TECHNOLOGY TRANSFER EFFECTIVENESS THROUGH INTERNATIONAL JOINT VENTURES (IJVs) TO THEIR COMPONENT SUPPLIERS: A STUDY OF THE AUTOMOTIVE INDUSTRY OF PAKISTAN

by

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ABSTRACT

This thesis investigates the important topic of technology transfer effectiveness from international joint ventures (IJVs) established in the automotive industry of Pakistan to their local components suppliers; a relatively under-explored area and context.

Using hybrid methodology (qualitative interviews conducted with the 50 Pakistani first tier suppliers, 3 of the major assemblers who control 95%-98% of the market and with the officials of the Ministry of Industries and Production, supplemented with survey questionnaire), the study argues that IJVs in the automotive industry of Pakistan have transferred very limited low-medium complexity parts technology to their Pakistani component suppliers. The results also demonstrate that the assemblers have not, so far, transferred the whole package of technology to their suppliers. This whole package of technology is important for the resource constrained and underdeveloped suppliers to move up in the global value chain. The results also point out that the willingness of the sender is an important aspect for any technology transfer to take place and, in the context of Pakistan; assemblers are willing to transfer components to component- based technology depending on the underlying complexity of that particular component.

Inter-organisational dynamics in the form of trust and social ties play a considerable and vital facilitating role in the transfer and effectiveness of technology. The recipient's role also in terms of learning intention and absorptive capacity is, highly relevant along with the willingness of the sender for the technology transfer to be effective.

The study also shows that different governance mechanisms play an important role for technology transfer effectiveness, and the results demonstrate that only a few suppliers have developed exploitative/ exploratory innovations and a depth/breadth of learning.

Finally, the study presents relevant contributions for managers, policy makers and researchers interested in the field of technology transfer and its effectiveness

This work is dedicated to:

My wife, Shoaira and my sons, Afnan, Ahmad and Usman

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CHAPTER 1: INTRODUCTION

This chapter deals with the background and motivation of the present research. The research objectives, contributions and research approach are then highlighted. In section 1.6 of this chapter, the organisation of the thesis is summarised and conclusions are presented in the final section of the chapter.

1.1 Background and Motivation

This thesis investigates the effectiveness of technology transfer from international joint ventures (IJVs), established in the automotive industry of Pakistan to their local Pakistani component suppliers. The topic of technology transfer is important in the context of developing and emerging economies because successful technology transfer and local technological development efforts can play a crucial role in the economic development of a recipient country to higher value added products/activities. It can also facilitate the recipient firms' efforts to move up the global value chain. For example, Korea, China and to some extent India, have moved up in value added global production networks on the basis of technology transfer and local technological development efforts (see, for example, Lall 1992, 1998).

Policy makers in developing and emerging economies have placed attracting Foreign Direct Investment (FDI) at the top of their policy menu, in the hope that investment by multinationals companies (MNCs) will bring much needed capital, sophisticated and updated technological knowledge, production methods, marketing techniques and tacit and codified managerial know-how (World Bank, 1993).

According to Meyer and Sinani (2009), local firms view FDI as both a competitor and a source of advanced technologies and managerial knowledge. With these benefits in mind, the Government of Pakistan has embarked upon liberalization, deregulation and privatisation programmes and has sector specific policies in place for FDI (Pakistan Board of Investment online). A recent report by the World Bank has ranked Pakistan as the 85th most business-friendly country in the world in the annual '*ease of doing business'* report (World Bank report, 2010).

The transfer and receipt of technological knowledge is of fundamental concern to researchers investigating how firms and local (national) economies grow in the context of technological knowledge, which functions as a base for developing sustainable competitive advantage (Lyles and Salk, 1996; Tsai, 2001; Zahra *et al*., 2000). Several scholars have suggested that recipient firms can gain long-term benefits from technology transfer (Szulanski, 1996, 2000; Dyer and Singh, 1998; Dyer and Nobeoka, 2000; Gupta and Govindarajan, 2000; Simonin, 1999, 2004; Zander and Kogut, 1995).

Similarly, some scholars have acknowledged that effective technology transfer is critical in a highly competitive and uncertain environment (Hansen, 2002; Pérez-Nordtvedt *et al.,* 2008; Bhagat *et al*., 2002) because the application of technology to commercial ends strengthen the competitive position of firms by leading to more innovations (Cohen and Levinthal, 1990; Nahapiet and Ghoshal, 1998).

Technology transfer has been studied from different perspectives. For instance, Gupta and Govindarajan (2000) investigated technology transfer from multinational companies (MNCs) to their subsidiaries (see also Foss and Pederson, 2002; Minbaeva *et al*., 2003; Inkpen and Dinur, 1998a). Inkpen (2008), and Lyles and Salk (1996), have studied technology transfer from parent firms to their IJV partners in emerging and transition economies. Some authors have investigated technology transfer between two joint venture partners (e.g. Hamel, 1991; Kale *et al*., 2000); while others have shown interest in the international acquisition context (Bresman *et al*., 1999). However, very few studies have investigated technology transfer from IJVs to their local suppliers. Zhao *et al*. 2005, 2009 are exceptions, but these studies have rarely touched upon the important aspect of technology transfer effectiveness from IJVs to their component suppliers in the developing countries context.

It may be argued that the study of technology transfer effectiveness from IJVs to local component suppliers is largely an understudied area (Schlegelmilch and Chini, 2003) As Esterby-Smith *et al*., (2008:677), state ‘‘transferring knowledge between organizations brings more complexity because of the multifaceted nature of the boundaries, cultures, and processes involved. It is therefore an interesting domain for further theoretical investigation’’.

Several other scholars have also emphasised the critical role of organisational learning and its contribution towards building the recipients stock of knowledge and often times it takes place through technology transfer from outside organisational boundaries (Argote and Ingram, 2000; Grant, 1996). Research has also acknowledged the crucial role of technology transfer in building organisational competencies/human resource development and performance from parents to their IJVs partners (Lyles and Salk, 1996; Tsang *et al*., 2004), returns on equity and sales growth in newly established international ventures (Zahra *et al*., 2000), and new product development in young technology firms (Yli-Ranko *et al*., 2001). Therefore, understanding the factors that contribute to successful technology transfer between organisations has become an important area of research inquiry for academics and planners alike (Easterby-Smith *et al*., 2000).

Despite obvious benefits of technology transfer, to the best of our knowledge no study has explicitly investigated technology transfer effectiveness from IJVs to their local suppliers. Pérez-Nordtvedt *et al*. (2008), suggest that we still know very little about what contributes to successful inter-organisational technology transfers, because transferring technology between different organisations is more complicated than transferring technology between units of the same organization (Inkpen and Tsang, 2005). In addition, successful transfer is difficult to achieve because many underlying factors, for example, inter-organizational dynamics in the forms of trust, social ties, transfer mechanisms, willingness of the sender to transfer a particular technology, recipient's absorptive capacity and the recipient's learning intent determined the successful technology transfer.

Hence this thesis aims to contribute to this debate by investigating technology transfer effectiveness from IJVs to their local suppliers in a developing country context.

It is relevant here to shed some light on what we mean by technology transfer effectiveness, by looking at it from the lens of the extant literature on the subject. Previous research has equated the term 'technology transfer' with 'successful' technology transfer whereby the transfer 'results in the receiving unit accumulating or assimilating new knowledge' (Bresman *et al*., 1999:444). A substantial portion of this research has conceptualized and measured technology transfer in terms of the extent of technology transferred (Agrawal and Henderson, 2002; Bresman *et al*., 1999; Dhanaraj *et al*., 2004; Lyles and Salk, 1996; Mowery *et al*., 1996; Tsang, 2002); time, budget and recipients' satisfaction (Szulanski, 1995, 1996), as well as breadth, depth and speed of transfer (Zahra *et al*., 2000). Other areas of research in this field include the rate of technology transfer (Zander and Kogut, 1995), or how it has helped the recipient firms (Bjorkman *et al*., 2004; Lane and Lubatkin, 1998; Simonin, 1999; Yli-Renko *et al*., 2001).

While these conceptualisations and measures are useful, we argue that they do not fully capture the complete picture of technology transfer effectiveness. The transfer may be on time, budget and useful, but it might not help the recipient's firm develop a dynamic technological capability. Therefore, there is a need to use a more fine grained approach to technology transfer effectiveness in order to capture the totality of the process of effectiveness. As Van Wijk *et al*. (2008), suggest future studies need to include more fine grained measures of technology transfer, such as exploratory and exploitative innovations. Harryson *et al*. (2008), also suggest that we should not just be focusing on technology transfer, but also on the transformation and integration of technology into commercial innovation.

In order to serve this call, we conceptualise technology transfer effectiveness, as an outcome of the technology transfer in terms of breadth and depth of learning (Zahra *et al*., 2000) and exploratory and exploitative innovations (He and Wong, 2004; Jansen *et al*., 2006), as we believe these measures are comprehensive for studying effectiveness in the context of the component suppliers, because the automotive industry is a dynamic and competitive industry. In the automotive industry, newer models are launched very quickly so the depth, breadth, exploratory and exploitative innovations matter a great deal lot for the industry to remain competitive.

The automotive industry in Pakistan is an interesting and relevant context to study technology transfer effectiveness for several reasons:

First, Pakistan’s policy towards the automotive industry underwent considerable changes in the past. In the 1950s, the industry went through a liberalisation phase, then it was made very rigid via nationalization in the 1970s, which was subsequently followed by real liberalisation and inward FDI flows into the industry in the 1990s.

Second, the automotive industry is R&D and technology intensive and has the potential for creating vertical business linkages with the local component suppliers. Japanese leading auto manufacturers, for example, Toyota, Honda and Suzuki have established IJVs with Pakistani companies. The aim of this thesis is to investigate the technology transfer effectiveness from IJVs to their Pakistani component suppliers- making this as an appropriate context for this research.

Third, it manufactures products consisting of large numbers of different components requiring long supply chains. A multinational's investment in assembly plants may have a significant impact on local component suppliers in this industry.

Fourth, it is a unique industry in the context of Pakistan, because just three IJVs control 95%-98% of the market share in Pakistan (Ministry of Industries and Production, 2009).

Fifth, around 800 organised and 1200 unorganised component suppliers are operating in the market and these suppliers have extensive business linkages with the three IJVs.

Finally, it is hoped that the Pakistani case will provide insights in the field of technology transfer and its effectiveness that will enrich existing studies on technological transfer.

1.2 Objectives

The main objectives of this research are as follows:

1. To investigate the process of technology transfer from auto assembler (IJVs) to their Pakistani component suppliers.
2. To find out the type of technology transferred to Pakistani component suppliers.
3. To investigate the willingness of the senders (auto assemblers) to transfer technology to Pakistani component suppliers.
4. To highlight the role of the recipients (component suppliers) learning intent on technology transfer.
5. To find out the role of the recipient's absorptive capacity on technology transfer.
6. To investigate the role of inter-organisational dynamics in the forms of trust and social ties between assemblers and their components suppliers in technology transfer and its effectiveness.
7. To establish technology transfer effectiveness in terms of breadth, depth, exploratory and exploitative innovations.

1.3 Contributions

This research makes several theoretical, empirical and methodological contributions to the literature on technology transfer.

First, this is the first study that investigates technology transfer effectiveness in a holistic way, starting with the process of technology transfer, type of technology transfer, mechanisms used to transfer the technology, recipient related factors (learning intent, absorptive capacity), inter-organisational dynamics (trust and social ties), senders related factors (i.e., sender's willingness to transfer technology), and technology transfer effectiveness.

Second, unlike previous research which has especially focused on the volume of technology transfer, this study uses more fine grained measures, for example: depth and breadth of learning and exploratory and exploitative innovations to investigate effectiveness. Thus provides a more extensive understanding of the technology transfer effectiveness.

Third, this thesis makes an original contribution and fills a gap in the literature related to technology transfer effectiveness because, as the extant literature reveals, technology transfer effectiveness is an understudied area. In addition, no previous research has been conducted on technology transfer or investigated technology transfer effectiveness in the context of the automotive industry of Pakistan.

Fourth, unlike previous studies, this study investigates technology transfer effectiveness both through the lens of the sender (auto assemblers), the recipients (component suppliers) as well as considering the government as an important participant in the process and the effectiveness of technology transfer. Thus, this study acknowledges the role of these three parties in technology transfer effectiveness and by so doing, provides a better account of technology transfer effectiveness.

Fifth, this research combines different theoretical streams, for example, resource- based view of the firm (RBV), knowledge based view (KBV), organisational learning (OL), and social capital (SC) perspectives to investigate technology transfer effectiveness, thus appreciating the role of multiple theoretical perspectives to study technology transfer in a developing and emerging country context. This is important because these theories have been applied and tested time and again in the developed countries context, but none of these have been applied to the context of Pakistan. Again, this is important because, developing countries show distinctive cultural and institutional factors which are not found in the context of the developed countries; the literature on technology transfer and effectiveness in emerging and developing countries is at relatively early stage and needs more theoretical rigor to understand the phenomenon under investigation.

Sixth, this study applies qualitative interviews supplemented with survey questionnaires. Previous research on technology transfers have relied either on qualitative or purely quantitative research methods. Therefore, the credibility of the research findings has been enhanced by incorporating hybrid methodology and involving participants from both the sender's, the recipient's side as well as the Ministry of Industries and Production.
The contributions are discussed in detail in chapter 9.

1.4 Research Approach

Present research involves two phases of data collection. The first phase involves theory guided exploratory semi-structured interviews conducted with 50 Pakistani component suppliers, 3 auto assemblers (IJVs), along with the Ministry of Industries and Production. The detail of the research approach used during this phase of data collection is discussed in Chapter 6 (Methodology).

The second phase is characterised by face- to- face survey questionnaires distribution amongst the 50 component suppliers. This phase is also discussed in Chapter 6. The results of the qualitative semi-structured interviews, supplemented with survey questionnaires results, are discussed in Chapter 7. The empirical setting of all these phases of data collection is technology transfer effectiveness from IJVs to their Pakistani component suppliers in the automotive industry of Pakistan. Chapter 5 gives a more detailed background of the automotive industry of Pakistan. The section 1.5 provides a brief prefatory note on some of the major terminology used in this thesis.

1.5 A Note on major terminology

To help the reader comprehend this work more clearly, this section provides the succinct note on major terms used in this thesis: tacit and explicit knowledge, absorptive capacity, learning intent, breadth and depth of learning and exploitative/exploratory innovations.

Tacit vs. explicit knowledge

Tacit vs. explicit characteristics is concerned with how well the knowledge is articulated. Explicit knowledge can be expressed and communicated in the forms of documents, i.e., recipe of pizza dough, hence easy to transfer. Tacit knowledge is difficult to articulate, for example, teaching someone how to ride on a bicycle. This kind of knowledge is 'sticky', difficult to codify and transfer (for detail see chapter 3).

