discourse function	**Example extract(s)** taken from executive summaries in the corpus	Comment
	of solution (obligatory)	Commercial markets.(ep3121e)	
Selling point/ Benefit 2	Ditto	**STRONG PARTNERSHIP** The marriage of Inertial Sensor technology from RASE and the manufacturing technology from MPP provides a strong foundation for the supply of Angular Rate Sensors to Barmstadt AG. (ep3037e)	Emphasising the selling point: Collaboration/Partnership
Selling point/ Benefit 3, etc	Ditto, etc., see Table 5-4 for a list of selling points.	**Lowest acquisition cost -** Spacetronics Missiles will only fund the difference in cost of developing the IMU from the RASE- funded IMU development programme.(ep3018e)	Emphasising the selling point: Financial Benefits
Recommendation/ Selling point/ benefit	Action(s) and/or product(s) specified.	RASE recommends the use of an Optical Fire Director (OFD), which has recently been refurbished by RASE, to replace the existing Forward OFD on RNOV SAHARA. This has the advantage of saving time and costs.(ep3016e)	
Closing/ Conclusion	Final (or reiteration of) particularly impressive selling point (optional)	In addition to providing a cost-effective product, RASE has a policy of through-life support, for both the equipment and the customer. The system will be fully supported throughout its normal lifespan.(ep3005e)	Final sentence or final paragraph, or last sentence in final paragraph. Can be couched as (ostensibly) a recommendation.
	Future reference - encouragement of further dialogue / future action/ design devt. potential / next step (optional)	During this program RASE remains ready and willing to assist LMEM in further refining the gyro requirements to meet the important technical and schedule requirement. RASE also welcomes discussions on how the sensor configuration may be modified to meet the long term performance and cost goals of this program.(ep3011e)	
	Prospective view of reading task, i.e. provision of broad proposal structure (optional)	**PROPOSAL FORMAT** This Proposal has been written to comply with the format prescribed in the Proposal Preparation Instructions and has been sub-divided into the following volumes: ***Volume 1Management*** Volume 1 describes how RASE will manage the programme of work to meet the contractual commitments. ***Volume 2Technical*** Volume 2 (this volume) describes the manufacturing and quality approach which will be adopted to comply with the requirements of the Statement of Work. ***Volume 3Risk*** Volume 3 contains the risk response. ***Volume 4Cost*** Volume 4 contains the commercial response and pricing details.	

Table 5-6: Generic structure of the executive summary – component realisations

The discourse structure of an example executive summary

The ep3024 executive summary (shown previously in Figure 5-14) is now reproduced to provide an overview of its discourse structure. Segments of text representing particular discourse functions, outlined in Figure 5-13, are now shown. Details of particular discourse functions are provided in the left-hand margin, distinguished by the use of colours.

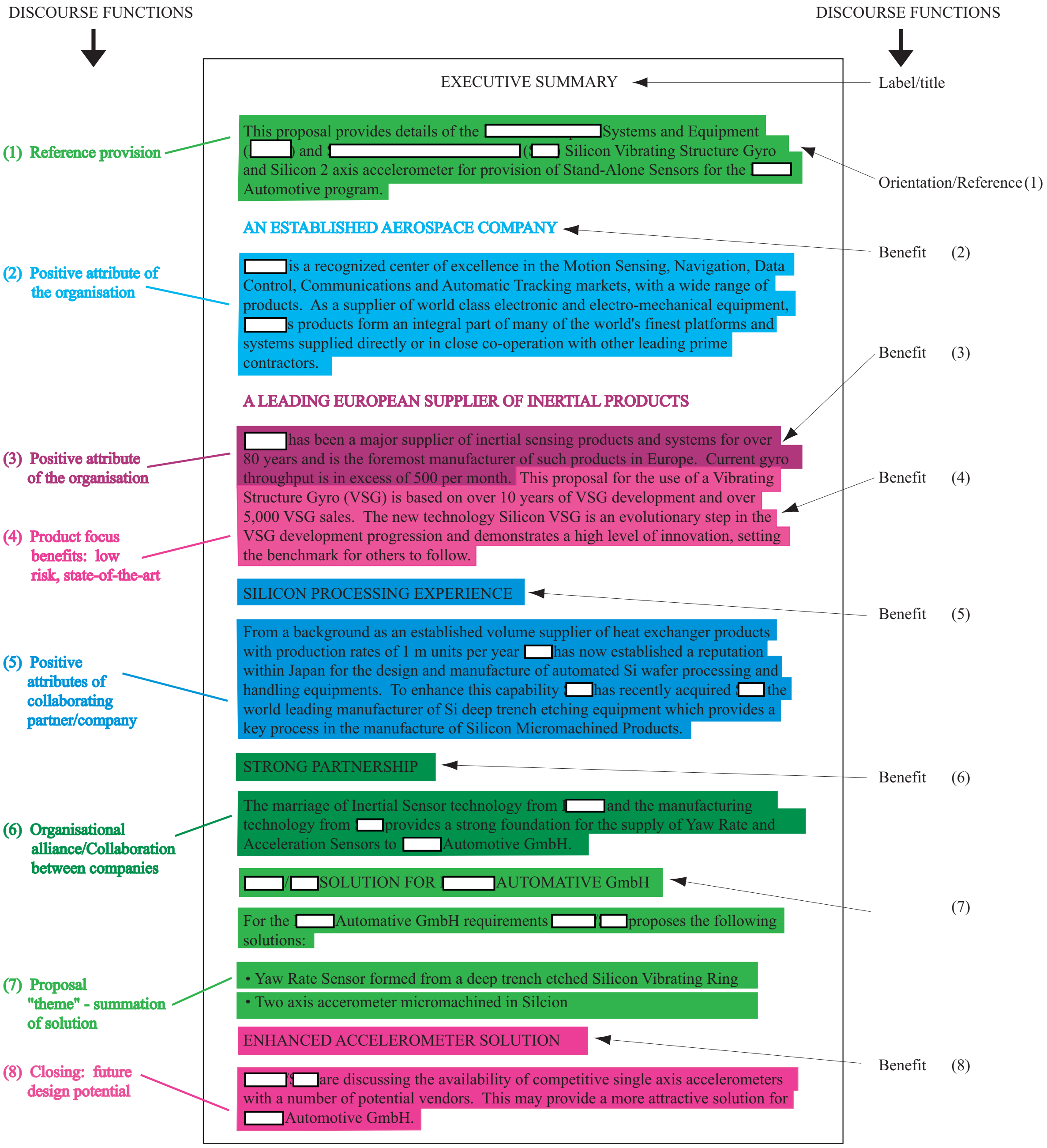


Figure 5-14: Discourse structure of executive summary

It can be seen that the executive summary comprises eight distinct segments, six of which are benefits and expressed in overtly persuasive language, and two (1 and 7) which are not. No. 7, for example, is simply a summation of the overall solution, a straightforward proposal statement (i.e. 'RASE/MPP proposes the following') followed by the naming of the two complementary products the engineers want to sell:

> RASE/MPP SOLUTION FOR FRASER AUTOMOTIVE GmbH
>
> For the Fraser Automotive GmbH requirements RASE/MPP proposes the following solutions:
>
> * Yaw Rate Sensor formed from a deep trench etched Silicon Vibrating Ring
>
> * Two axis accelerometer micromachined in Silicon

By contrast, No. 6 is clearly a bone fide 'benefit' being put forward as part of the proposed solution:

> STRONG PARTNERSHIP
> The marriage of Inertial Sensor technology from RASE and the manufacturing technology from MPP provides a strong foundation for the supply of Yaw Rate and Acceleration Sensors to Fraser Automotive GmbH.

Although a short extract, it contains examples of persuasive elements. The heading announcing the benefit of a collaborative effort, and comprising a juxta-posing of 'strong' with 'strong', respectively, an adjective with positive connotations, and a similarly positively loaded noun. There follows immediate reinforcement of the concept of a strong partnership through the use of 'marriage', which in a general sense is positively loaded and conveys the notion, again, of holding hands, working closely together, and getting on together. Further evidence of persuasive language lies in the reiteration of 'technology' in 'Inertial Sensor technology from RASE' and 'manufacturing technology from MPP', 'strong' in 'strong foundation' (another juxta-posing of words in a positive collocate).

Thus far, different segments of the executive summary have been recognised: those composed to convince the Customer of the benefits of the proposal, others which seem to perform a more straight-forward conveying of information, and others which perform a metalingual function. It will be seen that these observations are later refined, and lead to the development of categories with distinctive discourse functions, which are further refined into the Information Components, discussed in the next chapter. The refinement of categories, is accompanied by the use of more logically selected colours than those in Figure 5-14 above, because a colour-coding is applied to future diagrams in which product-related segments are distinguished by blues, company-related segments by reds and pinks, product support-related segments by greens, and metadiscoursal segments by yellows.

5.8 Concluding observations

To summarise the present situation: engineers would agree that the executive summary is a textual thorn in their sides. Their main concern is to produce a creative 'solution' in the form of a design, and in writing about it in the proposal they need to persuade the customer that it is the best of all the proposals put to him. They know the executive summary is important, but are hazy about what its function is and how it should be written. Throughout this study, I have observed persistent concern shown by engineers about the executive summary and proposal writing generally, amounting to a kind of anxiety. This concern is doubtless rooted in the fact that they can only guess about what happens to the proposal after it is delivered to the Customer. The striking fact remains that, in spite of text book descriptions which imply a clarity of process, declarations by successive governments about the need for transparency and openness, and the publication of selection criteria by those putting contracts out to tender, little is known about what happens when proposals are considered behind 'closed doors'. Certainly, to this day, engineers remain in ignorance about most that happens between the time they deliver the proposal to the Customer and when the winner is announced. Judging by the compartmentalisation of working practices and secrecy surrounding proposals, not only in this industry, but in other sectors, engineers' ignorance about proposal reading practices is therefore understandable.

Those early writing workshops saw the start of a deliberate policy of the company to include the executive summary in the overall proposal writing activity. It is still the case, however, more often than not, that the executive summary is left until the end, when, in the frantic rush to complete the proposal on time, some (possibly unwilling) engineer may be coerced into writing it, because others may be busy working on completing other parts of the bid. More recent practice, however, has seen a greater emphasis placed on drafting the summary from the start, in tandem with the planning of the proposal solution. In the proposal writing plan, time is built in for the executive summary to be drafted from the very beginning of proposal writing to ensure that it mirrors the design decisions taken during the whole process. In fact, a model approach current proposal writing teams try to adopt is to produce an initial draft of a strawman executive summary which reflects the essence of the design solution the engineers have decided upon at the outset. Those teams following this approach find it effective, since any changes in the evolving solution are expressed in the executive summary. Each time there is a change in direction or emphasis, this is discussed during team meetings, with concomitant changes made to the executive summary. In this way the overall 'vision' is encapsulated, and the document serves as a focus and reminder of the main selling points of the proposal, and the direction in which the design should progress.

It was only towards the very end of the study, after six years, that I was given access to the actual Customer, i.e. those who consider proposals of the kind submitted by HISE, and had the opportunity to gauge the accuracy of engineers' guesses about the executive summary's purpose. It appears the engineers are correct to assign (some kind of vague) importance to the executive summary, and to berate themselves for leaving it until last. It seems the decision to short list a proposal may on occasion be based exclusively on the executive summary, which is at odds with engineers' beliefs, since they tend to regard the more detailed technical aspects of the proposal to be the most important, and have directed their energies accordingly. They are right to concentrate on these sections, although it would be wise for them to revise previously vague notions about the executive summary, and to elevate its status.

It could be said that the executive summary has so far received a good deal of attention in this study out of proportion to its length, which is generally tiny compared to the proposal it represents. Further support for this view is the fact that it is not uncommon for the proposal to consist of only the technical section, which is submitted without an executive summary. In the proposal corpus, of the ninety-five proposals considered (and compiled) for this study, only about 30% contain an executive summary, and this is in spite of the fact that it is generally acknowledged to be good writing practice to include one. However, the attention so far paid to the summary, and the further examination it receives, can be justified for these reasons:

1. In an ordered proposal writing process, it helps the bid team to establish its proposal writing strategy.

2. It encapsulates the main benefits of the proposal for the Chief Readers.

3. It plays a pivotal role in the decision making process in the selection of candidates for the short list.

In the next chapter, both the executive summary and the (main section of the) proposal are examined with the purpose of exploring the notions of discourse function raised in this chapter. The potential for further, meaningful analysis of proposals will be explored, and an attempt will be made to discover if ideas about 'discourse components' can be refined further, in order to yield a useful taxonomy of component categories.

CHAPTER SIX - A SUGGESTED METHODOLOGY FOR ANALYSING PROPOSAL DOCUMENTS

6.1 Introduction

The previous chapter lists the different sections to be found in a technical proposal, and establishes that design engineers have to write two key parts: the executive summary and the technical section of the proposal. If the two are submitted together, they are referred to as a single textual entity, and called 'the proposal' or 'the technical proposal'. The technical proposal may be submitted as a single complete proposal in the case of smaller bids, or may be submitted as the technical volume, one of a tripartite set of proposals, the other parts of which are prepared by the commercial and legal departments of the company.

Up to this point the proposal has been examined taking a top-down view, and using an ethnographic perspective as a starting point. Account has been taken of the engineers' opinions about the documents they write, and observations made about the purposes underlying the texts, their macro structures, and discourse functions. Also included in this analysis were the contextual features supporting proposal text, i.e. page layout, design features, visuals, glossary, etc. , and the portrayal of the executive summary as an encapsulation of the whole proposal, with a discourse structure distinctive in the way that it highlights key benefits of the proposal to the Customer. Emerging out of the analysis so far has been the identification of sections, or 'segments', of text relating to particular discourse functions, most of which relate to particular selling points. It was thought that the devising of such a list could be potentially useful to engineers as a sort of 'bank' of selling points (or benefits) that they could refer to at the start of, or during, the proposal writing process, the idea being, for example, that they could make a selection when putting together the strawman.

This chapter continues the journey through the proposal document, now considering the structure of the main section of the proposal, which is frequently, though inadequately, referred to as the 'body', and could comprise several substantial sub-sections. The term 'body' is commonly used by various authors on writing to refer to that part of the proposal in which an argument is developed, or the case for a particular stance put forward. It seems that 'body' is often used because it conveys a general impression in a metaphorical sense that non-specialists can understand and relate to: the writing comprises various connected (and inter-connected) parts which perform different functions, much as the human body comprises arms, legs, head, torso etc., which themselves contain embedded structures (human organs, bones, blood supply system), all of which contribute to the successful functioning of the whole body. It is a term which is used glibly and conveniently. Unfortunately, authors who use this term in writing guides, rarely go beyond anything more than naming the part, albeit often a large one; hence the perpetuation of the writing mantra: ‘Introduction, Body, Conclusion’ being chanted by students and engineers alike.

The term is, however, of little help to these writers, because ‘body’ seems to refer to that part of any piece of writing that writers find most difficult, and which involves, among others, selecting relevant information, organising this information as ideas or facts in a coherent and concise manner, and making appropriate stylistic choices. The metaphor is therefore a good one for representing a general idea of the structure and for conveying a sense of its complexity, but it is inadequate for helping writers to identify the parts of the so-called body, let alone arrange and express them effectively. This chapter describes an analytical approach to help tackle the problem of information selection, among others. It describes the methods followed in an attempt to devise an approach with both general and specific applications to analysing proposal texts. The approach is a ‘grounded’ one which uses software which has been specifically designed for this type of research.

6.2 Trying to establish the ‘WHAT’-factor - towards a taxonomy of document topics

The stage has been reached where the observations, hypotheses, and hunches made about proposals and executive summaries need to be brought together in order to discover something about proposals that engineers would find useful and interesting, and not dismiss out of hand as being subjective and unscientific. Therefore, I decided at the start of this analysis to devise a set of analytical categories that would conform with certain criteria. If they were going to be of any use at all, they should:

- **be easy to use**. When such a list is achieved, the analysing (or coding) of text should be achieved faster than before.
- **have a specific focus**. It is unhelpful for the identification of information components, to have vague categories.
- **have comprehensive applicability.** The list should apply to every part of the document, and accommodate every word. In the holistic treatment of texts the analyst should not be faced with any part, however small, which cannot be accounted for.
- **be mutually exclusive**, in order to conduct the kinds of analysis where it is important to be able to allocate a text segment to one category only, and not cause the analyst any vacillating anxiety with a choice of categories to choose from.

It seemed to me that these characteristics were the corollary of some kind of analytical ideology, and that the approach had certain principles underpinning it: its ideological basis relied upon the researcher being consistent and maintaining the integrity of the categories being devised. Furthermore, the effectiveness of the tool could only be judged when it had been applied to the data and interpreted. It struck me that this process had parallels with anonymous marking of students' work. In such a situation, the marker has to trust the integrity of the marking scheme, or at least adhere to it, and ensure consistency in applying it when marking student assignments. There should be no chance, when matching confirmed marks to actual student names, of returning to a script and changing the mark, just because a student who has always done badly has amazed you by doing well. Similarly, as the analytical tool is being applied to text, the analyst should apply the tool consistently, even though it does not seem to be yielding interesting results; there should not be any fiddling of the data, or compromise if any segment does not quite 'fit'. The analyst is led by the data, and follows any trails that they indicate. It is an unfortunate (and frustrating) consequence if they are not interesting or fruitful. If this should happen, the analyst must start again, and take a different approach.

It appears to be received opinion that a researcher brings to his study a set of beliefs and ideas belonging to a particular ideology which reflects the philosophical / intellectual stance of the researcher and the discipline he represents (Rudestam and Newton 1992:22). It was an essentially heuristic approach , which is faithful to the 'grounded approach' used by Berkenkotter and Huckin (1995:3), which is also referred to as the 'constant comparative method' (Glaser and Strauss 1967:?). Rudestam and Newton provide a strikingly accurate description of the kind of process that evolved in this study, by first stating that such an approach is based on data collected in naturalistic settings where the data are coded into as many themes and meaning categories as possible. As the categories emerge and are refined, the researcher begins to consider how they relate to one another and what the theoretical implications are. They explain that gradually the theoretical properties of the meaning categories crystallise and form a pattern, and the pattern that emerges is sometimes called grounded theory (1992:36). None of the literature surveyed on this method mentions the extended and difficult periods that may occur as a result of following this method, during which the validity and the usefulness of what the researcher is doing seems obscure. This chapter, then, describes the approach, charts its progress, and reports on the results.

6.3 Analysis through use of software (QSR NVivo) – a report

6.3.1 Software to suit a grounded approach

I decided to use a recently developed software package, NUD*IST Vivo, to help me in the identification and refining of the discourse categories. This software is referred to as NVivo by its creators, to distinguish it from another rather better known package they had previously produced, called NUD*IST. NVivo is best described as a management tool, which provides the means of tagging and coding texts, and which is especially suited to a 'messy' bottom-up approach. Its makers claim it has been designed for qualitative research projects, and encourage users of NVivo to start using it early in a project, so that every item of information collected may be captured and recorded. The manual conveys the impression that the authors appreciate the nature of qualitative research, and the kind of ethnomethodological approach taken in this study. They appear to understand, for example, the researchers' magpie instincts in the early stages of a research project, when it is difficult for them to distinguish between significant or insignificant information, and they clearly try to accommodate this by suggesting that everything should be captured, and nothing lost in the analysis; an item of information which seems insignificant early in a project may prove crucial later (Richards 1999 : 23, 26). For anyone, like me, following a grounded approach which is essentially investigative, the software manual seemed to suggest that NVivo would offer a useful way of managing the large quantities of text I had collected. The following extract from the manual, for example, proved an attractive and irresistible exhortation to use NVivo for this part of the analysis:

> Qualitative projects often start from little structure, the launching place being curiosity or hunches, awareness of a problem or puzzle, rather than a formal hypothesis. This can be a serious problem when researchers are unable to get started , because the project seems to have no beginning. NVivo is designed to assist researchers working from such situations, as well as those with structured project plans. There is no need to wait until the project seems orderly (it may never do so!). (ibid.: 23)

I had reached a stage where I felt somewhat overwhelmed by ideas, hunches, and paperwork, and was not looking forward to the prospect of manually processing the texts, drawing up tables of findings, and cross-referencing. I had been at this stage before in previous projects and in this one: the analysis of the email questionnaire and interview data in Chapters 1-3 had all been annotated and tagged manually (apart from the use of the spreadsheet program EXCEL), and I wished to avoid the feeling of again being overwhelmed by the sheer volume of data. Furthermore, I was interested to see what sorts of results would emerge from the use of such an electronic tool, and whether the constraints and enforced systematicity would yield unexpected or more interesting findings. For these reasons, I decided to use NVivo as a data-handling tool to code text and manipulate it, in order to perceive patterns or trends. NVivo does not automatically code or tag text, but serves as a means for this to be done. It is highly labour-intensive.

The process for evolving the categories is now described.

6.3.2 A description of the analytical process

For the purposes of this description, I have divided the process into stages:

6.3.3 Devising the categories – a continuous drawn out process

In fact, the process of devising categories is an iterative one, during which, at times, you seem to take one step forward and two steps back, so that it is difficult to see much progress being made. However, in retrospect, it is possible to see that the process comprised the following stages:

1. 'quick and dirty' where the first batch of documents (or a single document) is analysed and any label that seems apt at the time, be it information- or topic-related, evaluative, or any other annotation, is attached to text segments. It would not be inappropriate to refer to this as a grape-shot approach.

2. trialling the labels on other document segments, and refining them by adjusting them, deleting them, merging them, and so on.

3. establishing some kind of taxonomic coherence, amending the labelling/ categorisation, and in the process, making further changes.

4. testing the categories by applying them to text, until a list of logical categories emerges which essentially offers the desired analytical prospects being sought, and which conforms with the criteria listed earlier.

6.3.4 Stage 1 - a grape-shot approach to begin with

At the start of this analytical process, I combed through a small sample of texts, a mixture of executive summaries and short proposals, in order to devise workable categories to account for hunches I had about sections of text, and to record my observations about the way they were structured and styled. The categories initially included those on linguistic features, e.g. loaded language, complex NPs, and clause patterns, as well as comments on subject matter and section topics. This eventually proved to be too messy and unwieldy, and, the more I used the software, I was to learn that NVivo would work better with more refined categories for the purposes I had in mind. Initially, I had been attracted by the software designers' claims that NVivo is useful at the genesis of a project, but failed to foresee the problems such a grapeshot approach could cause. To draw an analogy: it proved to be rather like the brainstorming diagrams (referred to as 'mind-mapping') that study guides encourage students to use to plan an essay, which seem to serve only to extend the period of indecision for some students, and certainly do not seem to help them produce well-organised essays. In the case of this analytical exercise, I found that quite well-evolved categories were needed before they could be tried out on a larger sample of texts. I had started out by thinking my ideas about the discourse functions, and in particular 'Information Components', were reasonably clear, but it soon became apparent, when trying to use the software, that they were anything but clear, and that rather better evolved categories were needed before they could be tried out on a larger sample of texts.

A rough list of categories emerged during this initial comb through (shown unexpurgated in Appendix O), as a first stab at devising a list of notional analytical categories. This first list attempted to account for all the kinds of information conveyed in proposals (including executive summaries), for example: that certain sentences or paragraphs were about how successful a product had proved with other customers; that other sentences expressed how committed the company was to quality assurance; and yet others that seemed to have something to do with the discourse itself, and seemed to relate to the organisation of the text and how it should be read. This early list also shows labels relating to authorial stance or evaluation, apparent persuasive language, or non-persuasive/ factual language, and other rhetorical features. In tandem with this list building, category labels from the list were used in early attempts to tag segments of proposals, a process which is described in more detail below. At this early stage, the segments were maximally groups of sentences which were several paragraphs long, or were one of the clauses or phrases in a sentence, or, minimally, a word.

Figure 6-1 below shows a screen dump of part of a proposal (EP3024) as it is displayed within NVivo. It shows the proposal text to the left, and NVivo coding stripes to the right. As can be seen, the coding stripes show multiple coding, or overlapping coding, where, for example, a paragraph may be about the superb manufacturing facilities, but also about research and development (R and D) facilities. In the case of the section of EP3024 in Figure 6-1, segments convey information about the company's structure or the structure of the proposal document, for example, or they simply label headings and sub-headings.

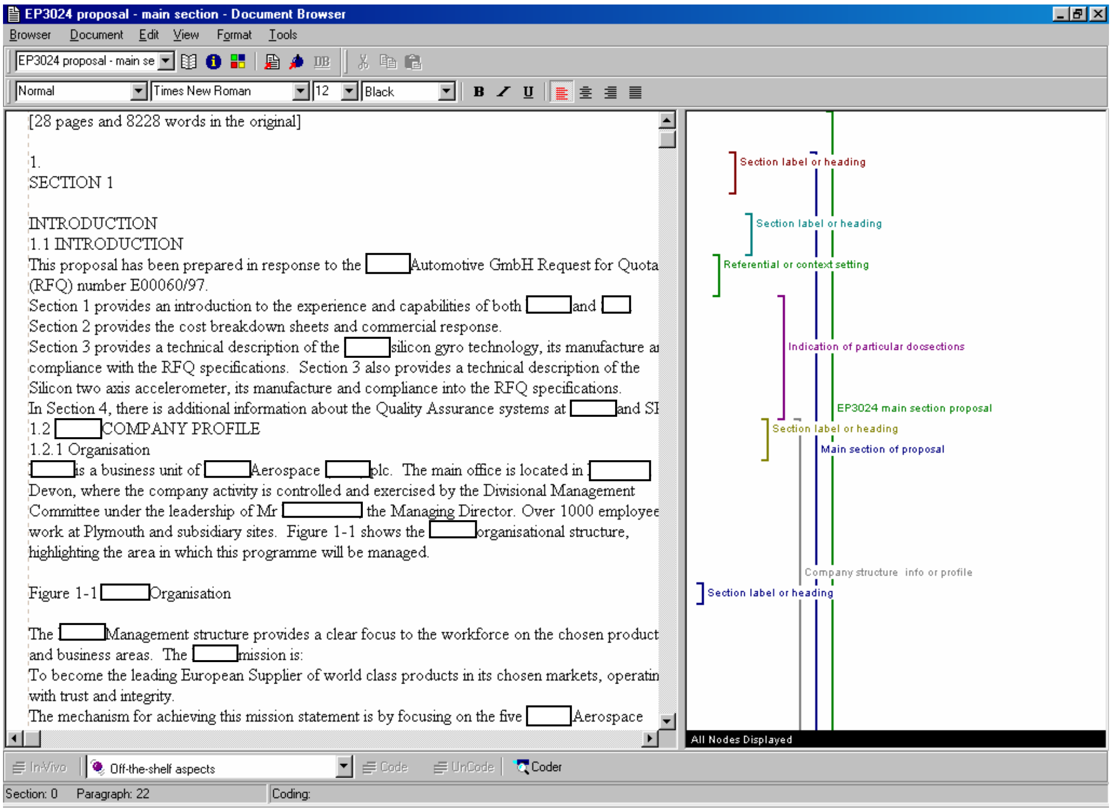


Figure 6-1: Grape-shot coding approach – results on-screen within NVivo (section of EP3024)

If I recognised a paragraph as having appeared in other proposals, I designated it as a boilerplate segment to mark it out as having been 'lifted and shifted', a term used at the company to refer to the ‘cutting’ and ‘pasting’ (word-processing features) of text. It has to be admitted, however, that some of this early coding was just plain wrong or irrelevant. Later attempts to code other proposals brought about refinements to coding/category labels, and led to more logical groupings. Later still, it became clear that some categories still overlapped with others in terms of information content, and, consequently, a process of category merging started to take place, as a natural part of this refinement process.

6.3.5 Stage 2 - Trialling and refining the categories - trying out a pilot version

Eventually, several versions of the list later (in all, there were eleven), when there emerged one which seemed to be fairly robust and appeared to conform with the criteria mentioned above, it was decided to try it out with a larger sample of texts. By this time, and more experienced with NVivo, I realised that, for the kind of analysis I wanted to do, NVivo was not forgiving and that the categories had to be robust before I could proceed with a representative sample of proposals and executive summaries. In order to be robust, the categories had to be mutually exclusive, and any overlapping that existed had to be resolved and removed absolutely, without compromising the integrity of the categories concerned.

A continuous process of refinement

As an example of this, let us consider the following segment from ep3024e, which is intended to impress the reader about the position of the company in the gyroscope field in terms of development, production, and sales:

> A LEADING EUROPEAN SUPPLIER OF INERTIAL PRODUCTS
>
> RASE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe(S1). Current gyro throughput is in excess of 500 per month(S2). This proposal for the use of a Vibrating Structure Gyro (VSG) is based on over 10 years of VSG development and over 5,000 VSG sales(S3). The new technology Silicon VSG is an evolutionary step in the VSG development progression and demonstrates a high level of innovation, setting the benchmark for others to follow(S4).
> [S = sentence]

I originally identified the following category labels for the text, some of which have since been changed:

1. Company's standing (Whole paragraph)
2. Good reputation (Whole paragraph)
3. Company's size (S1- S3)
4. Company's track record - – S1- S3
5. State-of-the-art features – S4
6. Expertise and experience of personnel – S3 - S4

However, examination of other executive summaries revealed the need to use the broader 'Good reputation' rather than 'Company's good reputation', in order to accept the inclusion within the text of any boast about the reputation of a product, as well as the reputation of the company. Similarly, a change was made to another category, i.e. 'Company's size'. It soon became evident that this label would automatically exclude any reference to customer numbers, number of units sold, or the scale of production, and, as a result, it was changed to 'Impressive size or scale'. At the time, it was reasoned that this label would admit claims about the size of any object, person, or phenomenon.

From the earliest stages of categorisation, a continuous process of this kind of refinement was taking place. Even though many of the early categories proved eventually to be invalid or unworkable, their creation and demise led to identification of the more useful categories for the analysis that emerged. In the end, for example, the category 'Impressive size or scale' was refined further to become 'Company pedigree and/or reputation', as the analysis became firm.

Take this extract from the executive summary EP3007e, as another example. Few would dispute that the heading 'Development Experience in Naval Electro Optical Tracking Systems' is a fair representation of the content, which is, after all, a listing out of specific examples of product development experience.

> **Development Experience in Naval Electro Optical Tracking Systems**
> The Sea Neptune 1 Electro-optical gun fire control system was developed in the 1970s, Sea Neptune 1 systems were fitted to the Royal Navy TURRET class patrol vessels and exported to customers in the Middle and Far East. Using this experience in naval Electro-optical tracking, RASE developed the high performance General Purpose Electro-Optical Director (HPEOD), which was selected by the Royal Navy in 1985. The resulting Sea Neptune 30 system (designated YGO46 in the Royal Navy) provides Electro-optical surveillance, tracking and gun fire control.(Extract from EP3007e)

The ostensible purpose of this extract, i.e. to outline the historical background of the product's development, initially caused some puzzlement because both its communicative function and the reason for its inclusion in the summary was not clear, bearing in mind that the aim of the summary is to persuade the reader about the benefits of the proposal, by highlighting the key ones. What were the motives of the writers for including this historical segment, and what were they trying to persuade about? Initially, it was thought that the purpose of the extract was to convince the reader of the 'proven performance of the product', because, by inference, the fact that the product was already in use by the Royal Navy and other navies could be considered to be proof of performance. However, remembering an interview with an engineer who explained that 'Proven performance' is a term is often used to refer to the fact that the product had been submitted to, and passed, numerous tests, I thought that perhaps 'proven performance' could be inferred from the historical information provided. The General Purpose Electro-Optical Director (HPEOD) must have been used by the Royal Navy for decades, since the Royal Navy has been using these systems since around the time of the 1970s. This implication aside, as part of design procedures, the HPEOD would have been submitted to a range of tests over a number of years as a matter of course, and its design modified as a result; hence the label 'Proven performance' seemed justified.

When asked about this section, another engineer agreed it concerned proven performance, but, after further mulling, introduced other terms. He suggested, for example, 'battle hardened' to describe equipment which has proved effective in a battle situation. He suggested it would have either proved itself or had its design refined using assessments of its performance in an authentic battle situation. Still trying to find a better category label, I asked him about the appropriateness of the category, 'Broad customer base'. His response was: "That might imply satisfied customers, but they aren't always satisfied".

As a result of this consultation, I made a note to do a search for the term ‘battle hardened’, since I recalled having heard it during interviews, but not having seen it used in documents [it isn’t]. It was a potential category label, but could have only limited use as it would be relevant to only a proportion of the products designed by the company (not all products are produced for battle/war). In the end, it was decided that a more comprehensive label was preferable, to encompass a greater range of products, similar to the general applicability of ‘proven performance’, for example. The whole point of identifying categories for the analysis at this stage, after all, was to devise a set which would be applicable to all executive summaries, and, it was hoped, eventually, all sections of the technical proposal.

The need for exclusive categories

When first encountered, this extract, taken from ep3007e, was coded against three categories, because it was not realised at the time that this multi-designation would lead to problems later in the analysis, when attempts would be made to measure the categories and make judgements about them.

> The Royal Navy system continues to benefit from further investment. Full integration of YGO46 with the Combat System Highway and Combat Management System of the Type 23 Frigate class completed sea trials in June 1996. Procurement of eye safe lasers for the fleet has commenced and the RN is making budgetary provision for the introduction of 3-5μ thermal imagers to enhance operational capability in tropical waters.(ep3007e)

The extract contains technical information about the product; it is clearly persuasive, because it is showing how the design is still improving because of continued investment and ongoing research and development. Since it is also pointing forwards to the future, it was coded to indicate this prospection. Initially, this segment was coded against:

1. research and development

2. special design features

3. prospection - future potential

It soon became clear that these were an inaccurate depiction of both the information contained within the piece, and its persuasive function, and furthermore, that the extract did not really fit into any of the above categories. This realisation was accompanied by a recognition of the need to move away from multi-labelling, and to identify a single label (or category) that would satisfactorily account for the function of the information it contained. The extract had something to do with research and development, but coding it against ‘R&D facilities’ was unsatisfactory. It was also was an uneasy fit with ‘special design features’. After discussing this matter with engineers, I changed ‘Special design features’ to ‘Special design improvements or enhancements' to accommodate it. Later still, when larger quantities of text needed to be accounted for, the category label was changed to 'Design improvements or special features', a subtle but nonetheless necessary change to maintain the integrity of the category.

There comes a time when a line has to be drawn under this list-building process and, to use an engineering term, a 'design freeze' declared, because, in a sense, the devising of this categorial list was a sort of design process, which saw the development of a tool for analysing text. The design freeze, then, is the point when the changes simply have to stop, and the tool be put to work. Of course, as in engineering, a design freeze is not really a freeze at all, in the sense that absolutely no changes can be made to the design plan; it is more usual than not for minor adjustments to be made. More unusually, major changes to the design may have to be done (see 'Threshold Three: production' in Chapter 1), but this is an undesirable scenario (engineers have referred to it as a nightmare scenario) which is not usually expected, and which any engineer will try hard to ensure does not happen. An analogy with the engineering design process can be drawn with the list I have attempted to devise. It is not feasible to 'go the whole hog' and apply the categories to the texts in a systematic way, unless the analytical categories are firm. Any unexpected changes that need to be made during the application of the tool, could require a complete revision of the categories and a repeat of the whole process.

Anyone who has done this kind of analysis may have shared my previous experiences of reaching the supposed final stage of interpreting the data, and even to be drawing graphs of the findings, only then to discover a flaw in the original analytical categories. Few are immune from the palpable frustration this causes. This dry run, then, was intended to prevent such a problem arising again, and, in fact, proved useful in revealing some of the flaws in the categorisations.

6.3.6 Stage 3 – Attempting to establish taxonomic order – general issues, subcategorising, and naming

Somewhere around this point of the analysis, I grappled with terminology. I seemed in danger of losing my sense of direction at this time, and was having difficulties, not so much with identifying the parts (or components), since most of these had evolved during the analysis using NVivo, but with placing them into groups or major categories, and naming those categories. I had succeeded in accounting for different segments of texts, by scrutinising each, asking what it was about, or what its function was, and considered every word in every document. However, it seemed for a while that the satisfaction gained from accomplishing this was going to be short-lived, if a coherent classification system was not evolved soon. According to Marder, the process of arriving at the categories is inherently one of formal definition, which in turn is the process of identifying the components through classification and differentiation: classification involves placing a term or component 'in the general group of things similar to it'; and differentiation means that the term or component 'is isolated from all other members of its class by indicating its distinguishing characteristics' (Marder 1960: 66).

On reflection, I had been devising and refining categories with a notional idea about my classificatory criteria. I had been examining a range of proposals to get some idea of what they were about: their substance, or their 'WHAT'-factor, for want of a better term. It seemed important to move beyond considerations of discourse purpose, proposal sections, layout, themes and/or selling points, and the organisation of ideas, and to ask what exactly it is that engineers write about in proposals to achieve their purpose of having the proposal accepted. Others have attempted to describe the structure of information in terms of information units (Brown and Yule 1983: 155), but in this study it was thought possible to be more content-specific. Was it possible to devise some kind of textual calculation which would facilitate the cataloguing and measuring of the information content of these texts? With an eye on the long-term, and eventually investigating the writing of specifications and requirements (that arise out of proposals), it seemed important to think of 'a way of producing metrics', as engineers would put it. There needed to be some kind of estimation of the text that could be related to (functional) points made about the product in the design code that engineers write to specifiy the product in finer detail. Engineers are not unlike linguists, in that they believe that improvements to the product cannot be made without some kind of 'metric' or measure. In the case of proposal or specification documents, it was thought important to identify the unifying content links between the various design documents.

I had been identifying categories as a means of discovering, and measuring, what the texts were about in an attempt to deconstruct the 'what'-factor of the texts, and it was for this reason that I initially called them information components. Most of them were about something; that is, they conveyed information about a particular aspect, feature, or thing. My reasoning was as follows: if anyone were to ask what any one of the components was about, I would be able to provide an answer that related to a particular topic, which could be summed up in a (noun) phrase, for example, the reputation of the company making the bid, a commitment regarding the documentation that would be produced, or a special design feature of the product being offered as part of the solution. I reasoned that these information components formed the bedrock of any text, upon which other judgements could be made. It seemed reasonable to assume that once this was established, it would then be possible to examine other linguistic aspects, or stylistic/rhetorical devices relating to each topic.

There are others who try to measure, or in some way account for, the information in written texts. Halliday, in describing how to measure lexical density, refers to density as a textual concept in relation to the presentation of information, and as being ‘a consequence of the subject matter’ within the text (1989:61-2). In demonstrating how to determine lexical density, he is demonstrating a concern about what I refer to as the ‘aboutness’ of the text, albeit for somewhat different reasons and from a different perspective. I have also been influenced by Davies and Greene, whose work on science textbooks informed my own study of text structure nearly two decades ago. They demonstrate through their analysis that scientific texts are information-dense and as a result provide arduous reading tasks to school children. If the children are not properly taught to practise ‘reflective’ reading habits, ‘rejective’ reading may result (1984:42). I was inspired by the analytical approach they recommend science teachers to follow in order to render such texts more accessible to students, even though the analytical work demanded would prove to be too time-consuming (and the linguistic aspects possibly too difficult) for working teachers to carry out. Davies and Greene set out to define precisely the ‘information structure’ of a text, stating that it is the ‘underlying level of information communicated through text that we want our pupils to reach’. They explain that ‘the notion of structure carries with it the notion of *parts*, or *constituents*’ before discussing the importance of ‘information constituents’ which they claim define the information structure of a given text (ibid:37-9):

> By information constituents we mean something like elements of content – the sorts of things we expect the text to be about: the information slots we expect to be filled.
> (Davies and Greene 1984:39)

Judging by these pronouncements on ‘information constituents’, it is clear that Davies and Greene have been influential in this work. My wish to discover some way of identifying discourse/information components in proposals was probably motivated by the notion they put forward that it is possible to identify in text ‘specific items of content’ (ibid:39). My use of the terms ‘segment’ and ‘extract’ with regard to text, is very similar to their idea that ‘in different texts the information constituents are expressed by language units that differ in size and in arrangement’(ibid:76). At the time, their work appeared fresh and ground-breaking because they tried to provide frameworks for different text types, which provided good models for anyone wishing to write scientific texts (ibid:89-132). However, their attempts to include in their analytical ‘frames’ consideration of other seminal developments in text analysis at the time, including coherence and cohesion, discourse organisation and information structure, and their wish to account for all scientific texts in school text books was to prove problematic: their text ‘frames’ were to prove an uneasy fit for those deviant (what Davies and Greene refer to as) ‘untidy’ texts that ‘violated’ the proposed frameworks (ibid:85). Nevertheless, their examination of the different types of text (classification, structure, concept-principle, mechanism, among others) has inspired many aspiring text analysts, and their work on multiple frame texts in the final chapter provides a hint of a promising route to follow. There is an underlying theme in their work which is somewhat reminiscent of Sinclair's ideas about 'open choice principle' texts, based on a 'slot and fill' principle which Sinclair regards as a segmental approach which is more relevant in the case of specialised texts like legal or technical texts (1987a:320, 324), especially when they write:

> Each example has been analysed to show how the text 'fills' the slots of the information structure or frame (Davies and Greene 1984:130)

The idea that text can be constructed or deconstructed in much the same way as a machine can be assembled or taken apart is appealing to engineers. It conforms with a scientific approach to any task, and, although surmise, it could be one of the reasons for Davies and Greene's distinctive and somewhat idiosyncratic approach to text: they were attempting to appeal to a scientific audience. This idea of portraying text as a construction of components is certainly an important feature of this analysis, as is the attempt to identify 'information' components, as distinct from, say, grammatical/syntactic components. The components must be recognisable and usable by those who compose proposal texts, i.e. the engineers. Certainly, the way that engineers 'lift and shift' portions of text to compile a document has persuaded me of the need to identify discrete information components in this way, my reasoning being that once this is achieved, other types of analysis will then be enabled.

Most researchers like to think that their ideas are original or new, but it is possibly Marder who, in a discussion about technical exposition, in particular, definition, first coined the word 'aboutness', which he sees as being an essential precursor to writing about any subject. He emphasises how important it is to establish the 'aboutness' of writing:

> One of the first questions asked about anything is, 'What is it?' The answer to this question clearly establishes the subject and allows the writer to proceed to the 'aboutness', that is, what he was to say pertaining to the subject (1960:61).

He then proceeds to explain the problem, not only of defining terms, but of the preliminary problem of what to define (ibid:63), demonstrating the fundamental need to establish the subject content or topics dealt with in the text. I was satisfied that the subject content had been accounted for since main categories had emerged that contained sub-categories for designating the information content, or so I thought, of proposal and executive summary text. It was, after all, these sub-categories that I was using as labels for coding the texts in NVivo. However, the general label 'Information Component' did not apply to other categories which had emerged, and this was where my problem lay. Some of these categories were distinguished not by their 'aboutness' but by a distinctive discourse function through which the writer attempts to influence the way a text should be read, and attempts to organise the reader in the reading of it. This presented me with a dichotomy which at first seemed to render my analysis untidy: most of the categories related to particular information topics, but others did not, relating instead to metalinguistic aspects.

It was reassuring to learn that others had also encountered this broad two-way split in textual function: Hunston and Thompson discuss the relationship that exists between writer and reader as not only existing 'in terms of the information in the text, however, but in terms of the text itself'. They refer to this latter aspect as 'organising the discourse', explaining that the relationship that exists between writer and reader is one in which the reader is subordinate, and which 'tells the reader "this is the beginning of our text, this is how the argument fits together, and this is the end of our interaction"' (Hunston and Thompson 2000:10). Clearly, this had been identified as being a significant feature of some texts, and since it was manifest in the proposal documents in this study, I decided to group the components together in a category called 'metadiscoursal' rather than the more traditional 'metalinguistic', since the components related to particular and, sometimes, whole pieces of discourse. This meant that the components fell into two broad groups, one topic-focused and the other metadiscoursal. The topic-focused group, became further subdivided into categories relating to the product or solution; matters relating to the company, including people working for the company; and, finally, matters relating to after-sales customer and/or product support.

However, what was a suitable label to use for all the categories, bearing in mind that not all of them depicted subject content, or 'aboutness'? After considering all manner of terms, including, among others, 'set', 'focus', 'domain', 'topic', 'theme', 'subject', 'point', but all in vain, I finally selected the cover-all compromise term 'Information Component' (IC) to refer to all the components. This is not a perfect term to use, since the Metadiscoursal IC s are not primarily conveyors of information about the solution, but it reflects the overriding interest in this study in information topics, particularly those relating to the product.

Eventually, a comprehensive list evolved which contained components which would be suitable for coding against a small but representative sample of documents, in this case, five proposals and five executive summaries. Table 6-1, below, lists thirty-nine ICs under four main categories, which were used for this analysis to examine the 'aboutness' aspect of proposals, and that are later applied in an attempt to understand the information structure of proposals. As mentioned earlier, there exists an exhaustive list in Appendix T, which itemises every category that emerged during the analysis. It contains six main categories, four of which are reproduced in Table 6-1 and are used for this analytical exercise. All the ICs are to be found in proposals, but only those marked with a dot were found in executive summaries.

The two other categories contain labels or coding categories which were needed to use the coding features of NVivo, or those which will prove useful in a future analysis, in which, for example, the evaluative features are examined. (At some future date, it would be interesting to identify the linguistic devices employed by writers to achieve the texts' ultimate purpose to persuade, for example.) These last two categories, then, are not relevant to this part of the analysis because they either perform a discourse function unconnected with the 'what' aspect of text; or were devised for using NVivo effectively.

First category - Product (or Solution) Focus
Compliance - how compliant or degree of ●
Cost benefit or implication, including potential savings ●
Costings
Design improvements or special features ●
Low risk ●
Manufacturing plan
Off-the-shelf aspects ●
Packaging
Potential improvements or benefits to the design ●
Product or solution gloss (or statement) ●
Programme schedule
Proven performance and tests success ●
Risk
State-of-the-art features ●
Technical response to requirement specifications (may be in Appendix)
Testing and tests
Track record of the product ●
Viability / feasibility / attainability of the solution ●
Second category - Company Focus, including engineering personnel
Collaboration and alliance benefits ●
Company pedigree and/or reputation ●
Company's commitment ●
Company's good **R** and **D** facilities ●
Company structure/information/profile
Expertise and experience of personnel ●
Kitemarks, standards, and accreditation
Quality Assurance

Production and manufacturing - good facilities and high standards ●	
Third category - Customer (and product) Support Focus	
Aftersales customer and product support provided ●	
Availability Reliability Maintainability	
Integrated Logistics Support (ILS)	
Installation	
Maintenance and support in the field ●	
Training provision	
User documentation, manuals, online help, etc.	
Fourth category - Meta-discoursal focus	
Distribution list	
Indication of particular docsections ●	
Proposal title	
Referential or context setting ●	
Security rating of document	

Table 6-1: Information Components (ICs) organised under four main categories

6.3.7 Stage 4 - Applying the categories to text – proposals and executive summaries (using NVivo)

Main documents examined for this exercise
Technical proposals:

1. **EP3042** – Proposal for a Radome for the Synthetic Aperture Radar for the Kastar Programme, December 1997

2. **EP3015** – Proposal for an Integrated Surveillance System for the xxxxx Naval Service, July 1997

3. **EP3024** – Proposal for Yaw Rate and Acceleration Sensors for Fraser Automotive GmbH, August 1997

4. **EP3020** – Proposal for the Replacement of the 8-12µm Thermal imager by a 3-5µm Instrument in the Sea Neptune 1A Fire Control Systems of the xxxxx Royal Navy, July 1997

5. **EP3018** – RASE Preliminary Response to Spacetronics Missiles Request for Information for the Development of an Inertial Measurement Unit for the Modular Air-to-Surface Weapon (AASM) Programme, July 1997

Executive summaries:

1. **EP3007e** – Proposal for a fire control system for the Indian Navy, May 1997

2. **EP3018e** – see EP3018 above

3. **EP3024e** – see EP3024 above

4. **EP3124e** – The provision of Next Generation Rate Sensor Units (NGRSU), June 2000

5. **EP3129e** – Mission planning and retrieval system, November 2000

To begin with, five executive summaries were annotated using the NVivo coder; in other words, text segments were identified and placed into one of the IC categories. As an example, Figure 6-2 below shows an executive summary (ep3024e) in which six ICs have been distinguished by different colours. Text is highlighted on screen by NVivo when any of it is coded, but since the actual coding and colouring of text is not automatically done by NVivo, the segments are shown in different colours in Figure 6-2 for reading convenience, having been coloured manually. The coding of text in NVivo is done by selecting a portion of text (a word, a phrase, or more) and allocating a coding label to it.