Absorptive capacity

Cohen and Levinthal (1990) define absorptive capacity as the ability to acquire and assimilate new external knowledge on the basis of its prior knowledge. According to this view absorptive capacity is a by product of firm's investment in R&D.

Learning intent

Hamel (1991) refers to learning intent, as the determination of an organization to learn certain skills possessed by its alliance partner.

Breadth and depth of learning

Breadth of learning insinuates the multiple areas in which a firm learns new technological skills through interacting with customers and businesses (Teece *et al*., 1994). Depth refers to a firm's mastery of new knowledge through diverse knowledge bases (Huber, 1991).

Exploitative and exploratory innovations

March (1991:85) defines exploitative and exploratory innovations as, ‘‘the essence of exploitation is the refinement and extension of existing competencies, technologies, and paradigms… the essence of the exploration is experimentation with new alternatives’’.

1.6 Organisation of the thesis

This thesis will document technology transfer effectiveness from IJVs to their Pakistani components suppliers of the automotive industry of Pakistan. This thesis is divided into nine chapters.

In chapter 1, the background and motivation, objectives, research approach, and contributions of this research are discussed.

Chapter 2 offers a discussion of the various theoretical streams, for example: resource- based view of the firm; the knowledge -based view of the firm; organizational learning; and social capital, to investigate the complex phenomenon of technology transfer and its effectiveness. These theories provide a good background to understand the value of acquiring valuable resources through the network, having absorptive capacity to assimilate the transferred technology, and the value of relational capital in the forms of trust and social ties for the receipt of useful know-how.

Chapter 3 discusses and explores the concepts of knowledge, technology and its transfer, and why technology transfer, and the role of foreign direct investment (FDI) in technology transfer are also highlighted.

In chapter 4 the research questions and conceptual framework of this research are presented, which draw insights from multiple theoretical perspectives. This framework is then applied to organise, code and analyse data.

Chapter 5 lays out the context of this research. The chapter gives a brief overview of the global automotive industry. The emphasis of this chapter is on the history of the automotive industry of Pakistan; various policy measures for this industry and the structure of the Pakistani component suppliers' industry.

Chapter 6 deals with the research methodology approach and the case is made to apply a multi-method research methodology to get insight into, not only the process of technology transfer, but also its effectiveness.

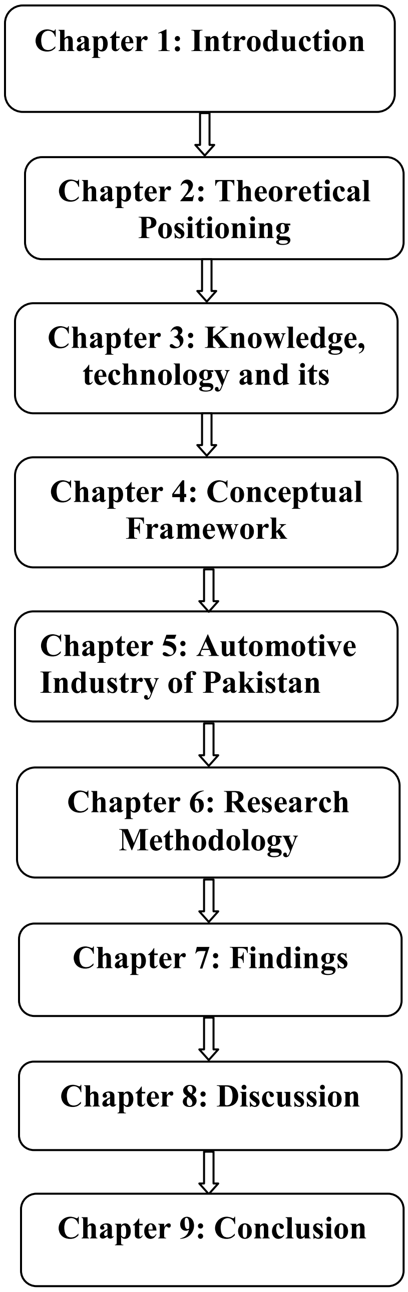
In chapter 7, the findings of this research are discussed by incorporating insights from the semi-structured interviews, supplemented with survey questionnaire findings to present the account of technology transfer processes, types of technology transfers, mechanisms used to transfer this technology, the role of recipient's learning intent, the recipient's absorptive capacity, the role of trust, social ties and technology transfer effectiveness.

In chapter 8, the results are summarised and discussed in the light of the literature review on technology transfer.

Finally, chapter 9 concludes the thesis, by highlighting the limitations of the study and future research directions.

The overall structure of this thesis is presented in figure 1.1.

Figure 1.1.Structure of the Thesis



Conclusion

Technological knowledge has emerged as a critical source for achieving sustainable competitive advantage. Often, policy makers in the emerging and developing economies have favoured foreign direct investment by multinationals as a package of advanced technology, marketing techniques and codified and tacit managerial know-how, as well as a recipe for their countries quick and easy economic development. Transferring technology between organisations presents great challenges for managers, and successful transfer is the ultimate goal for them. Technology transfer effectiveness will lead to capability development, performance improvement and innovativeness in the recipient's firm. Chapter 2 will provide the theoretical positioning, by presenting a brief overview of resource- based view of the firm (RBV), knowledge-based view of the firm (KBV), organizational learning and social capital theories.

CHAPTER 2: THEORETICAL POSITIONING

Introduction

In this chapter various theories will be discussed, for example, the resource-based view of the firm, the knowledge-based view of the firm, organisational learning and social capital in order to better conceptualise our understanding about the technology transfer process and its key factors, which make technology transfer effective, and moreover, to develop a conceptual framework for this research. In this chapter, we use the term 'buyers' in the context of the assemblers or IJVs established in the automotive industry of Pakistan, and 'suppliers' mean the domestic Pakistani component suppliers.

The chapter is divided into four sections. The first section deals with the resource-based view of the firm. In the next section, the knowledge-based view of the firm is presented. In the third section of this chapter, organisational theory is discussed. The fourth section highlights social capital theory. Finally the conclusions of the chapter are presented.

2.1 Resource-Based View of the Firm (RBV)

The resource-based view of the firm (RBV) provides a useful view of the firm's resources that are hard to imitate and provides the firm with a competitive advantage over its rivals in the market. Wernerfelt (1984), pointed out that a firm's resources can include ''anything which could be thought of as a strength or weakness of a particular firm and therefore, at a given time could be classified as tangible and intangible which are tied semi-permanently to the firm. Examples of resources are: brand names, in-house knowledge of technology, skilled personnel, trade contracts, machinery, efficient procedures, capital, etc.'' (Wernerfelt, 1984:172). For example, Hunt (Hunt, 2000: 34), has suggested that technological and knowledge resources can be ‘‘tangible and intangible entities available to the firm that enable it to produce efficiently and/or effectively a market offering that has a value for some market segments’’. Rodriguez and Rodriguez (2005), show that technological resources give a company with innovative capability, in the opportunity of developing a competitive advantage in global markets. On this basis, Lippman and Rumelt (2003), suggest that a firm can exploit their advantage by combining with outside resources.

These resources can give an enduring competitive advantage to a firm in that they are rare, hard to imitate and have no direct substitutes; firms can use these resources to their advantage and by using these resources they can avoid threats (Barney, 1991).

Therefore, the main argument of this theory is that a firm’s position in the market and environment is determined by the possessions of a bundle of resources (Penrose, 1959; Barney, 1991, 1996, 2001). According to the resource-based view, firms possess distinctive capabilities (competencies) and unique assets that are specific to them, and these distinctive capabilities and unique hard to imitate assets; determine the firm’s overall performance in the market vis-a-vis its competitors (Penrose, 1959; Wernerfelt, 1984; Prahalad amd Hamel, 1990). Tecce *et al*., (1997), went further to advance the notion of the dynamic capabilities approach to a firm’s advantage; according to them, a firm’s ability to acquire new knowledge to adapt to market conditions and upgrade one’s capabilities is crucial for a sustainable competitive advantage. But not all knowledge leads into competitive advantages (Barney, 1991; Peteraf, 1993). It is only when this knowledge is ‘sticky’ or ‘tacit’.

The developments in the resource-based view of the firm have highlighted the importance of technological knowledge as a key firm specific resource. According to Grant (1996: 375), ‘Knowledge has emerged as the most strategically-significant resource of the firm’, and that can lead to the development of a sustainable competitive advantage (Teece *et al*., 1997).

In order to study the technology transfer from automotive joint ventures to their component suppliers and the supplier’s subsequent use of the technology, we believe that the resource-based theory is appropriate as it focuses on the ability of a firm to be an architect of exploiting technological competencies through leveraging related resources and capabilities (Prahalad and Hemel, 1990). Therefore, we can say that the resource-based view of the firm considers a firm as a pool of resources and distinctive capabilities, and on this basis firms will determine their proper strategies (Prahalad and Hamel, 1990), and that will ultimately determine their performance.

A large body of extant literature shows the importance of these firms’ unique pools of resources in determining firm performance. For example, Rumelt (1991) found that firm specific resources within a given industry were more important in comparison to industry factors, when comparing the intra industry profits with inter-industry profits. Therefore, several scholars (Quinn, 1992; Grant, 2005) have argued that it is better to define the firm in terms of its resources, rather than merely on the basis of its market, thus providing the firm with a sound basis for strategy formulation and implementation.

Around the globe there are many companies who fulfil this definition, for example, Microsoft positions itself not as a software company, but a company that helps people and businesses develop their potential.

In the context of the automotive industry, and specifically in the automotive component suppliers’ context, these unique resources, which are hard to imitate and rare, can be considered to exist in the form of technological and managerial knowledge that many automotive companies possess, e.g. Toyota production systems. Therefore, in this study, it can be seen that automotive component suppliers may develop and exploit competitive advantages by combining their internal resources (current firm knowledge) with outside resources (technological know-how provided by other firms, i.e., Toyota, Honda, Suzuki, etc.) The global automotive industry is dependent upon radical innovations, for example, fuel efficient and electrical cars that can create a sustainable competitive advantage for these automobile companies. It is therefore logical for the automotive suppliers to examine their industry position, and partnerships with key automotive firms, to acquire access to technology and partner resources, thus filling important strategic and operational gaps.

In the context of ‘assembler-supplier interactions and learning, there is a strategic challenge involved in these alliances, which we called vertical learning alliances. Based on the premise of the resource-based view (Barney, 1991; Peteraf, 1993), and the dynamic capabilities approach of (Tecce *et al*., 1997), scholars of the learning alliance literature often posit that firms can accrue advantages by developing new capabilities through knowledge acquisition (von Hippel, 1988; Grant, 1996; Spender, 1996; Mowery, et al., 1996, 1998; Khanna, *et al*., 1998; Simonin, 1999, 2004; Anand and Khanna, 2000; Kale, *et al*., 2000; Dussauge, *et al*., 2004; Hatch and Dyer, 2004; Dyer and Hatch, 2006).

Following this line of thought, several industries witnessed the disintegration of vertically integrated enterprises and noticed that the matter of managing their supply network had become more prominent. For example, semiconductors and automobiles also witnessed the emergence of programmes focused on supplier development, that is to say, concerted efforts of knowledge transfer from assemblers to suppliers, whereby knowledgeable assemblers/buyers educated their suppliers about advanced production systems, i.e. 'flow', 'lean' or 'just in time' (Dyer and Nobeoka, 2000; Kotabe, *et al*., 2003; Dyer and Hatch, 2006). The logic is very simple, the knowledgeable buyers teach the less knowledgeable suppliers in order to develop a sustainable competitive supply chain[1] (Mesquita *et al*., 2008).

2.2 Knowledge based view of the firm

The resource-based view of the firm considers the firm as a collection of hard to imitate pools of resources and distinctive capabilities, and it is the deployment and subsequent management of these resources and capabilities that gives the firm a competitive advantage in the marketplace compared to its competitors. Scholars have developed its correlate, the knowledge based view of the firm (Grant, 1996; Nonaka and Takeuchi, 1995). These scholars argue that knowledge is the single most important organisational resource, and one that ultimately leads to the development of distinctive capabilities and competitive advantage (Bhagat, *et al*., 2002; Teece, *et al*., 1997). As Grant (1996:375), points out 'knowledge has emerged as the most strategically significant resource of the firm'.

The knowledge-based-view of the firm (KBV) scholars argue that firms are knowledge creating entities, therefore they suggest that knowledge is the very capability of a firm to create and utilise such knowledge for its sustainable competitive advantage, as well as to develop core competencies (Nonaka, 1990, 1991, 1994; Prahalad and Hamel, 1990; Nelson, 1991; Cyert, *et al*., 1993; Henderson and Cockburn, 1994; Nonaka and Takeuchi, 1995; Leonard- Burton, 1995; Kogut and Zander, 1996; Nahapiet Ghoshal, 1998; Spender, 1996;

[1] In this research, we take automotive companies, i.e., Toyota, Honda, etc. as buyers, and suppliers are their component parts suppliers.

Tecce, *et al*., 1990). The acquisition of knowledge and skills give a firm a competitive advantage and through this knowledge and these skills the firm is able to introduce new products, processes, services, or maybe improve existing ones more efficiently and effectively (Nonaka, *et al*., 2000).

The main assumption of the knowledge based view of the firm is that knowledge is the most strategically significant resource of the firm, particularly in technology intensive industries (Barney, 1986; Quinn, 1992; Grant, 1996). For technology intensive industries, and specifically for the automotive industry, the most important thing is the firm's capability of generating new knowledge along with having proprietary knowledge. Kogut and Zander (1992), discuss the notion of 'combinative capabilities', which consist of a firm's ability to use its existing stock of knowledge to create new knowledge as well as a firm's ability to utilise current knowledge. As Grant (1996:384), suggests that ''knowledge is the preeminent resource of the firm''. In a similar context, Liebeskind (1996) posits that knowledge is perhaps the most important asset that a firm possess.
The knowledge-based view of the firm (KBV) considers the firm as a stock of knowledge assets that it can utilise to create additional value (Grant, 2005).

Therefore, this theory views knowledge as the most important resource of the firm, a resource that contributes directly to firm's future performance. As this theory argues that knowledge is the key to sustained competitive advantage, it is therefore of the utmost importance that a firm possesses not only current knowledge but also has the capability to generate future knowledge. It is better to protect and develop new knowledge within a company than have its rival firms having more incentive to innovate (Liebeskind, 1996). In a similar vein, Galunic and Rodan (1998), find a firm's innovation as an outcome of the use of its knowledge based assets. Furthermore, Phene *et al*., (2006), suggest that the transfer and absorption of knowledge play a critical role in a firm's ability to create high value innovations.

The theory of the knowledge based view of the firm is built upon the main premise of the resource-based view of the firm, and mainly focuses on the knowledge as the main source of competitive advantage compare to a firm's other resources. Therefore, this theory in particular makes the case that knowledge is the most important resource of competitive advantage, and that the acquisition, possession and development of knowledge is obviously one of the most important strategic tasks the firms can pursue for a sustained long-term competitive advantage. As Itami (1987), argues that this technological knowledge is an 'invisible asset', and acquiring it requires the firm's commitment to organisational learning and knowledge management.