EXECUTIVE SUMMARY

This proposal provides details of the REM Aerospace Systems and Equipment (RASE) and Makemoto Precision Products (MPP) Silicon Vibrating Structure Gyro, and Silicon 2 axis accelerometer for provision of Stand-Alone Sensors for the Fraser Automotive program.

AN ESTABLISHED AEROSPACE COMPANY

RASE is a recognised centre of excellence in the Motion Sensing, Navigation, Data Control, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world class electronic and electro-mechanical equipment, RASE's products form an integral part of many of the world's finest platforms and systems supplied directly or in close co-operation with other leading prime contractors.

A LEADING EUROPEAN SUPPLIER OF INERTIAL PRODUCTS

RASE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe. Current gyro throughput is in excess of 500 per month. This proposal for the use of a Vibrating Structure Gyro (VSG) is based on over 10 years of VSG development and over 5,000 VSG sales. The new technology Silicon VSG is an evolutionary step in the VSG development progression and demonstrates a high level of innovation, setting the benchmark for others to follow.

SILICON PROCESSING EXPERIENCE

From a background as an established volume supplier of heat exchanger products with production rates of 1 m units per year MPP has now established a reputation within Japan for the design and manufacture of automated Si wafer processing and handling equipments. To enhance this capability MPP has recently acquired TTS the world leading manufacturer of Si deep trench etching equipment which provides a key process in the manufacture of Silicon Micromachined Products.

STRONG PARTNERSHIP

The marriage of Inertial Sensor technology from RASE and the manufacturing technology from MPP provides a strong foundation for the supply of Yaw Rate and Acceleration Sensors to Fraser Automotive GmbH.

RASE/MPP SOLUTION FOR FRASER AUTOMOTIVE GmbH

For the Fraser Automotive GmbH requirements RASE/MPP proposes the following solutions:

* Yaw Rate Sensor formed from a deep trench etched Silicon Vibrating Ring
* Two axis accelerometer micromachined in Silicon

ENHANCED ACCELEROMETER SOLUTION

RASE/MPP are discussing the availability of competitive single axis accelerometers with a number of potential vendors. This may provide a more attractive solution for Fraser Automotive GmbH.

Figure 6-2: Text segments representing different ICs in EP3024e

It can be seen that the green segment represents the ‘Referential/context setting’ IC, the purple represents ‘Company Pedigree’ ICs, and the red ‘Collaboration and Alliance Benefits’ ICs. The different portrayal of coding within NVivo is shown in Figure 6-3 below, which shows the ICs as (randomly) coloured vertical bars to the right of the text. Figure 6-3 is an actual screen dump of an NVivo screen display, and shows more clearly than Figure 6-2 above that there are two separate ‘Company Pedigree’ ICs and two separate ‘Collaboration and Alliance Benefits’ ICs:

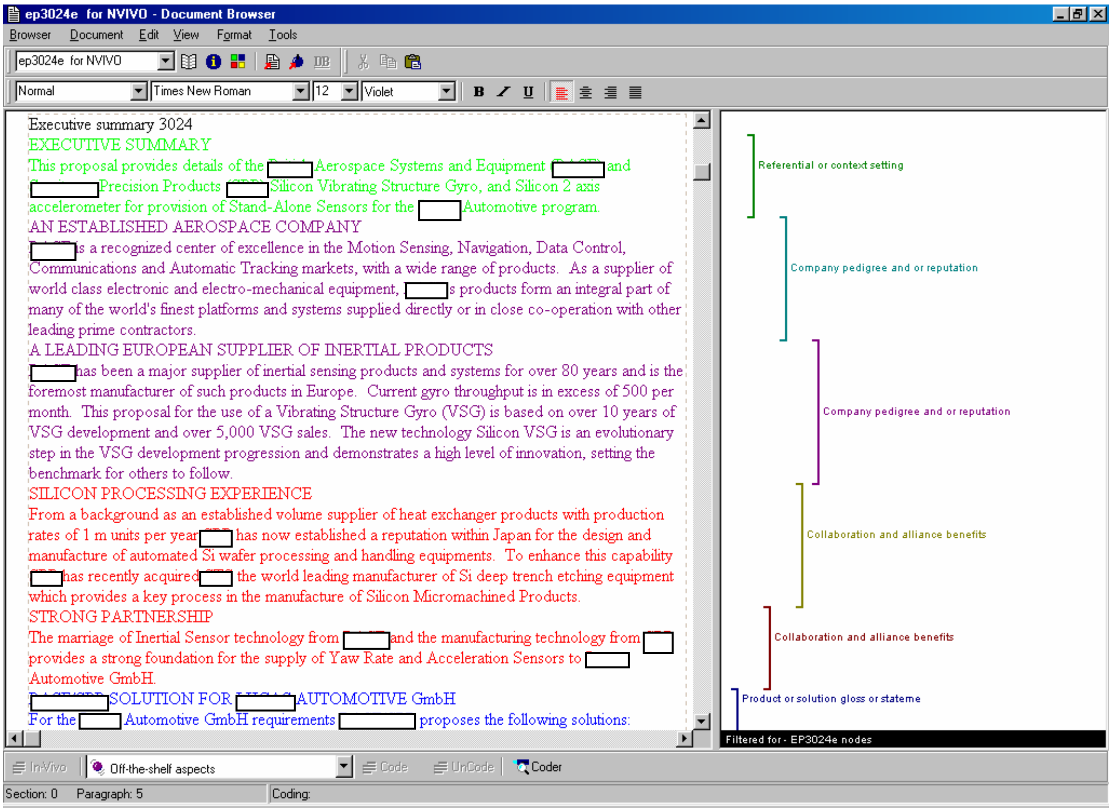


Figure 6-3: A screen dump from NVivo to show coding bars for an extract from EP3024e

The presentation of the coding in this way has proved useful in examining the ordering of ICs in a search for patternings within the discourse structure of executive summaries, as discussed in the next chapter. Screen dumps for the whole set of five executive summaries may be seen coded in a similar manner in Appendix N.

A useful feature of NVivo is the facility to provide printouts of the all the coded segments, sorted according to IC category. Printouts across a range of document sets are possible, or within single documents. An example of the latter, part of the executive summary EP3024e, is reproduced below as an NVivo printout in Figure 6-4. To use NVivo terminology, it is called a document coding report. Figure 6-4 is a verbatim reproduction, listing the text segments as ‘node extracts’; a ‘node’ is a term synonymous with ‘code’ or IC category. As can be seen, the first IC (or node) shown is ‘Collaboration and alliance benefit’ against which two text segments (or passages, to use NVivo terminology) have been coded. As above, the segments have been coloured to make them more easily distinguishable. The number of characters for each IC shown in the report provides a means of calculating the amount of text allocated to particular ICs. This feature is to prove useful later when an attempt is made to discuss textual patterning.

NVivo revision 1.2.142 **Licensee: Hazel Sales**

Project: 1 Documents engineers write **User:** Hazel **Date:** 9/6/01 - 08:20:51

DOCUMENT CODING REPORT

Document: ep3024e for NVivo
Created: 7/20/01 - 10:30:24
Modified: 8/25/01 - 04:56:36
Description:
Executive summary 3024
Nodes in Set: EP3024e nodes
Node 1 of 5 Collaboration and alliance benefits
Passage 1 of 2 Section 0, Paras 8 to 9, 499 chars.
SILICON PROCESSING EXPERIENCE
From a background as an established volume supplier of heat exchanger products with production rates of 1 m units per year MPP has now established a reputation within Japan for the design and manufacture of automated Si wafer processing and handling equipments. To enhance this capability MPP has recently acquired TTS the world leading manufacturer of Si deep trench etching equipment which provides a key process in the manufacture of Silicon Micromachined Products.

Passage 2 of 2 Section 0, Paras 10 to 11, 221 chars.
STRONG PARTNERSHIP
The marriage of Inertial Sensor technology from RASE and the manufacturing technology from MPP provides a strong foundation for the supply of Yaw Rate and Acceleration Sensors to Fraser Automotive GmbH.

Node 2 of 5 Company pedigree and or reputation
Passage 1 of 2 Section 0, Paras 4 to 5, 447 chars.
AN ESTABLISHED AEROSPACE COMPANY
RASE is a recognized center of excellence in the Motion Sensing, Navigation, Data Control, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world class electronic and electro-mechanical equipment, RASE's products form an integral part of many of the world's finest platforms and systems supplied directly or in close co-operation with other leading prime contractors.

Passage 2 of 2 Section 0, Paras 6 to 7, 569 chars.
A LEADING EUROPEAN SUPPLIER OF INERTIAL PRODUCTS
RASE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe. Current gyro throughput is in excess of 500 per month. This proposal for the use of a Vibrating Structure Gyro (VSG) is based on over 10 years of VSG development and over 5,000 VSG sales. The new technology Silicon VSG is an evolutionary step in the VSG development progression and demonstrates a high level of innovation, setting the benchmark for others to follow.

Node 3 of 5 Potential improvements or benefits
Passage 1 of 1 Section 0, Paras 16 to 17, 223 chars.
ENHANCED ACCELEROMETER SOLUTION
RASE/MPP are discussing the availability of competitive single axis accelerometers with a number of potential vendors. This may provide a more attractive solution for Fraser Automotive GmbH.

Node 4 of 5 Product or solution gloss or stateme
Passage 1 of 1 Section 0, Paras 12 to 15, 253 chars.
RASE/MPP SOLUTION FOR FRASER AUTOMOTIVE GmbH
For the Fraser Automotive GmbH requirements RASE/MPP proposes the following solutions:
* Yaw Rate Sensor formed from a deep trench etched Silicon Vibrating Ring
* Two axis accelerometer micromachined in Silicon

Node 5 of 5 Referential or context setting
Passage 1 of 1 Section 0, Paras 2 to 3, 279 chars.
EXECUTIVE SUMMARY
This proposal provides details of the REM Aerospace Systems and Equipment (RASE) and Makemoto Precision Products (MPP) Silicon Vibrating Structure Gyro, and Silicon 2 axis accelerometer for provision of Stand-Alone Sensors for the Fraser Automotive program.

Figure 6-4: A coding report for EP3024e produced by NVivo

In spite of the difficulties encountered when using NVivo, and I comment on these at the end of this section, its usefulness for this study ultimately lay in the fact that I was able to:

1. keep better control of large quantities of coded text. This proved invaluable when large quantities of documents were suddenly made available for this study.

2. ensure the coding was comprehensive, and that every part of every document was accounted for. This was an important feature when some of the documents were more than 10,000 words in length.

3. obtain printouts of coded extracts at the press of a button, although there were times when it was not obvious which button should be pressed.

4. code the extracts that had already been coded, in order to carry out another layer of analysis.

The software, in fact, offers a much greater range of functions than the ones mentioned here, but for this study, these are the ones that proved useful for helping to identifying and label ICs across a range of lengthy proposals, and to keep control of the labelling process from beginning to end.

6.4 Conclusion

The grounded theory approach is a risky one. After the laborious coding and preparation of the data, there reaches a point when, at the press of a button, the researcher could be left with numerous printouts of tabular data which may turn out to be nothing more than a morass of meaningless information. However, one of the first interesting results is that a set of information components can be identified, so that, so far as the substance of proposals is concerned, i.e. the topic content or the 'what' aspect, the information can be accounted for by a closed set of information components.

The information components (ICs) belong to four mutually exclusive information categories:

1 **Product or solution focus -** ICs which concern aspects of the product (or solution, as the engineers sometimes refer to it) specifically, e.g. its design, or performance

2 **Company focus -** ICs which convey information about the company which is submitting the bid, its collaborating partners (other companies), and its personnel, which in the case of proposals, is most often, the engineers concerned with the design and after-sales support of the product.

3 **Product and customer support -** the ICs for this category cover any aspect of the service offered to the Customer after he has taken delivery of the product.

4 **Metalinguistic focus -** this is a group which is different from the three above because it is text- rather than object-oriented; put another way, it could be said to have endophoric rather then exophoric reference. It refers to discourse organisation, and may also be an attempt to influence how the document is read; it categorises segments which help the writer to refer to the document itself, parts of the document, or to relate them to other documents (and possibly refer the reader to them).

CHAPTER SEVEN – POTENTIAL APPLICATIONS OF AN IC-BASED ANALYSIS

7.1 Introduction

The documents at the centre of this discussion, proposals, can be lengthy, and comprise compilations of sections written by different authors. The proposal shown in Table 4-3 (EP3049), for example, comprises a total of c.156,000 words, 56,000 of which form the technical proposal. The composition process for proposals is not unlike the construction of a jigsaw puzzle, or a stone dyke, where pieces are fitted together to form a whole entity, the pieces in the case of proposals being text segments distinguished by their information topic. Chapter 5 has discussed how concern about communicative purpose in text in EAP teaching is well served by a genre approach to text analysis. For teaching and learning purposes, the approach yields good results, especially when applied to shorter texts which are written strategically, usually by individuals (Swales 1981, 1990, Bhatia 1993). However, this approach is difficult to apply to longer texts like the discussion sections of MSc dissertations (Dudley-Evans 1986:144), and is inappropriate not only to the longer documents produced by HISE engineers, but to the shorter executive summaries they write as well. The discussion in Chapter 5 indicated that it is necessary to look beyond well trodden paths in the genre analysis domain, to devise an approach which would yield information of interest to engineers, without requiring a pedagogic interface.

This study has taken a departure from received approaches to text analysis in an attempt to accommodate the needs of the engineers and their writing processes, and has tackled the analysis of the texts from a different perspective. It has followed a grounded approach, having unpicked the information content they contain, in a reversal of the process engineers follow when compiling the documents, although it has not mirrored their process closely. I would claim that the process taken in this study is rather more systematic than that followed by the proposal writers, who admit that they would like to be more in control when writing proposals, and more confident when selecting and structuring information to be included. This ‘reverse engineering’ of the text has meant, in effect, that they have undergone a deconstruction based upon information content and the writing motive(s), and, as a result, has yielded three important kinds of output for this study:

1. definitive lists of information topics, about which proposals and executive summaries are written. These have been called Information Components (ICs), and are listed in the previous chapter. Data derived from ICs and their realisations can been used to produce graphical representations of the texts, in an attempt to recognise patterns which would otherwise remain undetected.

2. realisations for each of these topics in the form of text segments. These can be examined separately or as discrete groupings of IC text, rather than as an integrated part of a document, as they were first portrayed in Chapter 5. The coding (or tagging) of these segments enables them to be grouped into categories for further analysis.

3. character counts as raw numbers, giving an indication of the size of these segments, to be used for graphical representation of the data.

This chapter explores possible interpretations of results by considering data gained from using NVivo. It describes briefly how those outputs were obtained and translated into different representations, textual and graphic. It then offers an interpretation of the data, in the hope that it might provide useful insights to both engineers and ESP practitioners.

7.2 Housekeeping

The data gathered through NVivo is actually quite simple, although the process through which it was obtained seems complicated and arduous in retrospect. Before exploring some of the ways in which the data can be presented and analysed, it may be useful to give an idea of its character and appearance, and to show how it was organised and stored on the computer hard-disk to facilitate later investigation.

Two folders proved most useful when preparing this section, because they contain all the electronic files and (sub)folders for the executive summary and main (or technical) sections of proposals. (In unambiguous contexts, the main sections of proposals will be referred to as proposals from this point.) When browsing this data, one would view, first of all, the folder depicted by Figure 7-1, which is a screen dump showing the contents for proposals, which include an assortment of folders, Word files, and Excel files, all containing the results of analysing proposals within NVivo.

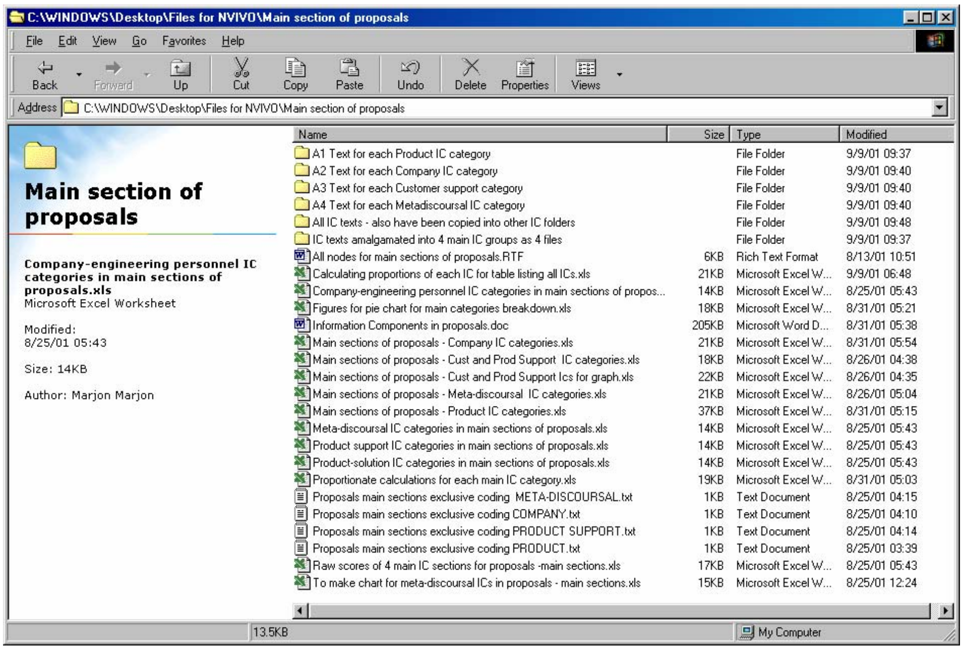


Figure 7-1: Contents of the main section of proposals folder

The folders at the top (A1, A2, A3 etc.) contain all the realisations of each IC, grouped together under IC categories, for example:

- A1 Text for each Product IC category
- A2 Text for each Company IC category
- A3 Text for each Customer support category
- etc.

Figure 7-2 below, is another screen dump of the view produced if one were to browse further down a level, by opening up a folder, the first one in this case. Figure 7-2 shows the contents of the folder, called ‘A1 Text for each Product IC category’, and it can be seen that this folder contains 15 ‘.rtf’ files, each containing text related to information about the product (or solution). Each file contains all the text identified and coded against product-related ICs, for example, Low Risk, Packaging, Cost benefit or implication, and so on. The files are ‘.rtf’ rather than ‘.doc’ files because NVivo requires the ‘.rtf’ format.

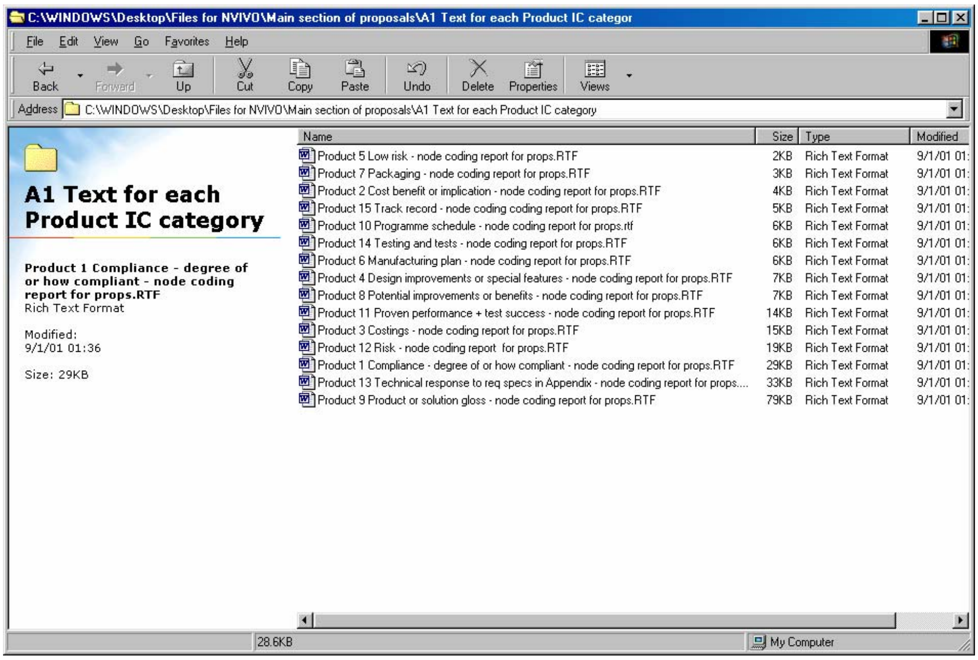


Figure 7-2: Contents of the Product-focused ICs folder

By coding segments of proposal text within NVivo, it is possible to separate out and group together those segments belonging to particular IC categories, so that they can be amalgamated into one file for ease of reference. It is possible for other permutations to be carried out; for example, different ICs could just as easily be joined with others, and stored separately. However, in this study, it was decided to start out by separating the ICs and to examine them as exclusive categories. It was thought that an understanding of each IC category was a prerequisite to any future study, which may involve comparison or cross-referencing, or any other kind of study.

Figure 7-3 shows what we would see if we wished to browse further to gain an impression of the data yielded by the analysis. If we wanted to see the text relating to a particular IC, we could continue down a level to examine one of the small ICs, open the file for Packaging IC, and we would see a node coding report in its entirety. Each IC is regarded by the NVivo software as a 'node', so that reports generated by NVivo are called 'Node Coding Reports'.

NVivo Extract 1 - Packaging IC in two proposals, EP3007 and EP3024
NVivo revision 1.2.142 Licensee: Hazel Sales

Project: 1 Documents engineers write **User:** Hazel **Date:** 9/1/01 - 01:45:02
NODE CODING REPORT

Node: Packaging
Created: 8/4/01 - 08:54:15
Modified: 8/12/01 - 06:53:08
Documents in Set: Proposals main sections exclusive co
Document 1 of 5 **EP3007 proposal main section**
Passage 1 of 1 Section 0, Paras 780 to 781, 308 chars.

5.6 PACKAGING STANDARDS
All spare parts will be packaged to a good commercial standard. RASE commercial packaging standards are in compliance with United Kingdom DEF STAN 81-41. The spares packaging will be labelled in accordance with the maintenance manual information to enable the part to be identified.

Document 2 of 5 **EP3024 proposal - main section**
Passage 1 of 1 Section 0, Paras 177 to 179, 687 chars.

2.4 PACKAGING
For the purpose of establishing an indicative price for a complete sensor, the package designs shown in Figures 2-1 and 2-2 have been assumed. These are of aluminium die-cast construction with automotive style connectors and would provide protection against most environments. A combined sensor is shown in Figure 2-3 although this has not been costed at this time.
Associated with these application specific packages are tooling costs which are detailed on the cost breakdown sheets. It is anticipated that further detailed discussion would need to take place on the exact packaging schemes for Fraser Automotive which could have some effect on sensor and tooling price.

This Node codes no other documents in this set.

Figure 7-3: Coding report for packaging IC

As this is, to use NVivo terminology, ‘a node coding report’ for a particular IC, it contains all the text extracts that have been identified as being Packaging-related ICs. Since packaging is one of the least written-about topics, only two instances have been found. The report presents them unexpurgated, stating their location, and size, in terms of the number of characters they contain. A feature of these ICs which seems striking during a skim through them is the more formal language used compared with the language in the executive summaries, as evidenced by preponderance of passive verb phrases (and the avoidance of dynamic active verbs) through the use of modal V + stative ‘provide/ have’ + NP, for example:

‘could have some effect’	instead of the more direct	‘could affect’; and
‘would provide protection’	instead of	‘would protect’

However, a direct comparison cannot be made, because this IC does not feature in executive summaries. Packaging is hardly important enough to deserve a mention in the executive summary, one would imagine, although it is conceivable (barely) that it might be in certain rare circumstances.

Instead, we are more interested in the largest IC category, which happens to be the main concern of design engineers, i.e. a description of the product or solution being proposed to the Customer. It is fortunate for this study that this category has emerged as being the largest in terms of sheer volume of text, commensurate with the importance attached to it by the engineers. A complete copy of this node coding report is provided in Appendix P, which contains verbatim all the text coded as Product/solution-focused, with just a few sections removed for reasons of commercial sensitivity. Two randomly selected extracts from this report are reproduced below, in Figures 7-4 and 7-5, again to give an impression of the data yielded by this analysis. As with the Packaging IC, the different parts of a proposal relating to the Product/solution gloss IC are listed as a run-on list, with all the extracts from one proposal grouped together, followed by extracts from the next proposal, and so on. In Figures 7-4 and 7-5, parts of the ICs from EP3007 and EP3018 are reproduced.

NVivo Extract 2 - taken from the proposal EP3007

…… ships cabling and safety circuits. Again REMA will provide the technical guidance to the Prime Contractor to minimise any envisaged risks.

Passage 3 of 7 **Section 0, Paras 82 to 88, 571 chars.**

Figure 2-1 Fire Control System Schematic

The shaded portion will be supplied by RASE. The Weapon Control Module and Control Console will be supplied by in-country partners.

The system performance is critically dependent on the selection of sensors appropriate to the task. RASE offers a Thermal Imager sensor in accordance with the ITT which is sensitive to radiation in the 8-12 μm waveband. RASE has reservations about the performance of this Thermal Imager in the expected environment and offers the option of a Thermal Imager sensitive in the 3-5μm waveband.

Passage 4 of 7 **Section 0, Para 88, 88 chars.**

The other sensors are the same as those fitted to ships in service with the Royal Navy. …..

Figure 7-4: First extract taken from Product/solution gloss node coding report

The ICs in proposals may be lengthy, with diagrams and photographs incorporated in the text, but NVivo is unable to reproduce the graphics (hence the wide gaps) and interprets the spaces as ‘passage’ boundaries. Thus, it may recognise 7 ‘passages’ for this IC in EP3007, when in fact they form contiguous text. This is a minor inconvenience, and it is possible to reformat the text for further analysis if necessary.

NVivo extract 3 taken from the proposal EP3018
…….. RBA500. These demonstrator units will undergo preliminary qualification to obtain a certificate of design to allow flight trialing in the AASM if required.
Figure 1-2 Phase I IMU Block Diagram

---

[1] Internal DB: This marks the close of a particular section which outlines the solution being proposed - first part of the introduction
Passage 3 of 6 **Section 0, Paras 50 to 59, 1570 chars.**

1.2.2.1 System Partitioning
A block diagram for the production silicon IMU design is given in
Figure 1-3.
The IMU Sensor Block will consist of three Digital Silicon VSG sensors, three Silicon Accelerometers and appropriate temperature sensors.
The Electronics will incorporate the digital interfaces to the sensors, a microprocessor and associated memory, address decoding circuitry, timing control circuitry, power conditioning electronics, interface electronics and I/O drivers. ……..
1.2.2.2 IMU Sensor Block
Roll/Pitch/Yaw Gyros
The Phase II IMU will still be based on the proven Silicon VSG but will incorporate Digital Signal Processing (DSP) techniques to close the gyro loops locally to the gyroscopes. Each gyro

Figure 7-5: Second extract taken from Product/solution gloss node coding report

[‘Internal DB’ in Extract 3 above refers to ‘Internal Databite’, a comment-like facility provided by NVivo.]

At glance it can be seen that the proposal ICs are qualitatively, and, of course, quantitatively different from the ones in the executive summary: they are longer; contain details of the product in list formations, comprising complex NPs, especially proper nouns and/or capitalised NPs, with pre-, but not post-modification of the NP head; the present tense and/or certain modal verbs seem to predominate; the overt persuasiveness of the executive summary seems lacking; and so on.

7.3 Information Component realisations facilitate focused text analysis

Realisations for every IC in the executive summary sample can be found in Appendix Q. Once all the ICs have been identified in the proposal document and/or the executive summary, it is theoretically possible for other text analyses to be conducted. The focus of any analysis would depend on the need of the writers, or readers, involved with the proposal at the time. Engineers have expressed an interest in the ‘metrics’ [their term] capabilities of the instrument, and requested that an analysis be done of a successful proposal they have been given from another company, with a view to comparing its IC components and structure with their unsuccessful ones.

Since a large part of my interest lies in the product-related ICs, it is a pity that neither time nor space allows for a closer examination of them. This would be a fruitful area for investigation in a future study, where, for example, a corpus linguistics approach could be conducted on the ICs, especially since the those for each of the four categories provide distinctive corpora for such an approach. The development of more refined stylistic, or other, categories would be interesting, especially those that may prove useful in tracing links between particular product features highlighted in the proposal, which then need to be broken down and described in the ensuing specifications documentation. The product solution IC, as it stands, is a category which suits the purposes of this illustrative chapter, but begs to be analysed further, if any more detailed information is to be obtained. As an example of the kind of insights afforded by a closer examination of ICs, a more detailed discussion is now provided of the small corpus of Metadiscoursal ICs identified in the executive summary sample.

7.3.1 An example of the kind results obtained from a closer linguistic analysis of ICs

This is an example analysis of the Metadiscoursal ICs. The executive summary sample yielded only one metadiscoursal IC, the Referential or context setting IC, although other metadiscoursal ICs may occur in Executive Summaries. The Referential or context setting IC is realised in four of the five executive summaries in the sample, and in every case comprises a single sentence in the simple present or simple progressive tense. All four realisations, two of which are listed below, take the form of declarative sentences following an SVO(+O)A structure:

> This response(S) provides(V) details of the HISE, Plymouth, proposal to develop and supply the Next Generation Rate Sensor Unit (NGRSU)(0) for the Aiming Unit of the Lightning Missile produced by the Longs Missile Systems Limited(A). (EP3124e).
>
> HISE(S) is proposing(V) an integrated PC based mission planning and Retrieval System(O) for the xxxx Airforce SU-30(A).(EP3129e)

The first three ICs are so similar, that it is possible that they are adaptations of a favourite sentence taken from another executive summary, using the ‘lift and shift’ practice mentioned earlier. Reference to the subjects in three cases is made through deictic devices, as in ‘this proposal/response’, and in the fourth case by use of a proper noun, the name of the company. In fact the first three examples follow the pattern:

> X provides details of Y + Z,

with X referring to the document itself; Y referring to the name of the proposing company juxtaposed with the name of the product being proposed; and Z referring to the system the product is intended to be integrated with. This final constituent is a recipient or benefactive adverbial (Biber et al 1999:781), and comprises a prepositional phrase headed by ‘for’, with the name of the receiving company or programme as object of the preposition. The fourth example follows the same basic structure, although the main verb is ‘is proposing’ rather than ‘details’, and the submitting company’s name is the subject of the sentence. Without wanting to read too much into this small sample, it is nevertheless possible to deduce, since these fulfil a locative function, that the positioning of such an IC at the start of the executive summary is significant, together with the need to name the main participants in the bid, in order to provide a point of reference for both readers and writers.

It could be argued that, by the very nature of the executive summary (i.e. it is an abstract of the main selling points of the proposal), this should be the only metadiscoursal IC that appears in an executive summary. Furthermore, it could be argued that every executive summary should begin with this IC, because of the function it performs in assisting the readers who need this information before they can begin reading. It has been established earlier that the executive summary is often separated from the main section of the proposal to be read by the Chief Reader, who may be presented with dozens of executive summaries to consider. These may represent a variety of projects, and one of the functions of this IC may simply be to enable the Chief Reader to place the summary in the right pile for reading. Once it has been so located, there is no further use for this IC, apart from serving as a reference, memory-jogger or label, and the Chief Reader can then make judgements about the rest of the text. This IC has little bearing on the main persuasive function of the document.

7.4 Different reports and graphs can be generated

If the figures generated by NVivo are transferred to Excel, graphical representation of the information content of texts is possible. For example, the bar chart in Figure 7-6 below depicts the types of ICs to be found in executive summaries, and their physical extent.

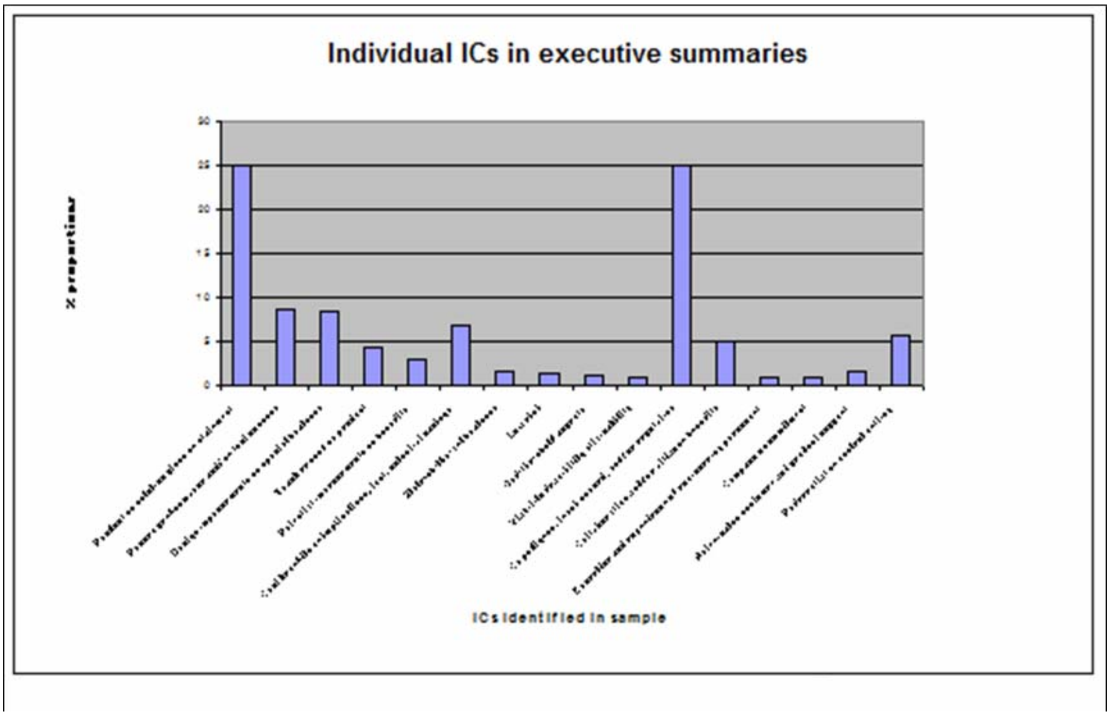


Figure 7-6: All ICs occurring in the executive summary sample

It is also possible to compare ICs in proposals with those in executive summaries. Engineers, being good at mathematics and fond of visualising figures in diagrammatic or graphical formats, would no doubt be able to produce a variety of graphs to produce the information they want. Even with limited Excel expertise, it is possible to produce a comparative bar chart, like the one in Figure 7-7 below, which is a simple conversion of percentages based on character counts delivered as part of the software report facility.

Figure 7-7 may be a somewhat simplistic representation, but nevertheless plainly reveals similarities and differences. For example, the executive summaries place the most emphasis on trying to persuade the reader that the company has a long pedigree and good reputation, although this benefit does not appear to be supported, or reflected to the same extent, in the main section of the proposal. The same observation could be made about cost benefits and collaboration/alliance benefits. It is interesting that the engineers place a heavy focus on company and company-related matters in the executive summary, when I would have expected the product to be the over-riding main focus. Product/solution focused ICs are clearly the most important ICs in the proposal itself, where the function of c.30% of the text relates to just one such IC, the product (or solution) gloss.

The other product/solution-related ICs (Technical response in appendices, Degree of compliance, Risk, Testing and test results, Quality assurance) also ‘describe’ aspects of the product, but these ICs are more rather more pedestrian, usually having been included to conform with proposal sections prescribed by the Customer. The fact that these sections have been written in order to comply with a writing requirement specified by the Customer may account for the distinctly less persuasive language that is used to express them. On the other hand, clearly persuasive ICs, which receive prominence in the executive summaries, for example:

- Proven performance,
- Design improvements or special features,
- Track record of the product,
- Potential improvements or benefits,

do not receive the same treatment in proposals, where they either receive markedly less prominence, or, in most cases appear to lack any supporting discussion at all.

Engineers' concern to produce executive summaries that encapsulate proposals would seem to be a logical aspiration when one considers how they are read, especially by the Chief reader. However, these few findings already show that executive summaries do not appear to achieve this purpose. It is possible that the engineers should consider conducting a similar kind of comparative exercise on a proposal document, as it is nearing completion, to ensure the summary reflects the content and intent of the proposal.

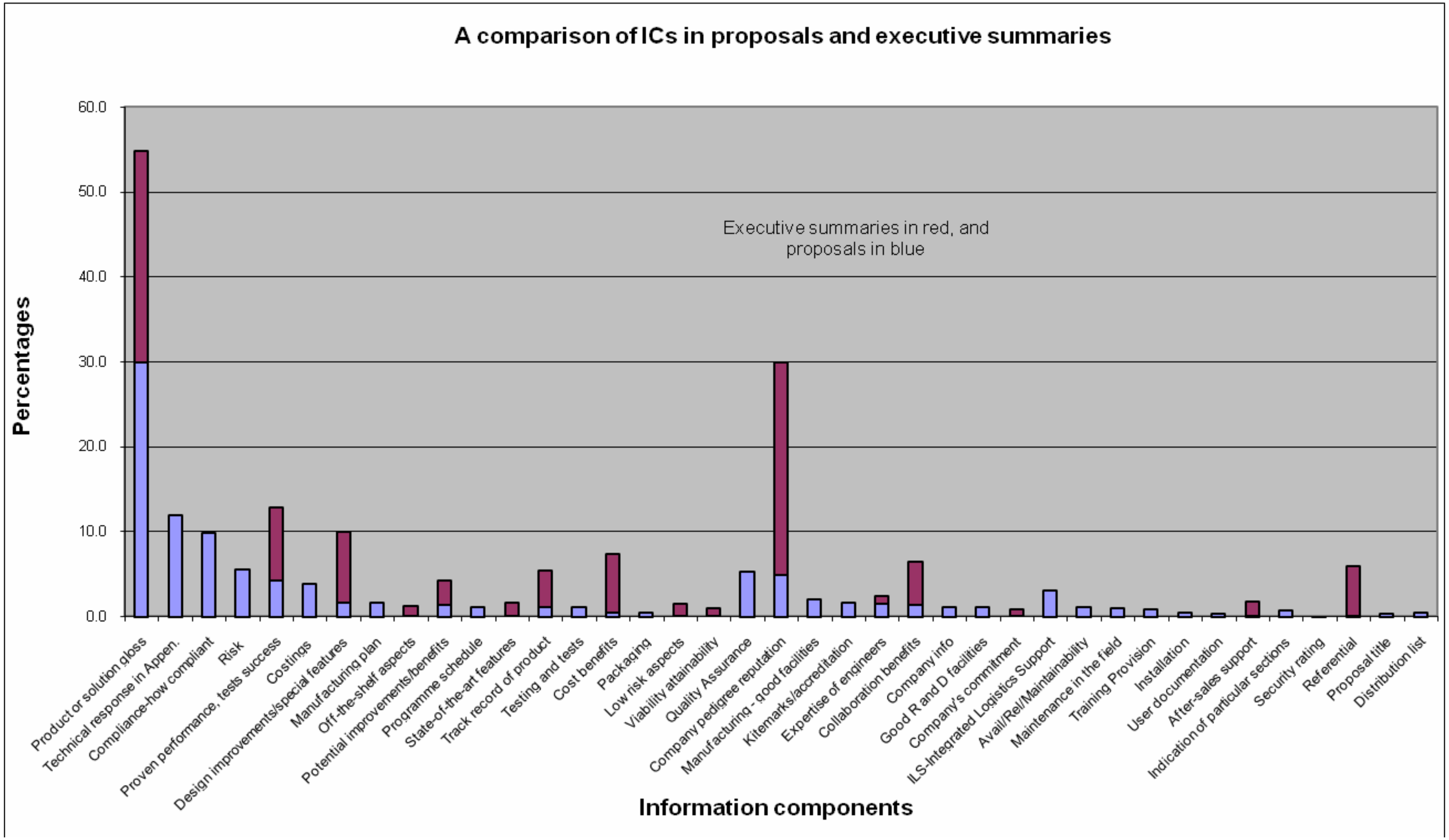


Figure 7-7: A comparison of ICs in proposals and executive summaries

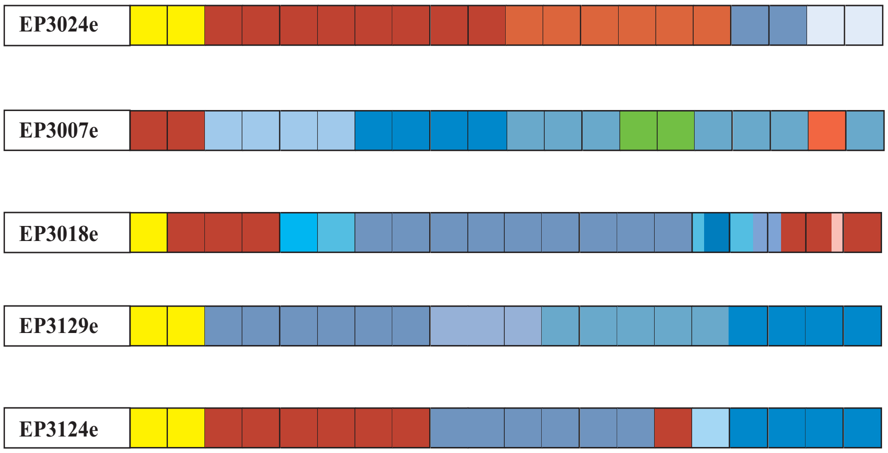
7.5 Textual pattern recognition: the use of colour coding to detect patterns

7.5.1 IC patterns in executive summaries

It was decided to use colour coding as an aid in the search for textual patterning. It was thought that a systematic colour coding procedure would make it easier to recognise patterns, or would indicate the possibility that none existed. Figure 7-8, below, is the result of this attempt. It represents the size (in terms of number of characters) of ICs in the sample of executive summaries examined, and their order of appearance in the texts. Each of the squares represents approximately 5% of the total text or summary, and each bar represents one of the executive summaries in the sample.

To help detect patterning, as can be seen in the diagram, different colours were chosen to represent the four main IC categories. The colours used for coding have been arranged so that all ICs concerned with the product are shades of blue, those concerned with the company (and its engineers) are shades of red, and those depicting customer/product support ICs and metadiscoursal ICs are green and yellow respectively.

Colouring in the squares is a similar process to the kind of artistry encouraged by the painting-by-number oil painting sets that some of us may recall receiving as gifts in our youth. These sets include a white board imprinted with a painting template, together with a set of capsules containing oil paint in different colours. The painter fills in oddly-shaped, often tiny, sections which have been numbered to correspond with particular colours, and has to be patient enough to apply most of the colours, which have to be applied one at a time, before the picture gradually becomes recognisable. In a similar fashion, colouring the ICs in Figure 7-8 was a painstaking process, during which I wondered whether any useful information would arise out of doing the exercise. At least, when painting a picture by numbers, one knows there will be an outcome that makes sense, unlike the situation when colouring in the ICs for Figure 7-8.



KEY

	Total for each comp
1. Product or solution gloss or statement	3540
2. Proven performance and/or test success	1207
3. Design improvements or special features	1180
4. Track record of product	615
5. Potential improvements or benefits	403
6. Potential savings/Cost benefits or implications	613
8. State-of-the-art features	218
9. Low risk	200
10. Off-the-shelf aspects	162
11. Viability feasibility attainability	125
12. Co pedigree, track record, and/or reputation	3540
13. Collaboration and/or alliance benefits	720
14. Expertise and experience of engineering personnel	133
15. Company's commitment	120
16. After-sales customer and product support	226
17. Referential or context setting	799
Total No. of characters	13801
No. of characters according to NVIVO	13801

Figure 7-8: IC patterns in executive summaries

Figure 7-8 above shows each executive summary as a horizontal bar, the total length representing the whole of the summary. Each IC is arranged in order of appearance, its length proportionate to its length in the text; the number of characters in each component has been calculated as a percentage of the total number in the executive summary. This somewhat simplistic measure is imposed on this study by the nature of the data provided by NVivo, but is nevertheless an effective way of presenting the information in order to see at a glance:

1 the IC membership of each executive summary.

2 the amount of text composed for each component.

3 and, most importantly, possible patterns of ordering.

Interpretation of results - an overview of general patterns

The feelings of doubt during the colouring exercise were assuaged somewhat by the emergence of a few patterns, indicating that the analysis could actually prove to be of some use.

Metadiscoursal

First, four out of the five executive summaries start with the same IC, the Referential or context setting IC, which ostensibly tells readers exactly which executive summary they are reading. This may appear to be stating the obvious, because it provides information the reader presumably already knows. It is not persuasive in any way, since it simply locates the executive summary and names the project that it represents in the form of a heading, usually. All the other ICs, however, are persuasive, often overtly so, and are completely different in nature from this Metadiscoursal IC.

As mentioned earlier, this IC performs a function which is part administrative and part discourse-organising, and it is logical that executive summaries should begin in this way. In this study, it is categorised as a metadiscoursal function because it labels the text to help orientate and organise the reading of it: The reader finds it useful to know which project the executive summary represents, especially the Chief Reader, who may be reading several executive summaries from different batches of submissions, across a range of different projects.

In the light of its function, this is usually an obligatory IC which is always placed at the very start of the executive summary. It could be argued that all executive summaries should begin with this particular IC, and it is the luck of the draw that a rogue summary was one of the five summaries in the sample. A check of the twenty-eight executive summaries in the corpus, shows another four which do not begin with this IC.

Company-focused information

Since the Metadiscoursal IC is usually a heading, it could be said that four of the five executive summaries begin with information about the company, followed by information about the product, and that this ordered appearance of:

COMPANY/PERSONNEL INFORMATION + PRODUCT INFORMATION

appears to be a general pattern. Executive summaries may contain more information about the company and its personnel than about the product, as revealed by EP3024e, 70% of which is devoted to this category of IC. In EP3124e, information about the company concerns 35% of the text, most of it in the early part of the summary. This emphasis on company-focused information is a curious finding, since it would seem to be a reasonable to assume that the proposal is supposed to be about the product. These findings indicate that in some executive summaries the company is selling itself and its staff as much as (or more than) the product.

It is interesting to see that all the executive summaries, bar one, give information about the company or company related information, for example, information about the engineers working on the project. EP3129e is the exception, and contains no mention of the company at all. The majority of EP3024, on the other hand, is concerned with the company-focused information. Now why should there be such a difference? One probable reason for this is that EP3024e is part of a proposal to a Customer unfamiliar with HISE as an organisation, so that the engineers writing the proposal believed it necessary to inform the Customer about their company. In the case of EP3129e, however, the proposal was intended for the MoD which knows HISE well, and so the engineers clearly felt providing the MoD with information about HISE as a company was unnecessary. Whether these assumptions are correct or not is another matter better investigated in another study, but the point that needs to made here is that useful questions about text arise from examining Figure 7-8 which could improve future proposal writing.

It can be seen, then, that after the initial referential IC company-focused ICs are presented before product-focused ones, and most of the former tend to be ‘fronted’ in this position. This foregrounding of information about the company is in itself an interesting feature, one of its functions being to set the context for information about the product to follow.

Product-focused ICs

Naturally, product-focused ICs are obligatory, and would be expected to form the bulk of executive summary text, as evidenced by, EP3081e and EP3129e, for example. However, EP3024e is the obvious exception to this tendency, to the surprise of the design engineers. Other executive summaries, however, are more heavily product-focused, (e.g., EP3007e), and in EP3029e, there is not a single mention of the company or the engineers. As has been mentioned, the executive summary is supposed to present the main benefits of the product (or ‘solution’) being proposed, and so one would expect a substantial proportion to comprise such ICs. Figure 7-8 appears to confirm this to be so. Furthermore, one would expect many of those ICs to be found in the summary to be clearly persuasive, and again, this is borne out by identification of such ICs as ‘proven performance’, ‘state-of-the-art features’, ‘Low risk’, etc.