2.3 Organisational learning theory

In a highly competitive environment, the ability of firms to learn from external diverse knowledge sources is an important contributor for their innovation and growth. Levitt and March (1988:320), define organisational learning as that which enables organisations to encode "inferences from history into routines that guide behaviour." More specifically, Huber (1991:89), states that ''an organisation learns if any of its units acquires knowledge that it recognises as potentially useful to the organisation."

Firms can acquire learning through two sources: firms can learn through experience and from information available within the firm, by analysing past successes and failures and incorporating that knowledge into future decisions making and developments. Firms can also learn from other companies. For example, in the case of auto component suppliers, the suppliers can learn and acquire technology from their auto clients.

Organisational theorists have been emphasising the vicarious learning of the firms for many years. This type of learning occurs when a firm acquires new knowledge vicariously by observing and copying the successful practices of other firms, as in the case of Korean and Taiwanese firms (Levitt and March, 1988; Huber, 1991; Lant and Mezias, 1992; Campbell, 1994; Miner and Mezias, 1996). Since all firms exist within a social community of other firms, and through shared knowledge (tacit and explicit) and by observing knowledge development, firms within a social community can learn from each other. So in the case of the auto component suppliers, they can learn best practices from auto assemblers and vice versa. However, it also depends on the willingness of the sender to teach and transfer knowledge and the intent on the part of the recipients to learn. As March and Simon (1958), point out that most innovation comes from borrowing ideas, which is the process of vicarious learning, rather than inventing new ideas.

In the context of this research, we will use Schwandt (1993:8), definition of organisational learning: ‘‘a system of actions, actors, symbols, and processes that enables an organisation to transform information into valued knowledge which in turn increases its long term adaptive capacity’’ in the form of breadth and depth of learning and exploitative and exploratory innovations.

Scholars have identified two main strategies of organisational learning: exploration and exploitation (March, 1991). Exploration involves actively seeking new knowledge that will add to an organisation's stock of core competencies, or knowledge generation in the dynamic capabilities aspect of the resource-based view of the firm (Nonaka, 1994; Teece *et al*., 1997). On the other hand, exploitation is the process of seeking new ways to improve existing organisational capabilities and using existing knowledge to increase organisational effectiveness (Jones, 2001).

More specifically, Mowery (1983), builds upon the idea of a firm's vicarious learning and suggests that firms who are already engaged in research and development (R&D) are in a better position to learn from external sources than are those firms who are not actively involved in research and development. This firm's ability to learn from external sources is called ''absorptive capacity'' (Cohen and Levinthall, 1990). In their seminal article, Cohen and Levinthall (1990:136), defined absorptive capacity as a firm's ''ability to recognise the value of new external R&D knowledge, assimilate it and apply it to commercial ends''. What this means is that a firm's readiness in its own knowledge stock affects its ability to both acquire and use knowledge from outside the organisation, and it also points out that firm regularly scans their industry for acquiring outside knowledge. The tendency to scan the industry environment is relatively high in uncertain or rapidly changing environments, and such kind of scanning is important for organisational performance and feasibility (Elenkov, 1997; May *et al*., 2000).

The automotive industry is characterised by increasing technological changes, so we might expect the component suppliers to continuously scan for external knowledge from auto assemblers and the same might be the case for auto assemblers. However, in the process of scanning the relevant industry for knowledge, Phene *et al*. (2006), argue that firms typically limit their searches for outside knowledge to extent of technology that are known to them. This argument fits well with the notion of the 'absorptive capacity concept'.

In the resource and knowledge based view, knowledge has a central place as a key source of competitive advantage.

Organisational learning theory complements both the resource-based view and the knowledge based view of the firm, because organisational learning is considered a key requirement for the effective development of organisational resources (Penrose, 1959; Mahoney, 1995; Eishenhardt and Martin, 2000). Theories of organisational learning also emphasise that all organisations within an industry are not equally in a position to engage in knowledge acquisition; internal factors of the organisation affect its ability to acquire and use knowledge. In the case of the automotive industry particularly, and specifically in the component supply context, one would generally expect differences amongst component suppliers ability to absorb and use assemblers' technological knowledge.

2.4 Social Capital Theory

We believe that in the context of inter-firm knowledge transfer, having a clear understanding of social capital theory is important. The underlying principles of this theory will help to develop a better understanding of technology transfer effectiveness in the context of Pakistan's automotive industry.

Social capital theory states that the social relation is a very important and valuable asset that stems from access to resources generally available through social bonds (Granovetter, 1992). Nahapiet and Ghoshal (1998), for instance, proposed three underlying dimensions of social capital: structural, cognitive, and relational. Both these researchers argue that the structural aspect is related to social capital arising from the structural configuration, social ties, diversity, centrality and boundaries spanning roles of network members. On the other hand, they point out that the cognitive aspect refers to the resources that provide partners to the relationship with shared representations, interpretations and systems of meaning. They also suggest that shared meanings, such as shared values and goals, develop through an ongoing and self-reinforcing process of participation in sense making processes as the partners construct a shared understanding (Weick, 1995). Finally, Nahapiet and Ghoshal (1998) pointed out that the relational dimension associates with personal relationships that develop through a history of interactions, for example, the extent to which trust; obligation and reciprocity exist between the partners.

The impact of social capital on knowledge transfer has been studied by various scholars, mainly in the context of joint venture partners. For example, scholars in the field of organisational studies posit that alliance partners 'investment in inter-firm knowledge sharing routines result in firm value creation' (Dyer and Singh, 1998; Grant, 1996; Tyler, 2001). In the case of the supplier's capability development, such knowledge sharing routines are fundamental to any supplier capability improvement effort started by a client firm. Knowledge shared by client firms includes both the transfer of factual knowledge, i.e., sharing of production schedules (Kogut and Zander, 1992), and the transfer of more tacit, "sticky" knowledge (Szulanski, 1996). Inkpen and Tsang (2005), for example, considered the conditions that facilitate knowledge transfer in strategic alliances. They suggested that knowledge transfer was reinforced when there were long time perspectives, high transparency and multiple knowledge connections between exchange parties, a non-competitive approach to knowledge sharing, repeated transactions, and frequent interactions. In this study, many similar factors in an auto assemblers-suppliers setting are considered.

2.4.1 Cognitive Capital

According to the social capital theory, cognitive capital consists of the resources providing the partners involved in a relationship with shared representations, interpretations and systems of meaning (Nahapiet and Ghoshal, 1998). In a similar vein, Tsai and Ghoshal (1998), argue that within a firm, cognitive capital is embodied in a shared vision, for example, collective goals and aspirations of the partners, and is present when partners have similar perceptions of common goals and how they should interact during the exchange process.

Furthermore, Inkpen and Tsang (2005), point out that shared goals and culture are the two primary dimensions of cognitive capital. However, they further argue that goals are shared when members of a network share a common understanding and approach to the achievement of network tasks and resulting outcomes. When goals and values are shared by the assemblers and their suppliers, continued interaction will result in more technology transfers and knowledge sharing. As Weick (1995), suggested that when goals are shared, ongoing interactions between buyers and suppliers should result in an ongoing and self-reinforcing process of participation in sense making and socially constructed understandings.

Conversely, if goals and values are inconsistent, interactions between the two exchange partners might be expected to lead to the creation of the misinterpretation of goals and conflict (Inkpen and Tsang, 2005; Schnake and Cochran, 1985). Therefore, as misinterpretation and conflict between the exchange partners intensify, both partners in the relationship become dissatisfied, and to limit information sharing, results in negative technology transfer effectiveness.

2.4.2 Structural Capital

In the context of structural capital, Bessant *et al*. (2003), discovered that the collectivity and shared purpose associated with a social capital dimension help to establish 'appropriate practices' between two interacting firms. Various strands of research have suggested that organisational practices may range from the sharing of codified knowledge to more tacit types of knowledge.

From organisational theory, to research in the field of international business, the pivotal role of general knowledge sharing to the acquisition of capabilities through inter-firm ties have been recognised (Ahuja, 2000; Gulati, 1999; Stuart, 1998), and knowledge sharing with key suppliers, more specifically (Dyer and Nobeoka, 2000; Uzzi, 1997). Uzzi (1997) suggested that relational embeddness is important to knowledge transfer between exchange partners.
Social ties facilitate the access and transfer of useful tacit knowledge between the knowledge transfer parties (Reagans and McEvily, 2003; Yli-Renko *et al*., 2001). Networks embedded social ties create specific transactions opportunities for the participants (Adler and Kwon, 2002). For example, Inkpen and Dinur (1998) found that strong ties between the alliance partners facilitate knowledge transfer.

To summarize the above points, structural capital, interactions between the exchange partners can be expected to improve the technology transfer process and its subsequent effectiveness. Furthermore, knowledge recipient firm capability development activities, those focus more on intense communication that encompass the transfer of tacit knowledge, will have positive impact on the improvements in quality, delivery, reliability and flexibility of both interacting firms than explicit information sharing and transfer between the parties.

2.4.3 Relational Capital

The relational capital refers to the nature of the relationships themselves and the assets that are rooted in these relationships (Tsai and Ghoshal, 1998). Previous research has pointed out the strength of relations and trust. Trust ‘‘reflects the belief that a partner’s word or promise is reliable and that a partner will fulfil its obligations in the relationship’’ (Inkpen, 2000: 1027). Trust enables knowledge transfer since it increases partners’ willingness to commit to helping partners understand new knowledge (Lane, Salk, & Lyles, 2001; Szulanski, Capetta, and Jansen, 2004).

Researchers in the automotive industry context have also argued that trust tends to increase with the length of the relationship between auto assemblers and their suppliers and this can lead to technology transfer from assemblers to suppliers (Dyer and Chu, 2003; Helper, 1991; Helper, MacDuffie, & Sabel, 2000; Sako and Helper, 1998).

This line of research shows that trust is an important element of knowledge transfer and sharing and with high level of trust, tacit knowledge takes place which in turn enhance knowledge transfer effectiveness.

Conclusion

In this chapter, the main aim has been to discuss multi-theoretical perspectives, i.e. the resource-based view of the firm, the knowledge based view of the firm, organisational learning and social capital theories, to develop a better understanding about technology transfer effectiveness from IJVs to their Pakistani component suppliers. These theories provide good understanding about the importance of acquiring the technological knowledge for developing sustainable competitive advantage. In some ways, these theories complement each other.

It has clearly emerged from the findings in this chapter that knowledge is the key source of sustainable competitive advantage and it is a company resource that is difficult to imitate. Organisational learning is the key to developing core competencies and knowledge stock through vicarious learning processes. The acquisition of technology from partner firms will enable the recipient firms to develop exploitative and exploratory innovations. For this to happen, the nature of social bonds and relationships in the forms of structural social ties, cognitive shared understanding, and relational social capital will be important to acquire the tacit technological knowledge. In next chapter the key concepts of knowledge, technology and its transfer are discussed.

CHAPTER 3: Knowledge, Technology and its Transfer

Introduction

This chapter deals with the key concepts of knowledge, technology and its transfer to develop a better understanding about these concepts, because these concepts form the core of this thesis. To understand technology transfer effectiveness from international joint ventures (IJVs) to their Pakistani component suppliers, it is important to have a clear idea about the type of knowledge and technology, and how the different types of technology transfers take place through various mechanisms.

This chapter is divided into eight sections. The first section will discuss the importance of knowledge, and will review the types of knowledge and transfer mechanisms in order to develop a better understanding about the technology. The second section will deal with the main contents of the technology by focusing mainly on various definitions of it and by focussing on the neoclassical and evolutionary view of technology. The third section will elaborate on the technology transfer aspect and why this transfer matters. In the fourth section, the main channels and mechanisms of technology transfer will be discussed. The fifth section deals with foreign direct investment as a main channel of technology transfer. The next section deals with joint ventures as a mean of technology transfer. In the eighth section of this chapter, the concept of technology transfer effectiveness is discussed. In the last section of this chapter, the conclusions are presented.

3.1 Importance of Knowledge

In order to develop a better understanding about the entire process of technology transfer and its effectiveness from IJVs to their Pakistani components suppliers, it is important to discuss different types of knowledge. Before moving on to discussing the different forms of knowledge, as a starting point, it is relevant to look at the importance of knowledge. The aim of this discussion is to orient the reader to the underlying logic of why the knowledge has become such a critical organisational resource in the global economy.

Many scholars have emphasised the important role of knowledge (e.g., Bell, 1973; Drucker, 1968; Toffler, 1990), amongst others. Bell (1973), even suggested that knowledge is the central feature of post-industrial societies. Knowledge is becoming a source of competitive advantage in highly interconnected and globalized markets, due to the intense competition.

The changing nature of the business environment has rendered knowledge a key source of developing long-term competitive advantages for companies (Lyles and Salk, 1996; Tsai, 2001; Zahra, Ireland and Hitt, 2000), and because knowledge is one of the intangible resources, it plays a very crucial role in the creation and development of sustainable competitive advantage (Grant, 2008; Hall, 1993; Sirmon and Hitt, 2003). The causal ambiguity nature associated with intangible resources means it becomes difficult for competitors to imitate such intangible resources, therefore, making their contributions more enduring (Nahapiet and Ghoshal, 1998).

Knowledge is a critical source of competitive success, because competition is becoming increasingly knowledge intensive. As Grant (1996:375), suggests ‘'knowledge has emerged as the most strategically-significant resource of the firm''. Both management executives and research scholars have identified and recognised an organisation’s ability to learn as perhaps the single most important factor in achieving long- term sustainable growth and competitive advantage.

Indeed in recent years, the academic literature on organisational learning as a source of competitive advantage has been expanding in an unprecedented fashion (e.g., Cohen and Levinthal, 1990; Teece, Pisano and Shuen, 1997; Kogut and Zander, 1992; Spender, 1996; Grant, 1996). Teece *et al*. (1997) have suggested a ‘‘dynamic capabilities’’ approach to firm-level advantage highlighting that a firm’s ability to continually learn, adapt and upgrade its capabilities is key to competitive success.

Other scholars have also argued for a ‘knowledge- based view of the firm’ highlighting that the key role of the firm is in creating, storing, and applying the knowledge (Kogut and Zander, 1992; Conner and Prahalad, 1996; Grant, 1996), rather than simply reducing transaction costs (Coase, 1937; Williamson, 1985).

Furthermore, some scholars have also pointed out a firm’s ability to imitate a rival firm’s knowledge as a source of long- term sustainability and competitive advantage (Lippman and Rumelt, 1982; Simonin, 1999). In addition, competition amongst firms has also become increasing knowledge based (e.g., Amesse and Cohendet 2001; Ruggles 1998; Scarbrough and Swan 2001).