Customer/product support-focused ICs

There is only cursory mention of information about after-sales support in EP3007e:

> Comprehensive support is provided to the RN and RASE export customers, with a full spares, repairs and post-design services infrastructure to ensure the continuing effectiveness of RASE systems throughout their practical life.(EP3007e)

This is, again, somewhat surprising, for three reasons:

1 It is generally acknowledged within the industry that Customer and Product Support is integral to the successful use of most systems and products, that it should be considered by design engineers from the outset of designing a product, and that it should be a significant feature of any proposal. Books on ILS are commonly found on HISE engineers' desks.

2 Substantial time, money, and engineer effort is invested in preparing the sections on Product and Customer support, also referred to as Integrated Logistics Support (ILS), in the main part of the proposal.

3 Interviews with the Customer have revealed this to be of fundamental importance, and influential in considering bids. In this business, the Customer is usually concerned as much about what happens when the product is in use as in the design of it

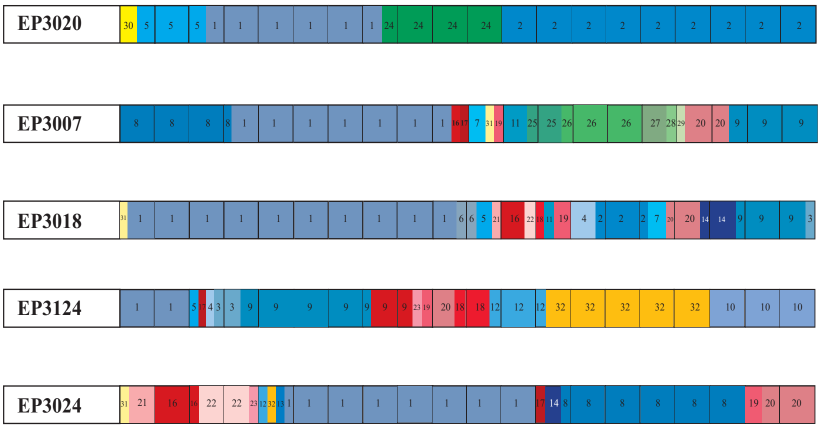
In spite of this acknowledged importance of ILS, however, engineers have commented on the fact that it tends to be undervalued by the company. I can only surmise that the design of the product, and information about those who design it/the company they work for, is sometimes considered to be more important for the Chief Reader to consider in the executive summary, although sections required by the Customer in some projects ensure that this neglect is not reflected in the main part of the proposal.

7.5.2 IC patterns in the technical proposal

Encouraged by the IC patterns revealed in executive summaries, the process was repeated with the main sections of proposals in order to see if any significant trends could be discerned, and to compare the patterns revealed with those in the executive summaries. A lengthy task, the completion of Figure 7-9 coincided with the near completion of this thesis.

An obvious difference between this and Figure 7-8 is the larger number of ICs reflected in the patterns in Figure 7-9, amounting to a total of thirty-four, compared to half that number for the executive summaries in Figure 7-8. Had I anticipated that the analysis would develop in this way, I would have ensured that all the proposals analysed would have contained executive summaries that would then have enabled a comparison to be made. However, in this exercise, only two of the technical proposals can be compared with corresponding executive summaries, i.e. EP3007 and EP3024. Even so, clear differences between these two proposals can be seen. Most of the executive summary for EP3024, for example, is concerned with company-related information, which is not reflected or supported in the (main) technical section, which is concerned with describing the product and explaining its compliance with the Customer's requirement. Since the executive summary is supposed to encapsulate the main benefits of the proposal, I would have expected the product to feature more prominently in the summary. The fact that it does not raises questions about reasons for this apparent mismatch. It was suggested earlier that, on occasion, the executive summary is written in haste, almost as an afterthought in the very last stages of proposal preparation, with whoever is tasked with writing it paying scant heed to the main selling themes of the proposal. On the other hand, it is possible that the proposal team used the degree of freedom allowed by the executive summary to write about ICs that could not be included in the proposal, because of writing constraints imposed by the Customer.

The technical proposal EP3124, however, seems to reflect the balance of company- and product-related ICs in the executive summary better, although it seems curious that two sections, one on Terms and Conditions, and the other concerned with Risk, should be such a large proportion of the proposal. However, this feature, together with their rather odd order of appearance, could be due to the Customer specifying that they should be included, and in this order.



KEY

	Total for each comp
1. Product or solution gloss or statement	56044
2. Proven performance and/or test success	7552
3. Design improvements or special features	2654
4. Track record of product	1851
5. Potential improvements or benefits	2486
6. Potential savings/Cost benefits or implications	1648
7. Programme Schedule	2080
8. Compliance - how compliant or degree of	18531
9. Technical Response to requirement specifications	9117
10. Risk	9885
11. Testing and Test	1891
12. Costings	6079
13. Packaging	578
14. Manufacturing Plan	2997
15. Proven Performance and Test Success	7552
16. Company pedigree, track record, and/or reputation	9262
17. Collaboration and/or alliance benefits	1351
18. Expertise and experience of engineering personnel	2677
19. Kitemarks Standards accreditation	2902
20. Quality Assurance	9780
21. Company Structure info	2016
22. Production and Manufacturing	3654
23. Good R & D facilities	1788
24. Maintenance and support in the field	1615
25. Availability, Reliability and Maintainability	1959
26. ILS Integrated Logistics Support	5645
27. Training Provision	1530
28. User Documentation	543
29. Installation	779
30. Proposal Title	140
31. Indication of particular doc sections	823
32. Terms and Conditions	17728
Total No. of characters	195137

Figure 7-9: IC patterns in the main sections of technical proposals

Having looked at a way of comparing individual IC categories in proposals and executive summaries, let us generalise the approach somewhat to see if it would useful to compare broader categories.

7.6 Comparison of broader categories

7.6.1 An overview of IC components in proposals and executive summaries

Two pie-charts are placed together below to provide a simple graphical view of the four main IC groups, to illustrate another way of making a direct comparison between proposals and executive summaries:

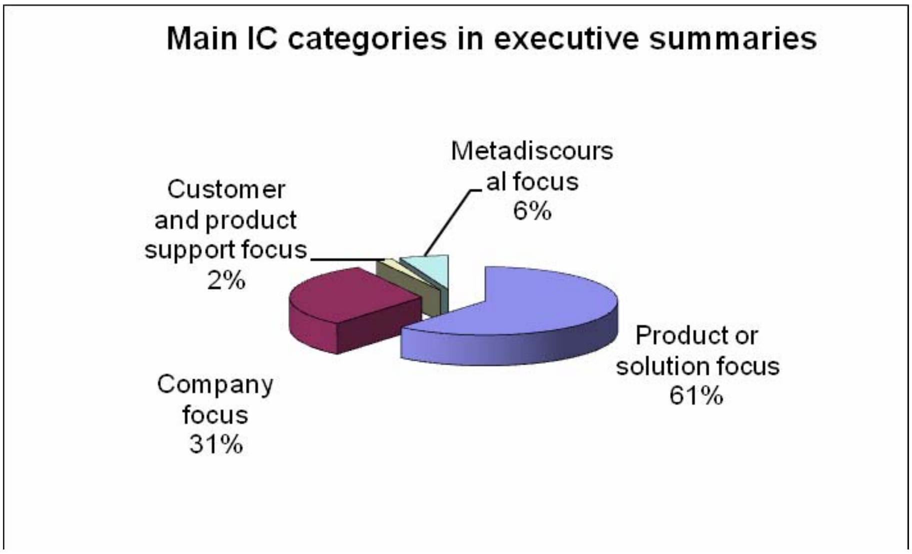


Figure 7-10: Main IC categories in executive summaries

The pie charts above and below are a graphic representation of proportions of text relating to each of the main IC categories in executive summaries and proposals, respectively. Again, these charts represent figures based on raw character counts derived from NVivo.

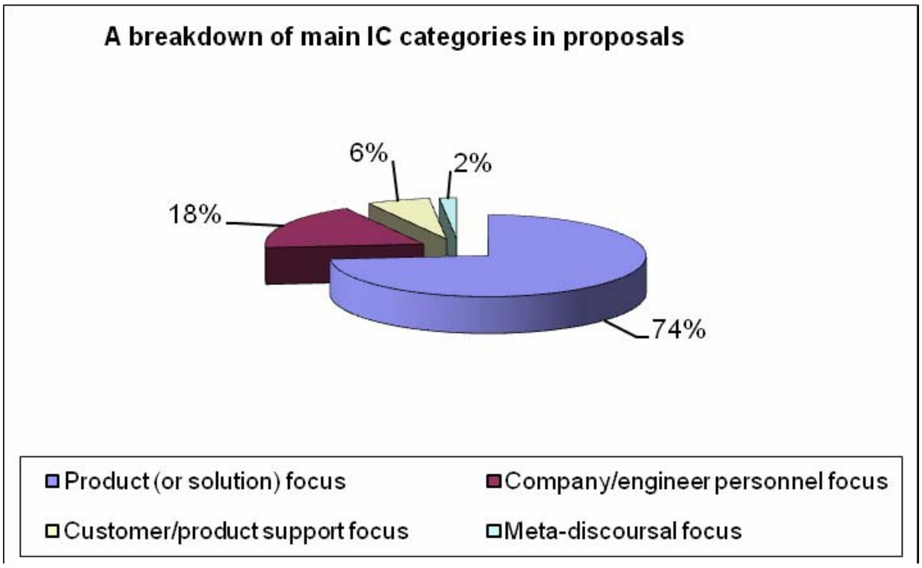


Figure 7-11: Main IC categories in technical proposals (main sections)

Comparing the two pie-charts, it can be seen that the largest IC category in both cases relates to information about the product, with 61% and 74% of the total text being devoted to product-focused ICs in executive summaries and technical proposals respectively. One would expect high proportions of text for product-focused ICs, since these describe the product to the potential customer. These proportions are significant so far as this study is concerned because it has been suggested that the proposal is in fact a quasi-product, and that the description of the product in the proposal is the first in a line of such textual product-substitutes (or documents) that the engineer writes, and presents to the Customer, until the product itself is delivered. It is also logical that the largest portion of the technical proposal should be product-focused, since it is this aspect which engages (in all senses of the word) design engineers most.

The second largest IC category in both executive summaries and technical proposals relates to information about the company. This was a surprising finding, initially, because, although I had expected to find company-related information to be significant, I did not expect it in such large proportions, i.e. forming up 31% of the executive summaries, and 18% of the technical proposals. These substantial proportions show how, in any type of proposal, the company is selling itself as well as the product, and, furthermore, that the company may need to 'sell' itself as part of the solution being proposed. Clearly, it needs to do this more in countries where it is less well known, and less to established customers, like the MoD and companies who know them well. In fact, the company's personnel, structures and systems are important to any customer considering a proposal submission.

Having observed proposal writing in progress, and the proposal team making a presentation to the Customer, I have observed the importance attributed to Company-related ICs by both the Customer and the proposing team, to a greater extent than I had envisaged. It is possible, given this significance, that the proposal should contain more information about the company than it presently does, in line with the proportions devoted to these ICs in the executive summary. It could be argued that these ICs are generally under-represented in the main sections of proposals, and that this may account for the Customer's occasional demands for such information to be included, as an attempt to ensure that such aspects are adequately covered.

7.7 Concluding observations

7.7.1 Proposal writing teams and implications for writing manpower

Writing teams generally comprise a preponderance of design engineers and engineers concerned with after-sales support and maintenance. Those concerned with management and commercial aspects of the proposal, or with writing the non-engineering (product / solution) aspects (who may also have been engineers in a previous working life), are usually in the minority. A major, recent proposal [Type 45 frigates], may be considered typical, in that twelve engineers worked on the product, or the technical part of the proposal, and only two worked on the rest of the solution, i.e. a ratio of 1:6, with one writer not responsible for design for every six design engineers contributing to the proposal. Considering what is revealed by the data, it could be argued that not enough manpower is allocated to writing 'the rest', since the proportions indicate a more desirable ratio within the writing team would be more of the order of 1:2 for the executive summary, and 1:4 for the technical proposal, with the larger number favouring the design engineers in both cases.

On reflection, however, this result is understandable: the design engineers are, naturally, totally concerned with coming up with the most attractive design (or solution) with which to win the bid. The proposal demands creativity from the engineers who concentrate on the design to the exclusion of anything else. It is unsurprising, therefore, that they should be less aware of the other, bulky, sections of the proposal, e.g. prices, terms and conditions, quality assurance. Parallels can be drawn with the building industry where the acknowledged 'king pin', a term used by members of the building team, is the architect. The architect is responsible for converting the design concept into a concrete building, and has the responsibility for creating the design in the form of a blueprint which others then have to use to construct the building. Behind the architect lies a huge team of engineers of various types, quantity surveyors, and building contractors, but it is the architect who has the kudos, and who has the highest prestige within any building project; hence their use of the term ‘kingpin’. A similar situation exists within the engineering environment: the design engineers are the king pins, and have the highest status in the project. The creative activity, and this includes text creation, centres on catering to their needs, i.e. to arriving at the best solution. In the process, others’ needs are somewhat neglected and under-resourced. The company has suffered some deep disappointments recently when major competitive bids were unsuccessful. It could be that some of the energy and resources which have been invested in the solution may be more wisely spent on those who have to produce the other sections.

7.7.2 Observations about Customer interference in proposal writing

First, those other lengthy sections are usually longer because the Customer has specified that they be so. With large projects, bidders have to respond to an RFI or RFQ which states in detail how many sections should be presented, how long they should be, the kind of information they should contain, and even, the font size and style. Clearly, from the Customer’s perspective, this is all important information for them to receive in order to reach a decision. However, whether the Customer is getting the best or most creative solution by insisting on these standardised formats is doubtful. It is contradictory to expect creativity within a prescriptive and restrictive format, which by its very nature is anti-creative. The general perception is that these formats have been devised to lighten the reading load for the Customer, and assist the decision-making process. However, it is doubtful that standardising the submissions in this way has the desired effect. If anything, it could be argued they are, in fact, making the task more difficult and are encouraging less innovative submissions: they are more likely to receive lexically dense texts (engineers spend much time condensing what they have been told to include, even though, they consider some of it unnecessary, to say in order to meet word limits), and bids which are difficult to differentiate between, apart from aspects of price or programme or other less design-creative aspects. But this is an aside, and a matter which is not a major concern of this study.

I return to the point made earlier, however, that the emphasis of writing effort specified by the Customer should indicate a review of the writers allocated to writing the proposal; although the design is always be central to the proposal, it could be argued that more writers should be allocated to reflect the emphasis placed on the other sections by the Customer. The fact is, of course, that the ‘solution’ is the whole of the proposal, and includes a host of other considerations underpinning or impacting on the engineering design. At present, these ‘other’ sections are often compiled at the very final stages of the proposal writing process, by a small number of writers. Exhausted by the hectic weeks of working under pressure, the engineering design team seems to fade away leaving a (very) few of their non-design colleagues to finish the job. It seems that they feel their work is done. Sometimes just one technical author, possibly working with one or two others concerned with financial or after-sales aspects, is left to produce the whole document, which, as we now know, is substantially larger than that part produced for the design solution.

In the light of these findings, therefore, it could be argued that writing loads should be redistributed so that more writers are allocated to writing the other (non-technical) sections, which, nevertheless, have a bearing on the overall solution.

7.7.3 Post-script to the chapter - observations about the NVivo software

The use of the word 'assistance' to describe the role this software played in this study gives a somewhat inaccurate impression, implying that the it had a positive impact on this investigation. In spite of its Windows-like presentation, for those familiar with Windows, this is not a user-friendly soft-ware package, and is not 'intuitive' enough for a hardened (but not necessarily dedicated) Windows user. I can make this claim, having confirmed that others have experienced similar problems with NVivo and simply given up on it, and not having yet encountered anyone who has successfully used it in a bona fide study. With the benefit of hindsight, it is possible that much time would have been saved had another analytical tack been followed. However, in truth, if NVivo had not offered such imaginative features, I would have abandoned any idea of using it soon after buying it, since it proved to be difficult to use, and weeks were spent, seemingly in vain, trying to master its arcane features. Consultation with other user-researchers revealed that they too were having difficulties. Like me, they were inspired by the claims made by the NVivo software designers, who were fellow researchers, seemingly in the fields of sociology and linguistics, who clearly understood the aspirations of those taking an ethnographic approach. It seemed a good idea at the time to follow the advice given in the manual not to delay using NVivo even at the very start of a project (Richards 1999:23 and 26). This encourages the unsuspecting to analyse texts within the software with only a glimmer of understanding about how to code them, and even less of an idea of how to compile results. (I use 'within' intentionally, since a characteristic of the software is that the texts become encapsulated in it, and almost imprisoned in it.) Do I regret having used it? The answer is 'probably not', because this was the best piece of software I had come across that was specifically designed to help researchers taking a grounded approach to deal with data in a systematic way. It was important to use such a package in order to assure the integrity of the data and the approach being followed.

CHAPTER - EIGHT CONCLUSIONS

8.1 What the study attempted to achieve

This chapter closes this account of my investigation into the writing produced by design engineers. It is incomplete, because the discussion has not travelled the full circle that had been planned. One of the main reasons for gaining admittance to (then) REMA was my interest in the writing of specifications and requirements, and the company's preoccupation with them. They were, and still are, regarded as difficult to write, and a potential source of design problems and concomitant financial outlays, upsetting both the carefully planned work procedures and the engineers that like to follow them. It is ironic that specifications and requirements were the initial focus of the study, and yet have been relegated to an appendix, because the investigation became caught up in examining proposals. Since I set out to conduct a holistic grounded study, it was probably presumptuous to believe that the intended course would be followed as planned. Quizzing engineers about their views and writing practices, taking part in their writing activities, rooting about in their document stores, and observing them at work inevitably led to a preoccupation with the documents that at present engross them, i.e. proposals.

The language of engineering, particularly those represented in an aerospace environment (electronic, electrical, mechanical) has been rather a cinderella domain for applied linguistic investigation, having been neglected for decades. One of the reasons for setting out on this study, apart from my own long-held interest in technical language, was to counteract what I detected as indifference verging on antipathy among my students and some of my peers towards engineers and engineers' language. I had a hope of rectifying this by contributing in some way towards encouraging more interest in the field. It was thought that this could be achieved by showing an understanding of the work culture of design engineers, together with their attitudes and views, and to put myself in the position of observer and interpreter. I had been taken with the practice of placing members of the Arts community in non-Arts work places, e.g. the 'resident' poet, artist, and even ballet-dancer, and although a less glamorous proposition to office workers, imagined myself to be the 'resident' linguist. The presence of expert writers at the company (technical authors), however, ensured that this remained a fantasy.

The intention from the outset was to take a problem-solving approach to texts that were proving problematic to the engineers. It was intended to take an ethnographical grounded approach, and to provide descriptions of writing practices and texts that the engineers could relate to and find useful. It was also hoped to follow an approach to analysing texts that might meld an applied linguistic perspective with that of the design engineers to yield results that might interest them.

8.2 Achievements

The interest derived from working amongst the engineers and other Helix Industries Systems and Equipment (HISE) employees, but remaining separate, has been immeasurable. This thesis was planned and written at the company as work activities were happening all around. Major decisions about what should be included or excluded were affected by interactions with engineers, or by observing them working and discussing with each other. The unfolding of this thesis sometimes seemed to relate to the events that evolved and waxed and waned in my writing environment. A degree of symbiosis was achieved: in return for access to meetings or information about their documents and writing, the engineers requested 'pay-back'; my feedback on a presentation, for example, or lessons on aspects of language were always seriously considered, and with interest. In turn, their feedback on my contributions informed this study.

Gaining acceptance from those at HISE proved a slow process in the early stages, but after about three years led to a degree of freedom and access to people and data that had not been anticipated at the start of the project. The length of time taken to complete this study, which seemed to be becoming excessive in the last two years, in fact benefited the study because it facilitated the development of this relationship with the company. It could be argued that a faithful grounded approach could not have been followed without it. It is possible that the engineers' idiosyncratic perspective of texts would not have emerged in other circumstances.

In the event, the information that was gathered via interviews and the intra-net, especially the email survey, helped to identify the texts that engineers are most concerned about, and those they find problematic. My earliest impressions about specifications and requirements being problematic were confirmed by the surveys which also revealed findings that had not been anticipated, for example that engineers did not find report writing problematic; report writing is a major feature of ESP text books. Instead other unexpected documents were identified, namely proposals and log books.

In one respect, it could be argued that proposals were examined at the expense of specifications, although I cannot resist drawing an analogy between the apparent hijacking of this study by proposals, with the role they play in the engineering workplace. The actual consumption of financial resources across the sector by proposal writing, and the concentration of engineers' creativity, time and effort by proposal writing is massive. For some of this study I tended to view proposals with some ambivalence, seeing parallels between their effect on the engineers and on this study: time is spent on proposals possibly at the expense of other productive activity.

However, in retrospect, it is understandable that such a course was followed, being a natural outcome of a grounded approach. It was recognised at the earliest stages that there were no easy answers to the problems about specifications identified by engineers. The commonly held belief, that the root of the problem lies with the engineers themselves and their poor writing skills, is but part of the answer. This study reveals that a minority of engineers, only 25%, find writing a problem. Although poor writing skills may be a contributory factor, it is more likely that other reasons may account for the problems, and that not all of them are linguistic. Had I pursued this tack, I would have succumbed to examining engineers' writing mistakes, a situation I had wanted to avoid. It had taken some time to shed the image of the correctionist teacher that, at first, I looked in danger of acquiring amongst the engineers. It has pejorative connotations, and would not have engendered the kind of co-operation I was seeking from the engineer informants. It had been one of my aims to explore the possibilities of broadening the remit of the applied linguist beyond that of correcting spelling and grammar mistakes, and to gain recognition for abilities to describe and diagnose linguistic problems in the broader text arena of documentation.

In this, the study seems to have achieved some success, especially with respect to proposals. A holistic description is provided that has clarified issues surrounding the proposal writing process, especially those concerning audience, selection of information to be included, and writing procedures and practices. A fundamental consideration, that of the need to produce a persuasive document which conforms with stylistic and rhetorical conventions of the discourse community has also been explored. These have resulted in an analytical approach informed by three main stands: early work in ESP on technical writing and engineering reports, pedagogically-oriented explorations of various genre analyses and approaches to text analysis, and publications intended for an engineering or commercial audience. The result has yielded a content-focused approach, which, I claim, is sympathetic to engineers' inclinations and writing needs. They seem to like it, and appear to find the identification of Information Components (ICs) attractive because:

1. the ICs could provide assistance in proposal planning during the drafting stage, providing a set of choices for them to choose from, much like a menu.
2. of the possibility, they suggest, of diagnostic exercises being conducted, once it is known whether a proposal has been accepted or rejected. ICs could provide the

means of recognising successful (or failing) patterns within proposals or proposal sections.

3. particular ICs could be examined, in order to identify specific features of successful or failed proposals.

8.3 What was not achieved

This project proved interesting throughout its duration, calling attention to a range of fascinating aspects, none of which I regret studying, not even those that proved fruitless. Nonetheless, at the end of it, my abiding interest in expository technical description remains somewhat unsatisfied. Engineers' attempts to represent the product in text are discussed throughout the study, leading to Chapters 6 and 7, which show the central importance of product-related ICs in proposals. During this study, it became apparent that 'writing connections' exist between the proposal and design specifications, in that the proposal influences what is written about the product at a later stage (sometimes years later) of the design process. The writing of specifications and requirements is influenced by what is written in the proposal, by very dint of the fact that engineers need to specify (describe) in writing the product that was 'promised' in the proposal. I would have liked to examine further the realisation of product-related ICs in proposals, and to follow their development in documents written after the proposal has been accepted.

The problems with specifying the design are diverse, and it is only at the end of the study that an understanding is emerging. In this study, it seemed sensible to trace the writing roots of specifications and requirements, and to describe the phenomena, including the texts, that give rise to them; hence the coverage of work and writing practices, the life-cycle of the product, and the text that is written as an early attempt to describe the product (or solution), the most important and problematic being the proposal.

8.4 What I hope to achieve – possible research arising

At this very final stage of the thesis, I indulge in some prospection, and attempt to express this diagrammatically in Figure 8-1. I realise that to present such thoughts at this late stage contravenes accepted writing conventions that new ideas should not be introduced in a conclusion. However, Figure 8-1 is similar to Figure 1-10, in that it has been in the making for the large part of the study. The finishing touches to it were made in the final stages when I had to crystallise my thoughts to bring this thesis to an end.

As I mentioned earlier, not all the work I have done on this project has been included in this study. Several avenues were followed, during which linguistic analyses were carried out, as exemplified by aspects of writing specifications and requirements contained in Appendix J. Word limitations and questionable relevance determined that much of the work resulting out of following these (often) red-herring trails should be excluded. It has, all the same, helped to inform this study, and some of it awaits completion, or will provide the focus for future work. Figure 8-1 is my view of engineers' texts, using the benefit of hindsight in the closing stages of this thesis to draft a picture for future work. It is intended to provide a backdrop for any future research arising out of this study. I discuss key aspects of this view after Figure 8-1 in written point form.

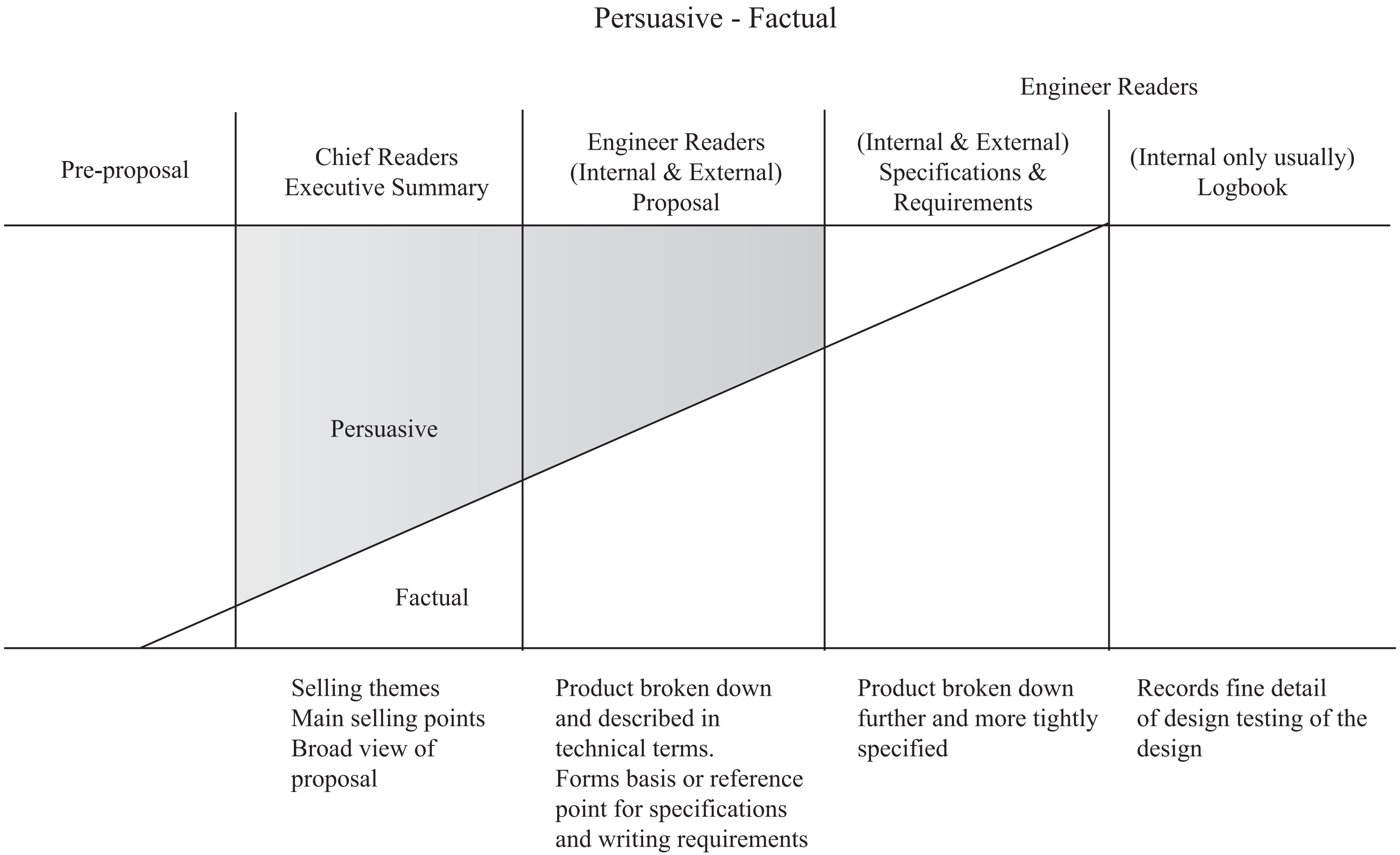


Figure 8-1: Diagrammatic depiction of the relationship between target readers and persuasive/ factual characteristics of design documentation

Concluding, forward-thinking observations

1. There exists a chain of texts which can be viewed as communicative events linked together by a common focus, i.e. the product. These are texts which have been found, without contrivance, to be texts demanding the most time to produce by the engineers.

2. The texts can be ranged along a persuasion-factual cline, ranging from the executive summary to specifications and requirements (and logbooks).

3. The amount of (overt) persuasion I would expect to find in a text would coincide with the type of readers reading each particular section, their reasons for reading, and the expertise and background knowledge they bring to the texts they read. Thus, Chief Readers would expect to read more overtly persuasive text, whereas engineers reading the main part of the proposal would expect to read more factual and technical description-type of text, which, in spite of its less obviously persuasive content and style, is still intended to persuade. In future work, it should prove fruitful to conduct more corpus-oriented linguistic analysis, among other approaches, to identify how this type of text persuades the reader.

4. The main part of the proposal spawns the specifications and requirements which are distinctive in that they contain no overtly persuasive language.

5. I am flying a 'kite' with this particular observation. The persuasion-factual cline, shown in Figure 8-1 above, portrays a dichotomy that exists which suggests engineers' texts may be placed in two broad 'emotive' categories: one that engineers find potentially 'threatening', and the other 'relatively non-threatening'. Threatening texts are those intended for the Customer, and which earn, or have the potential to earn revenue. They are produced for 'external' readers, who are in a position of power, in that they judge the texts, and base payments to the company on them.
   Non-threatening texts are those intended for an internal audience, or for the engineer's own records. They may be read only by other engineers in the company, or may be quite personal and read by nobody else. Engineers' logbooks are examples of this type of (relatively) non-threatening writing. In the course of this study, I observed the value placed on logbooks by the engineers, and identified two main types with distinctly different discourse/linguistic features.

6. It is anticipated that discourse features between the two emotive categories would be distinctly different. I am mindful that engineers would take exception to these category

labels, but as indicators of promising areas for future research, they will have to suffice for now.

A study of this nature demands a degree of discipline in the researcher, who has to keep in mind a clear sense of direction and not be overly distracted by innumerable linguistic leads that present themselves along the way. Throughout the study there has been potential for widening its scope, and from time to time in this discussion, there have been allusions to certain topics, for want of discipline, or the need to know more about them in order to better judge them for inclusion or exclusion. I have mentioned them, albeit briefly at this late juncture, as a combination of strawman / kite-flying / concluding observations that merit further exploration, and to indicate the wealth of topics and material that as yet await investigation.

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APPENDIX A - THE QUESTIONNAIRE SENT TO 120 DESIGN ENGINEERS VIA THE COMPANY'S INTRANET

Questionnaire June 99

Would you consider being one of my specialist informants?

Can I email you a question or three from time to time?

I am a researcher looking into the writing that RASE engineers do at work, paying particular attention to specifications, requirements, and proposals. Dr Tom Brookes has taken over from Dr Dave Edmondson as my RASE PhD supervisor, and acts as mentor and overseer for my research project.

Basically, I'm interested in what you write, what you think about it, and how you go about it. My specialist area is English Language and Applied (English) Linguistics, and my study has now reached a stage where I need to verify some of my findings, which is why I'm contacting you now.

What RASE engineers have told me so far:

Some of you don't like English very much

I've talked to around thirty-five of you, and so far my investigation has thrown up a range of interesting facts, like, for example, that a few of you dislike English to such an extent that you refer to it as "horrible", or claim to hate it. The RASE engineers who said these things said they didn't like English at school and deliberately chose not to follow a languages (or Arts) course in favour of science subjects as a sort of avoidance strategy.

Or you think English is not up to scratch

Other engineers haven't expressed dislike, but believe English (or the version of English engineers refer to as "natural English") to be inadequate for their writing purposes, especially if they are trying to write a technical response. Others are more concerned about writing offer letters, or tricky responses to customers, like for e.g. a diplomatic "thanks but no thanks we wouldn't touch this one" type of letter, where they wish they could write more elegantly.

A contradiction between what some of you say and what you actually do?

I haven't got my head round this yet. Many of you seem to believe that English is too vague a language to be useful to you. However, I've learned that a few of you start a new project with what some of you call vague-like thoughts. Because of this you find natural English useful to start with when you draft a more general requirement, which you can then hone and refine more at the design stage.

These are just a few of the things I've learned from RASE engineers who have been kind enough to talk to me about their writing. But now I need to find out how representative their views are, and this is why I've contacted you.

What I'm asking of you

I would be really grateful if you'd respond to the following questions. A "yes" or "no" will do for the most part, although you can expand however you like. Simply click on **Reply** to return your answers. I shall keep them confidential/anonymous. When I've gone through your responses I may return with more questions. This email survey is a first: I'm not aware of it having been done before.

Thanks very much indeed

Hazel Sales (When on site, I sit with Pip Parsons, Alan DeLaMothe, Steve Harley and Brian Pereira)

Initial questions

Please reply by 21 June, if you can.

Put short one or two-word answers, a *Y* for *yes* or *N* for *no*, or anything you fancy at the answer prompts.

1. What sort of engineer are you? *Answer*:
2. Why did you decide to become an engineer? It has been said: "People either fit into the English stream or the Maths stream - engineers fit into the Maths stream." Is this true in your case? Or/And was it possibly a dislike of Arts subjects like English (or under-performance in these subjects) at school which had something to do with the decision? *Answer*:
3. Roughly how much of your working time in % terms is spent on writing of any kind? *Answer*:
4. What do you write on a regular basis by yourself? Any of these document-types: memos, sales letters, reports, engineer log book entries, requirements, proposals, executive summaries? Or anything else? *Answer*:
5. What do you write with other people?
6. Which item(s) in 4. and 5. take(s) up the largest proportion of your time? *Answer*:
7. Which in 4. and 5. do you consider to be important? *Answer*:
8. Unimportant? *Answer*:
9. I suspect that you seldom (or never) use the guidance available for writing. Am I right? *Answer*:
10. How do you rate yourself as a writer? *Answer*:

APPENDIX B - TABLE TO SHOW DIFFERENT CATEGORIES OF ENGINEER

This table shows the different categories by which the engineers identified themselves in the email survey.

Question: What sort of engineer are you?

What sort of engineer are you?	Number	%
Electronics	15	25
Software	12	20
Systems	11	18.3
Mechanical	5	8.3
Production	3	5
Support	3	5
Mechanical design	2	3.3
Manufacturing process	2	3.3
Test equipment design	2	3.3
Hardware	1	1.7
Optical	1	1.7
Electronics and control systems	1	1.7
Metallurgical and materials	1	1.7
Other	1	1.7
Total	60	100%

Table to show categories/labels engineers use to refer to jobs that they do

APPENDIX C - LIST OF SPECIALIST INFORMANTS AND THE SPOKEN DATA THEY PROVIDED FOR EARLY SURVEY

[Specialist informant names can be found in Appendix S]

Who and what texts are written	When and where	Main topics	Problems mentioned
1. DE NB This is a compilation of 2 versions of this meeting	25.1.96 Meeting Notes	• Engineers' working methods • Capturing what engineers write	1. Writing clear concise instructions for engineers 2. Capturing any technical writing that an engineer does in relation to a particular product 3. Tagging and indexing all the writing that engineers do on design to fit within a database so that any aspect of the design is easily traceable, and any changes systematically recorded and accessible. An attempt is currently being made by Roy Orme to come up with an engineer's working method. 4. High level language description in software language 5. RASE problem No 1: nobody reads writing guides or procedures 6. RASE problem No 2: Capturing requirements and other technical records /descriptions 7. High level description on which machine code is based needs to be improved
2. J B	13.11.95 Tape 2. c.20 mins Needs analysis	• Provided feedback on a writing course I ran to help me prepare for the next one	8. Proposal writing is a problem 9. Bad grammar reflects badly on RASE and "turns off" the reader 10. Need to decide before writing that making a proposal is worthwhile - need to devise a pre-bid checklist 11. Need for writing guidelines for the executive summary (the implication being that this would then determine the structure of the proposal)

Who and what texts are written	When and where	Main topics	Problems mentioned
3. DE: technical aspects pf proposals research papers internal reports	16.6.98 Tape 25 c.75 mins	• Frederick [redacted], writer of [redacted] cardinal points specifications • MoD procurement process • The [redacted] documents and story behind them • Hard and soft requirements - continuum • Financial implications of writing requirements • Functional specs, system description	12. One of the first to raise contentious issue of writing deliberately vaguely 13. Having to conform to bidding and procurement procedures which are different and which may change 14. Lengthy bidding procedures which means costly bidding process 15. Wrongly or badly written specifications can lead to huge financial losses 16. Having to revise badly written documentation which is very costly 17. Needing to be able to distinguish between hard and soft requirements 18. Mis-match between what the customer expects and what the engineer produces.
4. Anon	10.11.97 Tape 10 c.45 mins	• Role of linguistics and syntactic analysis in writing requirements • Engineers have an educational background which reveals English-avoidance • How documents should be structured • Writing tools and their limitations • Engineers like models • Structuring texts which comprise unstructured detail • Limited usefulness of English	19. Engineers have problems when writing requirements 20. Syntactic analysis is inadequate when it comes to writing requirements 21. Engineers don't know how to write 22. They were no good at English at school 23. They can't use formal language properly if they can't write properly; ie good general writing skills are a prerequisite for writing good requirements and specifications 24. Engineers like to make models but it is difficult to build models from poorly written specifications 25. Information is badly organised within the specification 26. Engineers get lost in unstructured detail when writing requirements 27. Engineers don't know how to structure documents to organise information effectively 28. They rely too much on tools (RTM, Statemate, RDD100) to help them write specifications 29. They need to have suggested formats / text models for their documentation 30. English is not very useful as a language

Who and what texts are written	When and where	Main topics	Problems mentioned
5. IF proposals	13.11.95 Tape 3 c.15mins Needs analysis	• Writing process and RASE procedures for writing proposals	31. Became an engineer because he was no good at English 32. Grammar is a problem 33. Also not being concise 34. Inconsistencies of writing style is a problem in proposal writing 35. Plagiarizes when he writes 36. There is a need for someone to act as a filter for grammatical mistakes and stylistic consistency in proposal writing 37. Tight time constraints - never enough time, always cobbling together at the last minute 38. Lack of reasonable writing programme (or plan) when it comes to proposal writing
6. MC Short letters following up on phone conversations and meetings	13.11.95 Tape 2. c.15 mins Needs analysis	• Writing style, whose writing he admires, and how he'd like to write more elegantly	39. Would like to be a more elegant writer : he thinks his writing lacks variety and describes it as rather drab
7. KJ Letters to follow up telecons, letters of introduction	13.11.95 Tape 2. c.15 mins Needs analysis	• More interested in his spoken (telephone) language • A shortage of faith in his own writing and general use of language	1. Relies on the secretaries to correct his grammatical mistakes 2. Gets a mental block when writing a letter of introduction 3. Doesn't know how to write a warm letter without being "smarmy" 4. Not confident in his own use of English

Who and what texts are written	When and where	Main topics	Problems mentioned
8. RC	Aug 95 Tape 1 c.25mins Needs Analysis	• Proposal writing procedure and the bid writing process • His clear views about how writers should prepare for writing • The different audiences and different writers involved	5. These all relate to proposal writing: 6. Control of his writing by other more senior colleagues, and their power to change his text 7. The need to show more commitment to the product, to write what you believe, and by inference, be more persuasive 8. Formal specifications tend to mask what the product will be like 9. Need to improve standards of English 10. Need to be selected to tender and to win more bids 11. Shortageof time when writing 12. Stress and pressure of writing proposals relentlessly - feelings of tiredness and jadedness 13. Need to improve bid writing process 14. Editing by committee is a problem, as there may be disagreement, jumbling-up [of content and style]
9. AC Letters responding to customers asking for prices, or to turn down business, memos, finance reports,	Aug 95 Tape 1a c.15 mins Needs Analysis	• Describes his attitudes and approach to writing • More aware than most of his audience and his own writing abilities	15. Did not fit into the English stream (identical wording to what Brian pereira said) 16. Likes to check his writing with others. 17. Takes him a long time to write generally. 18. Time constraints ultimately determine how long can be devoted to writing. (Same as Graham) 19. How to reject without making reader feel slighted, and how to write letters which don’t sound rude or indifferent. 20. Control from senior colleagues over his wish to be candid. Eloqent and reasonable argument. 21. Implies that RASE is over-cautious in the documentation which is read by outsiders. 22. There is a need for a list of do’s and don’t’s for improving his writing. 23. Wants to be more concise and to get his meaning across in fewer words.

Who and what texts are written	When and where	Main topics	Problems mentioned
10. JD Proposals, legal documents: commercial terms and conditions	Aug 95 Tape 1a c.15mins Needs Analysis	• Mainly discusses his own inadequacies in writing	24. Did badly in English at school. 25. Doesn't like English 26. He's been told at RASE that his writing is pretty dire 27. Has problems with grammar and writing generally 28. Commercial terms and conditions are difficult to express
11. JB proposals, reports, business agreement, executive summaries	Aug 95 Tape 1a c.45 mins Needs analysis	• Was in charge of the writing courses on proposal writing. • Centred on briefing me on what was required. • Mainly about proposal writing procedures and the executive summary.	29. Found English hard at school 30. Problems with proposal writing: 31. Writing tends to be unstructured and ungrammatical 32. Need for a prescribed format for proposals and executive summaries 33. Writing needs to be more convincing and persuasive 34. Need to improve the selling features of documents so that the themes are clear and the objectives clearly stated
12. IL Standard offer letters, proposals	Aug 85 Tape 1 c.25mins Needs Analysis	• Basically: Blame English! • Improving proposal writing procedures. • Structuring proposals • Costs incurred in producing documentation	35. English is a problem because written text is notoriously bad at conveying thoughts. 36. Copies from other texts for damage limitation, easier writing, to ensure nothing is left out 37. Wants a top ten of do's and don't's 38. Proposal themes aren't understood, prescribed or adhered to 39. Proposals should be better planned, and better organised and structured 40. Proposals are not persuasive enough and need to be convincing 41. Need a number of bulleted simple guidelines or principles for writing proposals 42. Proposals are costly to prepare (showed two current examples costing £30, 000 and £100,000) 43. Too many different people with different viewpoints write proposals 44. Language is not clear and concise 45. Selling points (themes) in some proposals could be better

Who and what texts are written	When and where	Main topics	Problems mentioned
13. DM reports, proposals, memos, and letters	Meeting notes - 9.6.94. Interview and tutorial about his writing c.2 hours	• How he considers himself to be handicapped by his writing • Identifying what his writing problems are at work • What he has to write	1. Finds writing so difficult that he tries to get others to do it for him - poor grammar, spelling (his diagnosis). Also problems with sentence structure, organising ideas 2. His writing his hampering his promotion prospects 3. Writing is stressful 4. Finds it difficult to remember all the points he has to make. 5. Can't organise ideas logically 6. Inadequate grasp of vocabulary 7. Writing is very time-consuming - claims a para can take 5 hours to write 8. Stressful and sense of shame that writing inadequacies are revealed to others 9. Resorts to copying 10. Can't understand the grammar checker which usually flags up many poss errors. 11. I looked at some of Don's report writing and identified problems with:punctuation and sentence structure, overcomplicated NPs, inappropriate use of verb *be* ordering of information
14. GB faxes letters commercial proposals internal and external correspondence	13.11.95 Tape 3 c.20mins	• His own writing at work • Proposal writing • Views on company practices and policies • Changes at RASE	12. Engineers are no good at writingand not aware of issues surrounding writing 13. They feel inadequate when it comes to expressing ideas in writing 14. They use woolly language when they should be being precise and clear 15. Proposals are a problem to RASE in the undisciplined way they are put together - no prescribed process, or example set by management 16. The writing style of proposals should be improved in the commercial volumes to appear more friendly 17. His own language usage is old fashioned, and he wishes it were more modern 18. He calls his own command of English mediocre
15. JS reports manuals	13.11.95 Tape 3 c.15mins Needs Analysis	• His own writing process which is painstaking • A little about compiling contributions from different engineers to make a document	19. Needs to be less wordy and more concise 20. Needs to be able to cut through unneccessary detail and select information better 21. Finds he needs to rework a piece over and over - time consuming

Who and what texts are written	When and where	Main topics	Problems mentioned
16. DE	30.7.97 Meeting notes c.60mins	• General discussion about engineers' and RASE's problems or questions about writing • Tossing about ideas for me to explore • Highlights those topics of interest to RASE	22. Engineers self-selected, ie deliberately chose maths and science in order to avoid studying English at school 23. They don't like writing ("they're not going to write documentation unless you stand on their neck") 24. Engineers are not much interested in writing generally, and are especially uninterested in writing unconnected with design 25. Engineers are generally inarticulate 26. Engineers can't write coherently 27. They are reluctant to keep records of aspects of the design, which may prove invaluable later
17. JSm requirements	28.5 /23.12 Tapes 12a and 12b c.50mins Meeting notes	• Writing requirements • RTM (Requirements Traceability Management) • Communication breakdown in process of developing software programs • Attitudes towards English	28. In writing requirements - Mismatch between customer expectation and what the engineer actually produces 29. Problems with providing the end-user (as distinct from customer) with what he wants 30. Too many people in the design loop leads to communication breakdowns, and not being able to deliver what the user (as distinct from the customer) really wants or needs. A case of too many cooks. 31. Engineers can make a lot of mistakes in English. 32. As a language, English is inadequate for writing requirements. It presents problems because it allows one to express illogicalities (Jo Smart's view. I think she is referring to the fact that there is no formal test which will flag up the illogicality). 33. Identifying different functionning parts of a requirement, in order to decide whether it is high or low level
18. CP proposals commercial letters and proposals reports	9.12.97 Tape 13 Meeting notes c.75mins	• Preparing the way for the development of a generic proposal • Charles' views about writing, and how it should be structured • Proposal writing process	34. Proposals are usually prepared in a tremendous hurry. Time constraints affect quality. He has noticed an erosion of quality 35. Proposals need to be better structured 36. Writing style is sometimes inappropriate, eg colloquial language which is too chatty or sensationalist (journalese) 37. Need for a model proposal

Who and what texts are written	When and where	Main topics	Problems mentioned
19. CP	5.5.98 Tape 21 c.40mins	• Charles met with us to discuss the strawman generic proposal • His reactions to the document so that it could be further tailored to what he needs	38. What should be included in the technical response? ie should you include general technical description, or should you restrict yourself to the "prime technical response".
20. IS	Tape 26 10.8.98 c.30mins	• The start of the story behind [redacted] • Changes in the procurement process • Candid reflections on what was a painful writing experience which led to huge losses for the company	39. Tremendous time pressures to write the response to the Cardinal Points specification - over the weekend! 40. Lack of early detail (vague thoughts) led to problems with spares that were required 41. Mismatch between what the engineer thought the customer wanted and what the customer said he wanted ...... after the thing had been produced. 42. Vague language (deliberately so) in the specification, needed to be much more precise.
21. BP Design logs reports faxes/letters	Tape 4 22.8.96 and in note book c30mins	• Engineers' attitudes to documentation • Procedures • [redacted] project and the gun firing system itself • design and production processes	43. Writing procedures are too vague 44. Difficult to diagnose problem with equipment through design documentation, esp. when years have passed and the engineers concerned have left - Notebook P8 45. Engineers are writing mavericks (he described it as going off in different directions and doing their own thing. No standard company policy on writing - P14 notebook 46. Need for good documentation for Support engineers like himself who rely on it, esp when the product may have a life of 30 or 40 years. 47. VOLUMINOUS documentation - notebook P26 48. Million of £s are lost through badly written specifications and software.

Who and what texts are written	When and where	Main topics	Problems mentioned
22. TB Requirements design specs	Tape 5 19.2.97 and 5.3.97 c.40mins	• RTM and how it works • Writing requirements and specs • Formal and semi-formal language	49. Problems with writing requirements usually involve ambiguity, incompleteness, incorrectness Notebook p42 50. RTM was designed to help the engineer in his work, but they were having problems getting the engineers to use the tool. notebook P42 51. Working practices are not set up to use the tool properly Notebook P42 52. Misunderstandings of what the requirement is supposed to be can often give rise to problems “a long way down the design process”, requiring very expensive re-design work. Notebook P 46 53. Misunderstandings between the customer and the design engineer. 54. Awareness of the misunderstanding identified so late that sometimes a complete redesign is necessary. 55. Becoming paperless has seen a rise in the amount of paper being generated. Notebook P61

APPENDIX D - LIST OF PROBLEMS MENTIONED BY ENGINEERS IN INTERVIEW DATA

Problems mentioned

1. Writing clear concise instructions for engineers
2. Capturing any technical writing that an engineer does in relation to a particular product
3. Tagging and indexing all the writing that engineers do on design to fit within a database so that any aspect of the design is easily traceable, and any changes systematically recorded and accessible. An attempt is currently being made by Roy Orme to come up with an engineer's working method.
4. High level language description in software language
5. RASE problem No 1: nobody reads writing guides or procedures
6. RASE problem No 2: Capturing requirements and other technical records /descriptions
7. High level description on which machine code is based needs to be improved
8. One of the first to raise contentious issue of writing deliberately vaguely
9. Having to conform to bidding and procurement procedures which are different and which may change
10. Lengthy bidding procedures which means costly bidding process
11. Wrongly or badly written specifications can lead to huge financial losses
12. Having to revise badly written documentation which is very costly
13. Needing to be able to distinguish between hard and soft requirements
14. Mis-match between what the customer expects and what the engineer produces.
15. Engineers have problems when writing requirements
16. Syntactic analysis is inadequate when it comes to writing requirements
17. Engineers don't know how to write
18. They were no good at English at school
19. They can't use formal language properly if they can't write properly; ie good general writing skills are a prerequisite for writing good requirements and specifications
20. Engineers like to make models but it is difficult to build models from poorly written specifications
21. Information is badly organised within the specification
22. Engineers get lost in unstructured detail when writing requirements
23. Engineers don't know how to structure documents to organise information effectively
24. They rely too much on tools (RTM, Statemate, RDD100) to help them write specifications
25. They need to have suggested formats / text models for their documentation
26. English is not very useful as a language
27. Became an engineer because he was no good at English
28. Grammar is a problem
29. Also not being concise
30. Inconsistencies of writing style is a problem in proposal writing
31. Plagiarises when he writes
32. There is a need for someone to act as a filter for grammatical mistakes and stylistic consistency in proposal writing
33. Tight time constraints - never enough time, always cobbling together at the last minute
34. Lack of reasonable writing programme (or plan) when it comes to proposal writing
35. Would like to be a more elegant writer : he thinks his writing lacks variety and describes it as rather drab
36. Relies on the secretaries to correct his grammatical mistakes
37. Gets a mental block when writing a letter of introduction

38. Doesn't know how to write a warm letter without being "smarmy"
39. Not confident in his own use of English
40. Proposal writing is a problem
41. Bad grammar reflects badly on RASE and "turns off" the reader
42. Need to decide before writing that making a proposal is worthwhile - need to devise a pre-bid checklist
43. Need for writing guidelines for the executive summary (the implication being that this would then determine the structure of the proposal)
44. These all relate to proposal writing:
45. Control of his writing by other more senior colleagues, and their power to change his text
46. The need to show more commitment to the product, to write what you believe, and by inference, be more persuasive
47. Formal specifications tend to mask what the product will be like
48. Need to improve standards of English
49. Need to be selected to tender and to win more bids
50. Shortage of time when writing
51. Stress and pressure of writing proposals relentlessly - feelings of tiredness and jadedness
52. Need to improve bid writing process
53. Editing by committee is a problem, as there may be disagreement, jumbling-up [of content and style]
54. Did not fit into the English stream (identical wording to what Brian Pereira said)
55. Likes to check his writing with others.
56. Takes him a long time to write generally.
57. Time constraints ultimately determine how long can be devoted to writing. (Same as Graham)
58. How to reject without making reader feel slighted, and how to write letters which don't sound rude or indifferent.
59. Control from senior colleagues over his wish to be candid. Eloquent and reasonable argument.
60. Implies that RASE is over-cautious in the documentation which is read by outsiders.
61. There is a need for a list of do's and don't's for improving his writing.
62. Wants to be more concise and to get his meaning across in fewer words.
63. Did badly in English at school.
64. Doesn't like English
65. He's been told at RASE that his writing is pretty dire
66. Has problems with grammar and writing generally
67. Commercial terms and conditions are difficult to express
68. Found English hard at school
69. Problems with proposal writing:
70. Writing tends to be unstructured and ungrammatical
71. Need for a prescribed format for proposals and executive summaries
72. Writing needs to be more convincing and persuasive
73. Need to improve the selling features of documents so that the themes are clear and the objectives clearly stated
74. English is a problem because written text is notoriously bad at conveying thoughts.
75. Copies from other texts for damage limitation, easier writing, to ensure nothing is left out
76. Wants a top ten of do's and don't's
77. Proposal themes aren't understood, prescribed or adhered to

78. Proposals should be better planned, and better organised and structured
79. Proposals are not persuasive enough and need to be convincing
80. Need a number of bulleted simple guidelines or principles for writing proposals
81. Proposals are costly to prepare (showed two current examples costing £30, 000 and £100,000)
82. Too many different people with different viewpoints write proposals
83. Language is not clear and concise
84. Selling points (themes) in some proposals could be better
85. Finds writing so difficult that he tries to get others to do it for him - poor grammar, spelling (his diagnosis). Also problems with sentence structure, organising ideas
86. His writing his hampering his promotion prospects
87. Writing is stressful
88. Finds it difficult to remember all the points he has to make.
89. Can't organise ideas logically
90. Inadequate grasp of vocabulary
91. Writing is very time-consuming - claims a para can take 5 hours to write
92. Stressful and sense of shame that writing inadequacies are revealed to others
93. Resorts to copying
94. Can't understand the grammar checker which usually flags up many poss errors.
95. I looked at some of Don's report writing and identified problems with:punctuation and sentence structure, overcomplicated NPs, inappropriate use of verb *be* ordering of information
96. Engineers are no good at writing and not aware of issues surrounding writing
97. They feel inadequate when it comes to expressing ideas in writing
98. They use woolly language when they should be being precise and clear
99. Proposals are a problem to RASE in the undisciplined way they are put together - no prescribed process, or example set by management
100. The writing style of proposals should be improved in the commercial volumes to appear more friendly
101. His own language usage is old fashioned, and he wishes it were more modern
102. He calls his own command of English mediocre
103. Needs to be less wordy and more concise
104. Needs to be able to cut through unnecessary detail and select information better
105. Finds he needs to rework a piece over and over - time consuming
106. Engineers self-selected, ie deliberately chose maths and science in order to avoid studying English at school
107. They don't like writing ("they're not going to write documentation unless you stand on their neck")
108. Engineers are not much interested in writing generally, and are especially uninterested in writing unconnected with design
109. Engineers are generally inarticulate
110. Engineers can't write coherently
111. They are reluctant to keep records of aspects of the design, which may prove invaluable later
112. In writing requirements - Mismatch between customer expectation and what the engineer actually produces
113. Problems with providing the end-user (as distinct from customer) with what he wants

114. Too many people in the design loop leads to communication breakdowns, and not being able to deliver what the user (as distinct from the customer) really wants or needs. A case of too many cooks.
115. Engineers can make a lot of mistakes in English.
116. As a language, English is inadequate for writing requirements. It presents problems because it allows one to express illogicalities (Jo Smart's view. I think she is referring to the fact that there is no formal test which will flag up the illogicality).
117. Identifying different functioning parts of a requirement, in order to decide whether it is high or low level
118. Proposals are usually prepared in a tremendous hurry. Time constraints affect quality. He has noticed an erosion of quality
119. Proposals need to be better structured
120. Writing style is sometimes inappropriate, e.g. colloquial language which is too chatty or sensationalist (journalese)
121. Need for a model proposal
122. What should be included in the technical response? ie should you include general technical description, or should you restrict yourself to the "prime technical response".
123. Tremendous time pressures to write the response to the Cardinal Points specification - over the weekend!
124. Lack of early detail (vague thoughts) led to problems with spares that were required
125. Mismatch between what the engineer thought the customer wanted and what the customer said he wanted ...... after the thing had been produced.
126. Vague language (deliberately so) in the specification, needed to be much more precise.
127. Writing procedures are too vague
128. Difficult to diagnose problem with equipment through design documentation, esp. when years have passed and the engineers concerned have left - Notebook P8
129. Engineers are writing mavericks (he described it as going off in different directions and doing their own thing. No standard company policy on writing - P14 notebook
130. Need for good documentation for Support engineers like himself who rely on it, esp when the product may have a life of 30 or 40 years.
131. VOLUMINOUS documentation - notebook P26
132. Million of £s are lost through badly written specifications and software.
133. Problems with writing requirements usually involve ambiguity, incompleteness, incorrectness Notebook p42
134. RTM was designed to help the engineer in his work, but they were having problems getting the engineers to use the tool. notebook P42
135. Working practices are not set up to use the tool properly Notebook P42
136. Misunderstandings of what the requirement is supposed to be can often give rise to problems "a long way down the design process", requiring very expensive re-design work. Notebook P 46
137. Misunderstandings between the customer and the design engineer.
138. Awareness of the misunderstanding identified so late that sometimes a complete redesign is necessary.
139. Becoming paperless has seen a rise in the amount of paper being generated. Notebook P61

Problem categories arising out of the interview data Apr 99

Problems identified - 3 main categories:
1 Writing procedures and practices
observations of need for company to promote changes or improvements
1. inconsistent or inappropriate style
2. need for more persuasive (and personable) style
3. call for better writing procedures and guidelines
4. need to improve selection and organisation of content

engineers are writing mavericks, ie "do their own thing" and have their own individual writing practices
(over) reliance on other people
problems centring on writing tools
time constraints
need for models and prescription
being subject to checking and imposed changes by senior colleagues
2 Engineers' writing ability
general observations about the inadequacy of RASE engineers' writing

- **self-criticism**:
- not being concise
- copies or plagiarises
- writes in an inappropriate or inelegant style
- ungrammatical
- takes too much time to write

impact of writing inadequacies:

- poorly written specifications and requirements
- financial costs to the company
- communication breakdowns, especially with the customer
- badly written, badly organised, ungrammatical documents
- poor selection and organisation of information within documents
- dashed promotion prospects
- loss of face
- feelings of resentment

3 English - as a subject, and as a language
School experiences
1. no good at English as a subject, or found it hard
2. subject at school to be avoided

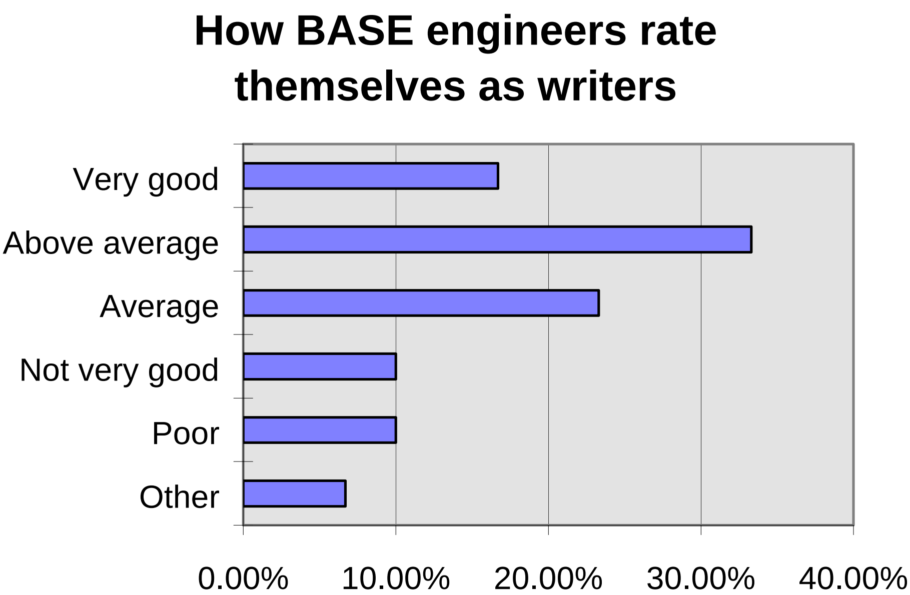
Inadequacies of English as a language
Unsuitable for writing requirements with

APPENDIX E - ENGINEERS' WRITING SKILLS – SELF-RATINGS

This is a summary of the responses to Question 10 of the email survey: How do you rate yourself as a writer?

Main findings - more positive than negative

Basically, more engineers rate themselves as being average and (well-) above average writers than those who hold more negative, or even pejorative, views about their own writing: just over 73% of the 60 respondents in the former category as against 20% in the latter.



Description of each category:

Highly positive - 16.66% of respondents

Engineers in this category rate their writing as being very good on the whole, and are confident of their judgement. Some of them know their colleagues have a high opinion of their writing:

> I'm told my reports read very well. I hate writing technical reports but I'm usually pleased with the results. As for poetry, well, Wordsworth has nothing on me ...(!)
>
> Pretty good though out of practice. I have been told by superiors that my use of English is among the best in the department.
>
> BRILIUNT
>
> P.S. Please spell my name correctly.

It is not easy to do justice in a summary like this to the range of opinion expressed in the answers, but this response encapsulates the feelings of several engineers who feel frustrated in their efforts to be creative and innovative in their work:

> I think that I write in a fluent understandable style which is perhaps a bit minimalist (see the above comments on requirements as an illustration). I believe that most engineers have passion and enthusiasm, and most managers require po-faced precision. On the basis that I think of myself as a true engineer, but my reports are read by managers I feel my ability to communicate in an interesting manner is compromised.

Positive - 33.33% of respondents

A total of twenty engineers fall into this largest category which represents those with opinions that are generally positive. It would be fair to describe these engineers as regarding their writing as being above average, or competent.

> I try to use plain English (but often don't). I try to view my writing from a readers' perspective. I am probably too verbose. I think my writing is more understandable than most engineers.
>
> Having read other engineers' work I would probably rate myself slightly above average - particularly on spelling.
>
> This is a difficult question, as I have not been assessed against either a standard or my peers. I'd like to believe that my writing is either average, or perhaps above average. PS I have had some formal training in writing both within and outside of RASE.

Neutral/non-committal - an average self-rating (23.33% of respondents)

This was the second largest category of engineers, who seemed to regard themselves as being able to "get by". Some of the engineers in this group may in fact be highly skilled writers in comparison with their peers; however, they rated themselves either modestly or unenthusiastically in the following ways:

> Average.
>
> Fair
>
> Average. Not very imaginative/creative.
>
> Adequate under pressure.
>
> Average to dull.

Negative - 10% of respondents

Six engineers gave themselves a self-rating which was more negative than positive, usually using pejorative terms to describe their writing:

> Poor - medium.
>
> Not very good.
>
> Unimaginative.
>
> One rung below a Sun journalist.
>
> Standard is sufficient to get by with little criticism from my peers. ...my handwritten work is still relatively poor and I am less able to identify problems with my grammar when I proof-read my hand-written work ...

Very negative - 10% of respondents

Responses in this category reveal clear self-denigration on the part of the engineer in the use of pejorative language:

> Poor.
>
> Sloppy and vague. [Sloppiness and vagueness are taboo in technical writing, which explains why this response is in this category, but whether this engineer is as bad a writer as he describes may be another story ....]

Why I asked this question

There is a fair amount of dark muttering in engineering circles about how badly engineers write. It needs to be remembered that this muttering is done by engineers themselves who are critical about their own writing, or who don't think much of the writing done by their colleagues. Since the beginning of this study, I have encountered opinions, mainly expressed orally, which have supported this view, indicating a generally negative attitude towards engineers' writing. However, I was curious about this blanket judgement, because I had noted in my data several cases of engineers who criticised others' writing abilities, but who thought their own writing was perfectly alright. This led me to wonder if I was witnessing some kind of "I'm alright, Jack" syndrome. Is it possible that engineers tend to denigrate the writing done by their profession, perpetuating a possible myth? I know there is, without exaggeration, great dissatisfaction about writing and documentation in the industry, how expensive it is, time-consuming, and costly when mistakes are made, but is it really all the fault of inadequate writing skills of engineers? Is it possible that there are other reasons to be found in the writing practices and working processes in the workplace? These a questions which need to be dealt with.

Analysing the answers

This proved to be as easy as I had hoped, especially since I had taken a risk by asking an open question. The opportunity to gather unconstrained comment proved irresistible, and over-rode the more sensible option of offering a closed multiple-choice question. There is no doubt that the information gained from the open-ended questions has proved to be much more rich and copious than that which would have been gained from a multiple choice questionnaire, and this question was no exception. Also, there was a higher take-up rate, because this format was adopted. It is evident that RASE engineers responded more positively, and with longer answers, offering extra information. Whether such a good response was due to the open format of the questionnaire, the topic, or any other reason, needs to be investigated. The disadvantage of this type of questionnaire is, of course, the time it takes to collate and analyse the results, which I had grossly underestimated. But I digress.

The majority of the responses fell neatly into five main categories:

1. Highly positive - the engineer rates his or her writing as very good on the whole
2. Positive - a generally positive self-rating of above average, competent
3. Neutral/non-committal - an average self-rating
4. Negative - a generally negative, or more negative than positive self-rating
5. Very negative - clear self-denigration on the part of the engineer

Several of the answers were short and easy to group into categories, with several engineers writing "poor", "fair", "average", "moderate", and "adequate". Even the longer answers lent themselves to categorisation, like these for example:

> I like to keep everything as brief as possible. My rating could be average.
>
> If I feel suitably inspired, I think I can write extremely well.

In a minority of cases, the responses were difficult to interpret, so I checked with the engineers themselves to confirm that my interpretation of their answers was correct. The engineer who responded "No, I don't", for example, confirmed this had been correctly categorised as "Very negative".

Four responses were informative but impossible to categorise, like these for example:

> It varies. It is related to the role of the writing and the situation in which it is written.
>
> Too short a time and I tend to be too concise and too ambiguous to be understood.
>
> I never "rate" myself, preferring to leave this to other people who check and receive my work. ...

Another response that was impossible to place, nevertheless reveals an awareness on the part of the engineer of writing issues. His candid answer is evidence of this:

> I don’t mind writing, and never have done - after all English is the International Engineering Language. My spelling is pretty crap, and my grammar has slipped since leaving school. I also tend to waffle a bit much in some areas, and miss detail in others. I’m sure this reply is a sound demonstration of this.

How to interpret the responses! eg ‘....fairly competent, but not quite a Charles Dickens!’ Note the number of engineers who use literary allusions or talk about being inspired or motivated.

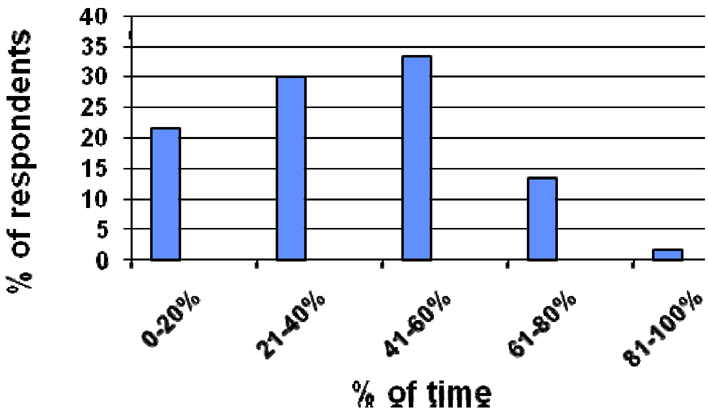
APPENDIX F - HOW MUCH TIME ENGINEERS SPEND WRITING.

This is a summary of engineers' responses to the question: Roughly how much of your working time in % terms is spent on writing of any kind?

The results:
More than 60% of work time spent on writing

Only one engineer spends more than 80% of his working time on writing. This high percentage reflects the demands of his work which require him to write a variety of documents including bids, responses to customer queries, product specifications, design requirements, and e-mails. The emails themselves cover a range of text types, for example, short chatty messages, more formal memos, reports, and design requirements. In all, only 15% of the engineers spend more than 60% of their time on writing. One of these explains how she calculated writing time, which includes coding [what engineers may call "comments in code" or "high level description". It is clear that in her case there is an overlap between "document writing" and coding:

> I'd say the percentage of time spent writing was about 75% including coding. At different phases of a project we might vary the ratio between document writing and coding but overall it's probably about the same percentage of our time.



40 - 60 % of work time on writing

By far the largest group comprising just over a third of all the engineers spends between 40 and 60 percent on writing:

> I write a lot of specs and reports.
>
> 15% requiring proper English, 30% informal writing (notes, programs etc)
>
> I probably spend near to 50% of my time on writing, where writing includes typing.
>
> I ... had a big spell of written work generation and forgot about the rounds of meetings I have to attend. If you include taking notes etc. The figure may well still be around the 50% mark.

20 - 40% spent on writing

The second-largest group of engineers comprising 30% of the total number of respondents spend between 20% and 40% of their time on writing. Few made any comments about their calculation, apart from clarifying their interpretation of writing and explaining how writing functions in their work:

> Discounting software programming and design drawings, approx 25%.

> Most of my time as an engineer is spent either designing on a computer or sketching solutions. Otherwise I'm ... doing practical electronics, defining the design. It is only at the end when the majority of the writing comes into play.

Less than 20% of work time spent on writing

21.6% of the respondents spend less then 20% of their time writing, with 8.3% of the engineers (a total of 5) spending less than 10% of their time on this. Three engineers in this lowest percentile perform managerial or team leading roles, and this accounts for the fact that they spend more time organising and scrutinising others' writing, rather than writing themselves. One explained his comparatively low writing percentage:

> As a "team leader" I seem to spend a lot of my time talking rather than writing!!

The nature of engineers' responses to the question

One engineer expressed surprise when he calculated how much time he spent writing:

> I will commit to 45% of my time writing. (I surprised myself that it was this high)!

Another expressed regret:

> Unfortunately it has become quite a high percentage (30-40%).

Several provided a range of figures, but at my request eventually arrived at a single figure which would fairly represent erratic work demands, the ebb and flow of writing tasks which may be short and intensive at some times, or protracted and combined with other non-writing tasks at other:

> This is difficult to evaluate, depending on the task could spend 100% for the period.

> About 5% on average. Can peak to 50% on occasion.

> Lately it has been 50%, but this may vary ±25% depending on what stage of a project I am working on.

> % of time involving writing ranges from 10% to 90%, depending on the phase of the project I'm working on. For a given project, the total work involving writing is probably around 10% to 40%. [Since I needed an approximation rather than a range, correspondence ensued out of which the following figure was settled on:] ...An overall figure throughout a given project? Well my best guess would be 40%.

> For the last 3 months 0%, prior to that ⇧70%

A few engineers saw the need to define what they understood by the word *writing*, taking care to distinguish between handwriting and using a word-processor, or between writing in Pascal and recording test results:

> If you include writing into a PC or laptop, about 50%. If you don't, very very little. I can't even read my own writing!

> 30% - 50%. I probably spend 50% of my time on writing , where writing includes typing. .... The reason for the variation, is that a lot of the other time can be spent in mathematical analysis if there are problems in a particular area. Although this normally involves writing at high level programming, eg Pascal, I doubt if that comes under your definition of writing. For a similar reason, logging of results of tests in a lab book is hardly writing, as it is often mostly the entering of numbers in tables in a lab book or lap top PC.

> Answer 20%. This is only English writing. I have not included Software writing.

Others found it necessary to qualify their figures because of the varied nature of their work, and the fact that they sometimes work away from RASE and do very little writing:

> This is an unreliable answer 'cos activities vary too much but approx. 20% - 40%.

50% overall - most of the time when on site.

APPENDIX G - PRODUCING A SYSTEM HANDBOOK - A [STRAWMAN] CASE STUDY

Process - using a straw man in the group construction of a text

In order to see how the straw man functions in a collaborative group writing activity, here is a description of how engineers worked together on a specific writing project to produce a System Alignment Handbook. Seven distinct writing stages can be identified:

1. Request received from customer for a manual

RASE received a memorandum from a customer, which asked for an extra manual to be written, and which provided a description of what the customer needed the manual for. The memorandum provided requirements expressed in general terms, for example:

> ... There is a need therefore for what loosely could be called the ‘Inexperienced Maintainer’s Guide to Alignment’,

and more specifically expressed demands, for example:

> ..... I would suggest that a simple Block Diagram of the alignment chain would assist in explaining what each stage of alignment is achieving,… where there is margin for either mechanical or electrical misalignment, and how it is corrected of catered for, and the effects on the equipment of corrections applied.

2. Response to request - group drafted proposal for manual structure

A group of seven engineers met to draft a proposal to the customer which would outline a structure for the manual. During the meeting, they brainstormed ideas and eventually decided what the Alignment Guide should consist of in terms of chapters and sections, eventually deciding on an outline for the whole document. When they decided on the shape the straw man - as they referred to it - should take, the team leader drafted a letter to the customer describing the proposed structure and projected cost.

3. Fleshing out the straw man

Some time later, an engineer called Alan was nominated to act as co-ordinator and to produce a straw man to conform with the description in the proposal to the customer. As co-ordinator, he had the ultimate responsibility of seeing to the satisfactory completion of the document.

Alan was a new member of the team, who had recently joined the company. He described himself as being “the new boy on the block”. The other engineers saw the writing task as an opportunity for inducting him into the team; the straw man was to assist in a team building process.

Alan worked almost exclusively on fleshing out the strawman for about six weeks. He found the task of producing it effective in bringing him into a close working relationship with the other members of the group.

Another reason for choosing Alan was his limited knowledge of alignment systems; it was thought he would have a better idea than the other engineers of the needs of the target audience, which the customer had referred to as “an inexperienced maintainer”.

Alan wrote the first version aiming it, as he described in his own words:

> ...at the young PO [Petty Officer] who’s just finished his course and hasn’t really got a clue, and he’s dumped onto this Type 23 frigate and one of the operators has come back

> and says well I think there's something wrong with the alignment. What shall I do about it PO? And he stands there waiting for an answer.

4. The co-ordinator's expectations of the peer review when presenting the first draft of the Alignment Document to the rest of the team

As mentioned earlier, the proposed structure for the straw man was presented to Alan when he was nominated co-ordinator. He was aware that the other team members would be involved in the revision process, and that he would have to take part in follow-up meetings with, as he put it, the potential for disaster. This is how he expressed it:

> ....but it was explained in the first place …OK this is just a purely documentary thing. The technical output of it .. alright if it's wrong then OK we'll shuffle it round til it's right…and at no time was it put that I was made to feel what a load of rubbish that was, go away again, 5 out of 10, see me later type of thing. It was more of an OK we'll collate all the information, we'll have a look at it. Anything we don't believe is correct, for whatever reason, we'll discuss, we'll sort out, and we'll come back again. They were all part of the team.

From his point of view, the others had an investment in the straw man. They were prepared to share their experience and expertise when the straw man needed to be checked over for the accuracy of the professional and technical information it conveyed.

Engineers initially react to the straw man by annotating

The other members of the group meticulously read and marked up the text, writing comments about a variety of aspects, for example, typing errors, missing words, disagreement about lexical choice, and vetoing information that may be misinterpreted or which may have the potential to cause problems for the reader, or, for that matter, the company.

Alan highlighted in orange the comments he accepted as valid and needing to be acted upon, and ignored others he considered to be unimportant. From time to time, he responded with his own comments in the margins, and occasional retorts.

There were three main categories of response from the members of the team: information and technical content, style, and metalingual comment. The table below shows the categories and subcategories of the engineers' written responses.

Types of comment invoked by the strawman - categories and sub-categories

Technical and information content:	**Style:**	**Metalingual comment:**
1. queries, eg, *Do you mean SAT 1 (G) ? - It is not against an object.*, to which Alan responded: *No I don't I'm referring to DOA test*	criticisms, eg, *[change] +ve -into positive, not +ve - this is a document, not notes.*, and *←poorly phrased. I know what you mean but this isn't it.*	An apology for over-zealousness, for example: *OOPS Sorry missed this. Thought it was T23 - Delete Comments.*
2. criticisms, eg, comments written against some diagrams about sensor bench mark dimensions: *You have described in detail the STU but not the HATS or SATS. There is inconsistency in the description. It is not clear what the HATS and SATS do from this DOC - AND which one should be used.*	(pernickerty) refinements, eg, *CAPS?*, *Missing line?*, and *Why unfortunate? To discover any misalignment, you must use the Ref scope.*	
3. identifying oversights, eg *We'd agreed to ditch this part.*, and *Explain why not the MLD.*		
4. suggestions for insertion, eg, *Statement on :- (a) How to select page (b) Units entered (c)How to use the page? May be useful*.		
5. indicating misleading or innaccurate information, eg, *Wrong.- you have confused verticality/tilt with racking.*		
6. discourse structure and text layout, eg, *Needs a bit of a lead in to this.* and *←Is there a heading missing here?*		

5. Meeting to discuss team members' comments - reshaping the strawman

All the members of the team then met to consider the comments that had been made about the straw man. By all accounts, the meeting was lively. Alan started off by summarising the oral and written feedback he had received, including specific comments which had been written on the document itself, explaining why he had accepted some but not others. The discussion which ensued thrashed out questions about the text at all levels: terminological/stylistic, rhetorical, structural, and diagrammatic.

The team eventually decided to review some of the fundamental principles underpinning the structure of the handbook, and to revise what it was trying to achieve. They eventually decided on the following changes:

- The introduction was to be rewritten to make it more personable and 'reader-friendly', in order to help the reader to recognise its usefulness more easily, and to relate better to the document.

- The number of chapters was to be reduced from six to four.

- The chapters themselves were to be restructured to exclude more theoretical information, and to adopt a problem-solving approach, trouble shooting approach instead. This was because the engineers believed that problem-solving was the primary function of the handbook. It was decided, therefore, that the chapters should try to anticipate practical problems the operators would encounter.

- They nevertheless acknowledged that the handbook should also perform some kind of text-book function, by conveying more theoretical and technical information about the system. However, this was to be moved from the main body of the document to the appendices.

- It was also decided to include a glossary of terms the engineers thought the readers would want to know about.

- The meeting was ultimately successful and highly constructive in the view of those who attended; a revised structure had been agreed, and the writing tasks shared among team members. Each engineer found himself allocated a chapter, or particular sections according to his expertise, or where he had been more vociferous in his comments. As one engineer put it: 'Each had to put his money where his mouth was, so to speak'; i.e., each had to act on his criticisms.

- The team leader pointed out that this meeting had lasted an hour and a half; which, in his view (and his words), was 'not too much time very well spent'.

6. Reconstruction - split task writing and revising

As it had been decided the expertise of the team should be drawn upon at this stage, rather than relying on Alan alone to reconstruct the straw man, individual chapters were written or rewritten by individuals or pairs of engineers, all of whom regarded this as a natural progression in the writing process.

The group commitment to the writing task was striking in this project, with the team members involved from the beginning, understanding the demands of the task, and working collaboratively as a group. [I was struck by the contrasting practices and attitudes of those working in academia.]

7. Final draft

Alan worked with another engineer to produce certain sections, at the same time keeping in touch with the others. He collated the work that they did, checking it for stylistic consistency before producing the near final, and then finally, the final version.

APPENDIX H - A DEFINITION OF A TECHNICAL NOTE

This is an extract from RASE Procedure 3B 54.100: ‘Promulgation of Technical Information’

1. DEFINITIONS

4.1 Technical Note

This is an informal document, giving a factual statement of events, calculations, or work done. It is used to disseminate information with a limited internal distribution, on a need-to-know basis. It will not normally be distributed outside of RASE and any external submission must be formally agreed with the relevant Product Manager.

APPENDIX I - EMAIL SURVEY: DRAFT SUMMARY OF RESPONSES TO QUESTIONS 4 TO 8

A summary of responses to Q4: What do you write on a regular basis by yourself?
Engineers' views of their writing problems - initial indications revealed by interview data
Introduction to the methodology
Rationale for early rounds of spoken data collecting
The aim behind this question was to produce a comprehensive list of all the different kinds of writing done by engineers at RASE. For this reason, the question was designed as an open question rather than multiple choice. Also, I had discovered some antipathy on the part of RASE engineers towards multiple-choice questionnaires, and that there was a general feeling of questionnaire weariness. However, I included some examples of the writing produced in an engineering environment across a range or work activities, because experience has shown that engineers do not always recognise the different types of writing that they do. It was hoped that these examples would demonstrate this fact to the engineers, that they would discriminate more between their writing tasks, that they would provide me with comprehensive individual lists, which I could then use to compile a list covering all writing activities.

In total, the engineers provided forty-nine different writing categories, describing them in terms of text-format (letters, emails etc), text-type (description, exposition, instruction, etc), or discourse function (as it relates to the product, customer, or RASE colleagues). This will, in fact, prove to be the main part of my study, and will be analysed more later. For the purposes of summarizing the responses to the questionnaire at this stage, however, these categories provide a useful starting point, even though there is a degree of overlap. For now, I shall provide a "quick and dirty" synopsis in the hope that some of the engineers will want to comment on my interpretation of these early findings.

For the purposes of simplicity I have grouped the categories notionally according to mode/format, message (discourse function), and target/audience/focus. The interesting thing about memos is that it is a label for a wide range of written communication ranging from quick informal hastily written notes to more formal technical documents. See 39Cl and 33JI. Ditto faxes. It is quite unsatisfactory to use the term memo as a catch-all term for writing requirements.

What engineers write - arriving at useful text or document categories

In all, the engineers responded by naming a total of 49 different writing/text categories that they produce at RASE. These are listed as raw data in Appendix 2 and include infrequently mentioned items like writing poetry, and post-its messages. The latter can be seen as being directly work related, whereas the former has a more indirect bearing, according to one of the engineers:

> Sometimes it helps to spend a few moments on something creative, which has got nothing to do with the problem you are working on - helps clear the mind.

It was sensible to reduce the number of categories because of significant overlap in some cases, as, for example, in the case of bids and proposals, engineering reports and technical reports, and manufacturing instructions and manufacturing specifications. The results of this question are therefore yield a reduced number of 22 categories which give an indication of the wide variety of writing that engineers do at work.

The results
For those who have investigated writing done in other (non-technical) work places (Davies et al 1996), a striking feature of these findings is that most of the writing done by RASE engineers is concerned with engineering design. Very little of their writing relates to

administrative / bureaucratic matters. This fact may be due to organisational changes that have brought about marked changes in writing habits, so that, for example, the dreaded "soft report" did not feature at all in any of the replies, in spite of the fact that most of the engineers write reports of various kinds.

I have devised four major writing/text categories of concern to RASE engineers and which are discussed briefly after the table:

1. Essentially technical and design-centred
2. Format-centred, ie not content specific
3. Intended for internal (RASE) audience, essentially concerned with personnel and administrative processes
4. Intended for external audience, essentially persuasive and/or "selling"

Figures for responses to email survey Q4: What do you write on a regular basis by yourself?

Writing/text type	No. of engineers	% of engineers
Essentially technical and design-centred		
reports - various and technical (elements of persuasion)	48	80
software design/requirements/ specifications	43	71.7
engineering log book entries	28	46.7
technical proposals (elements of persuasion)	26	46.7
manufacturing instructions and specifications	7	11.7
plans of various types (control, devt., test, etc)	6	10
technical notes	6	10
non-specific reference to descriptions, design documents, technical/business documents	6	10
manuals and handbooks	4	6.7
procedures	1	1.7
patents	1	1.7
Format-centred, ie not content specific		
memos	45	75
email	23	38.3
letters (external audience)	18	30
faxes	9	15
Internal (RASE) audience, essentially concerned with personnel and administrative processes		
presentations	5	8.3
minutes	3	5
training material	2	3.3
appraisals	1	1.7
External audience, essentially persuasive, "selling"		
executive summaries	9	15
marketing materials	2	3.3
web pages	1	1.7

Essentially technical and design-centred

Reports form the largest category with 80% of RASE engineers writing a range of technical reports. Almost as many write design requirements and specifications (71.7%), much of these related to software design. A surprising result from my point of view is the significant number of engineers (46.6%) who write log book entries, since these are not mentioned in any of the publications on technical writing. Similarly, the high number of engineers involved in proposal writing (also 46.6%) must be a reflection of the nature of RASE's work activity at present, which could be described as being business-seeking, as well as dealing with in-service products.

Fewer engineers (11.7%) are concerned with manufacturing instructions and specifications, reflecting their involvement with the implementation of a design in the production process.

The same number mentioned having to write plans, and revealed that have to write a variety of them. Plans have proved to be another surprise, much in the same way as the engineering log entries, and seem to be similar to the log entries in that they are almost a taken-for-granted aspect of engineers' work. I have little information on plans at present, and it is possible they should be placed in Category 3, since they appear to be some kind of administrative report describing intended action.

A small numbers of engineers (10%) is concerned with writing technical notes, which I interpret as being any (informal) recording of technical ideas for the benefit and future use by the writer, rather than by anyone else. Even smaller numbers of engineers are involved in writing manuals and handbooks, patents, and procedures.

Format-centred, ie not content specific
Significant numbers of engineers mentioned writing memos, emails, and letters (75%, 38%, and 30%). Only 15% mentioned faxes. I suspect that most, if not all, of the memos are in fact email messages, and that the memos within RASE can be viewed as being an email subcategory, since a wide variety of texts can be sent as emails. Email, in fact, denotes the mode of transmission and possibly the format of messages, but not the message type/genre. In this respect, faxes and letters are similar to emails, although within RASE, the term "letter" seems to carry a special significance. Information on letters that I have collected indicates that letters usually require careful preparation, often of a technical and/or financial nature, and are often in response to a query from a customer or supplier, or prospective customer or supplier. It is possible that RASE engineers are in a transition stage at present, moving from sending paper-based messages to transmitting nearly all messages electronically It follows, then, that the formal letter is on the wane, apart from those which may have legal significance in the future.

Intended for internal (RASE) audience, essentially concerned with work and administrative processes

Very small numbers are concerned with what may be called facilitative writing. This is the kind of writing which serves the purpose of working processes and professional learning within RASE. Presentations are the largest group, concerning 8% of engineers. These are a special case, because they make different writing demands on engineers from the other texts; there can surely be no other writing task which requires engineers to script-write, ie plan what they are going to say orally in front of a live audience of colleagues.

Intended for external audience, essentially persuasive and/or "selling"

The distinctive feature of texts in this category is that they are intended for audiences without RASE, who could be regarded as customers or potential customers. Fifteen percent of the engineers write executive summaries which are a somewhat odd part of proposals.

Only one engineer writes web pages, and two engineers prepare brochures and other publicity material. Both web pages and brochures require particular writing skills which are very different from those required for writing the texts in Category 1.

Postscript 2 - The raw data

Text-types	**No. of engineers**	Text-types	**No. of engineers**
faxes	9	• software change instructions	1
email	23	• software test description	2
• memos	45	patents	1
• responding to emails		procedures	1
• technical descriptions		instructions	1
letters to customer/sales?/external	17	manufacturing instructions	3
technical proposals	26	manufacturing specifications	2
executive summaries	9	work instructions	2
(engineering) reports	35	plans	2
• progress	2	• control	1
• test	3	• program	
• future technology	1	• development	1
• technical	5	• software quality control	1
• investigation	1	• software test plan	1
• trials	1	training material	2
log book entries	28	technical standards	1
design documents	1	Manuals and handbooks	4
• descriptions (inc.functionl)	3	Appraisals	1
• comments in code	1	Minutes	3
• specifications	5	Technical notes	6
• requirements	25	Technical/business documents	2
• software requirement specifications	1	Marketing materials	2
• software designs	2	Responding to customer queries/ reports to customer	1
• configuration specs.	1	Presentations	5
• code/software	4	Web pages	1
• interface specifications	1	post-its [eg tel. messages]	1
•		poetry [not strictly work related]	2

A summary of responses to Question 5: What do you write with other people?
Why I asked this question
I'm most interested in those documents or text-types which engineers take trouble over. I wonder if engineers consult with others over documents that they care about in a professional way or consider to be important. Over the past three years, I've observed that RASE engineers co-operate closely with each other in order to produce a piece of writing. This writing may be a lengthy document like a proposal, or it may be a memo, or a letter to a potential customer. This co-operative writing calls for trust in working relationships, since they are potentially exposing their writing, and also themselves and their abilities, to close examination and possible criticism by their colleagues.

The main findings
Engineers responded to this question with short concise answers, or lists of document-types, with a few offering an explanation or extra comment. Here are the six main categories of response in rank order:

1. Those who write (virtually) on their own (35%)
2. Proposals (33%)
3. Software design/requirements/ specifications (25%)
4. Reports (23%)
5. Manuals and handbooks (5%)
6. Presentations (5%)

Those who write nothing or very little with other people(35% of respondents)

This is the largest category with a total of 21 engineers claiming to write more or less on their own, although their views about this varies, as revealed by one engineer, who wrote in answer to the question "What do you write with other people?":

> No, but prefer to,

and another, who answered:

> As few documents as possible (writing by committee is a hassle).

Within this category, thirteen engineers write nothing (or virtually nothing) with others, and eight write so little that they consider it hardly worth mentioning.

Proposals - 33% of respondents

Writing proposals demands the most collaborative writing effort, involving twenty engineers, or 33% of the total. One engineer explained the process thus:

> We tend to write proposals as a group but not doing the same bits together (we do individual parts which are brought together as a whole).

His explanation provides a simple outline of what is in fact a complicated process, which is both time-consuming and costly to the company. An examination of this process, and an analysis of the writing done by the engineers is provided in Chapter X.

Software design/requirements/specifications - 25% of respondents

1. Reports - 23% of respondents
2. Manuals and handbooks - 5%
3. Presentations - 5%
4. One-off mentions: work summaries, code, test documents, statement of work, job analysis, training material, letters, memos, log book entries, test procedures, sales materials.

A summary of responses to Question 6: Which items take up the most time?

This is a summary of responses to Question 6: Which items [listed in the previous answers] take up the most time?

Why I asked this question

This in one of a group of questions I posed in an attempt to pinpoint those writing tasks that engineers are most concerned about. By taking a triangular approach, I reasoned, the responses to these questions (ie which documents/text-types do you write with other people, which take the most time, and which do you consider to be important), would help to narrow down the categories and indicate the most significant text-types/documents. It may be worth mentioning, I had already arrived at some categories in my BLN days (before Lotus Notes) , based on earlier but more restricted samples. Therefore, the results to these answers could either bolster my earlier work, or send it to the waste paper bin.

Nature of engineers' responses

With few exceptions, responses to this question were short and concise, giving the impression that the engineers did not ponder too long over them. Most gave one- or two-word answers, with a few providing some kind of explanation. Here are some examples of the longer replies:

> Probably the specs, as they are laborious to produce, and require frequent changes.
>
> Specification writing and responding to customer & supplier questions and comments.
>
> Technical reports, as they are generally linked to applied research projects. These can take several weeks to complete as they evolve with the research. Requirements also take a long time as they will change several times during the review process.

How the responses were analysed

Some engineers mentioned a single item, others mentioned two or more. Each mention of a document-type or kind of writing was counted as a member of a relevant category, so that, for example, the following answer was considered as a single mention, contributing only one item towards the category *Memos/emails*:

> Probably the day-to-day administration activities (memos & internal E-Mails).

Another shorter answer like the one following, however, may contribute towards four distinct categories, containing as it does four separate mentions:

> Memos, logbook entries, letters and appraisals.

The findings - which writing takes the most time

Major categories

All the respondents, with two exceptions, made a total of 95 mentions which contributed towards 21 separate categories. For the purposes of this summary, those categories which affect five or more engineers will be considered as being significant enough for the purposes of comparison, or, in other words, those categories containing 5% or more of the mentions. This concerns just under one-third of the categories, yielding the following six:

1. reports (22.1%)
2. software design/requirements/specifications (18.9%)
3. engineers' log books (9.5%)
4. memos and emails (9.5%)
5. proposals (9.5%)
6. letters/responding to customers' queries (5.3%)

It is interesting to note that responses to the previous question, which asked what engineers wrote with other people, indicated the following main categories:

1. Proposals (33%)
2. Software design/requirements/ specifications (25%)
3. Reports (23%)
4. Manuals and handbooks (5%)
5. Presentations (5%)

Minor categories

Of the 21 categories, about a third contain two or three mentions, for example: comments in code, plans, presentations, manufacturing instructions. One-third of the categories contain only one mention, reflecting specialised/isolated/less common writing done by the engineers concerned, for example: appraisals, patents, brochures, and training material.

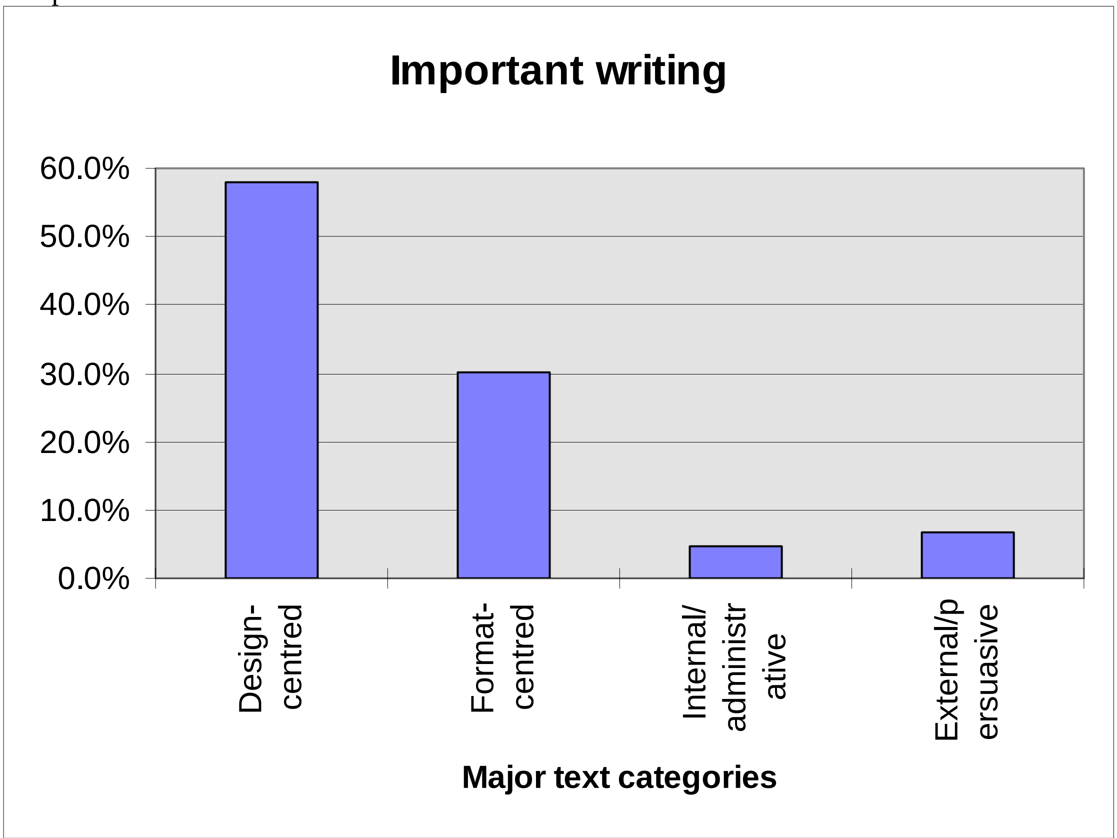
A summary of responses to Question 7: Which items are considered important?
This is a summary of responses to Question 7: Which items [listed in the two previous replies] do you consider to be important?