Accordingly, a large number of studies have emerged describing the various characteristics of knowledge that may also impede the imitation of these rent-yielding knowledge assets. For example: causal ambiguity (Lippman and Rumelt, 1982, Simonin, 1999), and complexity, tacitness and teachability (Barney, 1991; Kogut and Zander, 2003). Much of this work has taken place in the context of the resource-based view of the firm (Barney, 1991; Wernerfelt, 1984), the knowledge-based view of the firm (Grant, 1996) and of course the evolutionary theory of the firm (Nelson and Winter, 1982).

In addition to the above research, a parallel theme has also emerged in regard to knowledge as a strategic resource (Bartlett and Ghoshal, 1986; Gupta and Govindarajan, 1991; Kogut and Zander, 1993), amongst others. Knowledge transfer has also been recognised as a contributor of competency- based human resource development and performance in IJVs partners (Lyles and Salk, 1996; Tsang *et al*., 2004), sales growth and returns on equity in newly established ventures (Zahra *et al*., 2000), and new product development in young technology firms (Yli-Renko *et al*., 2002). Therefore, understanding the key factors that contribute to knowledge transfer effectiveness across organisational boundaries has become a key area of enquiry among both academics and practitioners (Easterby-Smith *et al*., 2000).

The above discussions have highlighted the important role of knowledge in this highly competitive business environment. Scholars have emphasised that knowledge is a strategic resource required by an organisation to compete and survive.
Keeping in mind the above discussion, it is important to define the various types of knowledge and the transfer mechanisms associated with each type of knowledge.

3.1.1 Types of Knowledge

The understanding of different types of knowledge is important because a sending firm needs a certain capability and transfer mechanisms to transfer different types of knowledge and the recipient's company needs absorptive capacity (Cohen and Levinthal, 1990) to receive different types of knowledge.

Knowledge is an elusive concept that has been classified and defined in the extant literature in many different ways (e.g., Hedlund, 1994; Huber, 1991; Nonaka and Takeuchi 1995, Spender 1996). For a starting point, we acknowledge the distinction between ***information*** and ***know-how*** put forward by Kogut and Zander (1992).

According to Kogut and Zander (1992: 386; see also von Hippel, 1988), ***information*** is ‘‘knowledge which can be transmitted without loss of integrity once the syntactical rules for deciphering it are known.’’ ***Know-how*** is ‘‘the accumulated practical skill or expertise that allows one to do something smoothly and efficiently.’’ The focus of this thesis is on the firm's technology assets, which include product related technology, process and managerial related technology. These technology assets may be viewed and categorised as consisting of both information and know-how, although some of these assets are relatively high in information, for example, the blueprint of a door handle component and others are relatively high in know-how, for example, different mechanisms to improve organisational processes or organisational routines.

In a highly regarded study, Winter (1987), took the information vs. know-how distinction even one step further by highlighting that knowledge could be understood in terms of four key attributes: (1) **tacit--articulate**, (2) **observable in use--not observable**, (3) **complex--simple**, and (4) **element in a systemic--independent**. These attributes are presented in figure 3.1. According to Winter (1987) these attributes are directly related to the ease of transfer of the knowledge in question, as some types of knowledge are tacit, hard to observe, complex and system dependent, and are thus very hard to transfer; other types are easy to articulate, observable in use, simple and system independent, Teachable, not teachable, and are very easy to transfer. Winter argued that simple knowledge requires little information to describe it. In contrast, more information is needed to describe the complex knowledge. Simonin (1999:600) defines complexity as "… the number of interdependent routines, individuals, technologies and resources linked to a particular knowledge or asset.'' Kogut and Zander (1992) suggest that complexity increased the likelihood of knowledge transfer within the firm rather than licensing a technology to third parties. Therefore, an important research issue is to what extent the sender is willing to transfer simple vs. complex knowledge to the potential recipients of the knowledge. In the case of the systemic knowledge it has to be described in relation to other knowledge systems. In comparison, independent knowledge can be described by itself.

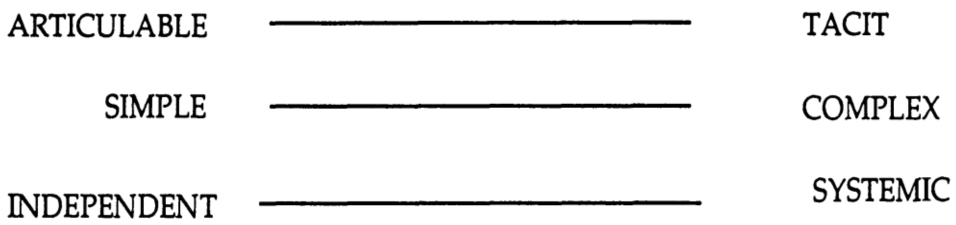
Teachable technological knowledge characteristic deals with the feasibility of teaching and communicating this sort of knowledge to the recipients of knowledge. The concept of teachability is more or less related to the concept of observability and imitability of knowledge. The observable and imitable technological knowledge is easier to teach, however, there are other factors, which are part of teachability (Kogut and Zander, 1993). The more teachable technological knowledge makes its transfer easier, faster, and less costly and may be over a short span of time. As, it has been recognized in the literature that any technology transfer project often requires the sending of engineers and workers from the senders to the recipients in order to assist them with building up the technological know-how. To the degree that this technological know –how is easy to teach, its transfer can be more feasible and, therefore, can be expedited to the recipients. In the case of

Winter (1987) treated each dimension of knowledge as a continuum along which each of the knowledge could be located. The position of knowledge along the continuum affect the amount and type of information required to describe it. Hence, it also affects the relative ease of its transfer across organisational boundaries. For example, greater knowledge complexity requires more information and willingness of the sender for this kind of transfer to take place.

In the case of the automotive industry, we argue that different auto components are based on simple/complex designs and engineering complexities and, therefore, require more or little information to describe and transfer. So we argue that the willingness of the sender will also depend on the type of knowledge being transferred to the recipients of knowledge. The complex/tacit knowledge requires richer mechanisms to transfer it (Teece, 1981). These various knowledge dimensions are depicted in figure 3.1. Knowledge located on the left side of the figure 3.1 is, relatively speaking, easier to transfer across time and space compared to knowledge positioned on the right side of the figure.

Figure 3.1

Dimensions affecting technology transfer



Source: Adapted from Winter 1987

The most widely cited distinction in the literature on knowledge transfer is between the two types of knowledge: **explicit and tacit** (Polyani, 1966; Inkpen and Dinur, 1998).

Explicit knowledge can be put into documents, file, codified, articulated and captured in the forms of text, diagrams and tables (Nonaka, 1991). This type of knowledge may be transmitted in formal, systematic language, and it may include facts and symbols (Kogut and Zander, 1992).

Explicit knowledge is embedded in standardised procedures (Nelson and Winter, 1982; Martin and Salomon, 2003a). However, this may also involve the tacit element as well. Nonaka (1994), further points out that organisations create knowledge through the continuous dialogue between tacit and explicit knowledge. He argues that explicit knowledge may be articulated in words and numbers and can be shared in the form of data, scientific formulae and specifications. This type of knowledge can be codified, relatively easily transferred and is free of context. Explicit knowledge has a "universal" character (Nonaka and von Krogh, 2009).

Tacit knowledge develops from the transfer of context-specific knowledge embedded typically in non-standardized and tailored processes (Polanyi, 1966). Tacit knowledge is difficult to capture in the form of text. Therefore, it cannot be articulated. Reed and DeFillippi (1990: 89) define tacitness as the implicit and non-codifiable accumulation of skills that result from learning by doing. As Polyani (1966:4), who coined this term puts it ''we know more than we can tell''. Tacit knowledge constitutes intuitiveness. Three decades later, Grant (1996: 114) admits that 'research into organisational learning and management of technology ... has made only limited progress in addressing the fact that, if most of the knowledge relevant to production is tacit, then the transfer of knowledge between organisational members is exceptionally difficult.'

Furthermore, Nonaka and Takeuchi (1995) posit that explicit and tacit knowledge are not mutually exclusive but complementary to each other and knowledge can be converted from one form to the other. However, the conversion of knowledge from one type to the other is not always an easy task for organizations. Organisations have to make systematic efforts to reap the benefits of tacit elements of knowledge. So, this form of knowledge mainly resides inside the mind of the individual, and it is difficult to articulate, i.e., riding a bicycle. Therefore, the organisation cannot leverage this form of knowledge since it is not explicit. It can only be captured through close interactions between people, i.e. scientists working together. In the context of the automotive industry, close interactions between component suppliers and assemblers are important to integrate the tacit component technology.

Tacit knowledge remains slippery and elusive, limiting the degree to which it might be articulated and shared. For example, Szulanski (1996) study found that most difficulties in transferring largely tacit knowledge are a result of the recipient's lack of experience to make effective use of new ideas and arduous relationships (according to him that is laborious and distant) between the source and the recipient. So the absorptive capacity or knowledge base of the recipient firm is important (Penrose, 1959; Cohen and Levinthal, 1990; Lane and Lubtakin, 1998; Zahra and George, 2002). As Cohen and Levinthal (1990:128) suggest:

''Prior related knowledge confers an ability to recognise the value of new information, assimilate it, and apply it to commercial ends. These abilities collectively constitute what we call a firm's absorptive capability''.

Polanyi (1966) further states that tacit knowledge is embodied in the intersection between the individual and his/her culture. Although tacit knowledge is arguably more valuable, explicit knowledge is easy to acquire and can be exploited quickly (Polanyi, 1966).

On the basis of the above discussion, we can say that different spectrums of knowledge can be categorized as relatively tacit or explicit. Generally speaking, quantifiable technologies, for example, production systems and processes are more explicit and more easily transferred than the ‘‘soft’’ human know- how (Von Glinow and Teagarden, 1988). In contrast, managerial and marketing expertise is more tacit than product development, production, and technology (Shenkar and Li, 1999; Lane e*t al*., 2001). Management and marketing skills are embedded within the organizations and are not easily codified in formulae or manuals; they also cannot be reverse-engineered easily (Zander and Kogut, 1995). As Barney (1991) points out it is impossible to copy exactly a top management team from other organization. According to Barney (1991) management knowledge is difficult to imitate. So the management skills cannot be packaged or bundled into blue prints, it requires closer interaction between two firms. Other scholars (Davenport, 1998), for instance, have suggested that knowledge is embedded in organisational process, routines and norms, and it can only be obtained through structured media or through person-to-person contact. Table 3.1 provides some examples of explicit/codified and tacit knowledge.

Table 3.1

Examples of Activities representing Codified vs. Tacit Knowledge

Type of Activity	**Relatively Codified**	**Relatively Tacit**
Export strategies	• Engagement of particular export intermediaries • Procedures for completing paperwork for export activities	• Decision-making procedures for selecting new markets • Integration of exported products with rest of global production system
Product development and manufacturing	• Exterior design of product • Assembly of discrete component parts	• Mechanisms for making continual process improvements • Links among engineering, marketing, and manufacturing
Human resource practices	• Codified human resource policies • Pay scales	• Links among human resource policies, other organisational practices, and organisational culture

Source: Adapted from Spencer, 2008: 345

The above literature clearly indicates that firms face difficulties when it comes to transfer hard to articulate knowledge and, therefore, this type of knowledge requires closer interactions between the sender and the recipient. However, this type of literature has not paid much attention to other contextual factors, i.e., local market characteristics and the willingness of the sender to transfer the tacit knowledge. This study intends to explore these issues in the context of the automotive industry of Pakistan. The next section deals with knowledge transfer in order to better understand how to transfer different types (explicit vs. tacit) of knowledge.

3.1.2 Knowledge Transfer

Knowledge transfer is the process of moving knowledge from one organisation to another organisation or from one unit of an organisation to another. The concept of knowledge transfer is difficult to capture, because there are many definitions of knowledge transfer. The extant literature does not make a clear distinction between knowledge transfer and the creation and sharing of knowledge. As Zander (1991) suggests recipients of knowledge would normally be obliged to dedicate substantial resources to assimilate, adapt, and improve upon original technology. According to Zander, the modification and further development of the technology are thus, very often, an integrated part of this transfer.

The extant literature also shows that what some scholars call knowledge transfer, others equate with knowledge combination, knowledge creation, learning, or sharing (Bartlett and Ghoshal, 1989; Hedlund, 1994; Huber, 1991; Nonaka and Takeuchi, 1995). For the purpose of this research, we use the term knowledge transfer only, and we use the definition of Argote and Ingram (2000), because this definition is comprehensive and covers both the sender's and recipient's related factors. Argote and Ingram (2000:151) defined knowledge transfer as, ''knowledge transfer in organisations is the process through which one unit (e.g., group, department, or division) is affected by the experience of another.'' Darr and Kurtzberg

(2000:29) go further by suggesting that knowledge transfer occurred, ‘‘when a contributor shares knowledge that is used by an adopter.’’

In a somewhat similar vein, Davenport and Prusak (2000) suggest that knowledge transfer involves: transmission and absorption. To transmit is to merely send, or present, knowledge to potential recipients. In contrast, absorption means the knowledge is absorbed its recipients, and knowledge is not really transferred unless it is totally absorbed by the recipients of knowledge. The goal of a knowledge transfer project is not only to transmit and absorb knowledge, but also to use and apply the knowledge, to improve an organisation’s ability, and thereby increase its value (Davenport and Prusak, 2000).

Research in the area of knowledge transfer has identified several elements involved in the knowledge transfer process, for example, knowledge (Bresman *et al*., 1999; Simonin, 1999; 2004; Szulanski, 1996; Zander and Kogut, 1995), senders of knowledge (Gupata and Govindarajan, 2000; Inkpen and Dinur, 1998; Szulanski, 1995; 1996), recipients of knowledge (Lyles and Salk, 1996; Siminon, 2004; Szulanksi 1996), factors related to the relationship between the two parties involved in the transfer (Inkpen and Dinur, 1998).

Majority of these studies have focused either on the relationship between the parties involved in the technology transfer, the recipient itself, the source itself or the type of technology being transferred. So far research has failed to simultaneously investigate all these elements.

This research will capture the sender’s-related, recipient’s-related factors, transfer mechanisms, transfer process, type of technology being transferred, and inter-organizational dynamics, i.e. social ties and trust to investigate technology transfer effectiveness. In this study, technology transfer and its effectiveness is understood as the movement of technology from senders (IJVs- auto assemblers), so that it is learned, and applied, in terms of exploitative, exploratory innovations, and the breadth and depth of technological learning by its recipients (Pakistani component suppliers). In this research, transferred technology includes product, process and managerial technology, and effectiveness includes exploitative, exploratory innovations, and the breadth and depth of technological learning, as the outcome of this transfer.

3.1.3 Knowledge transfer process

In his seminal article, Grant (1996), documents the attributes of the senders of knowledge and the recipients of knowledge, the characteristics of the knowledge, and the knowledge transfer process itself, as main elements of developing capabilities that lead to long-term competitive advantage of organisations. This is somewhat similar to the argument of Argote, McEvily and Reagans (2003), who identify properties of knowledge, properties of units, and the relationship between units as central elements for mapping the knowledge transfer process context. In this study, we will place these elements together and will investigate how these elements influence technology transfer effectiveness in the automotive industry of Pakistan. As Easterby-Smith *et al*., (2008) suggest that inter-organizational technology transfer entails at least two organizations, and therefore the need is to understand the inter-organizational dynamics between the parties involved in the technology transfer.