Main findings

The graph below represents a breakdown of the responses, which reveals that the most highly regarded writing tasks are those which are essentially technical and design-centred, ie they belong to the largest category identified in the responses to Question 4.

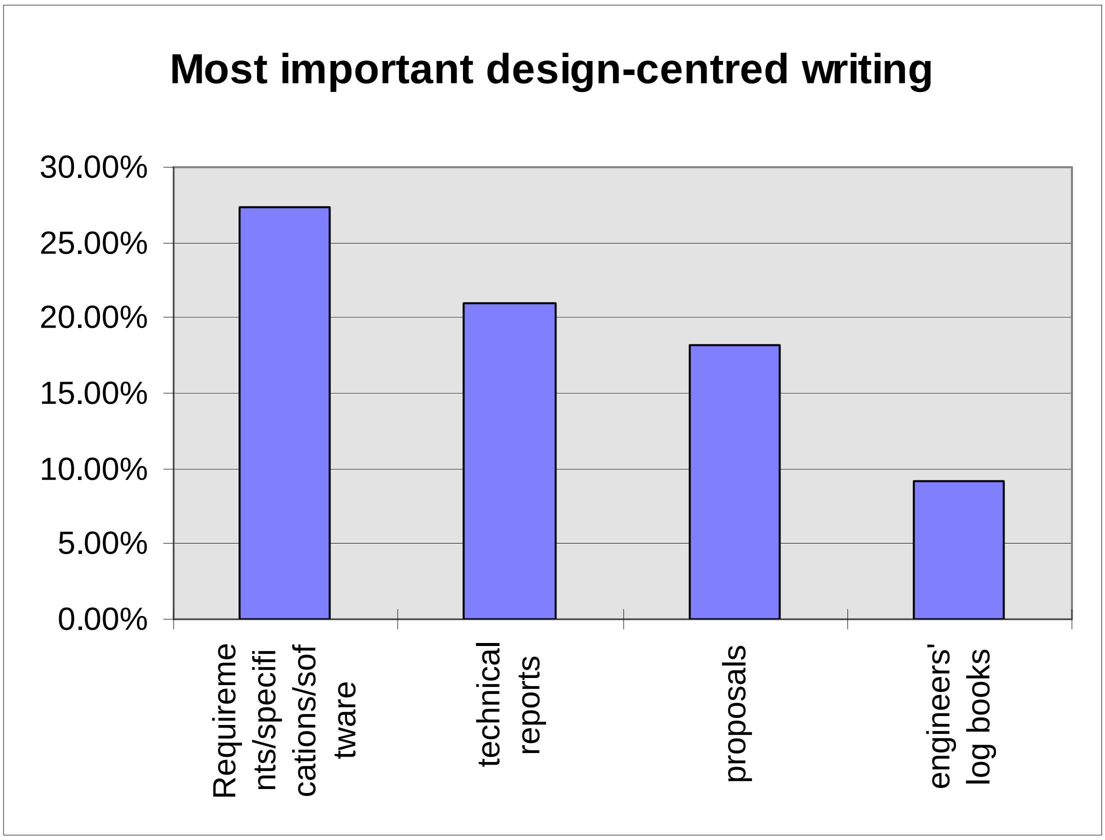
If we pay particular attention to those texts which have a clear purpose or content [which means all categories excluding Format-centred], it emerges that there is a limited set of texts mentioned by five or more engineers:

- reports
- requirements/specifications/software design
- proposals
- engineering log book entries
- executive summaries
- presentations



If we examine specific writing mentioned by engineers within the design largest category, the following emerge as being the most important:

1. requirements/specifications/software design
2. technical reports
3. proposals and bid documents
4. engineers' log books



Analysis and interpretation

It appears that most engineers are in the fortunate position at work of being required to write only those documents which they value. Only one engineer out of the sixty respondents did not attach much importance to writing. Of the rest, twenty-two engineers (36.6%) named particular text-types that they considered important, usually simply naming one or more items, eg:

- reports
- Responses to customer queries.
- Requirements, proposals, reports

However, a striking aspect of the findings is the fact that thirty-three (55%) believe that all the writing they do is important. Eleven simply wrote "All" as an answer, whereas others felt the need to explain themselves:

> This doesn't answer your question, but I consider them all important. If they weren't important, they wouldn't need doing, and I'd find something more important to do. In some way, they are opportunities to put your mark on something permanent, and a way of getting known about the company. This can of course, backfire in a big way!
>
> From my point of view, everything I ever do is important. It is just a question of which is most important - and that varies on a daily basis.
>
> They all have their importance, some not at the time that one wrote them, eg engineering log book entries.
>
> All. I try and do a good job with all my writing, and particularly so with appraisals.
>
> I consider all my output to be important - as it is a form of communication and needs to be accurate.
>
> ?at the risk of being flippant - all of them - they are all part of the job

A summary of the responses to Question 8 regarding 'unimportant' documents
The question was: Which documents [that they said they wrote by themselves or with others] do you consider to be unimportant?

Main findings: only a minority write anything they consider to be unimportant

1. 66.66% of respondents believe they do not write anything they would consider to be unimportant
2. 18.33% named particular documents or writing tasks they considered unimportant
3. 10% answered the question, but indirectly
4. 5% didn't answer

Discussion of the findings:
A significant majority (66.66%) do not write anything that they consider to be unimportant
The most striking finding is that most engineers not only spend significant amounts of time writing (responses to Q3) but they spend that time on writing which they consider to be important; exactly two-thirds of the respondents, a total of forty engineers, said that none of their writing was unimportant. This contrasts with findings of other surveys (Davies et al 1996, etc), and may be the result of fundamental changes in the workplace that had been made by the time the questionnaire was administered. The company had undergone yet another reorganisation, and work practices had changed so that certain administrative type documents, SOFT reports and the like, were no longer required, as this answer reveals:

> Nothing. There was a time in the past when we had to write what I call Processed Junk, eg soft reports. But they've done away with that now.

These changes in the workplace have had clear knock-on effects on the writing engineers have to produce. They have clearly reduced the range of writing engineers are required to do, and, it can be argued, the fact that engineers believe the writing they do to be relevant and important may be an indication that streamlining and improvements to the engineers' work practices have taken place, ie they only write what is important and useful to their work. The writing is more focused (on the product)

Engineers who write texts or documents they consider to be unimportant(18.33%)

A smaller group of eleven respondents consider some of their writing to be unimportant. Most named individual text-types, and although these are too small in number to be significant, it is nevertheless interesting to see what these engineers regard as unimportant:

One mention	Two mentions
technical reports	executive summaries
test descriptions/reports	(answers to) emails
bids	engineering log book entries
responses to customer queries	

There were two exceptions in this group: one who wrote the following, thereby damning most of his present work with the stroke of a pen:

> Most engineering documents,

and another, whose wrote intriguingly:

> … anything required for the sole purpose of comforting my boss.

Other irreverent or irrelevant responses (10%)

Three respondents left the question blank, and six gave cryptic or indirect replies, like the following, for example, which I took to imply the question is not relevant because it is not the engineer's responsibility to make such judgements:

> Everything I write is required, whether it is important or not is up to the user.

Inferences to be drawn from the engineers' responses

I had had a hint of what to expect from the responses to the previous question, Question 7, which indicated that some of the engineers found this question rather odd and possibly irrelevant. The responses were similar to the Q7 responses, and so in a more formal discussion of these findings, I should consider merging these two sections.

First inference - some engineers value highly the writing that they do

Some engineers clearly take care over their writing, seeing it as having a clear purpose and reflecting on them professionally, as exemplified by these responses:

> Strange question! [when asked to explain, the engineer wrote:] I'm not trying to pull the 'Added Value' aspect of my work, but I do regard almost everything I do as important and try to give each item as much attention as it needs – even a memo deserves that. Added to which I want to maintain the standard of my work.
>
> None. Writing is a medium for explanation, description or reviewing etc. I feel it is important that I can express myself well otherwise my efforts may be disregarded or overlooked.
>
> No, we need it all. Everything I write is necessary really. Even the progress reports are important. I quite like writing them. It's useful to think about what we've done and to put it in words.

Second inference - some engineers wouldn't consider writing anything that they viewed as being unimportant

I gained the impression that several respondents were surprised I should have thought they would spend time writing anything that was not important. Some replies seem to imply that they would not countenance doing any writing that was not important, that they would reject the task if they thought as much, and would cock a snook at anyone who would dare to try:

> Who would do things that are unimportant?
>
> At work I don't intentionally write anything if there's no reason for it. I can't remember having written anything for which there wasn't a reason.
>
> None, or I wouldn't do them.
>
> None of the items I consider unimportant. I try and only write things when they are important. This is my way of reducing how much I have to do.
>
> None, I wouldn't do it if I didn't feel it important

Third inference - some engineers don't question what they are asked to write

Other engineers, however, seemed to imply that if it is required or asked for, it must be important:

> I only write what I'm required to and it is usually relevant to my work.
>
> All company functions are important.
>
> All [writing tasks] are value added.

Why I asked these questions

My first reaction on reading the responses to this question was that I should have composed it and the previous question differently This is because, when drafting this question, I believed engineers had distinct attitudes towards different types of writing, and that they judged texts according to their usefulness. The degree of usefulness was determined by how the text related to the design, development, production, and use of the product/system.

When composing the questions for the questionnaire, one of my main aims was to identify those writing tasks that engineers were most concerned about. I had picked up anecdotal evidence that engineers were exasperated with certain writing tasks and questioned the value of what they were required to write in certain cases. Examples of this sort of writing were SOFT reports, [SOFT being the acronym for Strengths, Opportunities, Failures, Threats], and any other writing required for internal administrative purposes. I also had a collection of words RASE engineers use to refer to writing, and had noted the use of *ephemeral* to refer to admin-related texts. I inferred from this that *ephemeral* texts, by virtue of having brief lives, had no lasting value, and were therefore a category of texts valued less by engineers. I further reasoned that the engineers must consider such texts unimportant, much as professionals in other fields regard some of the internal administrative writing they have to do (Davies et al 1996). I was therefore expecting engineers to respond to this question by listing names of the different texts or documents. It transpired, however, that I would be surprised by the way the majority of the engineers replied to it, and this in turn caused me to question my own assumptions and motives for asking the question.

APPENDIX J - SPECIFICATIONS AND REQUIREMENTS

This appendix contains a discussion about specifications and requirements written about half-way through the PhD project. At that time it was believed that the focus of the PhD would be on these documents. However, as the study progressed, it became more concerned with the writing of proposals, which are precursors to specifications and requirements, and this development rendered this 'chapter' less central to the thesis. Since it informs parts of the study, however, and reference is made to it from time to time, it is included as an appendix. It also gave rise to an article on the subject (Sales 2000).

Introduction

If a proposal is accepted, the design engineers need to set to work on writing out the details of the design for others to act on. In the case of a complicated navigation system, for example, these others will be other design engineers who will specify, in a written description, the design of the specific components of the system for yet other engineers to examine and act upon. This action may involve further writing about the manufacture of the hardware components, or designing pieces of software to operate the system.

Text = product; ie it can be engineered

Engineers like to organise the development of their product, and specify how it will be done in a precise and ordered way. They see it as central to their work practice. Since the early specification of their product is in the form of text, it follows then that the engineer likes to exercise similar controls over text, that he can engineer text in the same way that he can engineer his product. This is revealed in the following part of a proposal written to impress a prospective customer with the way requirements are written and stored at RASE, especially the second sentence:

> The Requirements Specification for the Medium Grade Generic IMU was analysed and all text containing requirements applicable to software was captured using the RTM tools.
>
> These elements of text were then engineered to produce concise and unambiguous statements of requirement suitable for the development process to continue. (MS Aug 98)

This chapter describes aspects of the writing that has to be done, once the project gets the go-ahead. Specifically, specifications and requirements are the main texts concerned, together with the key issues surrounding the writing of them. Considering the importance of these texts in the design process, this chapter is not as long as it deserves to be, because the bulk of this study has been caught up in discussing proposals and executive summaries. These had to be examined, in order to better understand specifications and requirements, and, in this chapter, it is intended to discuss key issues and to indicate the direction that any useful examination of specifications and requirements should take.

At the very beginning of this study specifications and requirements were mentioned as presenting major problems to both the company and the engineers, involving the former in (sometimes huge) unexpected costs , and demanding from the latter major investments of time, energy, and a specialised type of writing with arcane writing conventions. This chapter, then, explains what has been learned about specifications and requirements, and, as a thought-provoking after thought, includes a mention of the logbooks that design engineers are so fond of keeping, but which, until now, no one has thought of mentioning in the literature about technical writing.

A significant finding in this study, and discussed in more detail later in this section, is that engineers' problems with writing requirements specifications relate to inconsistent usage of, and the lack of clear guidelines regarding, the use of modal auxiliary verbs. Any advice that is available on using these verbs, particularly *shall* and *will*, is conflicting. Existing guidelines seem to have sown confusion, leading to inconsistent usage and misinterpretation. It appears that attempts to systematise the use of

modal verbs has added an extra layer of complexity to a writing task which already begs to be understood and simplified.

Specifications and requirements are distinctive from proposals
(Chapter 1, which describes the design process and the life-cycle of the product provides background information for this section.)

Obvious differences between describing the product in a proposal and in specifications are:

1. The ideas about the solution put forward in a proposal must, through a series of writing and production phases, be transformed into something tangible that can be used by the customer. Using specifications to transform (sometimes vague) ideas into a physical product is the main purpose of this post-proposal stage, and functionality a key concern.

2. There is no persuasive intent in the writing of specifications and requirements, whereas persuasion underpins every aspect of writing in proposals.

3. Specifications and requirements are written by individuals, without the help of, or honing by, technical authors. The engineers may work as a team on specifications, but are responsible, as individuals, for particular sections.

4. Proposal writing is an expensive activity for any company in the aerospace business. The company makes financial outlays in the full knowledge that it will have to count its losses if the proposal loses, but that the money will have been well spent, obviously, if it wins. On the other hand, documents which specify the product, i.e. specifications and requirements, tend to have financial worth to the company, in that it receives payments from the Customer when these documents are produced. This has been a significant observation during this study: certain texts have monetary worth, bringing income to the company if they have been deemed to have been satisfactorily completed in the eyes of the Customer. As one engineer put it: ‘These are documents that the Customer sees, checks against criteria, and pays lumps of money’.

Why the interest in specifications and require - an attempt to keep control of the design process
Managing change
Without exception, every engineer consulted about this question agreed that specification writing is a major area of concern to them. They not only spend much of their working time on them, but have a genuine interest in improving the way they are written. All the engineers admitted that misinterpretations and misunderstandings have arisen through poorly written (in their opinion) specifications, which have proved costly to their company.

Put simply, one of the major problems as perceived by engineers, is how to manage change. They are concerned to reduce the confusion and misunderstandings that arise when changes are made to the design of the product. Concomitant with this is their desire to handle changes made to text to mirror changes in design. In fact, they have identified this as a fundamental problem in their working lives, because their inability to control this change is costing them dear. Rough guesses by senior engineers produce sums amounting to millions of pounds. Anecdotal evidence abounds, as do examples at the present time [cite newspapers]. There is a widespread acknowledgement that requirements, and more particularly, the way they are expressed, are a major problem in the industry.

Engineers aim to be precise and procedural, with carefully planned methodologies, as carefully thought out as their engineering calculations. The design and development of a product, be it hardware or software is seen as a process which can be plotted and planned, and indeed in the two years I have spent at RASE, I have seen three separate company initiatives, among others, specifically intended to learn more about and manage change, and to control changes made to the design: the research team's (Roy Orme's) methodologies in 1995-6, the Change Team's work in 1997, and more recently the Task Force, and, finally, the on-going attempts to encourage engineers to use the RTM

Requirements, Tracability, and Management (RTM) software, which has been designed to keep track of engineers' requirements writing. The main functions of the package are to help with the design, test specification and test procedures when producing software.

Whether it is a hardware or a software system, the engineer aims to describe the product's physical features and functions in documents called specifications or requirements specifications. These are read by the customer and by colleagues concerned with producing the product. Often comprising several hundred pages, these are hefty tomes, their physical dimensions a reflection of the engineers' weeks of toil spent specifying in detail every possible feature of the product as clearly and unambiguously as possible.

It is commonly accepted that a large proportion of engineers' working time is spent on writing specifications and requirements, although no one has objectively measured the actual amount of time spent on these. As in Hicks day, today there is much talk about how specifications take up a disproportionate amount of engineers' time and energy, the situation remaining the same as when Hicks wrote 'no accounting of technical wordage is available today' (1961:228). He does mention, however, that specifications account for 'millions of man-hours of writing time', a calculation no doubt intended to impress, and one not contradicted by the engineers I work with, who estimate that they can spend well in excess of 50% of their time writing specifications. However, they are not always sure that it is time well spent because of some of the problems which arise.

What are specifications and requirements and what has been written about them

In spite of the general acceptance that requirements are a major problem, and that badly written requirements can lose a company millions of pounds, little has been written in engineering literature that directly addresses the problem. Attempts to examine descriptions of how they should be written have yielded little, and it has been difficult to find anything other than vague definitions of what they are, or should be. Even less has been written about specifications in the field of applied linguistics, with one or two notable exceptions. For an industry which is fond of defining terms, useful definitions of specifications and requirements are hard to find.

Established reference books, for example, engineering and technology dictionaries and manuals used by engineers, reveal there to be a dearth of information about these terms. The McGraw-Hill Dictionary of Scientific and Technical Terms, for example, which boasts in the blurb to be the world's most comprehensive single-volume reference and an indispensable tool for scientists, engineers, students and the like, has no entry for either 'specification' or 'requirement'. The main library at the University of Birmingham had only one book on the writing of specifications, and it related to those in civil engineering (Haslam 1988). There seems to be a commonly held assumption, amongst the engineers and in engineering literature, that requirements and specifications are so commonplace, so fundamental to an engineer's work, that they do not need explaining.

However, engineers have stated that they need help with understanding specifications, and with the language needed to write them. Responding to my enquiries, they referred me to the company’s own writing guidelines, entitled ‘Hierarchy of Engineering Specifications’, where twelve different types of specification are listed, five of which relate to design. The rationale behind these guidelines, according to this document, is as follows:

> In order to properly devolve the requirements for, and specify RASE products, a hierarchy of specifications has been developed. This hierarchy ensures that the requirements are captured, devolved and recorded in a controlled and logical fashion such that demonstration of compliance and repeatable delivery of consistent product is possible.

This statement reflects the company’s concern to manage the writing of specifications, and to ensure some kind of control of the activity. Reading the document further, each type of specification is defined under the subheading ‘Hierarchy and Rules’, with the design specifications ranging from system specifications at the top to software specifications at the bottom, as follows:

1. System Specifications
2. Product Specifications
3. Design Proving Specifications
4. Design Requirement Specifications
5. Software Specifications

An examination of the definitions for the first two shows them to be concerned with procedural matters. They provide information about contexts for use, rather than their purpose, function, or language form:

> **System Specifications -** Mandatory unless substituted by a Product Specification or Design Requirement Specification.
>
> **Product Specifications** - Used in place of a System Specification or Design Requirement Specification on simpler and proprietary products. Product Specifications can be used in the selling of products into the open market place where RASE wishes to protect its designs by not disclosing the level of detail normally contained in a Systems or Design Requirement Specification. During development the product Specification acts as the requirement for all other specifications during which it is at its ‘Draft’ or ‘Preliminary’ issue. Once development is complete the product Specification becomes the technical description of the final product and is therefore subservient to the DRS. At this point it becomes ‘Approved’.

So far in this document, the information has been essentially regulatory in nature, and it is necessary to read on, to find out anything about language. The section, ‘Language Style’, included in the section on ‘Presentation and Format’, comprises a total of 162 words on language style relate mainly to the use of abbreviations, symbols and graphics. Language aspects are covered by just two sentences, as follows:

> 6.2.1 Specifications must be phrased in a language free from ambiguity and in such terms that contractual implications are clear and enforceable.
>
> 6.2.2 A clear distinction should be given between those statements that are mandatory and contractually binding or non-mandatory and express an aim/recommendation using appropriate wording.

Commenting on these guidelines, one engineer wrote: ‘Good advice, but doesn’t tell you how to do it!’.

Short though this advice may be, it nevertheless reflects two major concerns which recur in interview data and any material written about specifications, i.e. that:

1. specifications should be clearly and unambiguously written.

2. specifications that are mandatory should be clearly distinguishable from those that are not.

Specification writing has been regarded as problematic for decades, demanding writing that is clear, unambiguous, and accurate (Hicks 1961). The company, and the industry generally, has, over the years, invested in large research projects, with the aim of improving the writing of them. Researchers in the engineering field have been attempting to describe the problems, in numerous research papers and articles to try to counteract the problems that arise from poorly written specifications (Riddle and Saeed 1998, Meyer 1985, James 1997, Chen et al 1998), and suggesting fundamental changes to working and writing procedures. Their work is part of an attempt across the sector to establish rules for writing specifications, in the belief that the problem lies in the vagaries of the English language. Engineering academics in the tertiary sector cite the poor writing skills of engineering students as being the main factor contributing to the problems arising out of poorly written requirements. It seems to me that they compound the problem by denigrating the English language and devising writing tasks which even highly skilled writers would find difficult, if not impossible, to perform satisfactorily.

Categories of requirements/specifications - what do engineers want them to do

This concern about terminology is due in part to hearing the words 'specification/s' and 'requirements/s' used in engineers' discussions during meetings, and informal chats by the coffee machine or impromptu meetings and not at the time being able to deduce precise meanings of the words from the context of utterance fragments. Sometimes the engineers seemed to use 'specifications' and 'requirements' interchangeably, sometimes in the singular. When I have overheard them using the terms, and asked them to explain usage of the terms, they have willingly obliged. Overheard, for example, were the following utterances:

> "…so how are you going to respond to the requirement?"
> ['requirement' = the document provided by the Customer which specifies the product wanted.]
>
> " …it's a very active picture. The requirement's growing a bit. Good news for us: a growing contract.
> [Ditto.]
>
> "This specification outlines…."…
> [specification = document]
>
> "The technical requirements…."
> [requirements = detailed and numbered specifications/ requirements]
>
> "The prime requirements being met are to provide ……."
> [prime requirements = gloss of mandatory requirement]
>
> "An option requirement is ……"
> [a requirement which is desirable but not mandatory]

In informal talk, engineers tend to use the 'specifications' and 'requirements' interchangeably, although, strictly speaking, 'requirements' are hypotactically related to 'specifications'. Specifications comprise requirements, and requirements, in turn, may occasionally be referred to in contrastive terms as dichotomies; they are hard or soft, high-level or low-level, and formal or informal, depending on the context. Hicks (1961) describes different categories of specification, including: open, closed, and restricted.

When combined together, specifications and requirements are seen as defining the design task that engineers need to complete. So far as this study is concerned, it is useful to recognise that requirements (from now on any discussion of 'requirements' also applies to specifications, unless indicated otherwise) are hierarchically determined, there being three main levels, although there may also be intermediate levels of requirements:

1 High level
This is sometimes referred to as the requirement although it may be more formally referred to as Cardinal Specifications, or Invitation to Tender (the ITT for short). It describes what the customer wants in more high level [top down?] terms. One gets the idea that these are expressed in more general terms, compared to lower level design specifications/requirements. Those dealing with high level specs (where? In RASE?) are more likely to be Marketing men. Asking Steve and John England about Cardinal Points Specifications: High level contract requirement - higher level ITT, Outline points - basic things the customer wants, Main points that the customer wants, contains lots of info but not the nitty gritty Dave Edmondson picked out an example of a soft requirement, and one of a hard requirement. From what I can see, the soft req. contains adjectives (possibly of a particular type - check Q and G) in a complementary relationship, whereas the hard doesn't, and is centred on a dynamic verb.

2 Mid-level
This is a response from the tenderer? It involves the work of planners, and those concerned with cost implications. Would Doc 2 fall into this category?

3 Low level
This may alternatively referred to as 'sub-system', involves the engineers concerned with design, and specifies the finer design details of the product. This is where the use of modals becomes sensitive.

It appears that, when changes are made to high level descriptions of a product, huge problems occur when lower level requirements have to be re-written as a consequence of the high-level change. An engineer explained it thus:

> "People wonder why there's all this fuss about changing a single sentence of high-level description. It's because that sentence may give rise to 500 new sentences of code [at a lower level]. And I think sometimes engineers make a change and find it too tedious to record why. And then when they have to return to it later on, to make another adjustment, the engineer - or it may be another engineer - may find that what was blindingly obvious at the time, becomes opaque, and he can't fathom why on earth he made the change in the first place." [SO]

What engineers don't like about English
'Thou shalt not be vague'

This study has identified a curious language usage relating to the use of modal verbs, and that this usage appears to be foreshadowed by engineers' attitudes towards English. They seem to have a low opinion of the adequacy of the English language when it comes to writing engineering specifications and requirements, and have devised their own rules in an attempt to make English serve their needs better. In practice, these rules are not always applied, leading to new problems which include misunderstandings with the customer.

I have gained a clear impression that engineers believe English to be inadequate for their purposes. This impression has been gained from opinions expressed by RASE engineers in interviews, and from their reading material, which includes textbooks, engineering journal articles, and writing guidelines. A typical opinion of English is that it encourages engineers to be ambiguous, incomplete, and incorrect; engineers believe it is open to interpretation, making it difficult for conditions to be precisely defined. One of the consequences of this is that two people reading the same statement could come up with different interpretations, a potentially expensive situation for the company when the misunderstanding occurs between the customer and the design engineers. A mismatch between customer expectation and engineer provision happens more often than engineers would like, and this is a problem not restricted to RASE, but encountered across the engineering sector.

One engineer explained the problem in this way:

> The vast majority of problems arise from misunderstanding what your requirement is supposed to be. Quite often, you're an awful long way down the design process before you actually find you don't understand what's going on, or that you misinterpreted something. …… It's the ambiguity and incompleteness. People misinterpret what was written. The customer has one set of domain knowledge, the engineer has another. There is an intersection between the two, but because there is a difference in their knowledge, each may interpret a given statement in a given way, both of which are correct, but you may end up implementing something different from what the customer intended.[TB]

There also seems to be the impression that natural English leads writers to make errors when drafting requirements, because it encourages the construction of illogical expressions, as another engineer explained:

> "People can make an awful lot of mistakes in English: mistakes in logic. English will let you express a lot of illogicalities, and to an engineer that's impossible. … I think English is the problem. It's a language to express feelings and emotions; it's a language with shades of meaning. It's not a logical thing." [JS]
>
> "I'd like to see a situation where no English was used at all. I'm not interested in problems with English anymore, and want to banish it altogether."[JA]

Put simply, there is an assumption among the engineering fraternity that everyday English is unsuitable for their needs. They usually call this kind of English *natural* English or *informal* English, and have made a distinction between what they call *natural* or *informal* English and *formal* English. This attitude towards English in engineering industries, is equally matched by concern amongst engineers in academia, who are concerned about how to improve the clarity of engineers' writing. Academic journal articles and text books make references to the inadequacies of English, as exemplified by the following, the first from an article on how specifications should be phrased, and the second from a textbook:

> Req.I12 is interesting because it illustrates the deficiencies of English.

Fitzgerald (1993)

> Unfortunately, natural language has been found to be of limited use in the production of precise specifications. Natural languages have a variety and richness that tend to militate against precision: ambiguity and misinterpretation abound in natural language descriptions. This is not to say that natural languages cannot be used for specification purposes; it is just that to gain the required precision leads to documents that are so long that their sheer length becomes a problem.

Thomas et al (1991)

Modal verbs

What emerged during the study, is that some of these problems are due to engineers' their attempts to be unambiguous when drafting specifications, and the way they use modal verbs, particularly the modal auxiliaries 'will' and 'shall', in them. Put simply, an engineering-lore-kind of grammar prevails which advocates that 'will' should be used in statements to express a feature which my be desirable in a product, but which may not be compulsory. 'Shall', on the other hand, has some kind of mandatory force when used in third-person constructions. Kirkman (1992:124) discusses problems arising out of the use of these particular modals, urging engineers to use other less confusing ones instead. However, as will be seen later, 'will' and 'shall' are firmly entrenched in the engineers' lexicon, and have been attributed special meanings.

There appears to be a link between grammatical categories of mood and the writing of engineering specifications. This is because they are primarily concerned with interpreting the customer's needs and desires in terms of requirements. In fact, when talking about the customer requirements, engineers frequently refer to them as the customer's wish-list. Those familiar with Quirk and Greenbaum's grammar (1973), may recall that their description of the subjunctive mood is associated with, among other things, wishes and desires. Quirk and Greenbaum explain mood as relating 'the verbal action to such conditions as certainty, obligation, necessity, possibility' (Quirk and Greenbaum 1973:40). More particularly, they explain that a sub-category of the subjunctive mood covers subordinate constructions following optative verbs like 'wish', e.g. 'I wish I were dead'. This close association of the subjunctive with wishes and desires is generally accepted, as summed up by Richards et al who define the subjunctive mood as 'the form of the verb often used to express uncertainty, wishes, desires, etc.' (Richards, Platt and Platt 1992:236).

However, although there appears to be a connection between mood and engineers' use of modals, it is possible to become rather enmeshed in different notions of modality, the distinction between modality and mood, and semantic/grammatical categories of modal verbs, since these receive rather different treatment in various grammars. From my perspective it is clear that a description of mood like Quirk and Greenbaum's (1973), which is centred on verb form, has evolved into more recent descriptions of modality, as exemplified by Downing and Locke's, which explains modality in terms of speaker commitment; and in which modalising is contrasted with making a categorical assertion:

> This is an important choice which faces speakers every time they formulate a declarative clause: to make a categorical statement or to express less than total commitment by modalising. (Downing and Locke 1992:382)

We could follow a route which explores the distinction between modality and mood, or explore the extent to which modal verbs convey mood. However, at this stage, it does not seem pertinent to do so. Suffice it to say that I do not restrict my understanding of the term 'modality' to a morphosyntactic category of the verb or verbal inflection, since this more formal traditional view does not suit my purposes.

Instead I prefer a description which takes into account semantic and communicative functions, and which accepts that there is an intersectional overlap between notions of mood and notions of modality (Palmer 1986:21, and Crystal 1992:257). Modal verbs can perform the function of conveying shades of meaning which make them members of a greater semantico-grammatical category, a category which has expanded to encompass attitudinal perspectives of the speaker (Downing and Locke 1992:382 and Lyons 1977:452, cited in Palmer 1986:2).

Modality is an aspect of mood, and is 'frequently realized by inflecting the verb or by modifying it by means of 'auxiliaries' (Lyons, 1968:307). According to Lyons, modality is a grammatical marking of an utterance indicating the expectation or attitude of the speaker. While acknowledging the many different ways in which speaker 'attitude' is grammatically marked, Lyons describes three relevant 'scales' of modality:

> 1) wish and intention
> 2) necessity and obligation
> 3) certainty and possibility (ibid:308).

The customer's statements of need clearly convey basic modalities, as demonstrated in the following two examples taken from a Customer's requirement:

> A below decks operating position is to be provided in the Control Room.
> It is desirable that the system is hardened against the effects of an explosion.

In any responding specification, engineers attempt to use particular modal verbs correctly, especially 'shall' and 'will'. Without exception, they stress the importance of using 'shall' correctly, several complaining that the inaccurate use of modal verbs in writing specifications has led to misunderstandings and disputes with the customer. When asked, every engineer has no doubt that the use of 'shall' in a specification indicates an action which must be done, for example [my emboldening]:

> 5.7.6.3.1.1 The system **shall** accept positional data from a closed loop servo system which places the system in both elevation and training in response to demand signals. ………
>
> 5.7.6.3.2.1 The daylight TV camera **shall** convert optical images into composite video signals for TV monitor display and video recording purposes.
>
> 5.7.6.3.2.2 The THIM **shall** convert Infra-Red (IR) radiation into composite video signals for Video monitor display and recording purposes.

Those who wonder why the use of 'must' does not suffice, soon learn that the use of 'shall' has the function of signalling a requirement which must be carried out, and which is mandatory in contractual terms; in other words, it is a legal requirement. Any engineer will provide a quick gloss on this particular usage by explaining that a 'shall' indicates what must be provided for the customer, whereas a 'will' indicates what is desirable. When pressed, most agree that desirable attributes of a product may be expressed with structures other than 'will', a fact borne out by even a cursory examination of the data, but opinion is unanimous about the mandatory force of 'shall'. There is an unmistakable attitude of respect towards any use of 'shall' in specifications; the word seems to be accorded the highest status indeed so far as engineers are concerned.

Advice about how to use these modals is readily available in engineering handbooks, text books and the like, as shown in the following example which is an extract from a writing manual issued by a certification body (ISTEC):

> Within the criteria certain verbs are also used in a special way. Shall is used to express criteria which must be satisfied; may is used to express criteria which are not mandatory; and will is used to express actions to take place in the future. (ISTEC 1992: Para 0.12)

Another example, this time from a text book, reiterates the obligatory force of 'shall'::

> Definitions of 'shall' and 'will'
>
> 1.2 Capture 'shall' statements
>
> Purpose
>
> The purpose of this Activity is to produce an initial Requirements Trace Matrix (RTM) that contains the entire set of sentences from the System Specification, and any other agreed-upon documents, that include the word 'shall'. A sentence that includes the word 'shall' represents a requirement that must be satisfied. ……..
>
> Definition(s)
>
> **'shall' statement:** A single **'shall' statement** is a sentence that includes the word **'shall'.** A
>
> **'shall' statement** is extracted from the System Specification (and any other agreed-to documentation). A **'shall' statement** indicates a contractual requirement for the system to be developed. (Texel and Williams 1997:22)

This rule concerning the use of 'shall' and 'will' is not restricted to RASE, nor indeed is it restricted to the United Kingdom. I recall an American academic in Singapore railing against this peculiar usage, describing it as illogical and ungrammatical, and blaming it on reactionary British engineers who had imposed their entrenched practices on former British colonies. I remember thinking at the time that his argument sounded plausible. However, I have since learned that this usage is also common in America. RASE engineers say they are used to working with American counterparts who talk exactly the same language so far as 'shall' and 'will' are concerned.

The specification documents I have examined so far indicate that engineers do not seem to practise what they preach, at least not consistently. In fact, they use modals in ways other than those they themselves prescribe, with variations existing within and between documents. For example, a survey of 'shall' usage in four specification documents reveals:

1) an extract in one containing 65 requirements yields not a single *shall* (hardware requirements). There are, for example, numerous modalised structures, many of which convey mandatory obligation, but which do this through the use of the following:

> **must**, as in the following example: 'Appropriate software **must** be provided with the system to allow operator performance assessment.'
>
> **will**, as in 'For the System, the KLK Mk5 version of the Pedestal Sight **will** be used.'
>
> **is/are to + lexical verb** structures, as in 'The purpose of the GLKV **is to provide** fall-back modes of operation.'

2) another uses 'shall' in 30 out of a total of 42 separate requirements (hardware requirements);

3) another document, however, includes 'shall' in each of its approximately 2255 requirements (software requirements);

4) and in yet another, out of around two hundred and eighty requirements, all except five are 'shall' statements (software requirements). Here is an example:

> If power is removed from the unit while the system is held in the Power-up State following the detection of a fault, the system **shall** unconditionally leave the Power-up State in order to enter the Off-State.

Further examination of requirements specification documents reveals marked differences between them, in part a reflection of differences in the ways in which software and hardware requirements are

composed. The former, drafted with the aid of electronic writing tools designed specifically to control engineers' language, among other things, reveal a degree of uniformity and conformity with the conventions governing the use of modals, so that every requirement contains a 'shall' modal verb phrase, usually without exception. Nevertheless, and in spite of these specialist tools, software engineers report no reduction in misunderstandings that arise with the customer, and between themselves. In contrast, hardware engineers' requirements are more variable, exhibiting markedly less conformity to the engineers' rules governing modal usage. Hardware engineers tend not to use computerised writing tools, and so are less constrained when composing requirements.

They do not appear to use modals in the way that they themselves say they should. They will acknowledge, for example, that the following requirement is mandatory:

> The system **is to be** capable of calculating minimum range for crest clearance ....
>
> However, if this is a mandatory requirement, it would be interesting to learn why is it not expressed as follows:
>
> The system **shall b**e capable of calculating minimum range for crest clearance ....

Discovering the answer to this question will be the next stage of this investigation. Doubtless, the authors have their reasons, as do other engineers who seem to disregard the conventions.

A specification document case study - inconsistent prescription and practice

An attempt was made to gain a clearer impression of modal verb usage within a single document, which is a set of hardware requirements for a portable computer component, which seems to confirm earlier observations that modal usage in requirements is inconsistent. The inconsistencies revealed seem to be fairly typical, epitomising the characteristics of hardware requirements documents examined so far.

At the very beginning, the document includes in its introduction a list of definitions which contradict published guidelines, in particular regarding ‘will’ and ‘shall’, which are deemed in this document as having the same mandatory force. Prescribed usage for these auxiliaries, along with a list of abbreviations and references, is reproduced verbatim below:

> DEFINITIONS
> Within this document, the following terms shall be interpreted as described.
>
> | | |
> |---|---|
> | ‘May’ | Allowable. |
> | ‘Might’ | Allowable. |
> | ‘Shall’ | Obligatory (except where mentioned in a note). |
> | ‘Should’ | Preferable. |
> | ‘Will’ | Obligatory. |
> | ‘Would’ | Preferable. |

Although ‘would’ and ‘might’ are included in the definitions list, being defined as ‘Preferable’ and ‘Allowable’ respectively, they never actually appear in the requirements themselves. ‘Shall’ and ‘will’, however, occur the most frequently in the document: ‘shall’ in 44 of the 97 requirements statements, and ‘will’ in 32. On the other hand, certain modals have been excluded: ‘must’ and ‘can’ are actually used within the document to express a small number of requirements, but are missing from the list of definitions.

Furthermore, modals are not used as prescribed: either modals designated as having mandatory force are used a) to convey other (non-obligatory) meanings, or b) are absent from structures intended by the engineers to be mandatory. The latter is the case in eight of the requirements, of which the following is an example:

> The DTM (including cable and PSU) is required to be a portable item.
>
> [It seems that engineers’ problems with specification writing are not restricted to modal verb usage and interpretation: engineers agree that this is a mandatory requirement, but disagree over the interpretation of ‘portable’ in design terms.]

Conversely, the ‘obligatory’-designated ‘will’ is used, as shown in the following requirement, but not to convey mandatory force in forbidding the action; instead, it describes future intention and prediction in the following examples, respectively:

> Due to the simplicity of the DTM, reliability analysis <u>will not be undertaken.</u>
>
> Authorisation of further development or manufacturing release <u>will depend</u> on successful completion of formal reviews.

A pattern of usage is emerging indicating that mandatory force is also conveyed in modalised structures surrounding ‘be’, as evidenced by 13 of the verb phrases in the document: a significant proportion of these (8) follow the pattern:- modal + ‘be’[+ adj.] + prep. + complex NP , as in the following examples:

> shall be subject to the procedure set out in Ref. X
>
> will be limited to 3 man-days
>
> shall be valid from the delivery date to ABC plc
>
> should be of sufficient length to allow the DTU to be removed from the case for changing

The document contains another nine requirements intended by the engineers to be obligatory which do not contain an ‘obligatory’ modal from the definitions list. Some are catenative constructions, eg ‘are expected to be’, ‘are expected to discard’, ‘is to be produced’, ‘is required to be’, as exemplified by the following:

> A Master Record Index (MRI), showing the design standard of the equipment is to be produced in accordance with ISO 9001 approved Supplier’s procedures.

Furthermore, there are two non-modal structures with mandatory force:

> In the latter case, the connections required are as follows:- ….(followed by data tables)

> The Supplier is responsible for carrying out these tests.

Conclusion

Engineers’ problems with writing requirements specifications are partly caused by the lack of clear guidelines regarding the use of modal auxiliary verbs. Any advice that is available on using these verbs, particularly *shall* and *will,* is conflicting and often leads to misinterpretations of these modal meanings in the context of specifications between engineers and their customers, and between engineers themselves. Existing guidelines serve merely to sow confusion among the engineer writers, leading to inconsistent usage and difficulties of interpretation. It appears that their attempts to systematise the use of modal verbs has added an extra layer of complexity to a writing task which begs to be understood and simplified.

APPENDIX K - A NEW SPIN ON GYROSCOPES

MICROMACHINED SILICON PUTS A NEW SPIN ON GYROSCOPES

Helix Industries
Systems & Equipment

HISE, the leading UK vendor of gyroscopes has announced an industry first - it has developed the world's first commercially available micromachined ring gyroscope.

Over the past few years, developers of inertial systems have placed some important demands on manufacturers of gyroscopes. Not the least was that gyroscopes should be smaller, more reliable and less expensive. The result was that gyroscope designers moved away from a purely mechanical approach towards solid state devices. Today, these solid state designs have been in successful production for some time and have been used very effectively for platform stabilisation, remotely piloted vehicles, pointing, navigation and control systems.

But the market never stands still, and today, new requirements are driving the technology for the next generation of gyroscopes. This time around, it is not the military market that is asking for a low cost gyroscope system, but the commercial marketplace. Developers of vehicle dynamic control systems, navigation systems and active suspension systems all need gyroscopes which are more than an order of magnitude less expensive than their present day counterparts.

To address these needs, gyroscope designers have no alternative but to embrace new manufacturing technologies. In effect, this means that they must turn to micromachined silicon components for the mechanics of the gyroscope. They must then closely integrate the micromachined result with control electronics built from a single Application Specific Integrated Circuit (ASIC) in order to meet the required price/performance criteria.

In the development of these micromachined gyroscopes, techniques and technologies previously employed in the design of earlier systems can be effectively employed - and then cost reduced.

Such was the case with the development of the new silicon micromachined vibrating structure gyro from Helix Industries Systems and Equipment (HISE). Now in production, this new gyroscope will be delivered at a price an astonishing order of magnitude less than was achievable from older generation designs.

With the development of its earlier VSG2000 gyroscope, HISE designers developed an innovative patented mechanical ring structure to take the place of previous more expensive, mechanical rotating structures with gimbals and bearings. It was certainly cheaper. This new solid state gyroscope worked by making use of the Coriolis force - a force that is observed to act to a moving element in a rotating body.

In operation, the HISE mechanical ring gyroscope was made to oscillate by the application of alternating force to the ring. When this oscillating body was placed in a rotating reference frame, the Coriolis force came into play, producing a secondary oscillation orthogonal to the primary oscillating motion. (Figure 1).

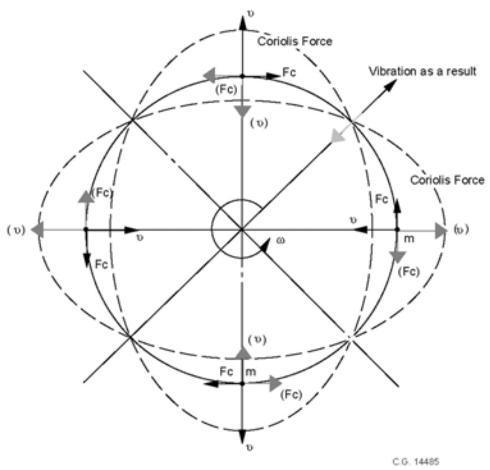


Figure 1

Measuring the size of the resultant vibration provided a signal proportional to the rate of movement of the gyroscope.
So HISE designers developed the unit so that the amplitude of the movement of the resonating structure was detected by a pick off positioned 45 degrees from the input drives.

The problem with this approach was that the specification of the gyroscope could be limited by the characteristics of the material used in the ring. As the rate of rotation increased, the ring motion would increase and the output become non-linear.

To solve that problem, HISE developed a patented closed loop gyroscope technique that amplified the signal from the pickoff and then fed it back to the ring as a nulling voltage, providing a force that cancelled the effect of the Coriolis force. In this way, the material used in the gyroscope ring did not cause errors. The output of the gyroscope was obtained by demodulating the nulling voltage output from the sensor to obtain a dc voltage directly proportional to the angular rate that was being applied.

Re-use of the ring oscillator approach, coupled with the integration of the gyroscope control electronics into a single ASIC, have helped HISE engineers with the development of the next generation design, the silicon vibrating structure gyro. But the most revolutionary aspect to the new design is the way that the entire mechanical gyroscope has now been integrated into a small micromachined element smaller than a penny. This is, in fact, the first time that micromachining has ever successfully been used to build a commercial gyroscope.

The technology used to build the small micromachined ring that forms the heart of the new gyroscope was obtained through an agreement between HISE and Makemoto Precision Products (MPP). Another Maketomo group company specialises in the production of silicon processing equipment, including etching machines for micromachining. Through the use of such machines, MPP were able to optimise the manufacture of small micromachined rings used in the new design using a process known as deep trench etching.
The new gyroscope comprises the micromachined ring itself supported in an IC style package by eight small legs. Each of the eight legs carries three conducting wires onto the surface of the ring. (see Figure 2).

***Figure 2**: Each of the eight miniature legs carries three conducting wires onto the surface of the ring itself.*

Two wires carry current onto conducting surfaces on the ring, while the third connects to a ground plane. One wire carries current clockwise to "drive" the ring, while the anticlockwise wire is used as a "pick up"

A small magnet is bonded onto the base of the gyroscope. The magnet passes through the centre of the ring and is capped by a "C-shaped structure" that directs the flux from the magnet back onto the ring (Figure 3). When current flows through two of the conducting elements in the ring, the cross product of the current flowing through the ring, and the magnetic force field produced by the permanent magnet delivers a force that causes the ring to move outwards, in a similar fashion to the VSG rate sensor.

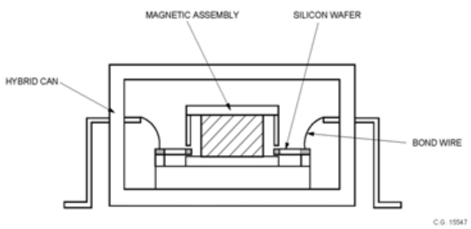


***Figure 3**: A small magnet is bonded onto the base of the gyroscope. The magnet passes through the*

centre of the ring and is capped by a "C-shaped structure".

By applying an alternating current to the conductors on the ring, the microminiature ring is made to oscillate.

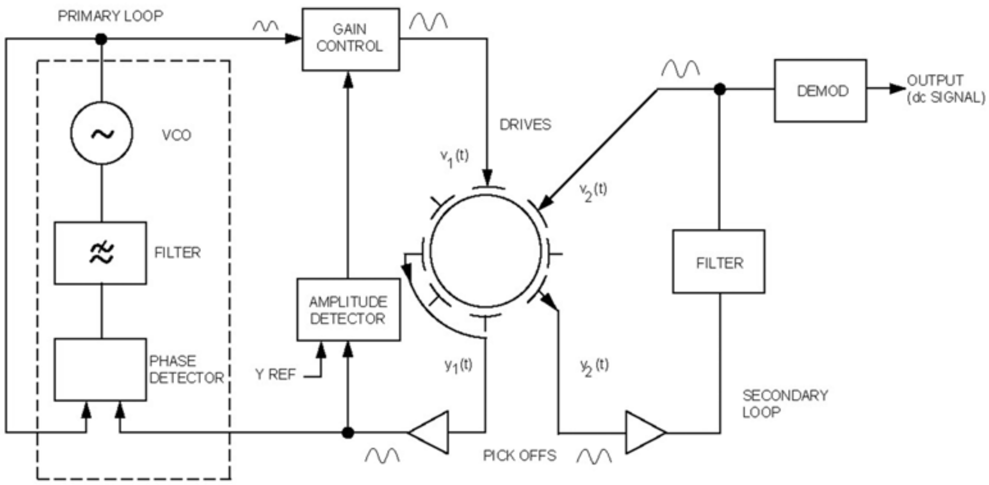
A voltage is created in the pick-off elements on the ring due to the fact that they are moving conductors in a magnetic field, and hence produce an output proportional to the amount of movement. As before, when there is no rate of rotation, there is no output on the secondary (orthogonal) axis. As the gyroscope is rotated faster, the output increases. Measuring the amount of secondary axis vibration again provides a measure of the rotation rate of the gyroscope.