In a similar vein, Szulanski (1996), describes knowledge transfer as a process consisting of sender, channel, message, recipient and context. For example, in his study of best practice transfer within the organization, Szulanksi (1996) suggests a four stage knowledge transfer process: initiation, implementation, ramp-up and integration. The initiation stage consists of identification and search for required knowledge transfer. In the implementation stage, knowledge transfer related activities are carried out by the sender and the recipient and knowledge is exchanged. In the ramp-up stage, recipients start using the knowledge and the unexpected problems faced by the recipients are identified and resolved at this stage. In the integration stage, the recipient achieves satisfactory results with the transferred knowledge and the knowledge is also documented and adopted at this stage in the recipient's context.

Szulanski (1996) also argues that knowledge transfer is difficult and it may face many barriers to its transfer even within the same organisational units. The recipients of knowledge need the motivation to learn that knowledge, and the sender of the knowledge must have something worthwhile to offer. Previous research has documented that the recipient's learning intent is a key determinant of knowledge transfer (Hamel, 1991; Perez-Nordtvedt *et al*., 2008). As Simonin (1999:409) puts it 'learning intent captures the degree of desire for internalising a partner's skills and competencies'. In this study, we also expect the learning intent of the suppliers related to technology transfer from their components buyers to be positively linked with the technology transfer effectiveness. Along with learning intent, the sender's willingness to transfer can be an equally important factor of the knowledge transfer process and its success (Ko *et al*., 2005). Sender's willingness is an important determinant of transfer technology.

The previous research has so far focused on in this concept through the lens of theoretical and case based studies (Husted and Michailova, 2002; Carbrera, 2003; Lindsay *et al*., 2003; Davis *et al*., 2005).

Though, the importance of this concept has been acknowledged, more empirical evidence is so far lacking. Only the studies of Szulanski (1996), Simonin (1999), and Gupta and Govindarajan (2000), are the few examples. These studies use different measures for this concept. For example, Simonin (1999 a, 1999b) uses two different measures for this concept for the transfer of marketing know- how, i.e., whether the partner has intentional routines, procedures and policies to protect the sharing of marketing knowledge, and partner protectiveness for the sharing of marketing know-how. On the other hand, Szulanski (1996) uses 13 items to measure sender's lack of motivation to share knowledge and suggests that knowledge related factors are important compared to motivational factors for the successful transfer.

Osterloh and Frey (2000) point out that extrinsic and intrinsic motivation have impact on both explicit and tacit forms of knowledge transfer. Since competitive advantage lies in exploiting tacit knowledge, therefore, transferring tacit knowledge requires long- term commitment and teaching (Winter, 1987). Scholars have also argued that firms vary in their ability to create and transfer knowledge (Teece, 2000; Kogut and Zander, 1993) or what Martin and Salomon (2003:363) called 'knowledge transfer capacity', as the ability of a firm (or the relevant business unit within it) to articulate uses of its own knowledge, assess the needs and capabilities of the potential recipient thereof, and transmit knowledge so that it can be put to use in another location''. In the context of this research, we also see sender's willingness or the ability to transfer the technology related to product, process and managerial technology as one of the key determinants factor behind the technology transfer effectiveness.

So far, the studies on technology transfer have entirely focused on the recipient side factors (Lyles and Salk, 1996; Simonin, 1999, 2004), and have not explored the interaction affect of learning intent and willingness to transfer; for example, lack of willingness to transfer and teach may inhibit the enthusiasm of learning and vice versa. In this study, we will explore these concepts simultaneously in the context of the automotive industry of Pakistan.

Szulanski (1996, 2000) documents the detailed view of knowledge transfer as a process, but his study is in the intra-organisational context and does not explore in detail the organizational dynamics in the forms of trust and social ties. Transferring knowledge within the organization is not that trivial compared to transferring knowledge between different organizations (Easterby-Smith *et al*., 2008). In addition, this line of literature has not fully captured the distinct phases within each stage of the transfer process which may ultimately affect the technology transfer and its effectiveness, as Van Wijk *et al*. (2008), point out that there is a gap in the literature about the distinct phases in the technology transfer process. In this study, we will examine the entire process and distinctive phases within this process by taking into account of the senders and recipients of technology in the automotive industry of Pakistan. The following section deals with the transfer mechanisms.

3.1.4 Knowledge transfer mechanisms

Prior research has shown that several mechanisms exist for knowledge transfer from one organization to another. These might include: staff training of the recipient organisation, planned social events, transfer of key staff members to the recipient organisations, providing business related documents, blueprints, or hardware that embodies the knowledge to be transferred to the recipient organisation, communication, observations, presentations, and interactions with suppliers and their buyers/assemblers. Sammarra and Biggiero (2008) suggest that knowledge transfer mechanisms supporting both formal and informal interactions used in an organisation will more likely transfer multiple types of knowledge.

Similarly, Mason and Leek (2008) also indicates that mechanisms associated with knowledge articulation in the form of conferences or inter-organisational reviews, and knowledge codification mechanisms in the form of documents, review procedures and decision support systems influence knowledge transfer. The transfer mechanisms also depend on the types of knowledge being transferred. For example, Hong and Nguyen (2009) suggest that knowledge embeddedness and knowledge types affect the nature of knowledge transfer and local adaptation mechanisms in MNCs. However, the above studies did not investigate the usefulness of these various mechanisms. In the context of this research, we argue that the usefulness of these transfer mechanisms may vary from context to context and therefore, requires full investigations.

In order to fully understand the mechanisms behind the transfer of knowledge, several scholars have developed different types of taxonomies of learning. As Rosenberg (1982), point out that learning not only occurs in the manufacturing stage, but also occurs at the stage of using new products, because some new products, especially capital goods only show some features in the process of utilising them by the final users. According to Rosenberg, it constitutes another mechanism of acquiring knowledge, i.e. ‘’learning by using’’.

Other researchers have discussed other mechanisms for the learning and development of technology. Some have termed it as learning by operating, learning by hiring (e.g., Bell, 1984), learning through training (Enos and Park, 1988), and learning by searching (Cohen and Levinthal, 1989).

The list of types of learning has expanded exponentially over the years (see Table 3.2).

Table 3.2

Taxonomies of Learning

Different Learning Taxonomies	Key Authors
Learning by doing	Arrow (1962)
Learning by using	Rosenberg (1982)
Learning by operating; learning by changing; system performance feedback; Learning by training; learning by hiring; Learning by searching	Bell (1984)
Learning by trying	Fleck (1994; Rosenbloom and Cusumano 1987)
Learning by interacting	Lundvall (1988)
Learning by selling	Thomson (1989)
Learning from inter-industry spillover	Malerba (1992a)
Learning to borrow	David (1993)
Learning by failing	Bahrami and Evans (1995)

Source: Based on Malecki (1997: 59)

The above table provides useful taxonomies of acquiring knowledge through various mechanisms. For example, tacit knowledge can be acquired and learned through social interactions (Lundvall, 1988). The next section deals with the various definitions of technology.

3.2 Various definitions and attributes of Technology

When it comes to defining the term ‘technology’, numerous conceptual difficulties crop up. It is a slippery term. Technology is, in fact, a broad concept, moving from simple production techniques to tacit management know-how.

The word technology is derived from two Greek words techne (meaning arts, or crafts) and logos (meaning word, or knowledge). In numerous instances, definition controversies may be easily resolved by simply referring to dictionaries. But this is not one of those instances. The Webster’s unabridged dictionary (1989:1872) presents three definitions of technology;

however, none of these definitions of technology resolves the controversies. According to this dictionary, technology is defined as: (a) the science or study of the practical industrial arts; (b) the term used in a science, technical terminology; (c) applied science.

While browsing through the literature on technology transfer, one can find various definitions of technology. Therefore, it is important to examine and compare different definitions in order to get a good feel for the characteristics of technology from a variety of angles. This will allow a connection of all the pieces of the puzzle in this study. First of all, we will deal with the neoclassical view of technology and subsequently with the evolutionary view of it in order to get a clear understanding of the concept.

3.2.1 The Neoclassical View of Technology

Neoclassical economists have always treated technology as exogenous to the firm. From the neoclassical point of view, they have conceived technology as necessary information for the design and production of specific goods by any number of alternative methods (Arrow, 1962). He further points out that technology is generally available and easy to reproduce and reuse. Moreover, according to their narrow perception of the term 'technology', neoclassical economists have treated technology as a ''public good''. According to the public good nature of technology, they have ignored the important aspect of cost associated with technology generation and its transfer. Generally speaking, firms have to make a lot of effort to learn and apply this technology for routine use. So there is a cost associated with the technological know-how.

However, in later studies, the learning mechanism is widely addressed and discussed. Arrow (1962) provides an endogenous theory to explain the development of technology. He equates the acquisition of knowledge with the learning process, and further points out that learning is a product of experience. Moreover, learning is associated with the repetition of dealing with the same problem. This repetition sharply diminishes the input, especially time input, required for the same output. Based on this idea, he draws a learning curve, and reveals the mechanism of ''learning by doing''. Furthermore, Arrow (1969) also suggests that firms can produce and use innovation mainly by dipping freely into a general stock or pool of technological knowledge.

On the other hand, there are also other scholars who describe the properties of technological knowledge as an economic good. For example, Romer (1990) suggests that knowledge is a non-rival good. It may be used simultaneously by two or more agents. Grossman and Helpman (1991) also recognise the two properties of technology. One is non-rival when an agent uses technology to produce goods or a service. This action does not preclude others from also doing the same. The other is non excludable, which means the creators, or owners of the technical information, often have difficulty in preventing others from making unauthorised use of it, at least in some of its applications.

However, assuming that technology represents free goods and anybody can use it, goes nowhere in understanding the characteristics of technology, and this view is contradicted by the growing number of empirical studies on technology transfer. These empirical studies indicate that international technology transfer carries significant resource costs (Mansfield and Romeo, 1980; Ramachandran, 1993; Teece, 1977). In his study on 29 technology transfer projects, Teece (1977) found that, on average, such costs were approximately 20 percent of the total costs of the project, and in some cases, these costs were as high as 60 percent. This clearly shows that technology transfer is a laborious process and firms must incur substantial costs in order to get access to technology, because some technology cannot be easily articulated and hence is difficult to teach. For example, the underlying knowledge of automotive pistons or power-train is highly complex and cannot be easily communicated to the component suppliers. The component knowledge requires close interactions and relies on the recipient's absorptive capacity to absorb this type of knowledge and the sender (assembler) willingness to transfer. Furthermore, this knowledge is not a public good.

3.2.2 Evolutionary view of Technology

Due to the narrow perception of neoclassical economists on technology, the evolutionary economists view technology differently. Some scholars have defined technology as generic knowledge. As Dosi (1988) calls these packages of generic knowledge ''technological paradigms''. In a similar vein, Zander (1991) defines technology as ''knowledge about a particular technique, the art of industrial production'' with a hardware part, i.e. tools and artefacts, and a software part consisting of information and skills relating to the use of those artefacts.

Furthermore, several other scholars have pointed out that technology must be understood as involving a body of artefacts, or a practice, and a body of understanding (Pavitt, 1999; Freeman, 1988; Rosenberg, 1976), amongst others. In a similar vein, several other scholars have defined technology as a broader body of knowledge constituting a set of related techniques, methods, and designs applicable to the entire class of problems (e.g., Rosenberg, 1982; Arora and Gambardella, 1994). Therefore, according to the evolutionary economists, 'technology' is an applied knowledge.

On the other hand, scholars from the discipline of management consider technology as firm-specific information including the characteristics and performance properties of the production process and product design (Caves, 1982; Dunning, 1981). According to these scholars, technology is mainly differentiated knowledge about specific applications, tacit and often uncodified, and largely cumulative within firms because of this, technology is included among the firm's ''intangibles'' (Caves, 1982) or "firm-specific" assets (Dunning, 1981).

From the above surveys, it is clear that the definition of technology varies, because of the varying perspectives of the study; technology is viewed in different ways by different authors. So two fundamental conclusions arise from these definitions: Firstly, there are two basic components in most definitions of technology: knowledge or technique, and the doing of things. Secondly, most of the definitions that deal with technology are too narrow centred on the production field.

Comparing these basic components of technology with the narrow scope of the traditional definitions, it is however, obvious that technology should have not only a production aspect, but also management or organisational knowledge. It should have two parts: tangible and intangible. ***Therefore, for the purpose of this study the broader definition of technology will be used and technology is mainly understood as a sub-set of knowledge which is applied knowledge, for example, hardware equipment, blueprints, documents, and knowledge including the tacit form as well as the management and organisational knowledge that allows organisations to upgrade their products, processes and managerial practices.***

In this research, three types of technology transfer will be explored, mainly: ***Product related technology***; ***Process related technology***; and ***Managerial related technology***. While previous research has focused technology transfer in general, relatively little attention has been paid to the full package consisting of product, process and managerial technology (Sammarra and Biggerio, 2008; Siminon, 1999b). These three areas of technology cover both tacit and explicit elements and are discussed below.

3.3 Types of Technology

The management literature generally refers to at least three types of technology: Product – related technology; Process-related technology; and Managerial- related technology.

In this section, the emphasis is on product related technology.

3.3.1 Product related Technology

Product related technology refers to the knowledge used to produce any product, for example, the information that specifies the product's characteristics and its uses. In this type of technology, the flow of technological knowledge from the sender to the recipient firm is through the means of providing product design, the specification of products and the provision of feedback on specific product performance (UNCTAD, 2001). In the automotive industry context, suppliers may receive component design, technical specifications, quality control parameters and technical consultations on component characteristics and feedback on the performance of components from their assemblers.

3.3.2 Process related Technology

Process related technology consists of the knowledge used in the production process to organise inputs and the operation of the machinery. This type of technology relates to the process by which a given product or service is produced (Grosse, 1996). This may also relate to the assistance provided by the sender of technology in terms of providing machinery or equipment, or other process related technical support in the areas of manufacturing of products, quality control, inspection and testing. Through this assistance, the recipients may improve and streamline their processes to ensure that products meet the customer requirements.

In the context of the automotive industry, as part of the process related technology, the sender (assembler) of technology may also send their engineers to their supplier's site. These visits are important for component suppliers, because these visits facilitate the transfer of tacit knowledge related to production processes and quality control (Ernst, 1997).

3.3.3 Managerial related Technology

This type of technological knowledge is used in operating a business. The acquisition of this type of technology enables the firms to compete by using its resources efficiently. In the context of the automotive industry, assemblers may also assist their suppliers in adopting inventory management systems, for example, a just-in-time inventory. Assemblers may also provide knowledge related to financial planning, marketing know-how, purchasing and human resource development practices.

Each of these three types of technology can create a competitive advantage for the organisation that acquires and possesses it. That is, although all organisations possess each type of technology, an advantage accrues to firms that are able to obtain and deploy superior technology (Grosse, 1996:782).

Therefore, the transfer of these three types of technology from Pakistan's auto assemblers to their local suppliers is the key for the development of a local supplier's technological base.

3.4 Why Technology Transfer?

Technology transfer encompasses the use of technology to achieve an objective that will be rewarded in the marketplace (Teece, 1976). Therefore, manufacturing, engineering, management, marketing, distributing and customer service are among the elements included in technology transfer.

From the developed countries firms' point of view, there are two main explanations for technology transfer. Firstly, it is a tool or an instrument for them entering into other countries' market. As Baranson (1978) points out that developed countries firms' use technology transfer or technology sharing to avoid the associated risks of investing in developing countries resulting from economic and political issues.

Secondly, technology transfer is one method of sharing the cost of the developing technology because scientific resources of developing countries are scarce and expensive, potentially making the cost of technology development prohibitive. No nation, not even developed countries have unlimited resources or can afford the luxury of monopoly over technology.

From the developing country firm's point of view, the necessity of technology transfer is that it is prohibitively expensive for them to develop that technology by themselves. So the firms based in the developing countries generally assume that MNCs will transfer their technology. Part of this assumption rests on the hefty claims made by host country government that MNCs will bring technologies as part of their investment plans to the host countries, and their domestic firms will ultimately benefit from this transfer. It would take a long period of time and much more money for them to generate the same technology developed by advanced countries. Therefore, the firms in developing countries must try to obtain technology by other means. The high cost of developing technology along with the uneven development path of technology in the world, also forces the less developed countries to adopt the path of technology followers. International technology transfer refers to the transfer of capabilities to manufacture a product or process from firms in one country to firms in another country (e.g., Chesnais, 1986; Baranson, 1976).

As we can see from the above arguments, technology transfer is important for the developing countries firms' point of view. Through the use of technology, the firms based in the developing countries can upgrade their capabilities. Furthermore, it is also expensive for them to develop technologies within the firm because of underdeveloped and weak institutional set-up, so they have to rely on foreign sources of technology. The next section deals with the channels of technology transfer.

3.5. Channels of Technology Transfer

As, we have discussed in the earlier sections that for tacit knowledge, firms have to make greater efforts and closer interactions are required in order to benefit from this tacit element. Also discussed was that knowledge is not a public good. Far from being willingly or easily transferred from the sender to the recipient of a technology, technology faces barriers and is relatively immobile (Attewell, 1992). A similar view is also shared by Tiemessen *et al*. (1997: 391), who warn that knowledge is not as mobile as has often been assumed, and by Kogut and Zander (1992), who point to the 'inertness of knowledge.' Knowledge transfer depends on how easily that knowledge might be transported, interpreted, and absorbed (Hamel *et al*., 1989). Zander and Kogut (1995) in their study of the transfer of manufacturing capabilities found that, indeed, the degree to which capabilities are codifiable and teachable (i.e., are non-tacit) significantly influences the speed of their transfer.

The neoclassical view of technology, which is slowly but surely fading and losing ground, has all too often treated technology as a 'bundle of blue prints', public goods characteristics and subject to modest or nonexistent costs of transfer. These researchers have often been telling the classical story about technology as a 'public good'. But technologies rarely can be put in the form of a 'book of blue prints', and even more rarely transferred as such (Mowery and Oxley, 1995). Various Scholars argue that technology transfer is a costly, time consuming and knowledge intensive process (Mowery and Oxley, 1995).

Technology transfer has been associated with a number of often explicit channels, i.e. Foreign Direct Investment, joint ventures, strategic alliances, licensing, technical agreements, exporting and trade in capital goods.

The importance and contribution of these channels has varied from one country to another. However, foreign direct investment (FDI) by multinational corporations (MNCs) is considered to be the major channel for access to advanced technologies by developing countries, and it has received much attention in the literature. FDI by multinationals is an important vehicle for the transmission of innovation across the World (UNCTAD, 2001). However, it is not clear from these studies how the transfer of technology takes place.

Multinational corporations (MNCs) control the majority stocks of intangible assets and are the major investors of world R&D investment (Dunning, 1988). Furthermore, Dyker (1999) suggests at least five different ways through which FDI stimulate the economic performance of its host countries: (1) integration of a host economy into a global economy; (2) increases the aggregate level of investment in the economy; (3) transfer of hard technology (product and process embodied); (4) transfer of soft technology (organisational, marketing); (5) networking and subcontracting with domestic enterprises.

In this study, particular interest is given to the hard and soft aspects of technology transfer, mainly in the forms of **product-related; process-related and managerial- related technology** from International Joint Ventures (IJVs) established in the automotive industry of Pakistan to their Pakistani component suppliers.

3.6 Foreign Direct Investment as a channel of technology transfer

Policy makers in developing and emerging economies often place bringing FDI into their countries as the top priority on their policy menu list, expecting that FDI will bring in much needed capital, marketing, management know-how and more importantly new technologies. Due to this nature, FDI has attracted a great deal of attention in the literature.

In the extant literature, the most often cited benefit of FDI is the superior technology brought in by MNCs, apart from capital inflows and additional employment in the host country. Dunning (1988), further points out that MNCs are responsible for about 80 percent of private R&D expenditure worldwide. That is why developing and transition countries encourage MNCs to invest in their economies in the hope that these MNCs will transfer technologies to domestic firms (Blomstrom and Kokko, 1998).

Furthermore, it is also suggested in the literature that FDI transfer more advanced technologies than other channels. For example, Mansfield *et al*. (1982) discovered that during 1960-78, the average age of technologies transferred by the US MNCs to their subsidiaries in developing countries was 10 years, significantly younger than the mean age of technologies transferred through licensing which was 13 years. Similarly, Glass and Saggi (1998) also find that FDI is the most important channel of technology transfer. They further argue that a faster flow of FDI to the host country increases the rate of innovation, imitation and technology transfer.

The theoretical debate overwhelmingly is in favour of the claim of positive technology transfer and spillovers taking place from FDI. The very presence of MNCs can also induce technical change, and promote technological learning, in the domestic economy directly or, indirectly through knowledge spillovers to the domestic firms. This knowledge spillover occurs as a consequence of MNCs introducing new technologies, and new organisational and marketing skills that are typically better than those in the domestic firms.

In his seminal paper, Findly (1978) also points out that the MNCs' capital plays the role of a generalised promoter of technology improvement—the more opportunities that the domestic firms have to observe the advanced technology used by foreign-invested firms, the faster their level of domestic technology will grow. Findly posits this as a 'contagion' effect. However, Young and Lan (1997) find that technology transferability is strongly influenced by the nationality of the multinationals and many investors are not a genuine source of technology. They further point out that the extent of technology transfer is very modest in the case of China.

It is also suggested in the literature that FDI transfers technology or spillover to domestic firms, principally via fours routes, as summarized by Gorg and Strobl in their review of the literature (2001). The first of these effects is the demonstration/ imitation effect. This takes place when domestic firms observe the activity of MNCs, and they start to imitate, or copy their techniques or processes, in order to become more productive. Local firms may also imitate foreign affiliates through reverse engineering and through personal contacts.

The second is the competition effect. When MNCs enter into the market they force domestic companies to increase their competitive capacity by changing their management style and upgrading production and process technology (e.g., Markusen and Venables, 1999; Wang and Blomstrom, 1992).

The third of these effects is the linkage effect. Domestic firms can learn from MNCs when they have close business relationships with the MNCs through upstream and downstream relationships in the value chain, as also pointed out by a number of scholars (e.g., Blalock and Gertler, 2008; Blalock, 2002; Lall, 1980; Rodriguez- Clare, 1996; Markusen and Venables, 1999; Lin and Saggi, 2004; Javorcik, 2004; Buckley *et al*., 2002; Dunning, 1993). Likewise, Chung *et al*. (2003) find that FDI by Japanese auto manufacturers in the US automotive industry has an overall positive effect on suppliers in the US automotive components industry. However, they find that US firms that supplied Japanese manufacturers did not increase productivity more than suppliers that did not contract with Japanese buyers. Therefore the authors argue that their results do not provide evidence of technology transfer, but instead reflect competitive pressure created by the Japanese FDI for the productivity improvement in the components industry. These scholars did not investigate the inter-organizational dynamics or the absorptive capacity of the recipients.

The fourth effect is the movement of a skilled labour force from the MNCs to domestic firms, as pointed out by several scholars (e.g., Blomstrom and Kokko 1998; Fosfuri, Motta and

Ronde, 2001; Glass and Saggi, 2002)2. MNCs are better equipped with resources, so they provide better training to their employees, these trained employees may later on take up jobs with the domestic companies and may become sources of technology spillovers.

However, lately these arguments have come under scrutiny which find mixed results of technology transfer through FDI, and have promoted many observers to question the existence of these spillovers. For instance, Rodrik (1999:37), comments, "today's policy literature is filled with extravagant claims about positive spillovers from FDI, but the hard evidence is sobering."

Aitken *et al*. (1997) and Aitken and Harrison (1999) have discussed that the competition effect could be negative if MNCs take demand away from domestic firms and may force them to further reduce their production. In this scenario, the domestic firms' productivity would decline, resulting in the spread of the fixed cost over a smaller quantity of products.

On similar lines, Girma *et al*. (2001) and Sinani and Meyer (2004) also point out that the employment effect may possibly be negative if the MNCs attract the best skilled workers away from the domestic companies, leaving them with less-skilled employees. The market-stealing and skilled employee stealing effects may be large enough to offset any of the positive effects that these MNCs may have on the domestic firms. However, there is a shortage of detailed firm level studies to further verify this particular claim.

This discussion clearly demonstrates the existence of several but opposing effects. Thereby making it difficult to formulate any clear expectations as to the overall global impact of MNCs investment on domestic firms. On the other hand, as Kinoshita (2001:5) pointed out, it

[2] Several of the researchers have confirmed this mechanism. See for example, Gorg and Strobl 2002.

is difficult to distinguish one from the other, since the mechanism of technology spillovers from FDI is complex and often interdependent. Overall, it could be said that FDI has positive, as well as, negative effects on host countries. Table 3.3 highlights some of the positive and negative effects of FDI.

Table 3.3

Potential positive and negative effects of FDI in host countries

Potential positive effects of FDI	Potential negative effects of FDI
Enterprise level:	**Enterprise level:**
- continued and expanded production	- labour shedding
- increased labour productivity	- disinvestment and downsizing of production
- access to investment capital	- transfer of R&D abroad
- access to worldwide sale and distribution networks	
- transfer of Western technology and know-how	
- improved competitiveness	
- increased R&D	
Local and regional Economy:	**Local and regional Economy:**
- saving of existing jobs and creation of new jobs	- local dependency on foreign capital
- increased wages	- external control of local economies
- growth or real income	- attracting skilled and semi-skilled workers from local companies
- increased tax base	- suppression or destruction of local firms unable to compete with FIEs supported by generous governments
- increased exports	- investment incentives and benefitting from transfer pricing
- labour training	- deskilling
- provision of social services to local communities	- regional specialisation in low-skilled, labour-intensive production
- spillovers to local and regional economy	- development of 'dual economy'
- increased opportunities for local companies to supply foreign-owned companies	- branch plant syndrome
	- instability of Western investment
	-Impact on the Environment

Sources: Based on Pavlinek (2004:48)

It is also important to note that FDI can take the form of either a wholly owned subsidiary or a joint venture. The literature has cited different factors behind the entry mode of MNCs (e.g., Dunning, 1981; Buckley and Casson, 1976; Kogut and Singh, 1988; Hennart, 1991). However, the factors behind the entry mode are not the main focus of this research. In the case of the automotive industry of Pakistan, three major Japanese assemblers (see chapter 5-the automotive industry of Pakistan) have formed joint ventures with Pakistani partners. In this research we are interested in studying technology transfer effectiveness from these three IJVs to their Pakistani components suppliers, and this is the main focus of this research.

Technology transfer from MNCs to wholly owned subsidiary is an internal transfer from parent firms located in one country to a subsidiary based in another country (see, for example, Gupta and Govindarajan, 2000; Minbeava, 2007). On the other hand, technology may also be transferred through joint ventures. For example, technology is transferred from parent MNCs to another company which the parent MNCs has equity interest in a host country's firm (Lyles and Salk, 1996). This technology can further transfer from IJVs to their local suppliers down the supply chain Therefore; this study focuses on technology transfer effectiveness from IJVs established in the automotive industry of Pakistan to their Pakistani component suppliers. It is also important to point out that, there has been no research conducted in the automotive industry of Pakistan on this particular topic to the best of our knowledge. The Pakistani government has also developed an auto policy (see chapter 5), and in subsequent news reports, the government officials have shown their keen desire for technology transfer from these joint ventures to the supplier networks.[3]

3.7 Joint Ventures as a channel of technology transfer

Several researchers have emphasised the role of joint ventures in learning and knowledge transfer (Mody, 1993; Inkpen, 2000; Inkpen and Crossan, 1995; Sakakibara, 1997; Simonin, 1997; Gulati, 1998; Lane and Lubatkin, 1998; Doz and Hamel, 1998; Tsang, 1999; Kale,

[3] Prime Minister Shaukat Aziz speech at the Pak Suzuki's Plant, Karachi, Pakistan, Dawn News 2007

Singh and Perlmutter, 2000; Lane, Salk and Lyles, 2001; Lyles and Salk, 1996), amongst others.

Many researchers have emphasised the use of joint ventures by firms to acquire technology related capabilities from joint venture partners, and a substantial amount of literature discusses the particular features of joint ventures and the participants' firms that facilitate the flow of technology based capabilities and their related knowledge amongst joint venture partners (e.g., Kogut, 1988; Hamel, Daz and Parahalad, 1989; Cohen and Levinthal, 1990; Hamel, 1991). Similarly, the study of Mowery *et al*. (1996) on strategic alliances and inter-firm knowledge transfer also supports the hypothesis that equity joint ventures are more effective conduits for the transfer of complex capabilities than are contractual based joint ventures. Furthermore, they also argue that '*absorptive capacity'* is an important way of acquiring technological capabilities through joint ventures and further bolsters the argument that a firm's experience in related technological areas is an important determinant of its absorptive capacity (e.g., Cohen and Levinthal, 1990). Cohen and Levinthal's (1990:128) define absorptive capacity as a firm's ability 'to recognize the value of new external knowledge, assimilate it, and apply it to commercial ends'.