Silicon has some very useful material properties for a sensor which is why it is already being used for the design of micromachined accelerometers in airbag systems. Because the silicon ring used in the new gyroscope is both small and light, it has low inertia. Therefore, when the can containing the gyro is moved, the ring easily moves with it giving very high shock resistance. And because it is silicon, the ring itself is relatively strong and very resilient, it does not "stretch" in the same fashion as metal - providing low hysteresis.

The gyroscope has also been carefully designed so the silicon ring itself has no fundamental vibration patterns at low frequency. All the fundamentals are at high frequency so that it is inherently insensitive to vibration.

The gyroscope manufacturing process first starts with a wafer of silicon. Using Industry standard deposition and patterning techniques, the insulators and conductors are laid down on the silicon. A resist is then applied and patterned. Then, through a process of etching, the unwanted silicon is removed, leaving the ring and the legs intact.

The electronics in the single ASIC controller is also a miracle of modern levels of Very Large Scale Integration (VLSI). A mixed-signal ASIC comprising both digital and an analogue electronics contains all the control circuitry that had previously been found in a discrete form in earlier devices such as the VSG2000 mentioned above. The ASIC includes the primary loop, gain control, amplitude detector, filter and demodulator (see Figure 4).



THE AMPLITUDE DETECTOR COMPARES THE AMPLITUDE OF THE PRIMARY PICK OFF WITH A STABLE REFERENCE.
THE ERROR SIGNAL IS USED TO ADJUST THE PRIMARY SIGNAL ACCORDINGLY.

C.G. 14486

Figure 4: *The ASIC for the silicon micromachined gyroscope includes the primary loop, gain control, amplitude detector, filter and demodulator.*

The ASIC also contains built-in test circuits which check the integrity of the sensor to a very high level, an important consideration in braking system design where safety of the system is of paramount importance.

Through effectively leveraging micromachining technology, the HISE Silicon VSG development has met the price/performance ratio that designers of next generation systems, such as car navigation systems are demanding.

The deep trench etching process has enabled HISE to exploit the technology to produce gyroscopes on silicon wafers at a price of $50 for high volume applications. This is important in a market which saw over 500,000 car navigation systems sold in Japan last year. And all of these represent a potential home for the new micromachined silicon gyroscope.

Although such systems can simply use CD-ROM map-based data and global positioning systems (GPS), they tend to be unreliable. Over the years, navigation systems designers have realised that in some places such as cities or canyons, accuracy of such systems can be sacrificed due to loss of signal from the GPS system itself. By coupling a gyroscope into the system, the reliability is enhanced. With a gyroscope, the rate of turn of the vehicle can be measured and used as an additional input to the system. Obviously, a good performance, low cost gyro is essential for such applications.

At the moment, navigation systems may be the first application to take advantage of the new technology, but braking systems won't be far behind. In fact, such gyroscopes may be the only alternative that designers have to consider in such an application, since vibrating beam devices have limited performance which doesn't meet the aspirations of most system designers.

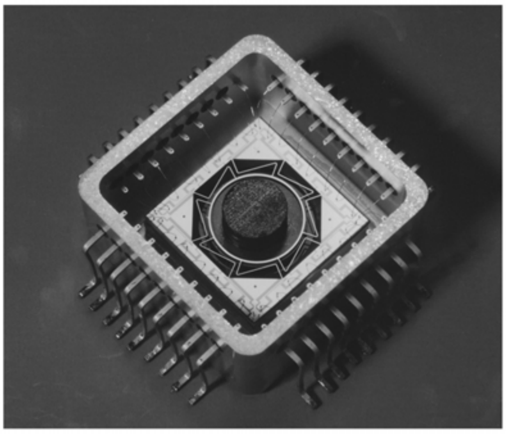
But what sort of performance do the new gyroscopes offer? And how do they compare with their earlier counterparts?

The new micromachined gyros give similar performance to their larger more expensive predecessors. Both devices provide a performance of 1 to 2 degrees per second rate error, and 1 to 2 percent of scale factor error over the full environmental specification. The silicon micromachined gyroscope is, however, much easier to manufacture in high volume at low cost.

On the other hand, the reliability of the HISE Silicon VSG is superior to the previous devices, due to the low parts count and low stress levels inherent in the design of a silicon ring.

The Silicon VSG micromachined gyroscope sets the standard for all gyroscope designs in the future.

HISE has made a significant advance in sensor development by being first into the market with such a design. The likely effect is that many designs that had previously considered a gyroscope too expensive will now come into fruition. A wide range of applications will benefit from this low cost, high performance gyro in the future.



For further details, phone or fax:

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NT2 2EE

APPENDIX L - STRAWMAN OUTLINE STRUCTURE OF A MODEL PROPOSAL

(produced Jan 1998)

Explanation: This is an outline I put to the team leader for silicon gyroscopes for the preparation of proposals for solid state sensors, because he wished to develop a generic proposal. This outline was developed specifically for solid state sensors, but, in fact, has wider applicability. Using REMA parlance, it was referred to as a 'straw man' to indicate that it was not a final plan, but a suggestion, which could be adapted or modified. It was also intended to serve as a kind of macro structure, within which potential boilerplate sections could be identified. This table, then, represents my view of how the generic proposal could be structured. The aim, at the time, was to see how useful to engineers such an approach to proposal writing could be.

	DISTINCT SECTIONS	**AIMS AND FEATURES, and subsections if applicable**
1.	**Front cover**	• Provide name and ref no of proposal • Help location, storage/filing, reference • Impress
2.	**Title page**	Should provide: • proposal title • proposal number • names of those accountable
3.	**RASE Proprietary statement**	To protect RASE property and establish legal copyright
4.	**Table of contents** (template and styles/headings could automatically generate this t.o.c.)	Would show • the <u>hierarchical structure</u> of the document (automatically generated by customised style/heading features on the wordprocessor), and • those sections which could be easily pulled out for reading by different members of the customer's team. The table of contents would show a <u>structure</u> something like this: **1 Title page** **2 Copyright / Proprietary statement** **3 Table of contents** **4 Glossary** **5 Executive Summary** **6 Technical Aspects of the Proposal** : RASE response to technical requirements Rationale for the RASE solution (if not 100% compliant) Product description, pointing to longer description in appendices Compliancy matrix **7 Commercial, Management, and Administrative Aspects** **8 ILS and ARMT section** (wouldn't this be subsumed under previous heading, ie No 7?) **9 Appendices** **Appendix 1** -(More detailed)Product Description **Appendix 2** - Information about REMA and RASE **Appendix 3** - Quality Assurance Procedures at RASE. **Appendix 4 -** Staff CVs (if required) **10 Index** (RASE practice to provide this?)

	DISTINCT SECTIONS	AIMS AND FEATURES, and subsections if applicable
5.	**Glossary**	I think this should be kept short, however, can anticipate interesting argument about which initials/acronyms should be used or avoided. An audience analysis should help us to decide. That and the style and readability flow of the text.
6.	**Executive summary** • This may be in the form of **an introduction / overview** of the proposal, or • **an introductory letter** Appropriate formats should be provided in the template	Address key readers of the proposal and: • **Highlight the benefits** of choosing RASE's solution, including mention of identified themes (e.g. degree of compliance, mention of substantial nature of RASE as an organisation, growth potential, low risk, long-term benefits - maintenance, development, training, product enhancement, political benefits) • **Summarise the main points** of the proposal which are covered in more detail in the Technical, Commercial/Financial and Management sections) • **Emphasise (or reiterate) the main point**(s) you want the reader to remember when he considers other bids • **Give the price** (it strikes me as a logical place to put this, but none of my informers has mentioned this. Or is there a more appropriate place for this?) **Possible subsections:** 1. degree of compliance 2. product (or solution) gloss 3. state-of-the-art design, engineering, and (possibly) production 4. tailored aspects 5. off-the-shelf but adaptable nature of the product (or solution) 6. low nature of the risk involved 7. proven performance 8. potential savings through, for example, safety improvements, low maintenance
7.	**Technical aspects of proposal**	To explain: • how RASE is responding to the technical requirements (including a compliancy matrix either in this section or in an appendix) • to what extent RASE proposes to give the customer what he wants • what the product is - a product description • where RASE proposes something different and why • To convince the customer that the RASE product is what is best in terms of design, function and quality • to the reader "why we're good at it". This would include information on design, testing, laboratory and manufacturing facilities, and expertise at RASE (it may be appropriate to include names and qualifications of RASE staff handling the project • future prospects, ie promising future developments which show the customer that RASE is active in R and D and that the product is dynamic and evolving. (Has to be worded carefully as we don't want the customer to think that the present product is flawed in any way.}

	DISTINCT SECTIONS	AIMS AND FEATURES, and subsections if applicable
8.	**Commercial, management, and administrative aspects of the proposal**	**Cost Plan** • To provide a breakdown of the costs, and how RASE would be paid. This would give details of special financial arrangements, and stepped payments. **Sales Contract** • To explain any special contractual arrangements • To state (for the VSG) standard terms and conditions **Personnel expertise** • To provide information about the people who would be involved in the project, their roles, the participating departments, the way the project would be organised, and its key stages of development. **Management Plan** • To describe the management plan, and a temporal breakdown of the stages **Quality Assurance** • To provide a summary of quality assurance aspects of the VSG • To send the reader to a more detailed description of QAC in Appendix 3.
9.	**Appendix 1 -Product description** Should probably be in an appendix	This would include physical, theoretical, and functional descriptions of the product (or solution) intended for a range of readers, including non-specialists, so that they would have a good idea about its value and usefulness, its appearance and how it works. The structure of this text merits in-depth analysis and description. This could be provided in an appendix as background information to the reader, who could be sent to it in the Technical Aspects section.
10.	**Appendix 2 - Descriptions of RASE and REMA**	These would be either 1. **selling-type texts**, giving the reader an idea of RASE's pedigree, and persuading the reader to see RASE as an established, professional, go-ahead, etc etc company, or 2. **factual**, providing information about the company structure, staff hierarchies, the manufacturing sites, management organogram, and any other information yet to be identified. These could vary in length depending on how they would be used as standalone sections in an appendix, for example, or as part of an introduction in a main section. I have yet to identify what particular information about RASE is wanted.
11.	**Appendix 3 - Quality Assurance Procedures at RASE for the VSG**	The aim of this section would be to • reassure the reader about the high QAC standards at RASE. • provide a succinct description of QAC procedures relating to the VSG.
12.	**Appendix 4 - Staff CVs** (optional)	Standardised prescribed format possible, although there are indications that this section won't be necessary for Charles's proposals
13.	**Index**	Standardised format possible, if an index is wanted.
14.	**Inside front and back cover**	This could be short bulleted sales-speak type text selling the virtues of RASE and/or REMA if Charles wants to explore this style of presentation a là the American Airlines proposal

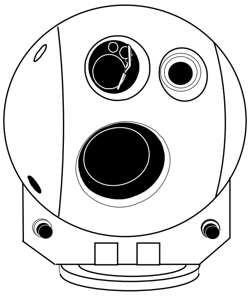
APPENDIX M IC providing historical context in an executive summary

This is an example of an IC providing historical context in an executive summary (taken from ep3044e).

Development Experience in Naval Electro Optical Tracking Systems

The Sea Neptune 1 electro-optical gun fire control system was developed in the 1970s and was fitted to the Royal Navy TURRET class patrol vessels and exported to customers in the Middle and Far East. Using this experience in naval electro-optical tracking, RASE developed the high performance General Purpose Electro-Optical Director (HPEOD), which was selected by the Royal Navy in 1985. The resulting Sea Neptune 30 system (designated YGO46 in the Royal Navy) provides electro-optical surveillance, tracking and gun fire control. Twenty-one HPEODs have already been fitted in Royal Navy frigates, and production is continuing for a further three of the Type 23 frigate class.

The first ship fit was completed in 1988, and the system has since been proved in world-wide service, providing highly reliable performance in all environmental conditions.



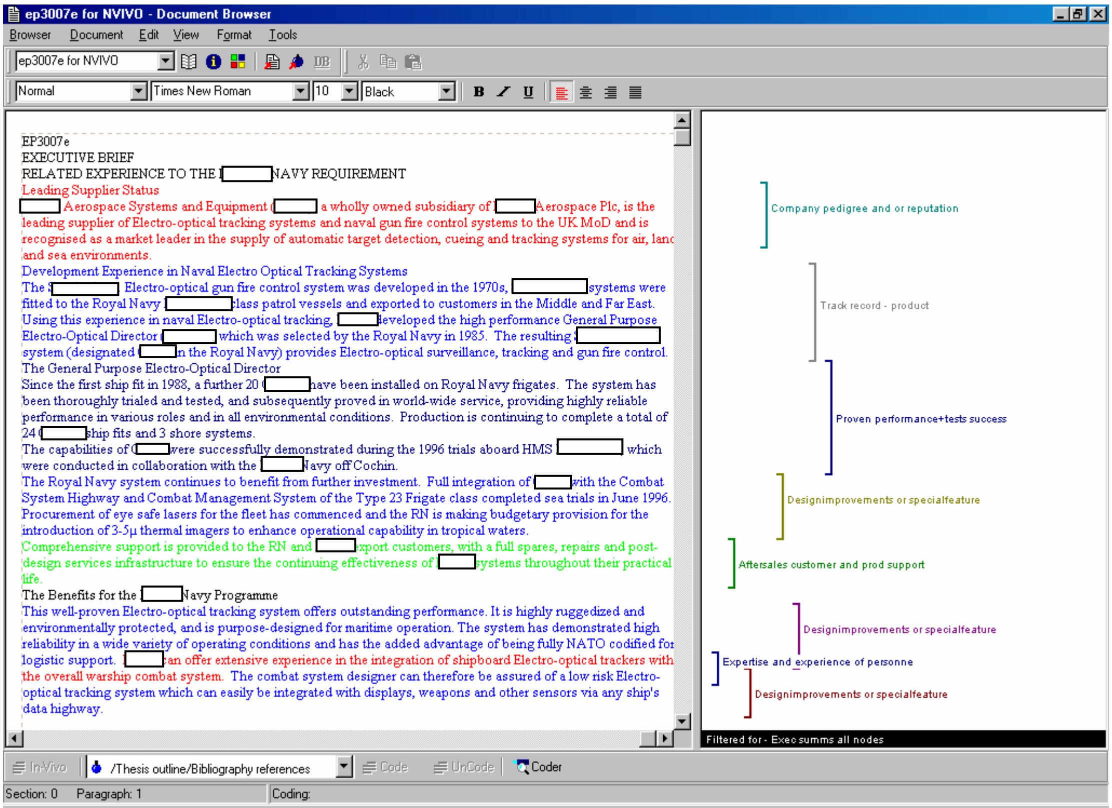
The General Purpose Electro-Optical Director

The Royal Navy YGO46 was initially supplied in a stand alone configuration to control the 4.5 inch gun. A further contract was received from the MoD in 1993 to integrate both the electro-optical sub-system and the fire control sub system with the ship's combat system highway. This development work is now complete and all type 23 frigates have been modified. Further MoD funded work is in progress to introduce a dual thermal imager fit providing a 3-5 µm thermal imager in addition to the current 8-12 µm thermal imager.

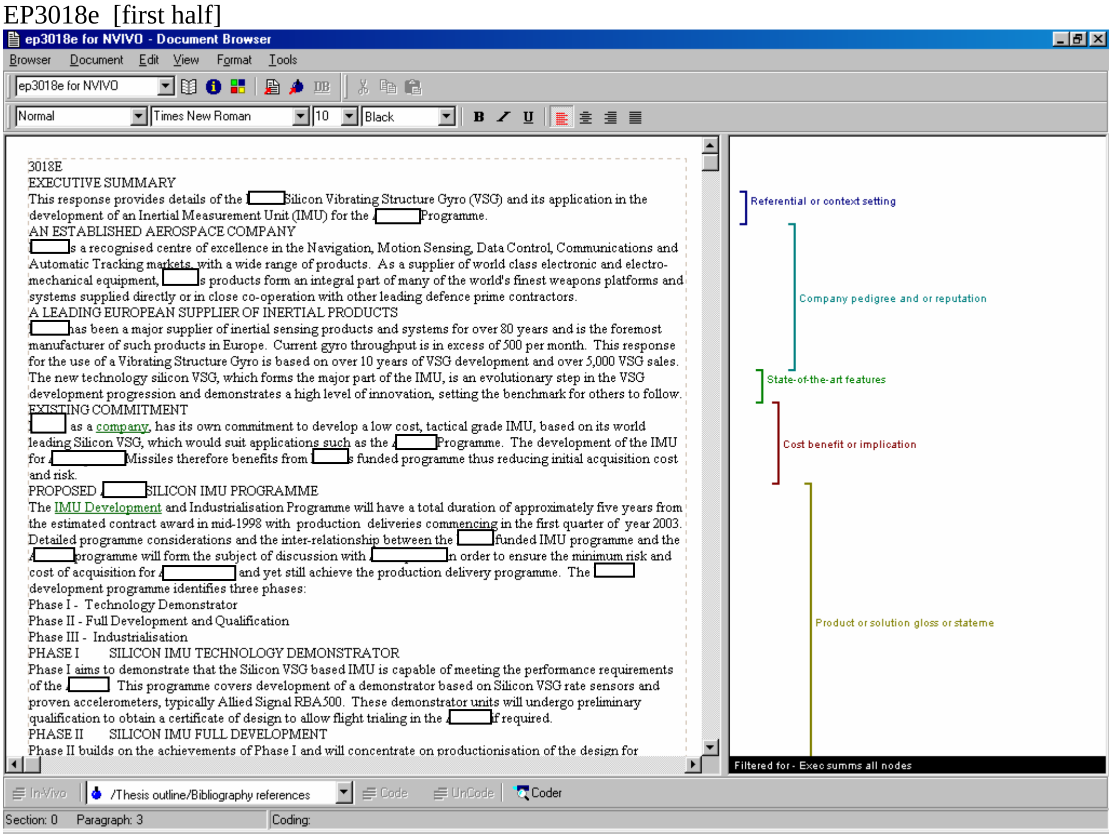
APPENDIX N - NVIVO CODING BARS FOR EXECUTIVE SUMMARIES

This contains the screen dumps of sample set of five executive summaries, discussed in Chapters 5 and 6.

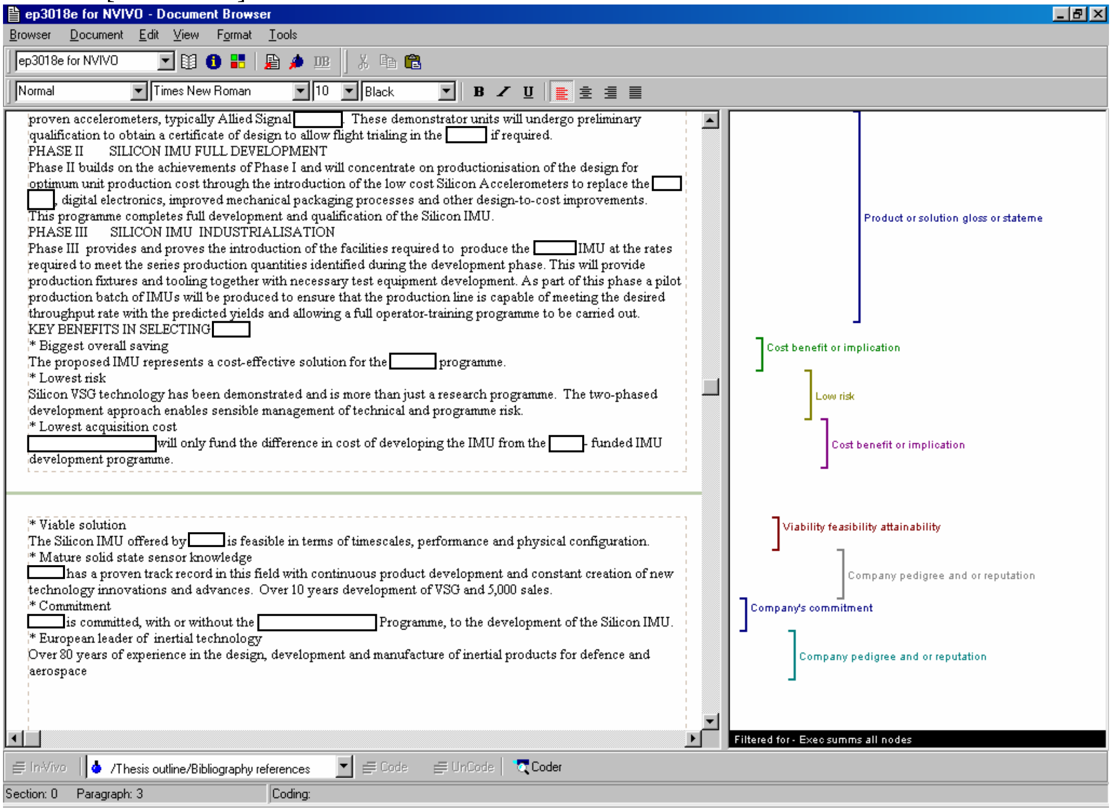
EP3007e



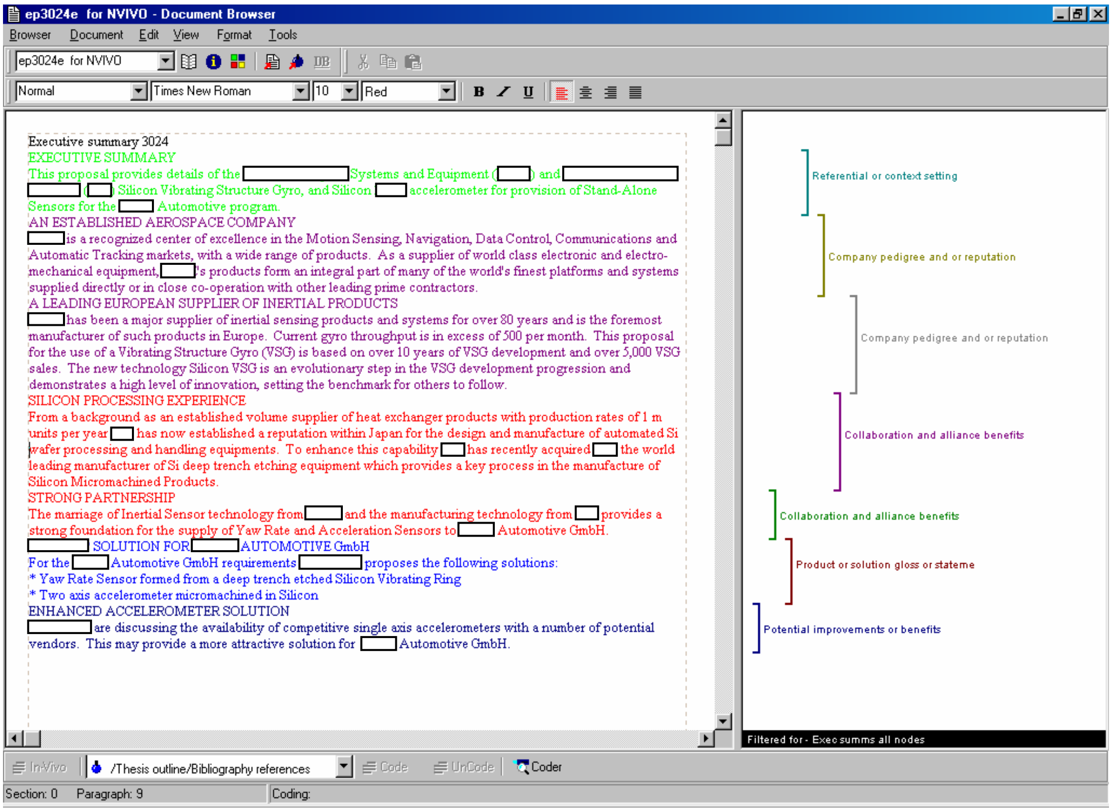
EP3018e [first half]



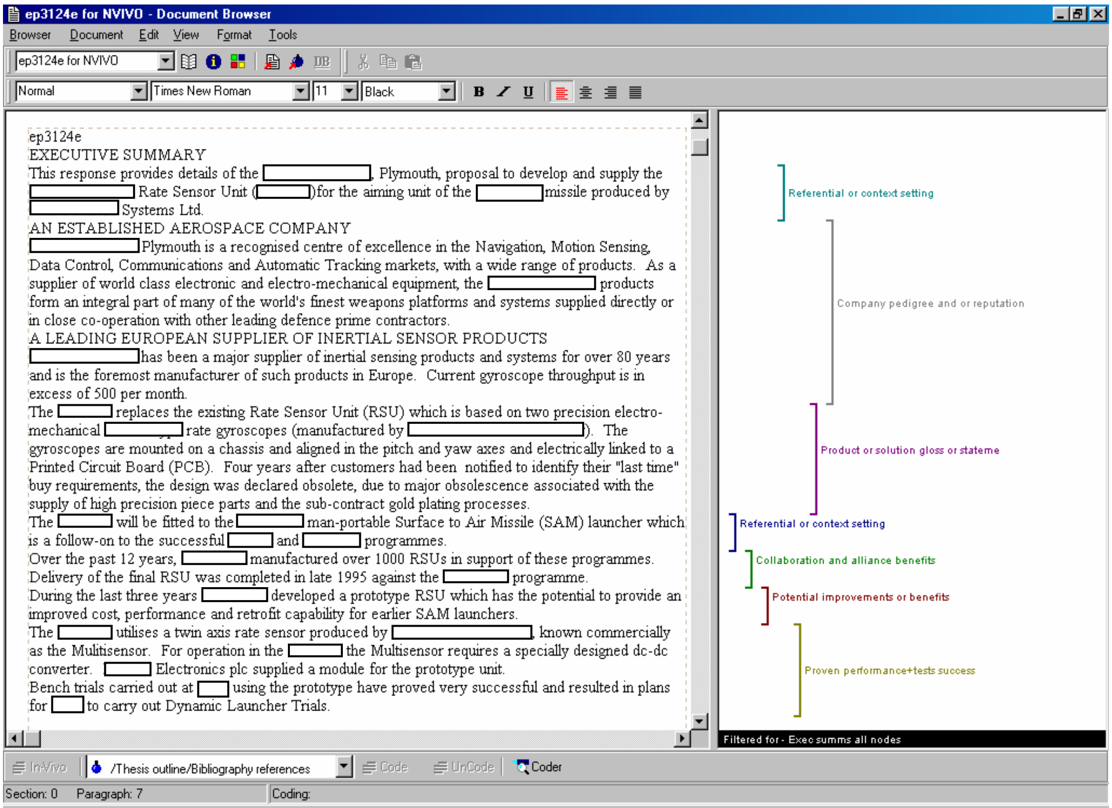
EP3018e [second half]



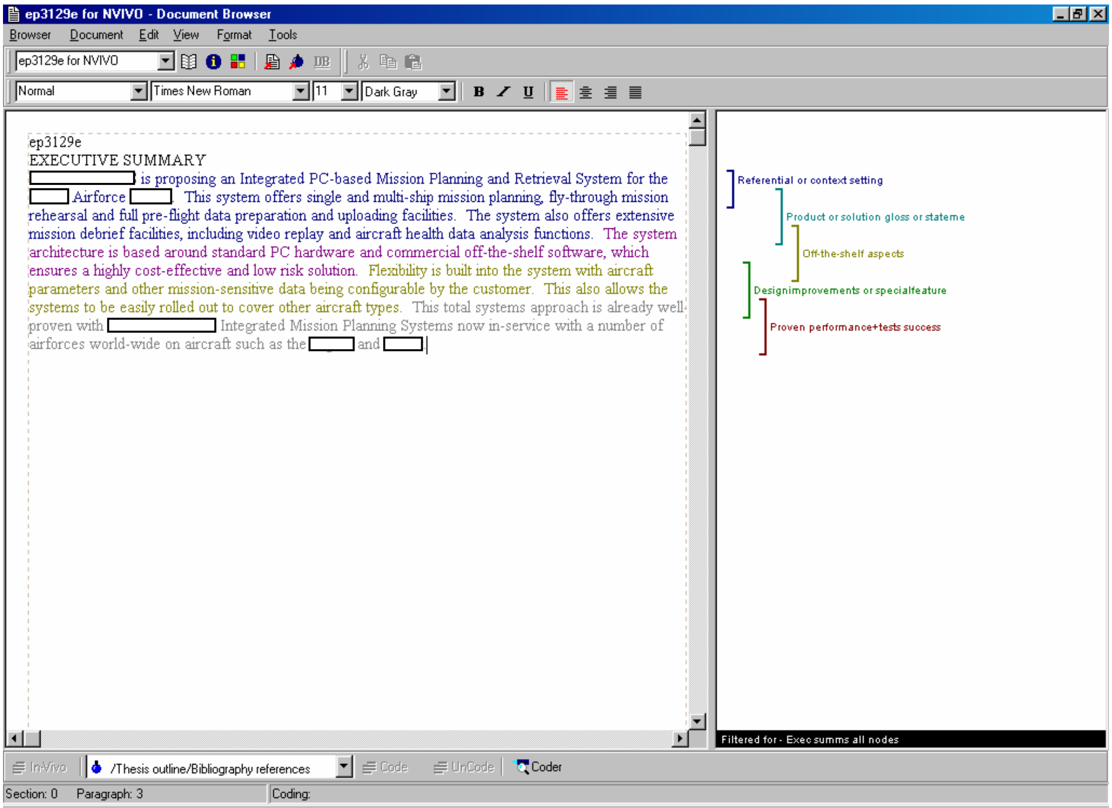
EP3024e



EP3124e



EP3129e



APPENDIX O - A FIRST ROUGH LIST OF CATEGORY CODINGS

This needs to be in an appendix

Very first list of nodes

NVIVO CODING NODES

The Tree nodes to be developed:

1. Product focus benefits
2. Company attributes benefit
3. Product Support benefits
4. Alliance benefits
5. Metalinguistic function
6. Discourse function
7. **Product Focus, with children nodes:**

[Product or solution gloss (in the case of executive summaries) - but **NB** this may not persuasive ? Keep an eye on this. I may need two categories, i.e.: Product or solution gloss persuasive/Product of solution gloss non-persuasive, ditto technical description/expository text]]

8. Solution gloss persuasive
9. Solution gloss non-persuasive/factual
10. Technical description persuasive
11. Technical description non-persuasive [misnomer, because it is expository/covertly persuasive]
12. Competitive pricing
13. Costings
14. Potential savings
15. Degree of Compliance -
16. Special design features
17. State-of-the-art features
18. State-of-the-art production methods
19. Tailored aspects
20. Off-the-shelf aspects
21. Proven performance
22. Prospection – specify future potential
23. Low risk
24. Historical development (overtly persuasive)
25. Historical development expository/factual(covertly persuasive)
26. **Organisation attributes**
27. Positive reference to company
28. Collaboration [Haze: I need to explain somewhere that this is a stated requirement of many bids these days, especially with large bids, or it is seen as an advantage to be teaming up with another organisation.] [Also, Haze: the following may not appear to be persuasive, and may be presented as being factual, but are in fact covertly persuasive]
29. Political benefits of collaboration
30. Good reputation
31. Qualities of collaborating partner
32. Centre of engineering excellence
33. Company's commitment
34. Company's size
35. Company's track record
36. Company's research and development facilities
37. Expertise of experience of personnel
38. Production facilities
39. Sustainability [i.e. ability to develop and support the product in the long term]
40. whoops I don't seem to be getting this right, or accommodating the need for persuasive and non-persuasive categories.
41. **Product support**
42. Product development and upgrades
43. After sales support
44. Maintenance and support in the field
45. Training
46. Product documentation
47. **Metalinguistic**
48. Overview of proposal structure
49. Particular sections of document

50. Discourse function

51. Referential [or reference provision] or context setting
52. Opening
53. Close
54. Section label or heading

APPENDIX P - NODE CODING REPORT FOR PRODUCT/SOLUTION GLOSS OR STATEMENT IC

This is the first part of the NVivo node coding report of all proposal text coded at the node: Product/solution gloss or statement. The report contains around 11,000 words, however, only 3 pages are included here:

NVivo revision 1.2.142 **Licensee: Hazel Sales**

Project: 1 Documents engineers write **User:** Hazel **Date:** 9/1/01 - 01:23:09

NODE CODING REPORT

Node: Product/solution gloss or statement
Created: 7/20/01 - 12:26:21
Modified: 8/12/01 - 07:58:19
Description:
InVivo node created from Nodes for NVivo 20 July 2001

Documents in Set: Proposals main sections exclusive co
Document 1 of 5 EP3007 proposal main section
Passage 1 of 7 Section 0, Para 9, 160 chars.

The proposal offers production equipment, currently in service with the xxxxxx and xxxxxx Navies, combined with the latest, state-of-the-art display technology.

Passage 2 of 7 Section 0, Paras 23 to 60, 3251 chars.

KEL offers:
* A state of the art operator console, available from the collaboration between KEL and Ultra (a British company with extensive console experience)
* A Weapon Control Module, already in service with the xxxxx Navy (well-positioned to provide high-tech Operators Console)
* Understanding of the ship fitting and integration aspects
* In-country customer support
* Near term business for xxxxxx industry
* Building a relationship to develop export potential for xxxxxx

RASE offers:
* Fully developed and well-proven installation data pack for EO Sub-System
* First class product, in the HPEOD. Fully tested and proven in RN service
* Extensive experience in EO Gun Fire Control systems
* Guaranteed minimum 20 years support
* UK MoD backed future development path.
* RASE experience as supplier to xxxxxx MoD in collaboration with xxxxxx Defence Industry.

1.2.1 Areas of Responsibility
It is proposed that KEL will act as Prime Contractor, with the full support of RASE.

RASE will provide KEL with the complete Electro-Optic Director and system from the RN production line built-up and tested with sensors. RASE will provide various documentation and services to support the Prime Contractor and System Integrator throughout the life of the programme (see detailed list of deliverables in Section 5).

As Prime Contractor K.E.L will negotiate the overall conditions of contract including commercial, product performance & quality aspects as well as programme timescales. During the programme KEL will be responsible for:

* Project Management
* Risk Management
* Quality Assurance
* Product Acceptance
* Documentation & Customer Support

Although also responsible for Overall Systems Engineering, as with many of the aspects in this area, KEL will employ the services of REMA to provide much of the technical guidance.

KEL will also be responsible for System Integration. This will include the preparation of Acceptance Test specifications, Final System Assembly and Test.

The provision of Weapons Control Module, Operator's Console, Man-Machine Interface Software and in-ship Installation all represent further sub-contracts:

(1) KEL is well placed to provide the Weapon Control Module as the company already has access to a controller suitable for the Oto 76mm Gun.
(2) The Operator's Console will be provided by Ultra, another British company. Ultra's experience in this field has been focused into their new, fully ergonomic, future proof design which is receiving wide acclaim by the industry as the obvious way forward.
It is proposed that KEL develop the required Man-Machine Interface (MMI) software with full assistance from REMA (on system operational issues) and Ultra (on terms of application development). Although both REMA and Ultra have the capability to do this work, KEL are able to offer the most cost-effective solution.

Ship installation is an area which is best handled within the overall ship refit regime. Your indigenous contractors will be able to provide integrated and eminently suitable solutions for ships cabling and safety circuits. Again REMA will provide the technical guidance to the Prime Contractor to minimise any envisaged risks.

Passage 3 of 7 Section 0, Paras 82 to 88, 571 chars.

Figure 2-1 Fire Control System Schematic
The shaded portion will be supplied by RASE. The Weapon Control Module and Control Console will be supplied by in-country partners.

The system performance is critically dependent on the selection of sensors appropriate to the task. RASE offers a Thermal Imager sensor in accordance with the ITT which is sensitive to radiation in the 8-12 µm waveband. RASE has reservations about the performance of this Thermal Imager in the expected environment and offers the option of a Thermal Imager sensitive in the 3-5µm waveband.

Passage 4 of 7 Section 0, Para 88, 88 chars.

The other sensors are the same as those fitted to ships in service with the xxxxxx Navy.

Passage 5 of 7 Section 0, Paras 92 to 112, 1484 chars.

2.2 GENERAL PURPOSE ELECTRO-OPTIC DIRECTOR (HPEOD) SUB-SYSTEM
The Electro-Optical Tracking Sub-System provides:
* Passive surveillance
* Long range target detection and acquisition for surface, air and Naval Gun fire Support (NGS) roles
* Smooth, high accuracy tracking
* Precise target ranging
* All weather (day and night) operation
The Electro-Optic Sub-System comprises three main assemblies:

* The General Purpose Electro-Optical Director (HPEOD) and sensors
* The Director Power Unit (DPU)
* The Director Electronics Unit (DEU)
The sensor platform is stabilised in azimuth and elevation to compensate for the effect of ship's motion. The DEU contains the equipment for controlling the director, managing the sensors and tracking targets. The DPU contains power amplification equipment which supplies the Director Drive Motors.

The Electro-Optical Tracking Sub-System is ideally suited for integration with a modem operator console and weapon control module to form a state-of-the-art Electro-optical surveillance, tracking and fire control system.

The HPEOD should be installed where:
* It is sufficiently high above the waterline to extend the horizon to [redacted] with good all-round vision
* The site chosen does not significantly deflect relative to ship's datum under ship motion
* There is sufficient room to provide maintenance access
The DPU is mounted between decks within a 20 m cable run of the HPEOD. There are no practical limitations on the position of the DEU.

Passage 6 of 7 Section 0, Paras 129 to 315, 9873 chars.

2.4 THE GENERAL PURPOSE ELECTRO-OPTICAL DIRECTOR
The HPEOD comprises a yoke, a sensor platform, sensors and an outer cover.

The HPEOD yoke is a light, rigid construction incorporating direct drive motors, digital servo control and inductosyn position feedback. This design provides:
* Minimal mechanical backlash
* High resonant frequency [redacted] giving excellent rejection of hull vibration
* High accuracy position information
* High pointing accuracy giving maximum resolution of target video
* Precise servo control
A cable band system enables the director to train [redacted] in each direction from the zero position. This eliminates the need for slip rings, giving high signal path integrity, high reliability and low maintenance. It also allows wash fluid to be provided from fixed structure tanks.

The sensors are mounted on a rigid platform within the yoke. The sensor mass is centred through the axes of rotation in order to:
* Reduce Moment of Inertia
* Minimise the effects of ship vibration
* Minimise coupling effects between axes
* Provide good shock survivability

Figure 2-2 General Purpose Electro-Optical Director with Sensors Fitted (Covers Removed)

APPENDIX Q - NVIVO REPORT ON EXECUTIVE SUMMARY NODES

This is an NVivo report, slightly adapted, which provides all the realisations of ICs identified in the five executive summaries examined in Chapters 6 and 7.

Metadiscoursal ICs
[One identified in this category, i.e. Referential or context setting:]
1. This proposal provides details of the REMA Systems and Equipment (RASE) and Makemoto Precision Products (MPP) Silicon Vibrating Structured Gyro, and Silicon to Access Accelerometer for provision of standalone sensors for Fraser Automotive Programme. (EP3024e).
2. This response provides details of the RASE Silicon Vibrating Structured Gyro (VSG) and its application in the development of an Inertial Measurement Unit (IMU) for the TTSM Programme. (EP3018e).
3. This response provides details of the HISE, Plymouth, proposal to develop and supply the Next Generation Rate Sensor Unit (NGRSU) for the Aiming Unit of the Lightning Missile produced by the Longs Missile Systems Limited (EP3124e).
4. HISE is proposing an integrated PC based mission planning and Retrieval System for the xxxxx Airforce SU-30.

Company-focused ICs
[Four different ICs identified in this category]
1. Company Pedigree Track Record and/or reputation of the company

Node 2 of 5 Co pedigree track record reputation
Passage 1 of 2 Section 0, Paras 4 to 5, 447 chars.

4: AN ESTABLISHED AEROSPACE COMPANY
5: RASE is a recognized center of excellence in the Motion Sensing, Navigation, Data Control, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world class electronic and electro-mechanical equipment, RASE's products form an integral part of many of the world's finest platforms and systems supplied directly or in close co-operation with other leading prime contractors.

Passage 2 of 2 Section 0, Paras 6 to 7, 569 chars.

6: A LEADING EUROPEAN SUPPLIER OF INERTIAL PRODUCTS
7: RASE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe. Current gyro throughput is in excess of 500 per month. This proposal for the use of a Vibrating Structure Gyro (VSG) is based on over 10 years of VSG development and over 5,000 VSG sales. The new technology Silicon VSG is an evolutionary step in the VSG development progression and demonstrates a high level of innovation, setting the benchmark for others to follow.

Node 2 of 6 Co pedigree track record reputation
Passage 1 of 1 Section 0, Paras 4 to 5, 335 chars.

4: Leading Supplier Status
5: REM Aerospace Systems and Equipment (RASE), a wholly owned subsidiary of REMA Plc, is the leading supplier of Electro-optical tracking systems and naval gun fire control systems to the UK MoD and is recognised as a market leader in the supply of automatic target detection, cueing and tracking

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4: AN ESTABLISHED AEROSPACE COMPANY

5: RASE is a recognised centre of excellence in the Navigation, Motion Sensing, Data Control, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world class electronic and electro-mechanical equipment, RASE's products form an integral part of many of the world's finest weapons platforms and systems supplied directly or in close co-operation with other leading defence prime contractors.
6: A LEADING EUROPEAN SUPPLIER OF INERTIAL PRODUCTS
7: RASE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe. Current gyro throughput is in excess of 500 per month. This response for the use of a Vibrating Structure Gyro is based on over 10 years of VSG development and over 5,000 VSG sales.

Passage 2 of 3 Section 0, Paras 31 to 32, 235 chars.

31: * Mature solid state sensor knowledge
32: RASE has a proven track record in this field with continuous product development and constant creation of new technology innovations and advances. Over 10 years development of VSG and 5,000 sales.

Passage 3 of 3 Section 0, Paras 35 to 36, 159 chars.

35: * European leader of inertial technology
36: Over 80 years of experience in the design, development and manufacture of inertial products for defence and aerospace

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4: AN ESTABLISHED AEROSPACE COMPANY
5: HISE Plymouth is a recognised centre of excellence in the Navigation, Motion Sensing, Data Control, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world class electronic and electro-mechanical equipment, the HISE products form an integral part of many of the world's finest weapons platforms and systems supplied directly or in close co-operation with other leading defence prime contractors.
6: A LEADING EUROPEAN SUPPLIER OF INERTIAL SENSOR PRODUCTS
7: HISE has been a major supplier of inertial sensing products and systems for over 80 years and is the foremost manufacturer of such products in Europe. Current gyroscope throughput is in excess of 500 per month.

Passage 2 of 2 Section 0, Para 10, 182 chars.

10: Over the past 12 years, Manchester manufactured over 1000 RSUs in support of these programmes. Delivery of the final RSU was completed in late 1995 against the Lightning programme.
11:

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2 COLLABORATION AND/OR ALLIANCE BENEFITS

8: SILICON PROCESSING EXPERIENCE
9: From a background as an established volume supplier of heat exchanger products with production rates of 1 m units per year MPP has now established a reputation within Japan for the design and manufacture of automated Si wafer processing and handling equipments. To enhance this capability MPP has recently acquired STS the world leading manufacturer of Si deep trench etching equipment which provides a key process in the manufacture of Silicon Micromachined Products.

Passage 2 of 2 Section 0, Paras 10 to 11, 221 chars.

10: STRONG PARTNERSHIP
11: The marriage of Inertial Sensor technology from RASE and the manufacturing technology from MPP provides a strong foundation for the supply of Yaw Rate and Acceleration Sensors to Fraser Automotive GmbH.
12:

---

5. EXPERTISE AND EXPERIENCE OF ENGINEERING PERSONNEL

Node 4 of 6 Expertise and experience of personnel
Passage 1 of 1 Section 0, Para 14, 133 chars.

14: RASE can offer extensive experience in the integration of shipboard Electro-optical trackers with the overall warship combat system.

6. COMPANY'S COMMITMENT

Node 2 of 9 Company's commitment
Passage 1 of 1 Section 0, Paras 33 to 34, 120 chars.

33: * Commitment
34: RASE is committed, with or without the Spacetronics TTSM Programme, to the development of the Silicon IMU.
35:

Product-focused ICs
[Nine subcategories listed]
1. *Node 3 of 5* Product or solution gloss or statement
Passage 1 of 1 Section 0, Para 3, 281 chars.

3: This system offers single and multi-ship mission planning, fly-through mission rehearsal and full pre-flight data preparation and uploading facilities. The system also offers extensive mission debrief facilities, including video replay and aircraft health data analysis functions.

Node 4 of 5 Product or solution gloss or statement
Passage 1 of 1 Section 0, Paras 12 to 15, 253 chars.

12: RASE/MPP SOLUTION FOR FRASER AUTOMOTIVE GmbH
13: For the Fraser Automotive GmbH requirements RASE/MPP proposes the following solutions:
14: * Yaw Rate Sensor formed from a deep trench etched Silicon Vibrating Ring
15: * Two axis accelerometer micromachined in Silicon

Node 6 of 9 Product or solution gloss or statement
Passage 1 of 1 Section 0, Paras 10 to 21, 2271 chars.

10: PROPOSED TTSM SILICON IMU PROGRAMME
11: The IMU Development[2]t and Industrialisation Programme will have a total duration of approximately five years from the estimated contract award in mid-1998 with production deliveries commencing in the first quarter of year 2003. Detailed programme considerations and the inter-relationship between the RASE-funded IMU programme and the TTSM programme will form the subject of discussion with Spacetronics in order to ensure the minimum risk and cost of acquisition for Spacetronics, and yet still achieve the production delivery programme. The RASE development programme identifies three phases:
12: Phase I - Technology Demonstrator

13: Phase II - Full Development and Qualification
14: Phase III - Industrialisation
15: PHASE I SILICON IMU TECHNOLOGY DEMONSTRATOR
16: Phase I aims to demonstrate that the Silicon VSG based IMU is capable of meeting the performance requirements of the TTSM. This programme covers development of a demonstrator based on Silicon VSG rate sensors and proven accelerometers, typically Allied Signal xxxxxx. These demonstrator units will undergo preliminary qualification to obtain a certificate of design to allow flight trialing in the TTSM if required.
17: PHASE II SILICON IMU FULL DEVELOPMENT
18: Phase II builds on the achievements of Phase I and will concentrate on productionisation of the design for optimum unit production cost through the introduction of the low cost Silicon Accelerometers to replace the xxxxxx, digital electronics, improved mechanical packaging processes and other design-to-cost improvements.
19: This programme completes full development and qualification of the Silicon IMU.
20: PHASE III SILICON IMU INDUSTRIALISATION
21: Phase III provides and proves the introduction of the facilities required to produce the TTSM IMU at the rates required to meet the series production quantities identified during the development phase. This will provide production fixtures and tooling together with necessary test equipment development. As part of this phase a pilot production batch of IMUs will be produced to ensure that the production line is capable of meeting the desired throughput rate with the predicted yields and allowing a full operator-training programme to be carried out.

Node 3 of 5 Product or solution gloss or statement
Passage 1 of 1 Section 0, Para 8, 568 chars.