Empirical literature on FDI and technology transfer has also considered and discussed these issues. According to Kokko (1994) technology transfer depends on the complexity of the technology being transferred by multinationals and on the technology gap between domestic firms and multinational firms. Kokko, by using cross-section industry level data from Mexico, finds no evidence for transfer in those industries where multinationals use very complex technologies, and, on average, a large technology gap does not appear to hinder technology transfer, although industries with large gaps and a high foreign presence experience lower transfer than others. Expanding on this work, Kokko *et al*. (1996) hypothesise that domestic firms can benefit only if the technology gap is not so wide so that domestic firms can absorb the knowledge available from these multinationals. Blalock and Simon (2009) also find supports that firms with greater absorptive capacity benefits more from multinational entry.

Furthermore, organizational flexibility, for example, non-bureaucratic, a non-hierarchical structure and approach to management is also thought to be associated with higher capacities for acquiring knowledge from partner firms (Dodgson, 1993; Lyles and Baird, 1994; Lyles and Salk, 1996). In a similar vein, several scholars have also emphasised that organisational flexibility promotes absorptive capacity and the process of knowledge transfer by encouraging greater receptivity among organisation members to new knowledge from outside of the organisation, by also encouraging and promoting collaboration and exchanges of knowledge within the organization (e.g., Brown and Duguid, 1991; Fiol and Lyles, 1985; Hedlund, 1994; March, 1991).

In large part of technology transfer literature, scholars have suggested the importance of having the possessions of relevant technical skills for the effective inward technology transfer to take place (Rosenberg and Frischtak, 1991, Agmon and Von Glinow, 1991). In a similar vein, Gambardella (1992) suggests that higher level of absorptive capacity would improve an organization's ability to exploit sources of external technical knowledge. Other scholars have also pointed out the importance of this concept. For instance, Makhija and Ganesh (1997) and Tsai (2001) argued that firms possessing a high level of absorptive capacity are more likely to have a better understanding about the new knowledge and to utilize this new knowledge from outside sources to help their innovation activities. Without having an adequate absorptive capacity, firms are unable to recognize and assimilate outside knowledge and hence unable to learn and transfer knowledge. For example, Szulanksi (1996) found that lack of absorptive capacity was a central barrier to internal knowledge transfer within organizations. On the other hand, firms that possess absorptive capacity are in a better shape and position to effectively assimilate external stock of knowledge. Therefore, in this study, we also argue that suppliers who possess ability to learn and assimilate their assemblers (Buyers) knowledge are in a position to effectively utilize their knowledge.

In addition, in the organization learning literature many scholars have used absorptive capacity to investigate knowledge transfer and organizational learning phenomenon. In their study on knowledge acquisition from foreign parents in IJVs, Lyles and Salk (1996) found that capacity to learn is positively associated with knowledge acquisitions in International Joint Ventures. For example, Lane and Lubtakin (1998) explored inter-organizational learning in the context of absorptive capacity as a dyad level construct. According to Lane and Lubtakin (1998) relative similarities in basic knowledge between partners have positive effect on organizational learning. Lane *et al*., (2001) also found that absorptive capacity play a positive role in inter-organizational learning. On the basis of their research findings, Lane *et al*., (2001: 1156), concluded that "the first two components, the ability to recognize external knowledge and the ability to assimilate it, are independent and yet distinct from the third component, the ability to apply the knowledge". In this respect, their study tried to refine the original definition of Cohen and Levinthal (1990).

Minbeava *et al*., (2003) argued that absorptive capacity of the subsidiary unit facilitate knowledge transfer. In another study, Minbeava (2007) also found out that receiver's absorptive capacity have a positive effect on the degree of knowledge transfer.

Many studies in the area of organizational learning have found that recipient's absorptive capacity is an important construct for the knowledge transfer process. Several scholars have suggested that the greater absorptive capacity of the recipients, the greater the flow of knowledge transfer (Szulanski, 1996; Lyle and Salk, 1996; Gupta and Govindarajan, 2000).

After reviewing this literature, it is clear that these above studies treat and limit the concept of absorptive capacity to within the firm boundaries, for example, firm's R&D spending and human resource practices (Minbeava *et al.*, 2003) or basically what goes inside the firm. Unfortunately, as argued by Zahra and George (2002, 186), empirical studies do not always capture the rich theoretical arguments and the multidimensionality of this construct. We also argue that by limiting this concept to firm level does not fully capture how the absorptive capacity is developed at the firm level, because firms interact with other institutional actors, i.e. local institutions and the knowledge senders.

In this study, we adopt Zahra and George's (2002) suggestions that absorptive capacity can be divided into: potential and realized. Potential absorptive capacity includes the capability to acquire and assimilate knowledge. Knowledge acquisition refers to the recipient's ability to identify and acquire vital knowledge to its operational use from the outside source, and knowledge assimilation refers to the recipient's capability to analyze, process, interpret, and understand the knowledge obtained from outside source (Szulanski, 1996). Zahra and George (2002) further point out that a high potential absorptive capacity does not necessarily imply enhanced performance; what is important is the possession of realized absorptive capacity in making effective use of the acquired knowledge by integrating it into the recipient's operation.

The above discussions have shown the important role of joint venture in the transfer of technology, but moreover the role of the recipients firms absorptive capacity to benefit from the transferred technology. It is clear from the above discussion and review of the main studies that most of the studies have focused on within the joint venture aspects of technology transfer and have paid limited attention to technology transfer effectiveness from IJVs to their local suppliers (Zhao *et al*., 2005).

However, despite the importance of technology transfer effectiveness from IJVs to their local partners, especially component suppliers, there has been little systematic discussion of this topic from the perspectives of both the sender of the technology (i.e., IJVs established in the emerging economies) and the knowledge recipient (i.e., local suppliers). Thus seven fundamental issues remain under-explored: (1) underlying factors that influence the willingness of the sender to transfer technology to their local suppliers; (2) factors affecting the motivation and capability of the local suppliers to acquire technology from their buyers-IJVs; (3) inter-organizational dynamics in the forms of trust and social ties and how it influence the technology transfer from senders to the recipients and its effectiveness in the forms of breadth and depth of learning, exploitative/exploratory innovations- an outcome of the transferred technology at the recipients end; (4) underlying mechanisms used to transfer the technology and their usefulness; (5) type of technology being transferred, single type of technology or package of technology (i.e., product, process and managerial); (6) entire process of technology transfer and the distinct phases within the transfer process; and (7) the extent of the technology transfer effectiveness (in the forms of breadth/depth of learning, exploitative/exploratory innovations) - the effect of the transferred technology on the dynamic capabilities of the local suppliers.

In this research, we seek to contribute to technology transfer literature by providing holistic view of technology transfer effectiveness in the context of the automotive industry of Pakistan. The next section deals with the concept of technology transfer effectiveness.

3.8 Technology transfer effectiveness

The concept of technology transfer effectiveness is hardly ever addressed in the context of international joint ventures firms to their suppliers. In this section, the concept of technology transfer effectiveness will be discussed. Successful technology from the source organisation to the recipient organisation is vital. There is a need for the domestic suppliers to acquire and master the transferred technology in order to develop core capabilities, particularly in the context of developing countries suppliers. In this research, technology transfer effectiveness is understood as the outcome of the actual transfer which adds value for the recipients in terms of developing their dynamic capabilities in the forms of breadth and depth of learning and exploitative and exploratory innovations.

The attempt to successfully transfer technology varies considerably. In order for a technology transfer to be effective, it must be adopted at the recipient's end (Leonard Barton, 1988). In a similar vein, Galbraith (1990) suggests that technology transfer is more successful when the transferred technology is not complex, and is well understood by its recipients. In the early studies of technology transfer, researchers found out that transfer costs decrease with experience (Mansfield *et al*., 1979; Teece *et al*., 1976, 1977).

The aim of any technology transfer project is to transfer the sender's knowledge successfully to a recipient organisation. The recipient organisation's main aim is to successfully integrate this new knowledge. In the context of the component suppliers, it is believed that the same holds true. Technology transfer effectiveness, therefore, refers to the potential of the component suppliers to turn the acquired technology into a competitive advantage in the form of exploitative/exploratory innovations and a depth and breadth of technological learning (Zahra *et al*., 2000), since knowledge is a source of competitive advantage (Grant, 1996).

Effectiveness is, generally, seen to be one dimension of performance, besides efficiency and adaptiveness (Katsikes *et al*., 2000). In a similar vein, Buckley and Carter (1999) suggest that an important requirement for effective transfers of knowledge is for the sender organisation to recognise the knowledge requirements of the recipient organization in order to provide what is appropriate, and in a format that is appropriate.

In the extant literature, scholars have used four different approaches to measure transfer success as a dependent variable. For example, Hakanson and Nobel (1998) define transfer success as the number of knowledge transfers engaged in during a certain period of time. From the project management point of view (Pinto and Slevin, 1987) a successful project is one that is on time, within budget and where the recipient is satisfied with the outcome (Szulanski, 1996).

The scholars in the area of technology transfer and innovation define technology transfer success as the degree to which the transferred knowledge is re-created at the recipient organisation. According to these scholars, successful knowledge sharing results in an organisation mastering the product designs, manufacturing processes, and organisational routines that are new to them (Nelson, 1993). Also, knowledge transfer is seen to be occurring through a dynamic learning process where organisations interact with clients and suppliers to innovate or creatively imitate (Kim and Nelson, 2000). This approach highlights the re-creation of a sender's knowledge in the recipient's environment. The problem with such a replication approach is that the sender's knowledge might be embedded in many different organisational structural elements. For instance, it may be embodied in people's skills, tools, routines and in the systems used by the organisation (Argote and Ingram, 2000).

Some scholars have defined successful transfer, as knowledge internalisation (Meyer and Rowan, 1977). According to this approach, successful transfer is the degree to which a recipient organisation obtains ownership of, commitment to and satisfaction with the new transferred knowledge.

In the literature, scholars have used the term 'knowledge transfer' in association with 'successful knowledge transfer. As Bresman *et al*. (1999:444) suggest that successful transfer 'results in the receiving unit accumulating or assimilating new knowledge'. Most scholars have measured knowledge transfer in the context of the extent of knowledge transferred (Lyles and Salk, 1996; Mowery *et al*., 1996; Bresman *et al*., 1999; Hakanson and Nobel; 2000; Agrawal and Henderson, 2002; Tsang, 2002; Dhanaraj *et al*., 2004). Szulanski (1995, 1996), for instance, identifies three dimensions to the knowledge transfer process, timing, budget and recipient unit satisfaction, in his study of the 'stickiness' of best practices within the firm units. In a similar vein, Zahra *et al*. (2000) applied three dimensions, i.e., breadth (amount), depth (understanding), and speed (pace) of learning by the new venture firms in international expansions. On the other hand, some scholars have exclusively focused on the rate of knowledge transfer (Darr *et al*., 1995; Zander and Kogut, 1995), or how the acquired knowledge has helped the recipient firm/unit (Bjorkman *et al*., 2004; Lane and Lubatkin, 1998; Lord and Ranft, 2000; Simonin, 1999; Yli-Renko et al., 2001).

Furthermore, Reagans and McEvily (2003:249) have pointed out that knowledge transfer represents a cost ‘‘in terms of time and effort’’. Similarly, Hansen *et al*. (2005) used the transfer cost of knowledge sharing in organisations, while others have used balanced scorecard measures to measure knowledge transfer effectiveness (Jo Rodes *et al*., 2008). In defining technology transfer effectiveness; we follow Daft (1998:663) who defined effectiveness, as ‘‘the degree to which goals are attained’’. The attainment of goals refers to this research in terms of exploitative/exploratory, and depth and breadth of learning.

Though the above measures are useful they still do not embody the full picture of transfer effectiveness. While the transfer was on time and within budget, it might not help the recipients acquire the depth or breadth of learning, or exploitative and exploratory innovations to develop dynamic capability. Therefore, as discussed in chapter 1, there is a need to focus more on the fine grained measures that might capture the totality of this concept. Hence, to serve the call of Van Wijik *et al*., (2008) which suggests that future studies should utilise more fine grained measures of technology transfer effectiveness, for example, exploratory and exploitative innovations.

Therefore, for the purpose of this research, we conceptualise technology transfer effectiveness in terms of depth and breadth of technological learning (Zahra *et al*., 2000), and exploitative and exploratory innovations (Benner and Tushman, 2002; He and Wong, 2004; Jansen *et al*., 2006).

Breadth refers to the learning which one can acquire through exposure and interaction with diverse environments which facilitates system openness and promotes technological learning (Kim, 1997). Depth of learning refers to the deeper understanding of the concepts and skills. Although learning different, many skills and concepts can be challenging when the skills involve tacit knowledge, developing a deeper understanding of the skills is even more challenging (Bohn, 1994). Exposure to and direct involvement with the customers and businesses is an important means of 'learning by doing' (Dodgson, 1991a), which promotes deeper technological learning (Ganesh, Kumar and Subramanian, 1997). The deeper understanding of this knowledge induces the development of dynamic routines that contribute complex problem solving (Lei *et al*., 1996).

According to Benner and Tushman (2002: 679), "Exploitative innovations involve improvements in existing components and build on the existing technological trajectory, whereas exploratory innovation involves a shift to a different technological trajectory" Similarly, He and Wong (2004: 483) defined exploitative innovation as "technological innovation activities aimed at improving existing product-market domains" and exploratory innovation as "technological innovation aimed at entering new product- market domains."

Exploitation is the process of seeking new ways to improve existing organisational capabilities and using existing knowledge to increase organisational effectiveness (Jones, 2001). Exploitative innovations are incremental innovations and are developed and designed keeping in mind the needs and requirements of existing customers or markets (Benner and Tushman, 2003:243; Daneels, 2002). Several scholars, for example, (Abernathy and Clark (1985; Benner and Tushman, 2003; Levinthal and March, 1993; Lewin, Long, & Carroll,

1999) have suggested that these types of innovations broaden the scope of existing knowledge and skills, expand existing products and services, improve current designs, and also increase the efficiency of existing distribution channels.

Exploratory innovations are radical innovations that are designed to satisfy the needs of emerging markets and customers (Benner and Tushman, 2003:243; Danneels, 2002). These innovations offer new designs, create new markets, and develop new channels of distribution (Abernathy and Clark, 1985), and these types of innovations require new knowledge or the departure from an existing knowledge base (Benner and Tushman, 2003; McGrath, 2001; Levinthal and March, 1993).

These all studies show that learning, improvement, and acquisition of new knowledge are central to both exploitation and exploration. In this study, these two types of innovations along with breadth and depth of learning are taken into account while investigating technology transfer effectiveness - the effect of the transferred technology on the dynamic capabilities of the Pakistani suppliers. Through the above discussion it is clear that technology transfer is successful, or effective, only when the transfer is complete and adds value to the recipient organisation's dynamic capabilities. Dynamic capability cannot develop unless the technology transferred results in breadth and depth of learning and exploitative/exploratory innovations at the recipient's end. Furthermore, capabilities cannot contribute to sustainable competitive advantages unless they are developed on the basis of breadth and depth and exploitative/exploratory aspects (Inkpen, 2000).