8: The NGRSU replaces the existing Rate Sensor Unit (RSU) which is based on two precision electro-mechanical GR-H4 type rate gyroscopes (manufactured by HISE Manchester). The gyroscopes are mounted on a chassis and aligned in the pitch and yaw axes and electrically linked to a Printed Circuit Board (PCB). Four years after customers had been notified to identify their "last time" buy requirements, the design was declared obsolete, due to major obsolescence associated with the supply of high precision piece parts and the sub-contract gold plating processes.
9:

Passage 2 of 2 Section 0, Para 9, 167 chars.

9: The NGRSU will be fitted to the Lightning man-portable Surface to Air Missile (SAM) launcher which is a follow-on to the successful Spearline and Starspray programmes.
10:

---

2 *Node 4 of 5* Proven performance+tests success
Passage 1 of 1 Section 0, Para 3, 198 chars.

3: This total systems approach is already well-proven with HISE Integrated Mission Planning Systems now in-service with a number of airforces world-wide on aircraft such as the Jaguar and Hawk.

Node 5 of 6 Proven performance+tests success
Passage 1 of 1 Section 0, Paras 8 to 10, 593 chars.

8: The General Purpose Electro-Optical Director
9: Since the first ship fit in 1988, a further 20 HPEOD have been installed on Royal Navy frigates. The system has been thoroughly trialed and tested, and subsequently proved in world-wide service, providing highly reliable performance in various roles and in all

environmental conditions. Production is continuing to complete a total of 24 HPEOD ship fits and 3 shore systems.
10: The capabilities of YGO46 were successfully demonstrated during the 1996 trials aboard HMS Monmouth, which were conducted in collaboration with the xxxxx Navy off Cochin.
11:

Node 4 of 5 Proven performance+tests success
Passage 1 of 1 Section 0, Paras 12 to 13, 416 chars.

12: The NGRSU utilises a twin axis rate sensor produced by HISE CNI, known commercially as the Mulitisensor. For operation in the NGRSU the Multisensor requires a specially designed dc-dc converter. Roland Electronics plc supplied a module for the prototype unit.
13: Bench trials carried out at SMS using the prototype have proved very successful and resulted in plans for SMS to carry out Dynamic Launcher Trials.

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3. *Node 3 of 6* Design improvements or special feature
Passage 1 of 3 Section 0, Para 11, 418 chars.

11: The Royal Navy system continues to benefit from further investment. Full integration of YGO46 with the Combat System Highway and Combat Management System of the Type 23 Frigate class completed sea trials in June 1996. Procurement of eye safe lasers for the fleet has commenced and the RN is making budgetary provision for the introduction of 3-5μ thermal imagers to enhance operational capability in tropical waters.
12:

Passage 2 of 3 Section 0, Para 14, 349 chars.

14: This well-proven Electro-optical tracking system offers outstanding performance. It is highly ruggedized and environmentally protected, and is purpose-designed for maritime operation. The system has demonstrated high reliability in a wide variety of operating conditions and has the added advantage of being fully NATO codified for logistic support.

Passage 3 of 3 Section 0, Para 14, 198 chars.

14: The combat system designer can therefore be assured of a low risk Electro-optical tracking system which can easily be integrated with displays, weapons and other sensors via any ship's data highway.

---

4 *Node 6 of 6* Track record - product
Passage 1 of 1 Section 0, Paras 6 to 7, 615 chars.

6: Development Experience in Naval Electro Optical Tracking Systems
7: The Sea Neptune 1 Electro-optical gun fire control system was developed in the 1970s, Sea Neptune 1 systems were fitted to the Royal Navy TURRET class patrol vessels and exported to customers in the Middle and Far East. Using this experience in naval Electro-optical tracking, RASE developed the high performance General Purpose Electro-Optical Director (HPEOD), which was selected by the Royal Navy in 1985. The resulting Sea Neptune 30 system (designated YGO46 in the Royal Navy) provides Electro-optical surveillance, tracking and gun fire control.

---

5. *Node 3 of 5* Potential improvements or benefits
Passage 1 of 1 Section 0, Paras 16 to 17, 223 chars.

16: ENHANCED ACCELEROMETER SOLUTION

17: RASE/MPP are discussing the availability of competitive single axis accelerometers with a number of potential vendors. This may provide a more attractive solution for Fraser Automotive GmbH.

Node 2 of 5 Potential improvements or benefits
Passage 1 of 1 Section 0, Para 11, 180 chars.

11: During the last three years Manchester developed a prototype RSU which has the potential to provide an improved cost, performance and retrofit capability for earlier SAM launchers.
12:

---

6. *Node 5 of 9* Cost benefit/implications/potential savings
Passage 1 of 1 Section 0, Paras 8 to 9, 354 chars.

8: EXISTING COMMITMENT
9: RASE, as a compan[1]y, has its own commitment to develop a low cost, tactical grade IMU, based on its world leading Silicon VSG, which would suit applications such as the TTSM Programme. The development of the IMU for Spacetronics Missiles therefore benefits from RASE's funded programme thus reducing initial acquisition cost and risk.

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7. *Node 3 of 9*
Passage 1 of 2 Section 0, Paras 23 to 24, 103 chars.

23: * Biggest overall saving
24: The proposed IMU represents a cost-effective solution for the TTSM programme.

Passage 2 of 2 Section 0, Paras 27 to 28, 156 chars.

27: * Lowest acquisition cost
28: Spacetronics Missiles will only fund the difference in cost of developing the IMU from the RASE- funded IMU development programme.

---

8. *Node 8 of 9* State-of-the-art features
Passage 1 of 1 Section 0, Para 7, 218 chars.

7: The new technology silicon VSG, which forms the major part of the IMU, is an evolutionary step in the VSG development progression and demonstrates a high level of innovation, setting the benchmark for others to follow.

---

9. *Node 4 of 9* Low risk
Passage 1 of 1 Section 0, Paras 25 to 26, 200 chars.

25: * Lowest risk
26: Silicon VSG technology has been demonstrated and is more than just a research programme. The two-phased development approach enables sensible management of technical and programme risk.

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10. *Node 2 of 5* Off-the-shelf aspects
Passage 1 of 1 Section 0, Para 3, 162 chars.

3: The system architecture is based around standard PC hardware and commercial off-the-shelf software, which ensures a highly cost-effective and low risk solution.

APPENDIX R - EXTRACT FROM EARLY NOTES MADE ON YGO46

Doc 2: Proposal for Gun System Automation 8 - main bid

Quick review of some textual features

Title: Proposal for Gun System Automation 8 - main bid
YGO46 EP2205
Tender Ref - NSW 32B/1085

Dated November 11 1983

Produced by REMA Group, Bracknell Division for The Director of Contracts - Surface weapons CB/SW32B, Procurement Executive, Ministry of Defence, A.S.W.E., Portsdown, Cosham, Portsmouth, Hants. PO6 4AA

A few figures

Number of words - 61,600 (includes everything)

Number of pages - around 300, excluding Section VIII, which is the compliance matrix

of connected text

Number of sections 9, including an Executive Summary

Checklist of main sections

1. Title page
2. Proprietary page
3. List of effective pages, and separator cards
4. Executive Summary with 13 sub-sections, excluding introduction.
   13 pages
5. Guide to proposal (instead of Table of Contents)
6. Executive Summary
7. Part 1 - System Description
8. Part II - Technical Specification
9. Part III - Performance
10. Part IV - System Operations Procedures
11. Part V - Integrated Logistics Support
12. Part VI - Management and project Control
13. Part VII - Management and Quality Control
14. Part VIII - Appendices:
15. APPENDIX A - Statement of Compliance
16. APPENDIX B - Glossary of Terms
17. APPENDIX C- Supporting Documentation
18. APPENDIX D - Protection Against nuclear and Electro-Magnetic Effects

Background considerations

This was written as though the equipment already existed, even though the customer, the MoD, and RASE knew that the equipment had yet to be designed. A Senior Engineer referred to it as collusion, a pretense that was maintained to keep the procurement people at the MoD happy because a new system of procurement had been introduced. In other words, the writers are in effect attempting to deceive, or lie ….. except that everyone seemed to know about it, apart from the Civil Servant who dreamt up the new procurement process. This must be reflected in the way the language is used.

Interesting features

Purpose - to win the bid. This proposal is an attempt to persuade the Procurement Executive at the MoD to order the equipment from RASE. In a nutshell, this is document attempts to persuade, though whether it is a persuasive text, in the usually accepted sense, e.g. loaded or emotive language, remains to be seen. NB Note made in diary entry to ask Owen-Pike about why RASE won the contract. ie Was there anything about Doc 2 that persuaded them. If so, what? This may be a red herring, but it is worth following up, considering the vast effort that goes into preparing proposals. Is it true that, in the end, the efficacy of the product (and engineers' expertise/ service accompanying it) is reflected by the documentation generated by it?

Verbs - The document reads as though the equipment already exists, through use of present active and passive, and occasional use of particular modals to maintain the (false) picture:

> The Gun controller's Desk unit consists of a Main Desk Unit …..
>
> This unit contains all the interface electronics ….
>
> Adjacent to the Data Recording and Analysis Equipment can be mounted a ruggedized printer, used to provide a fixed record ….
>
> During trials operation, recording equipment can be operated remotely from the Gun Control Console.

Tables, graphs, and calculations - these form a significant part of the document

<u>3.3.2 Trials Assessment</u> Curious paragraph about weapons testing. It is clear it describes a reconstruction, but nevertheless tries to imply the existence of the equipment. Contortionist writing.
There is also quite a big section analysing the YGO46 performance in Section 3 Annex A, which, if based on hypothesis, has been carefully phrased to maintain the fiction that the equipment exists.

Headings and sub-headings seem to be similar to Doc 1, ie noun phrases, generally not V-ing forms with very few exceptions, generally pre-modified, but a few more with post-modification.

Each paragraph deals with a new part of the equipment or a distinct function. This is usually identified in the first noun phrase of the first sentence. If it isn't, it is mentioned in the first sentence at least.

A few sentences beginning with an adverbial.

I suppose that what is remarkable is its similarity to the Doc 1 (the document it is responding to) and the way it mirrors the structure of Doc 1. Also the way it is aware of the way it will be read; it is written to help the reader navigate it, split it up into sections for different readers, and the text divided into a tickable list.

APPENDIX S - ENGINEERS AND SPECIALIST INFORMANTS CONSULTED (Names have been obscured for reasons of confidentiality)

Initial	Name
DE	[redacted]
JB	
IF	
MC	
KJ	
RC	
AC	
JD	
JB	
IL	
DM	
GB	
JS	
JSM	
CP	
AG	
IS	
BP	
TB	
PP	
RO	

Respondents to email questionnaire

[redacted]	[redacted]	[redacted]

APPENDIX T - PRINTOUT FROM NVIVO SHOWING ALL CODING CATEGORIES

This is a printout from NVivo showing all categories, including Information Components (ICs), used for analysing proposals and executive summaries. Several categories, which could be described as 'housekeeping' categories were devised to assist in the use of NVivo, and are not explained or mentioned in the thesis.

Project: Documents engineers write **User:** Hazel **Date:** 8/3/01 - 03:19:47
<u>NODE LISTING</u> in discourse function groups for coding
Nodes in Set: All proposal nodes incl exec summary
Created: 8/3/01 - 12:36:05
Modified: 8/3/01 - 12:37:11
Number of Nodes: 76

First category: Product or solution focus

1. Compliance - how compliant or degree of•
2. Cost benefit or implication (incl. potential savings)•
3. Costings
4. Design improvements or special features•
5. Low risk•
6. Manufacturing plan
7. Off-the-shelf aspects•
8. Packaging
9. Potential improvements or benefits to the design•
10. Product or solution gloss (or statement)•
11. Programme schedule
12. Proven performance + tests' success•
13. Risk
14. State-of-the-art features•
15. Technical response to requirement specifications (may be in Appendix)
16. Testing and tests
17. Track record - product•
18. Viability feasibility attainability•

Second category: company+ engineering personnel focus

19. Collaboration and alliance benefits•
20. Company pedigree and/or reputation•
21. Company's commitment•
22. Company's good **R** and **D** facilities•
23. Company structure/information/profile
24. Expertise and experience of personnel•
25. Kitemarks, standards, and accreditation
26. Quality Assurance
27. Production and manufacturing - good facilities and high standards•

Third category: product Support focus

28. Aftersales customer and prod support provided•
29. Availability Reliability Maintainability
30. Integrated Logistics Support (ILS)
31. Installation
32. Maintenance and support in the field•
33. Training provision
34. User documentation, manuals, online help, etc.

Fourth category: meta-discoursal focus [concerned with the concepts/results of linguistics, or the language used to discuss language]

35. Distribution list
36. Indication of particular docsections
37. Proposal title
38. Referential or context setting
39. Security rating of document

Miscellaneous - mainly labels or marking out sections:

40. EP3007 main section of proposal
41. EP3007e
42. ep3018e
43. EP3018 main section of proposal
44. EP3020 proposal
45. ep3024e
46. ep3031e
47. EP3042p
48. ep3124e
49. ep3129e
50. Closing
51. Commercial section
52. Executive summary
53. Main section of proposal
54. Management section
55. Opening
56. Proposal title
57. Section label or heading
58. Security rating of document
59. Tabular data
60. Technical section
61. Terms and conditions
62. Sustainability

My assessment of the discourse as being marked / evaluative

63. Assurance about use of product
64. Boilerplate
65. Disclaimer or hedging
66. Legalese
67. Performance claims unsubstantiated
68. Technical description
69. Technical description overtly persuasive
70. Historical perspective and/or development
71. Historical perspective and/or development overtly persuasive
72. Solution gloss overtly persuasive
73. Assertion and/or proclamation [may be unsubstantiated, or associated with *will*]
74. Company and/or engineers' positive attributes
75. Positive reference to company

Types of comment invoked by the strawman - categories and sub-categories

Technical and information content:	Style:	Metalingual comment:
1. queries, eg, *Do you mean SAT 1 (G) ? - It is not against an object.*, to which Alan responded: *No I don't I'm referring to DOA test*	criticisms, eg, *[change] +ve -into positive, not +ve - this is a document, not notes.*, and *←poorly phrased. I know what you mean but this isn't it.*	An apology for over-zealousness, for example: *OOPS Sorry missed this. Thought it was T23 - Delete Comments.*
2. criticisms, eg, comments written against some diagrams about sensor bench mark dimensions: *You have described in detail the STU but not the HATS or SATS. There is inconsistency in the description. It is not clear what the HATS and SATS do from this DOC - AND which one should be used.*	(pernickerty) refinements, eg, *CAPS?*, *Missing line?*, and *Why unfortunate? To discover any misalignment, you must use the Ref scope.*	
3. identifying oversights, eg *We'd agreed to ditch this part.*, and *Explain why not the MLD.*		
4. suggestions for insertion, eg, *Statement on :- (a) How to select page (b) Units entered (c)How to use the page? May be useful*.		
5. indicating misleading or innaccurate information, eg, *Wrong.- you have confused verticality/tilt with racking.*		
6. discourse structure and text layout, eg, *Needs a bit of a lead in to this.* and *←Is there a heading missing here?*		

5. Meeting to discuss team members' comments - reshaping the strawman

All the members of the team then met to consider the comments that had been made about the straw man. By all accounts, the meeting was lively. Alan started off by summarising the oral and written feedback he had received, including specific comments which had been written on the document itself, explaining why he had accepted some but not others. The discussion which ensued thrashed out questions about the text at all levels: terminological/stylistic, rhetorical, structural, and diagrammatic.

The team eventually decided to review some of the fundamental principles underpinning the structure of the handbook, and to revise what it was trying to achieve. They eventually decided on the following main changes:

- The introduction was to be rewritten to make it more personable and "reader-friendly", in order to help the reader to recognise its usefulness more easily, and to relate better to the document.
- The number of chapters was to be reduced from six to four.
- The chapters themselves were to be restructured to exclude more theoretical information, and to adopt a problem-solving, trouble shooting approach instead. This was because the engineers believed that problem-solving was the primary function of the handbook. It was decided, therefore, that the chapters should try to anticipate practical problems the operators would encounter.
- They nevertheless acknowledged that the handbook should also perform some kind of text-book function, by conveying more theoretical and technical information about the system. However, this was to be moved from the main body of the document to the appendices.
- It was also decided to include a glossary of terms the engineers thought the readers would want to know about.
- The meeting was ultimately successful and highly constructive in the view of those who attended; a revised structure had been agreed, and the writing tasks shared among the team members. Each engineer found himself allocated a chapter, or particular sections according to his expertise, or where he had been most vociferous in his comments. As one engineer put it: "Each had to put his money where his mouth was, so to speak"; ie, each had to act upon his criticisms.
- The team leader pointed out that this meeting had lasted an hour and a half; which, in his view (and his words), was "not too much time very well spent".

6. Reconstruction - split task writing and revising

As it had been decided the expertise of the team should be drawn upon at this stage, rather than relying on Alan alone to reconstruct the straw man, individual chapters were written or rewritten by individuals or pairs of engineers, all of whom regarded this as a natural progression in the writing process.

The group commitment to the writing task was striking in this project, with the team members involved from the beginning, understanding the demands of the task, and working collaboratively as a group. [I was struck by the contrasting practices and attitudes of those working in academia.]

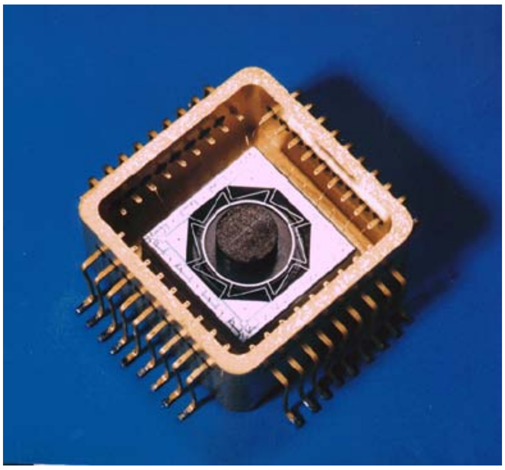
7. Final draft

Alan worked with another engineer to produce certain sections, at the same time keeping in touch with the others. He collated the work that they did, checking it for stylistic consistency before producing the near final, and then finally, the final version.

APPENDIX U - THE GENERIC PROPOSAL DEVISED BY THE SVSG TEAM

GENERIC PROPOSAL FOR THE SILICON RATE SENSOR

EP3063 Draft 2 **June, 1998**



REM AEROSPACE
Systems and Equipment

REM Aerospace Systems and Equipment - RASE - a wholly owned subsidiary of REM Aerospace plc, is a leading supplier of motion sensor products and based in Plymouth, UK. RASE has many years of experience in the design and manufacture of inertial equipment which includes the solid state Vibrating Structure Gyroscope technology.

MPP has many years of experience in aerospace equipment, industrial machinery and semiconductors. Their commitment to the Motion Sensor market started with a licence on the RASE VSG technology and the development of a 3-axis silicon accelerometer. MPP is a major supplier of motion sensor products to Japan and other parts of Asia.

MPP

GENERIC PROPOSAL FOR THE

SILICON RATE SENSOR

EP3063 Draft 2 **June, 1998**

Prepared by ....
Author name

Approved by ....
Approver name

Authorised by ....
Authoriser name

REM AEROSPACE SYSTEMS AND EQUIPMENT

PROPRIETARY

Publication Number: **EP3063** **Issue: 1**

Entitled: **PROPOSAL FOR THE SILICON RATE SENSOR**

Any inquiries relating to this document or its contents should be addressed in the first instance to:

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EXECUTIVE SUMMARY

REM Aerospace Systems and Equipment (RASE), in an established partnership with Makemoto Precision Products (MPP), has pleasure in providing is pleased to provide a quotation for the RASE Silicon Vibrating Structure Gyroscope (SVSG) for XXXX. In this document, RASE proposes a fully compliant solution in response to XXXX's requirements for the XXXX Programme. [or In this document RASE responds to XXXX's requirements for the XXXX Programme with a proposal which is compliant in key respects, with exceptions detailed in Sections 1.

Introduction to the Proposal Team - RASE and MPP

RASE, a subsidiary of REM Aerospace plc in the United Kingdom, is an established centre of excellence and in the research, design, development and production of motion sensing equipment. MPP in Japan in specialises in semiconductor manufacturing equipment and micromachined sensors, although as a company, it has wide-ranging operations. RASE will provide sensor application support together with refinements in advanced product design for rate sensors and accelerometers, while MPP will manufacture the rate sensor.

More information on RASE and MPP can be found in the glossary and in Appendix B.

Product and Specifications

The product RASE proposes is a variant of the RASE SVSG to meet the XXXX requirement. It is a micromachined SVSG which is XXXXt (give size, 9mm diameter? work, performance?) and has proven robustness in both military and automotive fields. A more detailed description of the product is provided in Section 1 and Appendix A.

RASE is responding to XXXX's request for a rapid response, by arranging for demonstration units to be sent without delay on XXXX 1998. RASE is sending these modified units in the absence of a detailed requirement specification as a demonstration of RASE's wish to work with XXXX on this project. RASE would like to emphasise that these units may not demonstrate full production quality standards.

Timescale

The RASE proposal complies with the delivery dates XXXX has specified. RASE is able to provide 150,000 sensors a year, growing to meet the anticipated demand for 450,000 sensors by January 2002. However, programme timing is a dynamic process, and RASE looks forward to reviewing and refining these targets in co-operation with XXXX.

Costs and commercial considerations

The unit price per unit is US $XX with Non-Recurring Expense of US $YY at 1998? prices.

The RASE quotation shows prices for the years 2000 and 2001? which are slightly higher than subsequent years. The reason for this is that, initially, RASE will supply off-the-shelf units which offer a wider range of features and applications, and which are, as a result, more expensive. However, the chart shows a price reduction from the year 2002 to coincide with the development of more tailored sensors for the XXXX Programme. High standards of quality and robustness will be maintained in both versions of the sensor.

Structure of this proposal

The proposal comprises three main sections and four appendices:

Section 1	Technical Response, including a detailed description of the proposed product, compliancy statement
Section 2	Manufacture
Section 3	Commercial, Management and Administration
Appendices	
A	Product Description
B	RASE Organisation and Related Experience
C	Quality Assurance

Who to contact for additional information

RASE appreciates being given the opportunity to make a proposal to XXXX and hopes for a favourable response to it. RASE has a proven track record in successful collaborative projects. It is proud of its silicon VSG which is at the cutting edge of gyroscope technology, and of our successful working relationship with MPP in developing the gyroscope.

If the XXXX team has /If you have any questions, or need further information, please (do not hesitate to) contact XXXX on:

Telephone:	(01752) 695695	International:	+44 1752 695695
Fax:	(01752) 695500	International:	+44 1752 695500

Yours sincerely

XXXX
VSG Product Leader

GLOSSARY

ASIC	Application Specific Integrated Circuit *VSG electronics in a discrete analogue format - a development of that already proven on RASE VSGs.*
REMA	REM Aerospace Public Limited Company *the largest aerospace and defence company in Europe with 43,000 employees and customers in 72 countries. REM Aerospace is structured from fourteen business units.*
RASE	REM Aerospace Systems and Equipment *a business unit within REM Aerospace plc and a recognised centre of excellence in the Motion Sensor market.*
IC	Integrated Circuit *a miniaturised electronics package replacing conventional circuits made from descrete components*
IVD	Interactive Vehicle Dynamic
LINS	Laser Inertial Navigation System *a navigation system based on Ring Laser Gyroscope technology. RASE systems are in service on military aircraft and helicopters.*
PZT	Piezoceramic *first generation VSGs were based on a piezoceramic cylinder design.*
SVSG	Silicon Vibrating Structure Gyroscope *a VSG using a silicon resonator. The use of silicon is the route to cost reduction.*
MPP	Makemoto Precision Products *a Japanese corporation based at Amagasaki City, Hyogo Japan. MPP has established a reputation for the design and manufacture of automated Si wafer processing and handling equipments.*
SRC	Sowerby Research Centre *formed to provide REM Aerospace with a centre of research excellence for the acquisition of new technology.*
VLSI	Very Large Scale Integration *a miniaturisation technique used to allow the VSG electronics package to be implemented on a single ASIC.*
VSG	Vibrating Structure Gyroscope *A new generation gyroscope which utilises the phenomenon of coriolis acceleration and requires no rotating parts, gimbals or bearings.*

SECTION 1

TECHNICAL RESPONSE

INTRODUCTION

The purpose of this Technical Response is to describe the RASE SVSG solution to the XXXX requirement Specification No XXXX

The Vibrating Structure Gyroscope (VSG) is a new generation gyroscope which utilises the phenomenon of coriolis acceleration and requires no rotating parts, gimbals or bearings. It is used to sense motion and has applications where there is a need to stabilise, reorientate or redirect. It is highly versatile and can be used for a range of purposes on sea, land and in the air, although it was originally designed to meet the demands of the automotive industry. It can be used, for example, to measure the roll, heave, and pitch of a ship, the tilt of a train as it goes into a bend, or to improve the steering and stability of moving cars.

More recent versions of the sensor use silicon, a material with a strength to weight ratio three times that of steel, as its vibrating element. The silicon is (deep) trench-etched to produce an accurate, planar sensor, which is small (give dimensions), light, strong, and resilient. The sensor is integrated with its control electronics, onto a single Application Specific Integrated Circuit (ASIC), has a rugged solid state design with a low parts count, and is housed in an environmentally protected (?) package.

The VSG can be delivered in high volumes, and at competitive prices. Its robustness, longevity, reliability, and high performance, make it an integral component/essential requirement of modern vehicle dynamics and navigation systems.

This sensor is the product of research and development partnership between REM Aerospace Systems and Equipment and Makemoto Precision Products in which inertial sensor technology from RASE has been combined with MPP's manufacturing expertise.

A more detailed description of the VSG can be found in Appendix 1.

COMPLIANCE STATEMENT

RASE proposes a compliant solution to the XXXX requirement for a YYYY gyroscope.

The compliancy has the following exceptions/deviations:

Customer Requirement Para No.	**Compliance Deviation**

NOTE: For full compliancy tables see Appendix D

RASE PROPOSED SOLUTION

XXXX Requirement Compliance Matrix

Achieved performance on current Si Rate Sensors (example)

• Single Axis Rate Sensor	
• Rate Range (± 350) deg/s achieved	± 100 normal range
• Scale factor range	dependent on rate (5000 mV for full scale)
• Scale Factor variation over temperature (uncompensated)	± 2.0%
• Scale Factor variation over temperature (compensated)	± 0.5%
• Linearity	± 0.2 deg/s
• Zero Offset variation over temperature 1 sigma (uncompensated)	± 3 deg/s
• Zero Offset variation over temperature 1 sigma (compensated)	± 0.6 deg/s
• Noise (0 to 50 Hz)	0.2 deg/s rms
• Bandwidth	35 Hz
• Ready time	< 500 msec

Programme performance (example)

Performance

This is a target specification which is based on areas of planned development and prediction from experience on similar sensor development programmes. The specification parameters will be agreed at T_{0+12}

• Single Axis Rate Sensor	
• Rate Range	± 150 to 200 deg/s as required
• Scale factor	dependent on rate range (5000 mV for full scale)
• Scale Factor variation over temperature 1 sigma (compensated)	± 500 ppm
• Linearity	± 0.1 deg/s
• Zero Offset variation over temperature 1 sigma (compensated)	± 100 deg/hr
• Noise (0 to 50 Hz)	0.1 deg/s rms
• Bandwidth	35 Hz
• Ready time	< 500 msec

Mechanical

• Package dimensions	60 x 30 x 25 mm
• Interconnections	10 header pins

Electrical

• Power supply	± 5 V approx. 60 mA
• Rate Output	0 to 5 V (2.5 V at zero rate output)
• BIT	BIT provides a nominal 0.5 x maximum rate output on initiation. A continuous background BIT facility will be provided.

Environment

The rate sensor will operate to specification under the following environments:

• Vibration	0.3 g^2/Hz (300 to 3.5 kHz)
• Acceleration	1000g 0.6 ms
• Temperature	-40 to +85 °C

SECTION 2

MANUFACTURING PLAN

TRAINING

CAPABILITY

See Appendix B Section XX

MANAGEMENT PLAN

Development to manufacture plan of customer-specific gyro, See Figure XX

Prototypes

Explanatory notes refer to Figure XX

Qualification

Testing

Plan Design, Assembly And Procurement Of Manufacturing Line

(if for high volume, if low volume use current factory line)

SECTION 3

COMMERCIAL, MANAGEMENT AND ADMINISTRATION

Methods of Payment

Assumptions

Conditions of Sale

Costs

IPR

Cost Plan (example)

See Table 1

Table 1 Silicon Gyro Bid - RASE Accr

Description	QTY Per	Unit cost	Cost per set	Cost per set	Cost per set	Comments

PRICES REMOVED

Description	QTY Per	Unit cost	Cost per set	Cost per set	Cost per set	Comments

Description	QTY Per	Unit cost	Cost per set	Cost per set	Cost per set	Comments

[redacted] Aerospace Systems and Equipment

STANDARD CONDITIONS OF SALE

1. **DEFINITIONS**
In these Conditions the following titles shall have the meanings ascribed to them:
"[redacted]" mean [redacted] Aerospace Systems and Equipment.
"Quotation" means [redacted]s letter attached hereto and all documents attached or referenced therein together with these Standard Conditions of Sale.
"Purchase" means the person, firm or company to whom the Offer is addressed.
"Articles" means all equipment, material and services to be supplied by [redacted] in accordance with the Quotation.

2. **ACCEPTANCE**
The Quotation shall become a binding contract upon acceptance by the Purchaser within the validity period of the Quotation either by formal written acceptence or by telex accepting all the terms thereof. The accepted Quotation shall constitute the entire contract between [redacted] and the Purchaser, and supersede all other previous communications, representations or agreements between the parties.

3. PRICES
(a) The prices of the Articles are those specified in the Quotation, and unless otherwise stated elsewhere therein such prices shall be valid for a period of 30 days only from the date of the Quotation.
(b) Unless otherwise stated elsewhere in the Quotation all prices include the cost of delivery f.o.b., U.K. port, or f.o.b. U.K. airport, or the Purchaser's address if within the United Kingdom. Any other delivery required may be subject of an extra charge.
(c) The prices are inclusive of the cost of packing, but to commercial standard only; any other standard of packing required will be the subject of an extra charge. Where delivery is to the Purchaser's address in the United Kingdom packing will not be suitable for reconsignment unless specifically requested by the Purchaser, whereupon such packing may be the subject of an extra charge.
(d) The prices quoted apply only to the quantities and delivery schedule specified in the Quotation.

4. **PAYMENT**
(a) Unless otherwise specified elsewhere n the Quotation, payment of the price or of any stage payment for which the contract provides shall be made by the Purchaser within 30 days of the date of [redacted]s invoice therefor.
(b) Without prejudice to any other of [redacted]s rights or remedies the Purchaser shall in addition to payment of the price pay interest at the rate of 2% per annum above the then current base lending rate of the Midland Bank on any sum remaining unpaid after the due date until the date of actual payment.
(c) Notwithstanding [redacted]s rights under Condition 9 hereof, if the Purchaser fails to make any payment within 30 days after the same shall have become due [redacted]hall have the right by notice in writing forthwith to suspend all further work or deliveries until such default be made good without prejudice to any other rights or remedies which may be available to [redacted]
(d) If the Purchaser should fail to take delivery of the Articles [redacted] shall be entitled forthwith to invoice for the Articles and payment shall be due thereon as if delivery had been made notwithstanding [redacted]s right of lien (including lien for storage or demurrage charges).

5. **OWNERSHIP**
Ownership in the Articles shall not pass to the Purchaser until [redacted]has received payment in full.

6. **DELIVERY**
(a) Unless otherwise stated elsewhere in the Quotation, [redacted]shall deliver the Articles f.o.b. U.K. port, or f.o.b. U.K. airport, or to the Purchaser's address if in the United Kingdom, whichever alternative is specified in the Purchaser's acceptance of the Offer or, if none, whichever alternative [redacted]deems at its discretion to be the most appropriate. The risk in the Articles shall pass to the Purchaser on delivery.
(b) A default by [redacted]n respect of any particular delivery under the contract shall not affect any other delivery under the contract nor entitle the Purchaser to repudiate the whole or any other part of the contract.
(c) All delivery dates or periods given in the Quotation are deemed to be computed from the date of receipt of the Purchaser's order. However, whilst every reasonable effort will be made to meet contractual delivery dates, times or dates for delivery are estimates only unless specified to the contrary elsewhere in the Quotation, and [redacted]hall not be liable for the results of such delay.

7. **ACCEPTANCE/REJECTION PERIOD**
(a) Articles delivered under the contract will be deemed to have been finally accepted if [redacted]to not receive notice of rejection within two months of the date of such delivery.
(b) Any article rejected outside the two month period stipulated in (a) above but returned and accepted as a valid warranty within the terms of Clause 8 will be repaired or replaced (at [redacted]s option) under warranty. However, [redacted]will not accept debit notes nor issue credit notes for Articles returned after the expiry of the said two month period.

8. **WARRANTY**
(a) Except as provided in (e) and (f) below, [redacted]will repair or at its option replace any Article found within a period of 12 months from date of delivery to be defective due to faulty workmanship or defective materials provided that:
   (i) the Purchaser has notified [redacted]n writing of the alleged defect within 30 days of discovery hereof and has thereupon returned the Article to [redacted]properly packed and at the Purchaser's risk and expense; and
   (ii) the Article has been stored, maintained, installed, operated and used in accordance with the applicable specifications, manuals or instructions issued by [redacted]and in accordance with sound engineering practice; and
   (iii) the Article has not been subjected to any misuse or neglect or been involved in any accident.
(b) Except as otherwise agreed in writing, [redacted]shall not be responsible for any dismantling or reassembly costs incurred by the Purchaser or any third party in connection with this Condition.
(c) Upon completion of the repair or replacement of any Article accepted by [redacted]as a valid warranty the unexpired period of the warranty shall then apply with respect thereto and shall run from the date of delivery of such repaired or replacement Article.
(d) Where a repair or replacement of an Article is accepted by [redacted]as a valid warranty claim [redacted] shall reimburse the Purchaser's reasonable transportation costs of returning the defective Article, and the repaired or replacement Article shall be delivered to the Purchaser at [redacted]s expense and risk. Ownership of any Articles replaced hereunder shall re-vest in [redacted]
(e) No warranty is provided in respect of thermionic valves, tubes, lamps, bulbs or batteries, whether furnished as an Article or part of an article.
(f) Where [redacted]sells Articles which are made to a design furnished by the Purchaser, [redacted] warranty obligations shall extend solely to workmanship and to materials not provided by the Purchaser or its representative and not to fitness for purpose nor merchantable quality.
(g) Articles represented by the Purchaser as being defective shall not form the subject of any claim for work done by the Purchaser or for any loss, damage or expense whatsoever and howsoever arising, directly or indirectly, from any alleged defect except as provided in Condition 13.
(h) [redacted]warrants that, except as provided in (f) above and unless stated to the contrary elsewhere in the Quotation, the Articles are of merchantable quality, and conform to the applicable specifications and descriptions elsewhere in the Quotation (if any).
(i) The foregoing provisions of this Condition represent the entire liability of [redacted] its employees and agents in respect of defective Articles and all other conditions, warranties and liabilities as to quality, description, fitness for purpose or otherwise, whether expressed or implied by statute common law and hereby excluded.

9. **TERMINATION**
If the Purchaser shall make default in, or commit any breach of any of, its obligations to [redacted] hereunder or if any distress or execution shall be levied upon the Purchaser or its property or assets or if the Purchaser shall make or offer to make any arrangement or composition with creditors or commit any act of bankruptcy, or if any petition or receiving order in bankruptcy shall be presented or made against the Purchaser or if the Purchaser shall be a company and any resolution or petition to wind up such company's business shall be passed or presented otherwise than for reconstruction or amalgamation or if a receiver of any such company's undertaking, property or assets or any part thereof shall be appointed [redacted]hall have a right forthwith to determine the contract in whole or in part upon written notice being given to the Purchaser or delivered to the Purchaser's last known address without prejudice to any claim or right which [redacted]may make or exercise.

10. **OVERSEAS CUSTOMERS OR END USERS**
(a) Any Quotation made by [redacted]to an overseas Purchaser and any contract resulting therefrom is conditional upon export clearance being authorised by the appropriate authority.
(b) Any non U.K. tax, duty or other impost on sums payable by the Purchaser to [redacted]under the contract will be to the Purchaser's account.

11. **EXCUSABLE DELAY**
[redacted]shall not be in default by reason of any failure to perform its obligations hereunder if such failure arises by reason of any event beyond [redacted]s reasonable control including but not limited to acts of God, war, fire, flood, strikes, riots or civil commotion, sabotage, action of any government or any act or omission of the Purchaser of a third party. BASE undertakes to advise the Purchaser at the earliest opportunity if such a situation arises and is likely to affect BASE's performance hereunder, and BASE shall take all reasonable steps to minimise the effects of such delay.

12. **INTELLECTUAL PROPERTY RIGHTS**
Unless otherwise specified elsewhere in the Quotation, and subject to the rights of third parties, all intellectual property rights of whatever sort in the Articles are vested in and remain with [redacted]

13. **LIMITATION OF LIABILITY**
(a) Except as otherwise stipulated hereunder, [redacted]shall not be liable for any loss sustained by any person or damage to property whatsoever and howsoever arising, directly or indirectly, out of or in consequence of any act or omission of [redacted]in performance of the contract.
(b) The Purchaser shall indemnify and hold [redacted]harmless against any claim by, or loss or damage to, any person or property directly or indirectly occasioned by or arising from:
   (i) the use or operation of the Articles (excepting claims in respect of patent or other intellectual property infringements which are dealt with under Condition 14 hereof).
   (ii) default (which term shall include but not be limited to non-compliance with any obligation hereunder, any delay or giving of wrong information and any lack or required information) of an obligation of the contract or misuse of an Article by or on the part of the Purchaser.
(c) Nothing contained in these Conditions shall affect [redacted]s liability as may be imposed by the Unfair Contract Terms Act 1977 for death or personal injury caused by the negligence of [redacted]

14. **PATENT INDEMNITY**
(a) In respect of the infringement of letters patent or any other intellectual property rights relating to any part of the Articles, [redacted]s liability shall be limited to Articles of [redacted]design and relate solely to infringement of United Kingdom patents. In the event of such infringement [redacted]s obligations shall be limited to (at [redacted]s option) either replacing the infringing item by a non-infringing item, or securing at its own cost a licence permitting use of the said item by the Purchaser (or end user, as applicable) without infringement, or paying a sum of money to the Purchaser in compensation for loss of use, such amount not to exceed the original contract price of the said item.
(b) [redacted]shall, as far as it legally may, allow to the Purchaser the benefit of any reliefs or indemnities received from the supplier of any infringing item not of [redacted]s design.
(c) No liability shall be accepted by [redacted]n respect of infringements arising by combination of the Articles with any other items, or from their use for a purpose not specified or disclosed to [redacted]
(d) This indemnity is conditional upon [redacted]receiving the earliest possible notice from the Purchaser of any claim being made or any action threatened or brought against the Purchaser and the Purchaser permitting [redacted]to conduct any litigation which might ensue and all negotiations for the settlement of the claim.
(e) The Purchaser for its part warrants that any design or instructions furnished by it shall not be such as will cause [redacted]to infringe any letters patent or other intellectual property rights and shall indemnify BASE in respect of any such infringement.

15. **SUB-CONTRACTING**
[redacted]reserves the right to sub-contract the fulfilment of the contract or any part thereof.

16. **LIEN**
In addition to any right of lien to which [redacted]may by law be entitled, [redacted]shall in the event of the Purchaser's insolvency be entitled to a general lien on all items in [redacted]s possession (notwithstanding that such items or any of them may have been paid for) for the unpaid price of any other items sold and delivered to the Purchaser by [redacted]under the same or any other contract.

17. **WAIVER**
Any failure, delay or indulgence on the part of [redacted]n exercising any power or right conferred hereunder shall not operate as a waiver or such power or right or preclude the exercise or any other right or remedy hereunder.

18. **NOTICES**
Any notice or other communication sent to the Purchaser in connection herewith shall be sufficient if sent to the address notified to [redacted]for that purpose or, in the absence of such notification, to the Purchaser's address last known to [redacted]

19. **LAW**
The construction, validity and performance of the contract shall be governed by English law.

20. **GENERAL**
If at any time any term or condition hereof is or becomes illegal or void as a consequence of the operation of law then the remaining provisions hereof shall remain in full force and effect.

Management Plan (sample)

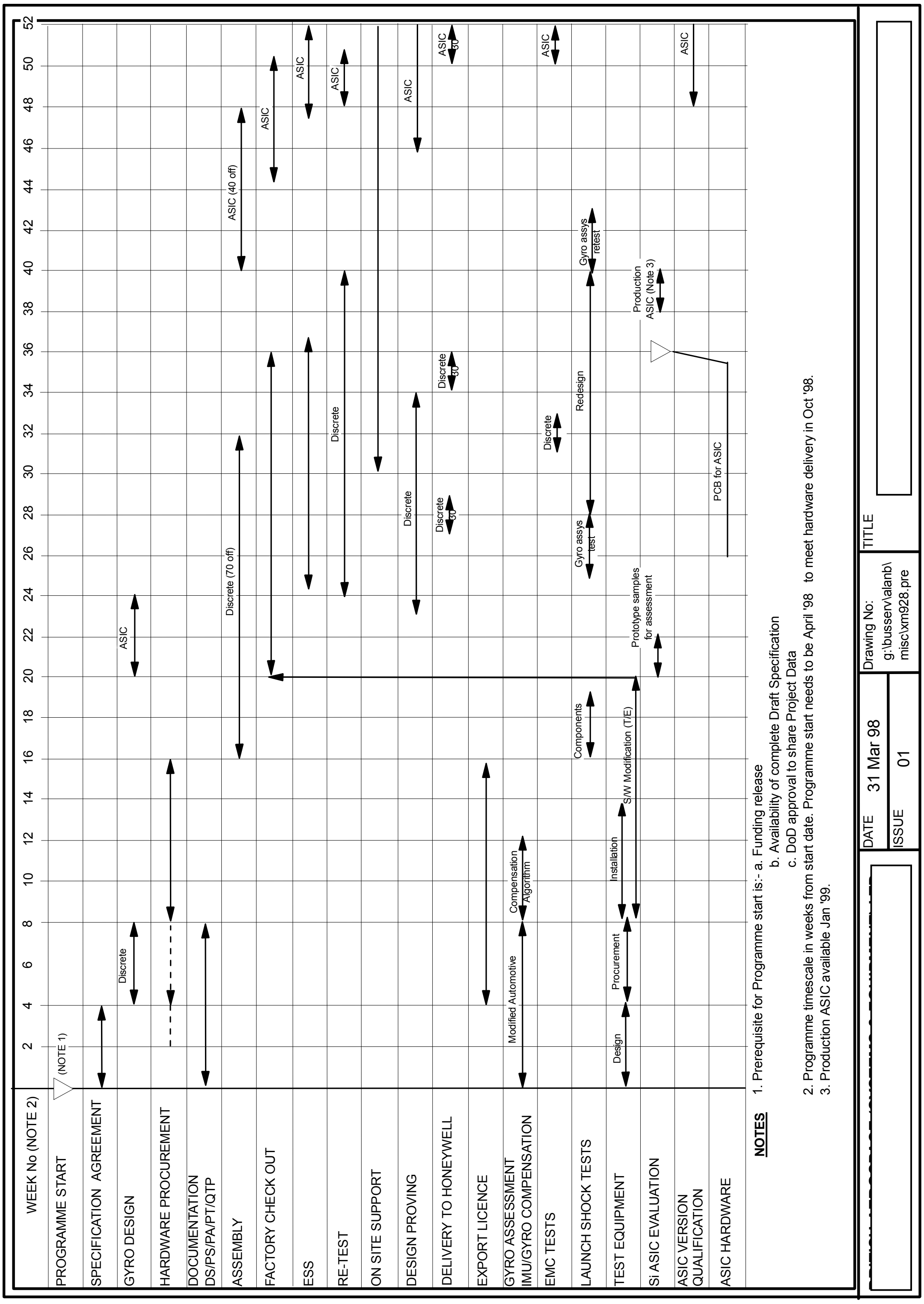


Figure 1 Sample Program Plan

APPENDIX A

PRODUCT DESCRIPTION

TECHNICAL OVERVIEW OF RASE'S CORIOLIS GYROSCOPE TECHNOLOGY

The SVSG is based on a planar resonating ring design. RASE has extensive patent coverage encompassing all aspects of the design and implementation. In particular, US Patent 5226321 relates to the use of the planar ring design with US Patent application 970337.5 specifically covering the Silicon VSG implementation including the drive and pick-off transducer mechanisation. RASE has also filed numerous applications relating to improved performance devices and design variants offering increased functionality. This is a technology area to which RASE has a deep commitment and is actively involved in an intensive research and development program to enhance and extend its product range.

Coriolis gyroscopes may be fabricated using a variety of different structures as the resonant element. These may be conveniently divided into three categories:

- Simple oscillators (mass on a string, beams)
- Balanced oscillators (tuning forks)
- Shell resonators (wine glass, cylinder, ring)

A common feature in all of these designs is the maintenance of a resonant carrier mode oscillation to provide the linear momentum which produces a Coriolis force when the structure is rotated about the appropriate axis (see Figure 2). All VSGs manufactured by RASE have been of the shell resonator type. These are designed to overcome the mounting sensitivity problems often associated with simple oscillators and balanced oscillators, thus improving bias performance.

When the structure is rotated about the axis normal to the mode motion Coriolis forces are generated around the ring. The net effect of these forces sets the secondary $\cos 2\theta$ response mode into motion, at a relative angle of 45° to the primary mode, with an amplitude proportional to the applied rate. Improved scale factor linearity performance is obtained by nulling this motion by means of an appropriately positioned transducer. The applied rate is then proportional to the nulling force.

The heart of any Coriolis gyroscope is the resonator itself with the device performance acutely dependent on the stability of the material parameters. The piezoceramic VSG design gives excellent performance in terms of the drive and pick-off transducer gains but it is difficult to machine and its mechanical properties exhibit significant temperature sensitivity.

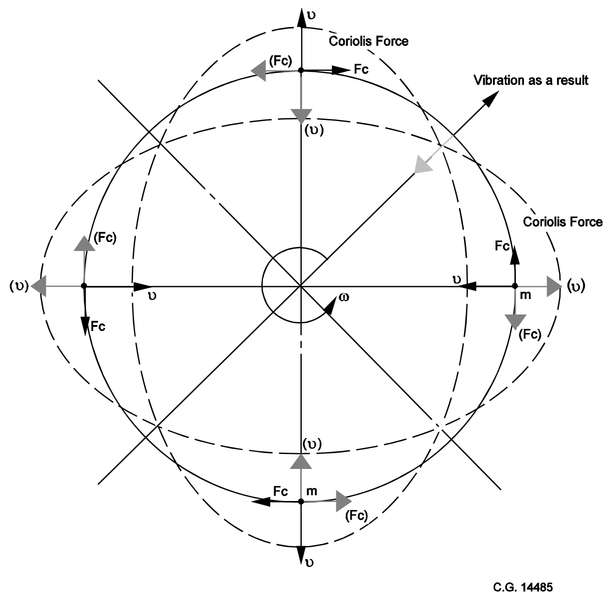


Figure 2 Coriolis Effect

The next generation of VSG was a natural evolution of the technology which overcame these specific limitations. This was achieved by moving to a planar metal resonator giving more stable material parameters in a design which is easier to manufacture. This necessitated the use of alternative drive and pick-off transducer technologies. This patented design utilises a magnetic drive with the ring motion detected by a capacitive sensor. This is also an established product with both commercial (VSG 2000, VSG 2010) and military (RG 600) variants available with over 300 units produced to date. The product range is shown in Figure 3.

The third generation of VSG is a further natural evolution of the technology which builds on the knowledge and strengths of the existing product range. The planar ring design is ideally suited to manufacture using Silicon micromachining techniques. In addition to the obvious advantages of the wafer processing capability developed for the electronics industry, bulk silicon provides an excellent resonator material. Silicon offers long-term stability as it is a pure crystalline material and, oriented correctly, is isotropic.

The experience gained in the development of the previous VSGs has afforded RASE a comprehensive knowledge of the performance drivers and design requirements for this class of rate sensor.

The advent of appropriate micromachining techniques facilitated the rapid development of the Silicon VSG with the measured performance largely in accordance with predictions. While still at a relatively early stage of development, the Silicon VSG is achieving performance which matches that of the previous generations of RASE VSGs.

Detailed modelling indicates that performance improvements can be achieved through better matching of the carrier and response mode frequencies and increasing Q, the mechanical quality factor. Design and processing modifications will be incorporated to facilitate these improvements.

Figure 3 RASE's Piezoceramic and Metal Ring Gyroscopes

VSG Experience at RASE

Research and development of the Silicon VSG has built on the considerable experience gained with ceramic cylinder and metal ring vibrating rate sensors. The SVSG is an evolution of the vibration technology developed at RASE, each development being built on the experience gained with the previous technology. This SVSG uses a planar resonant ring with electromagnetic drive and pickoff.

Temperature performance limitations with bias and scale factor on the ceramic cylinder led to the vibrating metal ring design. This in turn led directly to the silicon ring resonator which allows significant cost reduction to be achieved while substantially retaining the improved performance of the metal. Additionally, this provides a sensor less susceptible to both vibration and magnetic interference.

The SVSG utilises deep trench etched bulk silicon technology to produce the small micromachined ring that forms the heart of the gyroscope.

The planar ring design is uniquely-suited to take advantage of the accurate mechanical tolerancing (sub-micron level) that can be achieved with silicon micromachining. This tolerancing accuracy has its origins in the lithographic processes but is only achievable in two dimensions (ie, the plane of the wafer).

The majority of other Coriolis sensor designs resonate in the plane of the wafer but respond to rate by vibrating in a direction normal to this plane. Therefore, to achieve and maintain performance requires the mechanical tolerances to be controlled in three dimensions. Accurate control of the depth of a microstructure is far more difficult. The RASE SVSG design maintains all the motion in the plane of the ring where the dimensions can be accurately achieved, thus fully capitalising on the processing capabilities. The RASE design is inherently insensitive to variations in the ring depth.

The SVSG comprises the micromachined ring itself supported by eight legs. The strength of the legs has been analysed and provides a safety factor of at least 10 times under 10,000 g load acceleration and gives an extremely robust ring attachment method. Each of the eight legs carries three conducting wires onto the surface of the ring (see Figure 4). The photograph in Figure 5 provides a view of part of the ring.

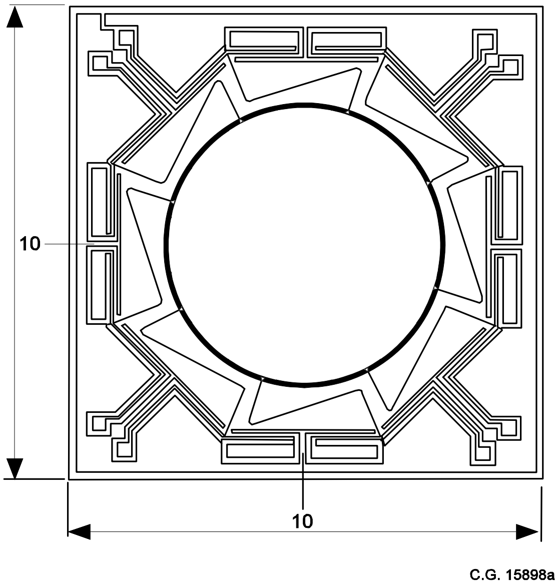


Figure 4 Diagram of Silicon Resonator Ring

Figure 5 Microscopic View of Silicon VSG Resonator
Each of the eight legs carries three conducting tracks onto the surface of the ring

The three conductors on each leg are used to carry drive current through one segment of the ring, pick-off the voltage induced in another adjacent ring segment, whilst a central conductor provides a ground plane.

A small magnet is bonded onto the base of the gyroscope. The magnet passes through the centre of the ring and is capped by a "C-shaped structure" that directs the flux from the magnet back onto the ring (Figure 6). When current flows through two of the conducting elements in the ring, the cross product of the current flowing through the ring and the magnetic force field produced by the permanent magnet delivers a force that causes the ring to move radially.

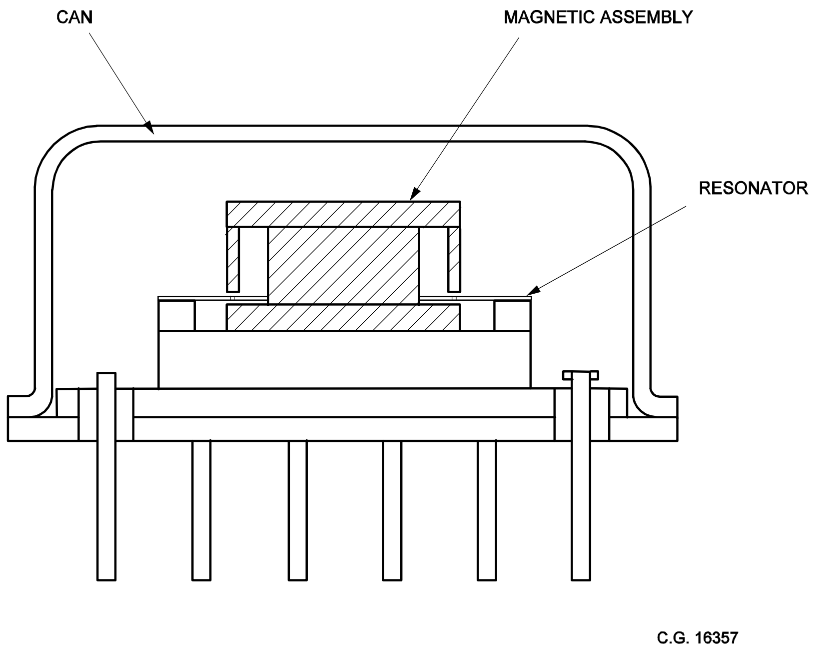


Figure 6 Resonator Assembly

By applying an alternating current to the drive conductors on the ring, the microminiature ring is made to oscillate in the cos2θ mode as shown in Figure 2.

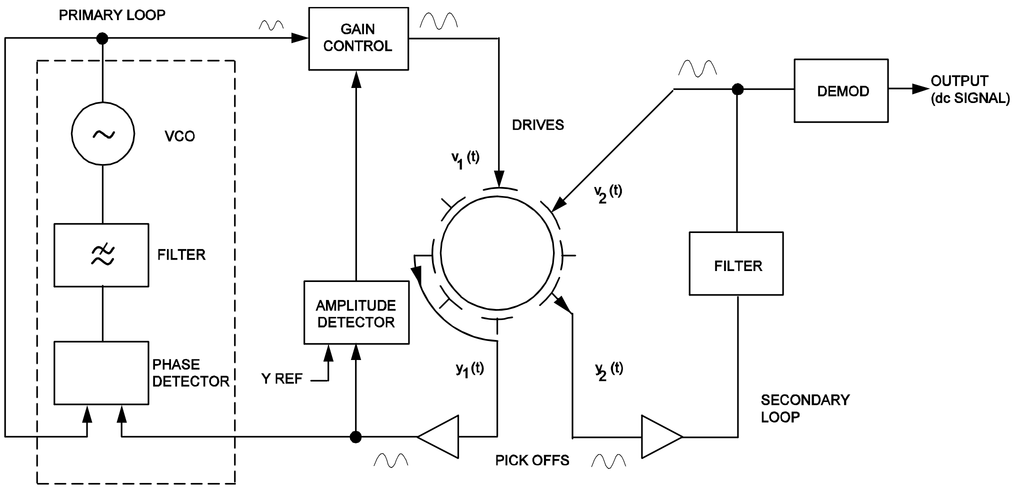
A voltage is created in the pick-off elements on the ring due to the fact that they are moving conductors in a magnetic field, and hence produce an output proportional to the amount of movement. When there is no rate of rotation, there is no output on the secondary axis. As the gyroscope is rotated faster, the output on the secondary increases. Measuring the amount of secondary axis motion provides a measure of the rotation rate of the gyroscope.

Because the silicon ring used in the gyroscope is both small and light, it has low inertia and therefore very high shock resistance. The choice of silicon as the resonator material provides the benefits of strength with resilience making it an ideal material for this application.

The gyroscope has also been designed so that the silicon ring itself has no fundamental vibration patterns at frequencies below 5 kHz. All the fundamental vibration modes are at high frequency so that it is inherently insensitive to normal vibration and shock environments.

The gyroscope manufacturing process starts with a wafer of silicon. Using industry standard deposition and patterning techniques, the insulators and conductors are laid down on the silicon. A resist is then applied and patterned. Then, through a process of etching, the unwanted silicon is removed, thus defining the leg and ring structures.

The electronics exists in a discrete analogue format, which is a development of that proven on earlier RASE VSGs. The electronics is currently being developed as a single ASIC using Very Large Scale Integration (VLSI). The electronics includes the primary loop, gain control, amplitude detector, filter and demodulator (see Figures 7 and 8).



THE AMPLITUDE DETECTOR COMPARES THE AMPLITUDE OF THE PRIMARY PICK OFF WITH A STABLE REFERENCE.
THE ERROR SIGNAL IS USED TO ADJUST THE PRIMARY SIGNAL ACCORDINGLY.

C.G. 14486

Figure 7 VSG Rate Sensor Schematic

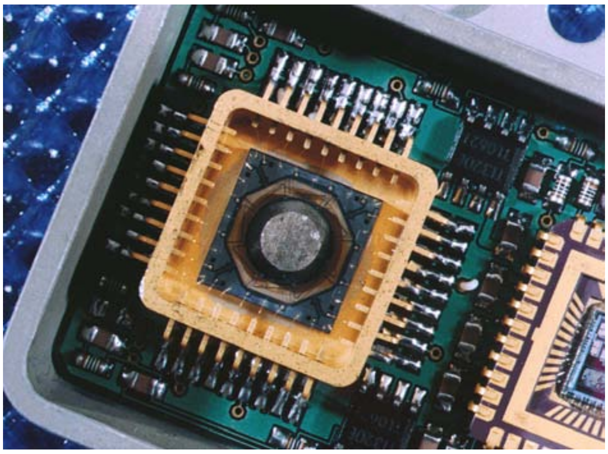


Figure 8 Silicon VSG Package
Close-up view including the ASIC

The developed ASIC will contain circuitry for scale factor and bias compensation as well as built-in test circuits which check the integrity of the sensor to a very high level.

The deep trench etching process has enabled RASE to exploit the technology to produce gyroscopes on silicon wafers for high volume applications. This is important in the automotive market which saw over 500,000 car navigation systems sold in Japan in 1997. This market is the driver which has accelerated the development of the silicon technology.

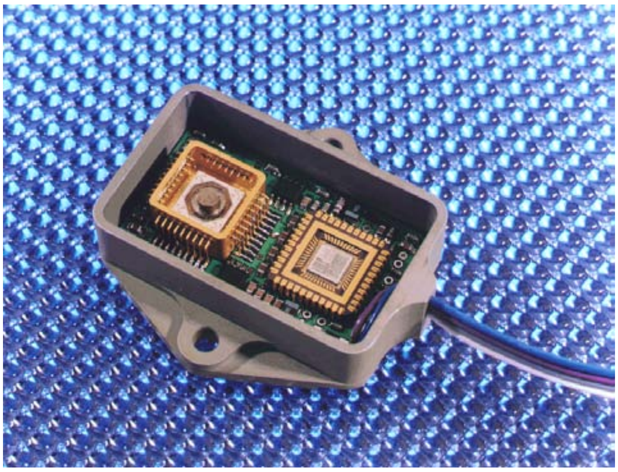


Figure 9 Typical Commercial Single Axis Silicon VSG Package
Showing integral ASIC

Over 1000 SVSGs have been produced, and delivered to a range of customers for assessment, integration and assembly into Own Equipment Manufacturer (OEM) products.. They have proved to be extremely rugged operating under high levels of applied vibration and shock. Performance has been characterised for scale factor, and bias over temperature both at RASE and by customers, and work is on going to produce a comprehensive error model. In addition work has been carried out to evaluate other important parameters such as noise, bandwidth, start-up time, output stability and hysteresis.

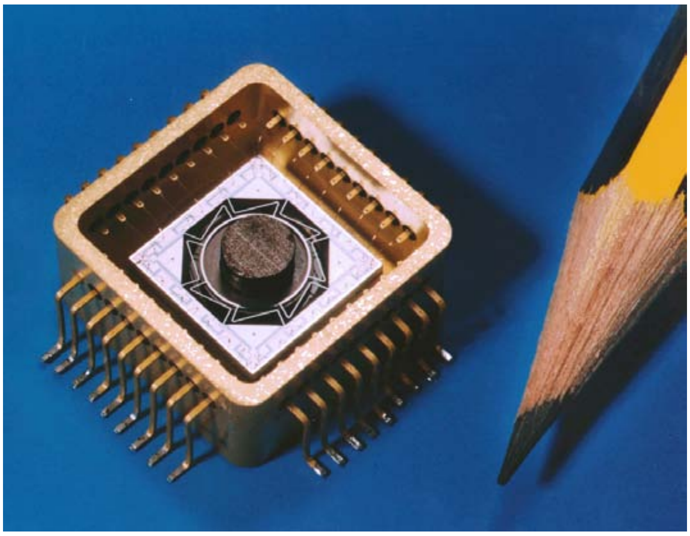


Figure 10 SVSG - The World's First Commercially-Available Micromachined Ring Gyroscope

APPENDIX B

RASE PROFILE

B.1 ORGANISATION AND MANAGEMENT

B.1.1 Corporate Management

REM Aerospace plc is the largest aerospace and defence company in Europe with 43,000 employees and customers in 72 countries. Figure 11 shows the REMA Corporate Structure.

REM AEROSPACE PLC Chairman - [redacted] Vice-Chairman - [redacted] Chief Executive - [redacted]		
COMMERCIAL AEROSPACE	DEFENCE	OTHER BUSINESS
REM Aerospace Airbus	REM Aerospace Systems and Equipment MD - [redacted]	Head Office
REM Aerospace Asset Management	REM Aerospace Military Aircraft and Aerostructures	REM Aerospace North America Inc
REM Aerospace (Aviation Services) Ltd	REM Aerospace Royal Ordnance	Bowerby Research Centre
REM Aerospace Regional Aircraft	REM Aerospace Systems and Services	Chichester Business Aviation
	REM Aerospace Australia Holdings Ltd	Burlington Securities

Figure 11 REM Aerospace Corporate Structure

RASE is a wholly-owned subsidiary of REM Aerospace (REMA) plc and comes under the wing of the defence group. The main office is located in Plymouth, Devon, where the company activity is controlled and exercised by the Divisional Management Committee under the leadership of Mr. [redacted], the Managing Director. Approximately 1000 employees work at Plymouth and subsidiary sites. Figure 12 shows the RASE organisational structure.

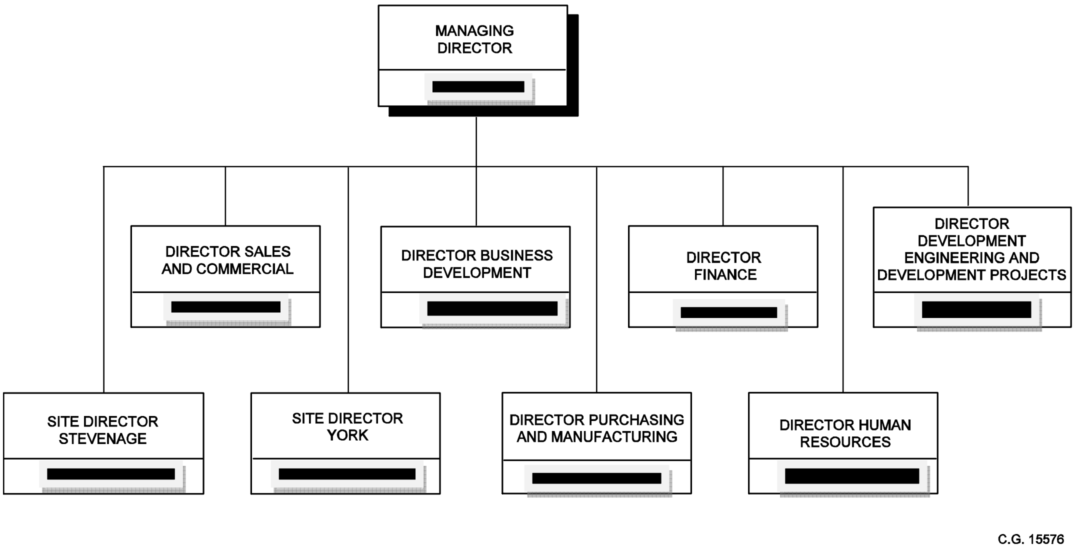


Figure 12 RASE Organisation

The RASE Management structure provides a clear focus to the workforce on the chosen products and business areas.

Our mission is to be a world leading supplier of innovative sensing and control technologies working with and supporting our customers, suppliers, partners and colleagues with trust and integrity.

The mechanism for achieving this mission statement is by focusing on the five REM Aerospace values:

- Customers - Our highest priority
- People - Our greatest strength
- Partnerships - Our future
- Innovation & Technology - Our competitive edge
- Performance - The key to winning

B.1.2 Company Profile

RASE is a recognised centre of excellence in the Navigation, Motion Sensing, Actuation, Communications and Automatic Tracking markets, with a wide range of products. As a supplier of world-class electronic and electro-mechanical equipment, and working closely with other leading defence prime contractors, RASE's products form an integral part of many of the world's finest weapons platforms and systems supplied directly or in close co-operation with other leading defence prime contractors.

The 15 acre site at Plymouth (see Figure 12) occupies over 260,000 square feet of purpose-built engineering and manufacturing including a major investment in Clean Rooms for the manufacture of conventional, solid state and ring laser gyros, and avionic products. Extensive research, development and environmental facilities are available on site.

RASE is certified to design, develop and produce avionic equipment to both military and civil standards and has ISO9001 accreditation.

The Manufacturing Facility contains clean rooms, assembly areas, controlled environment test facilities along with a dedicated machining and PCB capability.

Figure 13 RASE Site at Plymouth

The Engineering Facility provides design teams which comprise Systems, Software, Hardware Production and Support Engineering. The facility includes CAD/CAE and also contains laboratories for research and development, failure analysis and material science, and Electro-Magnetic Compatibility.

The Environmental Engineering facility is purpose-built and is one of the most comprehensive and sophisticated in the south west of England. It contains vibration and shock equipment catering for products ranging from miniature electronic assemblies to structures weighing up to 2 tonnes. Equipment is available for the environmental test and qualification of products over a wide range of vibration, temperature, shock, humidity and combined environments.

Related Experience

RASE and its predecessor companies have been major suppliers of inertial sensor products and systems for over eighty years. Inertial sensing technologies include mechanical, ring laser, fibre optic and vibrating structure. Over thirty engineers are directly engaged in gyro research and new product development.

VSG Developments

RASE commenced research into VSG technology for rate measurement in 1985, using piezoceramic (PZT) cylinders. The prime application was initially for a three axis version for inclusion in a terminally guided mortar bomb.

Development of a single axis version as a stand alone product was started in 1989, with the commercial sector being the main target market.

In 1991, research was started into resonator technology to improve stability. The program moved onto the development of VSG2000, a metal ring based VSG.

Both the single-axis and 3-axis PZT VSG entered initial production in 1993. Initial batches were for 250 off 3-axis packs and 1000 off for the single axis version. Also during 1993, licensed assembly of the single-axis VSG was started at Makemoto Precision Products (MPP) and pre-production VSG2000s were supplied to a military customer for evaluation and proving.

Batch production of VSG2000 was started in 1994 and mass production studies begun. Development of the RG600 was also started, specifically aimed at the military environment. The RG600 is based on the PZT VSG2000 but with improvements to the metal ring suspension and electronics which result in a more rugged and robust product.

Today, over 5000 PZT VSGs have been sold, by RASE, into a diverse number of applications such as instruments, oceanographic surveying equipment, tilting trains, remotely piloted vehicles (RPVs), missiles, robotics, ejector seats, and stabilised platforms. Automotive applications have included Interactive Vehicle Dynamic (IVD) control and navigation aids. Current production throughput of PZT VSG is 200 per month.

In 1995 development of the Silicon VSG was started, based on the PZT VSG physical principle, but with the resonator constructed from micromachined silicon. To date, over 1000 resonators have been produced. The Silicon VSG provides a technology leap in terms of low cost rate measurement.

A Military Grade IMU is undergoing full development program based on the SVSG.

More details of VSG sensors are provided in Appendix A.

RASE has been awarded a contract from Northrop Grumman for the supply of 3-axis rate sensor packs for the UK Apache program. The sensor pack incorporates three orthogonally mounted Metal Ring VSG RG600 rate sensors and associated electronics designed to be a form, fit and function replacement of the current Longbow 3-Axis Rate Sensor. The RG600 not only provides significant cost savings to the program but also provides a sensor pack inherently more robust and reliable and with a longer service life.

MAKEMOTO PRECISION PRODUCTS LTD (MPP) COMPANY PROFILE

Makemoto Precision Products Ltd is one of the Makemoto Group of companies, based in Osaka, Japan. It specialises in aerospace engineering and, more recently, micro-engineering using silicon and other materials. MPP owns the world's leading silicon dry-etching machinery company (TTS, Wales) and, with that company, has created a specialisation in precision silicon etching. This technology is fundamental to realising silicon gyro structures.

RASE has a long standing partnership arrangement with MPP, dating back to the production of the first VSG (1992). Both companies produce and sell the RASE-designed ceramic VSG.

In 1994 the partnership was extended to cover development and production of the Si Gyro. RASE holds the Gyro IPR and patent portfolio, and MPP has responsibility for Production Engineering, and initial production facilities - to make sensor elements for both MPP and RASE markets. It is intended that the partnership will be extended to form a Joint Venture company for manufacture. RASE will exclusively market, sell to, and support the Military market-place, and MPP the Automobile market-place.

APPENDIX C

QUALITY ASSURANCE

C.1 RASE QUALITY SYSTEM

RASE has held Quality Approvals for Motion Sensing and Gyroscope work for over 80 years. Our current third party Quality Approvals include:

- BS EN ISO 9001 (1994) including "Tick IT" (Software approval Scheme) and the Aerospace Sector Certification Scheme (TS 157), certificate number 924157. ISO 9001 incorporates ISO 9002.
- REMA Civil Aviation Requirement A1 Primary Company for Instruments Systems and Equipment, Navigation Systems and Equipment, and Components. Approval reference number DAI/9315/91.

As a supplier into many of the world's leading aerospace and defence contractors, RASE holds a number of second party Quality Approvals.

C.2 RASE QUALITY POLICY

It is RASE policy to maintain exceptional customer satisfaction through continuous improvement. The company will continue to obtain and maintain appropriate Quality System approvals including ISO 9001.

The aim of this policy is to develop the idea that the activities conducted within the company can be built up into processes that deliver products and services to RASE customers, or manage and support the operation of the business. Each working interface within these processes can be considered as a customer/supplier relationship.

By developing a knowledge of the processes every employee will:

- Understand their role in the organisation and how they contribute to its success.
- Be aware of the effect of their activities on all others within the process.
- Know who their suppliers and customers are and how the requirements are passed to them.

This allows RASE to focus on improving the quality of what is received and delivered using the principles of continuous improvement.

RASE has an integrated set of procedures and instructions that describe these processes. RASE ensures that this process structure is compliant with statutory and regulatory requirements, and meets the operational and quality system standards required by its market.

A full description of the Quality System and its compliance with these standards is contained within the RASE Quality Manual, a copy of which can be made available on request.

The Manager of the Quality Assurance Department is responsible for the implementation, management and enforcement of the quality system. He has the authority and organisational freedom to identify problems and to initiate, recommend and provide solutions. In matter of quality conformance, the Manager of the Quality Assurance Department shall not be overruled by the Manager of any other Department.

APPENDIX D

COMPLIANCY STATEMENTS

This section contains the detailed compliancy tables with reference to the individual requirements of this proposal.

Table 2 Compliancy Tables

Item Ref	Requirement	Compliant	Part Compliant	Non-Compliant	Comment
1.1	Measurement Range	⌧			
1.2	Nominal Scale Factor	⌧			
1.3	Scale Factor Accuracy	⌧			

FUTURE PRODUCTS

RASE and MPP are leading suppliers of high quality motion sensors to world markets. RASE's 80 year pedigree in this field has been achieved by a long term policy of investment, demonstrated by an ability to meet the requirements of existing and new markets and applications.

All current and future sensor markets demand highly reliable solid state products with continuous cost reduction, RASE's inertial sensor experience and MPP's manufacturing and production expertise make a world-beating combination.

The planned improvements to our product range are as follows:

- Development of a new silicon rate sensor to give:
- Improved performance
- Reduced power consumption
- High reliability
- Smaller space
- Built-in test
- Research into future generation products

FUTURE PRODUCTS

RASE and MPP are leading suppliers of high quality motion sensors to world markets. RASE's 80 year pedigree in this field has been achieved by a long term policy of investment, demonstrated by an ability to meet the requirements of existing and new markets and applications.

All current and future sensor markets demand highly reliable solid state products with continuous cost reduction, RASE's inertial sensor experience and MPP's manufacturing and production expertise make a world-beating combination.

VIBRATING STRUCTURE GYROSCOPE

Principles of Operation

January 1994

REM Aerospace

(Systems and Equipment) Limited

VIBRATING STRUCTURE GYROSCOPES

1. *INTRODUCTION*

Gyroscopes are instruments which are used to measure angular motion. The Vibrating Structure Gyroscopes described in this paper are simply devices which provide a voltage proportional to the rate of turn applied to the gyroscopes sensitive axis.

Research and Development of solid state gyroscopes has been ongoing within BASE over the last five years. It is felt that in the future most conventional motor driven, spinning wheel gyroscopes will have been surplanted by solid state devices. This is due to their simplified construction, improved reliability and shock handling capability. To ensure that BASE continues to be a leading supplier of gyroscopes it has continued to research and develop new products.

From this research programme a family of Vibrating Structure Gyroscopes has been developed which is being made available to military and commercial markets.

This paper describes the principles on which these devices work.

2. *PRINCIPLES OF THE VIBRATING STRUCTURE GYROSCOPE*

2.1 Coriolis Effect

All of the vibrating devices described work on the basic principle of detecting Coriolis forces. These forces are generated when a moving particle is rotated. The simplest example of this coriolis force is to imagine watering your garden with a hose pipe: as you turn the water expelled from the pipe appears to move in a curve. In the fixed earth bound frame of reference this is due to the positional lag due to the rotation. However in the rotating frame this apparent motion is seen as being caused by the Coriolis force. If you don't believe this is a real force, the next time you visit a childrens playground try kicking the centre of the roundabout while it is spinning, and you are on the ride, and you will feel a force pushing your foot away.

Mathematically the coriolis force (Fc) is equal to twice the mass (m) times the vector cross product of the angular rotation frequency (ω) and the linear velocity of the mass (v).

ie $Fc = 2m\ [\underline{\omega} \times \underline{v}]$

2.2 How the Coriolis effect can be used to detect angular rate of turn

To use the coriolis effect to detect angular rotation a solid structure is forced to vibrate normally at its resonant frequency. The vibration provides the structure with a linear velocity component. When the structure is rotated the coriolis forces cause the vibration motion of the structure to be coupled in to an other vibration mode or plane of the structure.

This is most simply illustrated using the simple oscillator type of device as shown in figure 1.

2.2.1 Simple Oscillators

Simple oscillators can comprise either a single mass or a uniform continuous system, as shown in Figure 1. Both are set into resonance along a single axis with the angular rate applied perpendicular to it. As the mass vibrates in the Y axis, the velocity of the mass reverses on each traverse. This causes the coriolis forces which act in the x plane to rotate, hence they couple the vibration into the x plane. Since the coriolis forces are proportional to angular rotation rate the magnitude of the coupled vibration is a direct measure of the applied rate.

Because these devices are not balanced the mounting arrangement is critical to ensure minimum coupling into the unwanted mode, and any non–uniformity would introduce an error signal. The device is also very sensitive to any linear vibrations.

2.2.2 Balanced Oscillators

Perhaps the most well know vibrating gyroscope is the tuning fork. The major difference between this device and the simple oscillator is that externally the device is balanced and therefore a nodal point exists where the tuning fork may be mounted, as shown in Figure 2. An applied rate about the centre axis results in a torque about the stem. This may be measured directly or transmitted to a second resonating device, which is used to detect the vibration.

2.2.3 Shells

This group covers all types of axissymmetric shells, some of which are shown in Figure 3. The principle of operation is more complex than the two previous groups.

Figure 4 shows the vibration pattern seen at the end of the shell. Here there are two portions of the cylinder moving with velocities acting at 90° to each other. Rotional motion produces coriolis forces acting at 90° which squeeze the cylinder and couple vibration to a point 45 degrees relative to the driven axis.

3. *DEVELOPMENT OF VIBRATING STRUCTURE GYROSCOPE*

The cylinder based design was developed for a number of reasons:

1. The cylinder may be fixed at the base which is a nodal point for a fixed–free cylinder.

2. Manufacturing problems should be minimised due to the simplicity of design.

3. Various drive and detection methods could be used.

4. The cylinder is a balanced structure and is less sensitive to external vibration.

A Piezo–electric, structure was chosen because a monolithic structure could be produced, thus minimising manufacturing effects. The only available material for this configuration is man–made ceramic, the most suitable of which is one of the lead zirconate titanate composites.

The cylinder is manufactured as a single part, it is closed at one end which has a stem for mounting purposes. In order to provide the means of driving and detecting the vibration electrodes are printed on the cylinder. These are equally spaced around the circumference of the cylinder.
In order to enhance the performance of the basic sensor and obtain an electrical output from the device various servos are used. The basic equations which describe the motion of the cylinder are:–

for the drive mode (forced vibration)

$$A \cos\omega_v t = \beta_1 \cos\omega_v t + k\omega\ \beta \cos\omega_v t \ .... \qquad (1)$$

Vibration Amplitude A = Driving function β_1 + Coriolis forces
ω_v = frequency of vibration, K is coriolis coupling coefficient

for the output mode (coupled vibration)

$$B \cos \omega_v t = \beta_2 \cos \omega_v t + k\omega A \cos \omega_v t \ .... \qquad (2)$$

Vibration Amplitude B = Driving function β_2 + Coriolis forces

Note β_2 term included because we want to servo the secondary mode.

Figure 5 shows the block diagram of the Electronics. The electronics includes two servo loops.

The first servo loop operates to keep the frequency and amplitude of the forced vibration constant. The second servo loop operates to null the coupled vibration hence B is set to zero. This simplifies equation (2) to give

$$\beta_2 \cos V\omega_v t = -k\omega A \cos\omega_v t \ .... \qquad (3)$$

used to null the vibration $ß_2$. Demodulating this signal provides an electrical signal proportional to rate of turn.

4. *MAIN FEATURES OF THE VSG*

4.1 No Moving Parts – The sensor contains no bearings, motors or gimbals. This has the benefit of giving very reliable operation with virtually unlimited life.

4.2 Simple Construction – The sensor contains few parts and assembly is very simple. This allows cheap and reliable manufacture. The unit is also light in weight. (See figure 6)

4.3 Short Run–Up Time – The sensor has no conventional spinning wheel and, as a result, achieves ready state within a very short period. This period is governed only by the capture time of the phase locked loop used to excite the resonant structure, and is in order of 300ms. This time can be adjusted according to requirements.

4.4 Low Power Requirements – Unlike a spinning wheel gyro, the sensing element requires very little power to excite it in its resonant mode.

4.5 Low Noise – The absence of moving parts and, in particular bearings, results in a sensor having very low inherent noise.

5. *PRODUCT RANGE*

The product range of vibrating structure gyroscopes at BASE is as follows:

4.1 **3–axis high sock** – a compact 3–axis pack designed to withstand shocks up to 10,000g.

4.2 **Single Axis VSG** (Type 299640) – single axis device suitable for a wide variety of applications.

4.3 **VSG 2000** (Type 292101) – enhanced performance with a design for high volume production.

4.4 **RG 600** – enhanced performance packaged to withstand a harsher environment suitable for military applications.

Data sheets are available on each of these products.

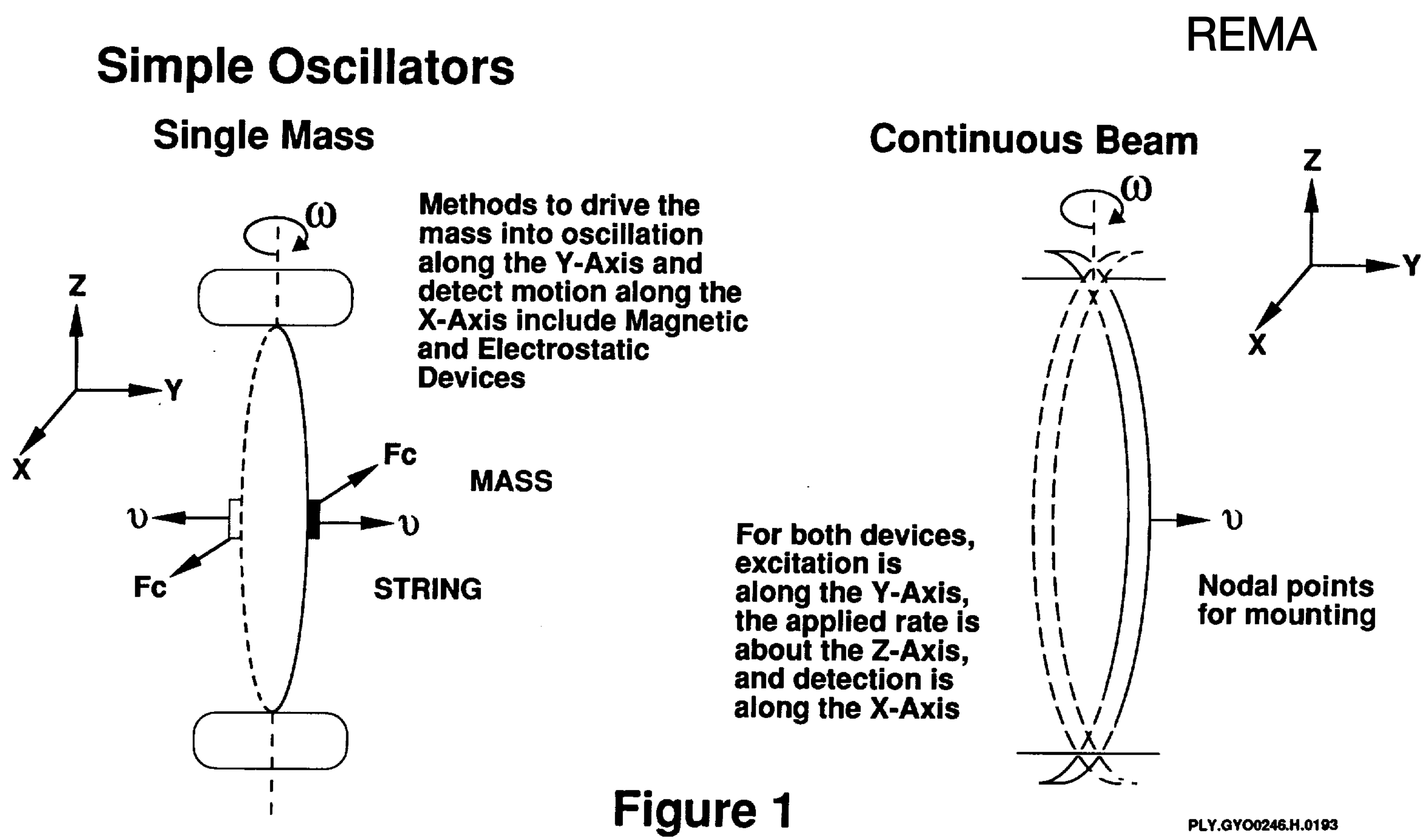

REMA
Simple Oscillators
Single Mass
Methods to drive the mass into oscillation along the Y-Axis and detect motion along the X-Axis include Magnetic and Electrostatic Devices
Z
Y
X
ω
Fc
MASS
STRING
υ
Continuous Beam
For both devices, excitation is along the Y-Axis, the applied rate is about the Z-Axis, and detection is along the X-Axis
Nodal points for mounting
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Figure 1

Balanced Oscillators

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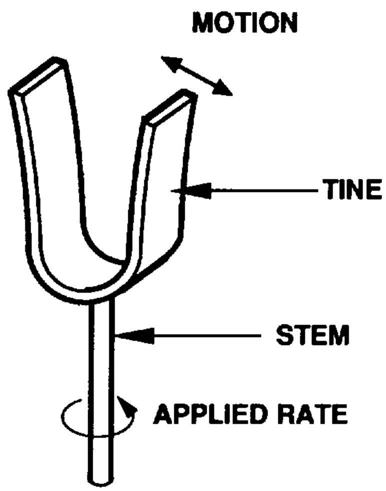

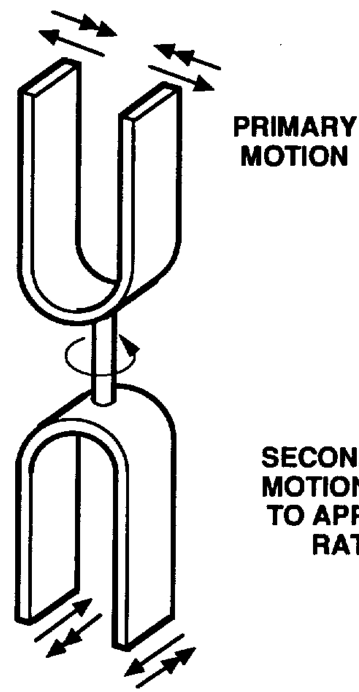

An applied rate about the stem axis generates a torque in the stem which may be measured directly or transmitted to a second resonant device

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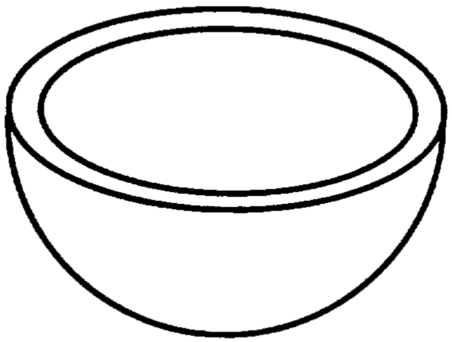
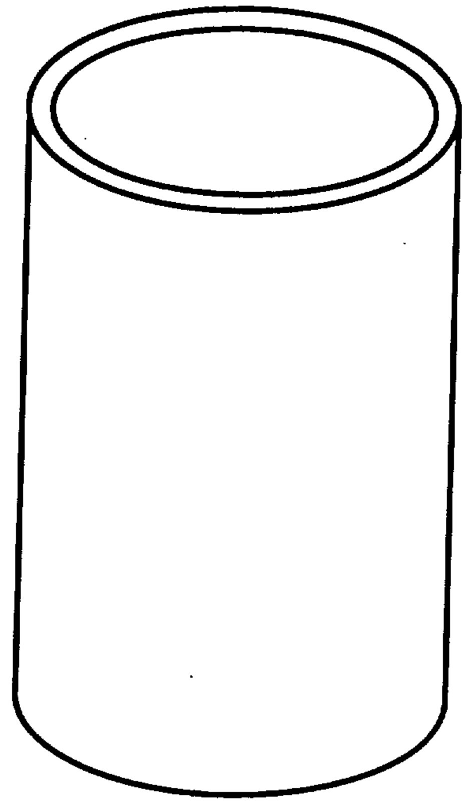
Shells

REMA



HEMISPHERE



CYLINDER

- All types of axis symmetric shells
- VSG and VSG 2000 use this arrangement
- Nodal points exist for mounting

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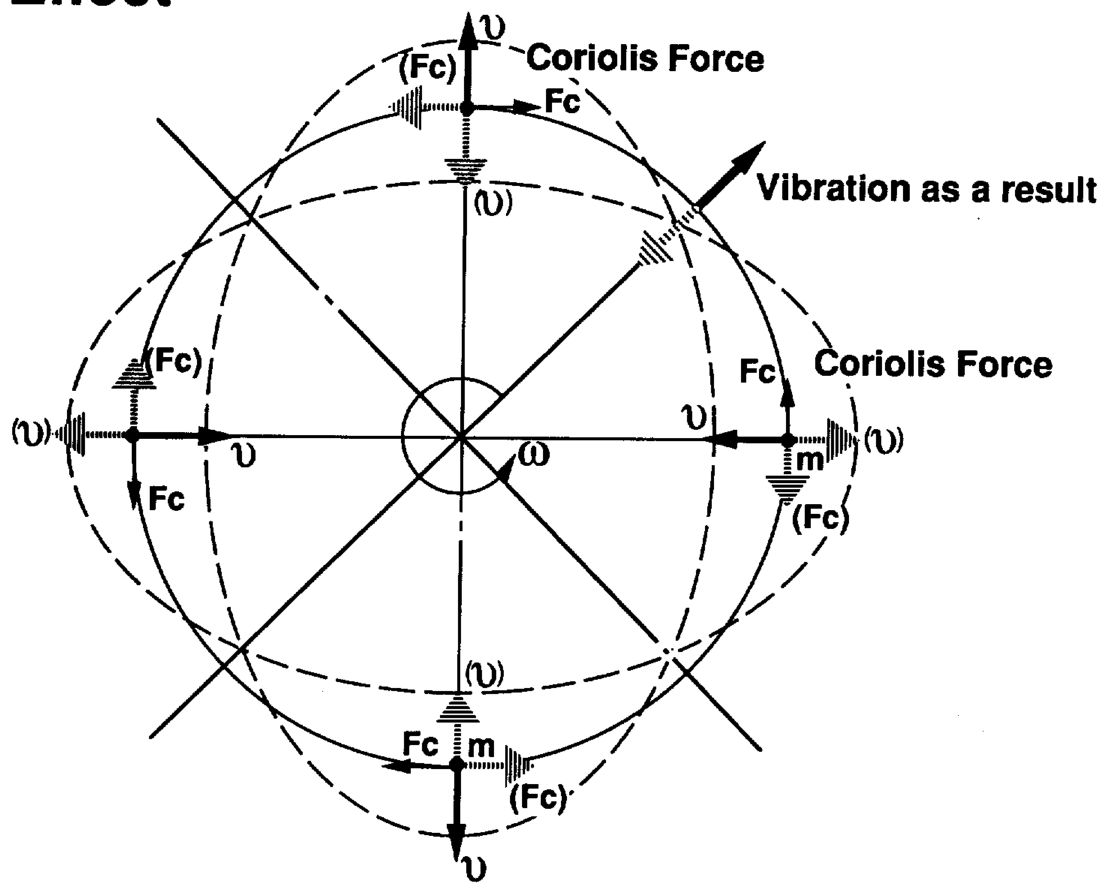
Coriolis Effect

REMA



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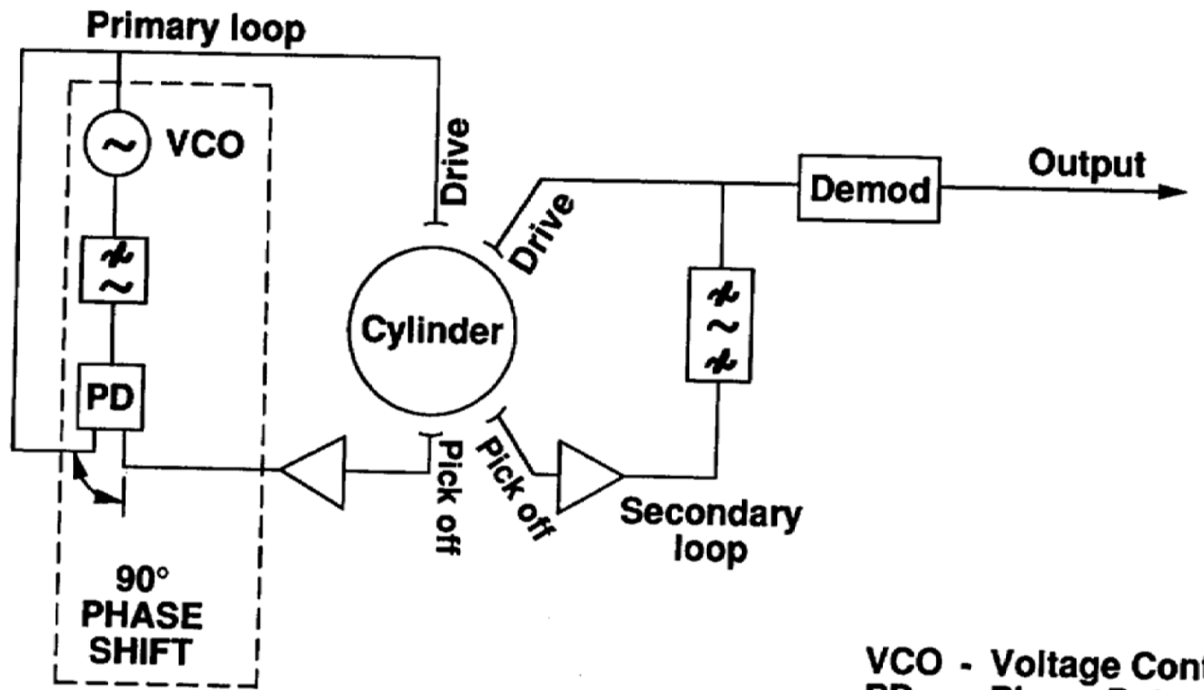
System Diagram for the VSG

REMA



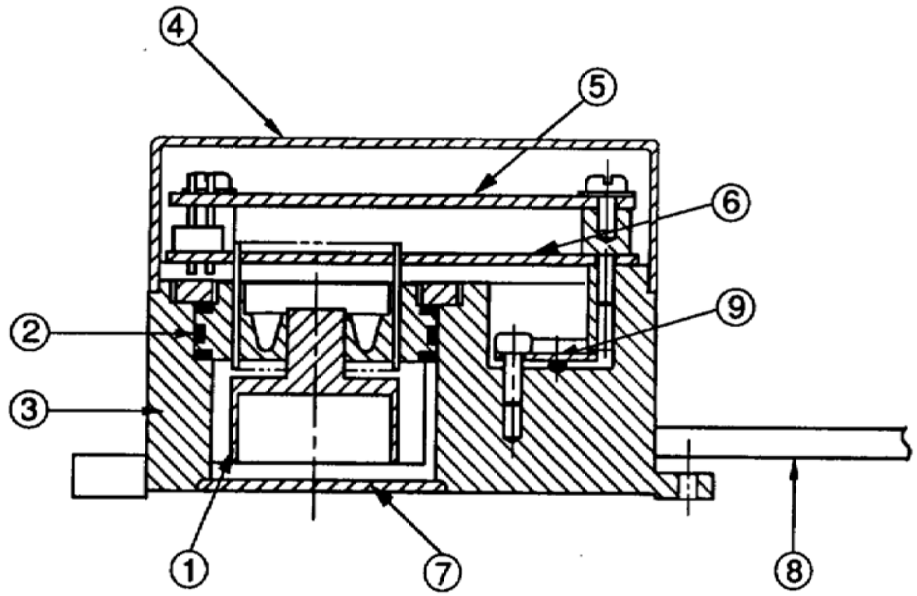
VCO - Voltage Controlled Oscillator
PD - Phase Detector

Figure 5

PLY.GYO0243.H.0193

REMA

Single Axis Assembly



Item	Description
1	Cylinder
2	O-Ring
3	Housing
4	Cover
5	Processor board
6	Pre-amp & Power Supply board
7	Disc
8	Cable
9	Cable Clamp

PLY.GYO0480.H.0293

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