Conclusion

In this chapter, we have discussed the importance of knowledge in this highly competitive business environment. Through this discussion, it is clear that to develop a competitive advantage firms must develop and utilise different types of knowledge. Some knowledge is explicit and easier to teach and transfer, whereas other knowledge is tacit and complex and therefore difficult to transfer. In order to transfer the tacit knowledge it is clear from the extant literature that learning through interacting is an important way to transfer and absorb this type of knowledge and the absorptive capacity of the recipient is also an important factor.

Technology transfer can take place through a variety of channels, and foreign direct investment by multinationals is an important channel of transfer to the recipient's country firms. Whilst most of the studies have discussed technology transfer from parent to their joint ventures partners, very few studies have investigated technology transfer taking place from joint ventures to their local suppliers. The type and whole package of technology transfer is also hardly ever covered in the context of this transfer.

Technology transfer effectiveness has been looked at from various angles, for example, cost, time, usefulness and satisfaction. Although these concepts are important they do not fully capture its entire effectiveness. This research will utilize more fine grained concepts, i.e. breadth/depth of learning and exploitative/exploratory innovations to capture the technology transfer effectiveness. This chapter has also shown that overwhelming number of studies have been conducted on technology transfer either in the MNCs or Joint ventures context, but limited attention has been paid to the technology transfer effectiveness from IJVs established in the developing countries to their local suppliers. The following chapter will discuss the research questions and conceptual background which are the basis of the empirical investigation of this study.

CHAPTER 4: CONCEPTUAL FRAMEWORK

Introduction

In chapter 2 and 3, we have discussed the theoretical positioning and literature related to technology transfer, which are the building blocks of this research. Combining these various streams of literature, this study identifies technology transfer in the automotive industry as an important strategic source of competitive advantage for the global automotive industry in general and particularly for the local auto components (parts) industry of Pakistan. Successful technology transfer from auto assemblers to their Pakistani components suppliers will help the suppliers to link up in the global value chain networks.

Therefore, having examined the theoretical and empirical contributions of previous studies, the conclusion is that there is a research gap in regards to technology transfer effectiveness through IJVs to their local component suppliers and need for further empirical investigation. There is a need for a deeper understanding of the technology transfer effectiveness in regards to breadth and depth of learning and exploitative and exploratory innovations as an outcome of technology transfer which may affect the dynamic capabilities of the recipient firms. The following research question guiding the empirical investigation is proposed:

What extent technology transfer is effective from IJVs to their local suppliers in terms of breadth, depth of learning and exploitative and exploratory innovations and what are the determinant factors which influence technology transfer effectiveness?

From the review of the literature a number of key issues have also been identified that are believed to impact on technology transfer effectiveness. Therefore, in posing the overall research question a number of further questions arise:

- What is the process and distinct phases of technology transfer from senders (assemblers) to the recipients (suppliers)?
- What type of technology is being transferred from assemblers to their Pakistani component suppliers and the impact of this technology on the effectiveness?
- What are the mechanisms use to transfer technology?
- Are the mechanisms useful?
- What extent are assemblers willing to transfer different types of technology (product, process and managerial-related) to Pakistani component suppliers?
- Does learning intent influence more technology transfer and its effectiveness?
- What is the role of the recipient's absorptive capacity in the process of technology transfer and its effectiveness? How absorptive capacity is developed at the recipients end?
- What extent social ties facilitate technology transfer and its effectiveness from assemblers to their Pakistani suppliers?
- What is the role of trust in technology transfer and its effectiveness?

The theoretical grounding for the research questions and the conceptual framework are explained and discussed facilitating understanding of the findings in Chapter 7.

The key concepts of this conceptual framework are:

1- Technological knowledge characteristics;
2- Sender's willingness to transfer technology;
3- Suppliers learning intent;
4- Absorptive capacity;
5- Inter-organization dynamics in the forms of trust and social ties; and
6- Technology transfer effectiveness.

In this chapter, we elaborate these concepts in order to develop a better understanding about this research. A conceptual framework of this thesis is developed in this chapter. This framework will be useful for guiding data collection, organisation and focus the analysis of the data. As Miles and Huberman (1994:17) argue that ‘‘better science happens with an explicit framework rather than by pretending some kind of inductive purity’’. It is also important to mention that we use technology and knowledge interchangeably throughout this chapter.

The following section discusses the characteristics of knowledge.

4.1 Technological Knowledge Characteristics

Technological knowledge characteristics have a huge impact on the transfer process itself. Scholars have argued that tacit knowledge; compare to explicit knowledge has the potential to generate benefits for organization by its nature of being difficult to imitate (Barney, 1991; Nonaka, 1994). The characteristics of technological knowledge have serious implications for its transfer, because certain knowledge cannot be easily codified and transferred.

Kogut and Zander (1993), in their award winning article pointed out that decision to transfer technology within firm or in the market place can be explained by the characteristics of knowledge. In addition, empirical studies of technology transfer also support the proposition that the characteristics of the knowledge determine the costs associated with transfer and its mode of transfer.

It is also important to mention that the characteristics of technological knowledge, i.e. complex/ teachable and explicit/tacit are chosen for this study, as they are the constructs of knowledge that can be, by far, the most important to influence the technology transfer process and its effectiveness. In the context of the automotive industry, some technological components are complex, and some are easier to teach and transfer. For example, Wire harness vs. Power-train components. Wire harness is a good example of very standard codified type of component and are therefore relatively easy to teach and transfer to the component suppliers compared to power-train, because power-train components are based on complex design and engineering.

These technological knowledge characteristics are more comprehensive in a sense that these characteristics incorporate most of the characteristics discussed in prior research (Winter, 1987; Lyles and Schwenck, 1992; Zander and Kogut, 1995).

Knowledge has emerged as one of the key source to develop sustainable competitive advantages. The transfer and effectiveness of this knowledge can increase the returns on investment. In the past, scholars investigating knowledge transfer have mainly focused on a single type of knowledge (Kogut and Zander, 1995; Simonin, 1999, Gupta and Govindarajan, 2000). We argue that the package of knowledge consisting of different areas of knowledge can give a better picture about the technology transfer effectiveness compared to a single type of knowledge. As Sammarra and Biggiero (2008:801) suggest, ‘‘the simultaneous considerations of different types of knowledge in the context of inter-firm innovation collaboration has not yet received proper conceptual or empirical elaboration’’. Similarly, Brenner (2007) indicated that the extant literature on inter-organizational knowledge transfer tends to ignore what types of knowledge are transferred, and establish it to be a relevant area of research inquiry. In this thesis, we will focus on three types of knowledge: product, process and managerial. This research does not use tacit and explicit dichotomy in a straightforward manner. Rather it situates this distinction in the local (Pakistani) industrial context. Tacitness is defined in contingent fashion and linked the technological package in question with recipient's perception, i.e. recipient's perception is taken into account to decide when knowledge is considered tacit or explicit.

The package of knowledge consisting of both explicit and tacit elements will lead to higher innovativeness compared to only one type of knowledge. Scholars in the knowledge-based view of the firm (Grant, 1996; Kogut and Zander, 1992; Rodan and Galunic, 2004) all have emphasised that competitive advantage depends on bringing together and recombining diverse knowledge.

Although these studies have increased our understanding about the characteristics of knowledge, the whole package of knowledge and its role on technology transfer effectiveness largely remains underexplored. Having briefly examined the contributions of previous studies, the conclusion is that there is a need for a much broader understanding about the whole package of technology transfer instead of focusing at only one type of technology. The whole package of technology is central to the debate on the beneficial role of FDI in a host economy.

In this research, three areas of technology transfer are investigated: product-related, process-related, and managerial-related technology and its impact on technology transfer effectiveness from IJVs to their component suppliers. Using the complex/teachable, explicit/tacit dimensions, we can conceptualise product-related, process-related and managerial related as complex or teachable, as explicit or tacit or combination of both. However, it should also be noted that there is an interaction effect between the package of technology transfer, the sender willingness to transfer and recipient's learning intent and absorptive capacity. Nonaka (1994) and Nonaka and Takeuchi (1995) observe that knowledge is created, organized, and transferred by the willingness and motivation of the sender and its recipients. The above discussion leads us to the following research question for the empirical investigation in the automotive industry of Pakistan.

What type of technology is being transferred from assemblers to their Pakistani component suppliers and the impact of this technology on the effectiveness?

Following section discusses senders' willingness to transfer technology.

4.2 Senders willingness to transfer technology

Sender's willingness is an important determinant of technology transfer and its effectiveness. Alhough, the importance of this concept has been acknowledged, more empirical evidence is so far lacking. Only the studies of Szulanski (1996), Simonin (1999), and Gupta and Govindarajan (2000), offer some examples. As Van Wijk *et al*., (2008:830) pointed out, ''research on organizational knowledge transfer is burgeoning, and yet our understanding of its antecedents and consequences remains rather unclear''. Part of this reason could be that researchers have been focusing more on the recipient's side factors while taking the sender side as given thus limiting our understanding about this important topic of technology transfer and its effectiveness.

So far, scholars have focused more on the recipient's learning intent and absorptive capacity as the main factors for knowledge transfer (Hamel, 1991; Cohen and Levinthal, 1990; Gupta and Govindarajan, 2000). They have labelled an organization's ability to recognise and assimilate new outside knowledge as the main determinants of transfer success (Zahra and George, 2002). Since the knowledge transfer project involves a sender and a recipient, these studies have addressed only the recipient's side factors thus ignoring the role of the sender. The sender willingness to transfer technology remains underexplored (Martin and Salomon, 2003). Although, research has recognized the importance of both the sender and the recipient in the knowledge transfer process (Szulanski, 1996), a research gap exist in respect to the sender's willingness to transfer technology and its associated determinants.

The process of knowledge transfer can be hampered by the unwillingness on the part of the senders to pass on the knowledge to the recipients due to the fear that the transfer of knowledge can result in loss of control and ownership (Szulanski, 1996).

In the case of the automotive industry, we argue that assemblers' willingness to transfer complex technological knowledge to suppliers in one of the key determinants of technology transfer effectiveness. If assemblers show motivation to teach the Pakistani component suppliers, it will help their long-term sustainability and exploitative and exploratory innovative capability and breadth and depth of learning. Therefore, auto assemblers (buyers) willingness to engage in knowledge transfer activities with component suppliers is instrumental.

The sender willingness will also determine the process of technology transfer and the distinct stages within the process. The willingness will also impact on the choice of mechanisms used to transfer technology and their usefulness. So in the context of the sender willingness, we will also investigate the entire process of technology transfer from the sender and recipients' point of view. The distinct phases within the transfer stage will be looked at, as the previous studies have paid less attention to the distinct phases within the transfer process (Szulanski, 1995).

The sender role is also important about the choice of mechanisms adopted for technology transfer. One of the objectives of this research is to investigate the mechanisms and their usefulness, as in the past researcher has focused less on the usefulness and the appropriateness of these mechanisms in a particular context.

On the basis of the above discussion, the following research questions will be explored in the context of the automotive industry of Pakistan.

What extent are assemblers willing to transfer different types of technology (product, process and managerial-related) to Pakistani component suppliers?
What is the process of technology transfer from senders (assemblers) to the recipients (suppliers)?
What are the mechanisms use to transfer technology
Are the mechanisms useful?

Recipient's learning intent is discussed in the following section.

4.3 Suppliers (recipients) learning intent

Willingness and motivation is a key element to learning and lack of motivation can hinder knowledge transfer process. As Mowery *et al*. (1996), underline the motivation or intention that a potential recipient must adopt in order for the knowledge transfer to be successful. The literature on knowledge transfer suggests that recipients' learning intent is one of the key factors in enhancing, or jeopardizing, the knowledge transfer project. For example, scholars have found that motivation to learning positively impact the degree of knowledge transfer

(Gupta and Govindarajan, 2000; Tsang, 2002), and a lack of motivation on the recipient's end leads to 'stickiness' in the knowledge transfer process (Szulanski, 1996).

Moreover, we can argue that if the component suppliers are genuinely motivated to acquire technology possessed by the buyers, they will be better equipped to understand the technology that is being transferred to them and the sender will be more willing to transfer the technology. As Simonin (1999:409) puts it 'learning intent captures the degree of desire for internalising a partner's skills and competencies'. In this study, we also expect the learning intent of the suppliers related to technology transfer from their components buyers to be positively linked with the technology transfer effectiveness. As, Pérez-Nordtvedt *et al*. (2008), point out recipient's learning intent is a critical factor to knowledge transfer success.

Hamel (1991) argues that a recipient's intent to internalize the sender's know-how is a key determinant of learning. The suppliers learning intent would focus on their learning efforts and will increase their awareness of the need for acquiring knowledge. Previous research has investigated learning intent in the context of MNCs and intra-organizational and research is lacking in the smaller suppliers and developing economies context.

Therefore, in this research, we will investigate the recipient side learning intent factor to get a better idea about the interactions affect of learning intent with the willingness of the sender. So far research has not addressed how learning intent affect the willingness of the sender to transfer more knowledge or the role of absorptive capacity on recipient's learning intent. Previous research has investigated this concept from the recipient's side making it a nodal level of analysis, but in this research we will explore the recipient's learning intent from a dyad level perspectives. These perspectives will give us a better picture about resource allocation and learning programmes the recipients have in place.

The above discussion leads us to the following research question.

Does learning intent influence more technology transfer and its effectiveness?

The following section explores another important recipient's side factor: Absorptive capacity.

4.4 Recipient's absorptive capacity

The concept of absorptive capacity has been used to explain a variety of organizational phenomenon in the field of strategy, international business, and technology management (Zahra and George, 2002). In their seminal paper, Cohen and Levinthal (1990:128) define absorptive capacity as ''firm's ability to recognize the value of external knowledge, assimilate it, and apply it to commercial ends".

According to Mowery *et al*. (1996), it is the process of long-term investment and knowledge accumulation within the organization, and its development is path dependent. Therefore, the targeted efforts to develop skills, learning culture and ability within organizations to recognise and assimilate external knowledge are a necessary pre curser for the effective exploitations of external knowledge. In the context of the automotive industry, it is also argued that those component suppliers who possess absorptive capacity will be in a better position to exploit the transferred technology. Hence a component supplier's absorptive capacity is a necessary component of technology transfer effectiveness at the supply end

For example, Szulanksi (1996) found that lack of absorptive capacity was a central barrier to internal knowledge transfer within organisations. On the other hand, firms that possess absorptive capacity are in a better shape and position to effectively assimilate external stock of knowledge. Therefore, in this study, we also argue that suppliers who possess ability to learn and assimilate their assemblers (Buyers) knowledge are in a position to effectively utilise their knowledge.

However, previous studies have limited this construct to the firm level of analysis what goes inside the firm and have not explored how absorptive capacity is developed at the firm level. The general assumption is that absorptive capacity as a firm level construct reinforces knowledge transfer, yet others found no such evidence (Lane and Lubtakin, 1998). Though proxy measures have been used, i.e. R&D, as Zahra and George (2002) suggests that absorptive capacity is a multidimensional construct. Unfortunately, as argued by Zahra and George (2002, 186), empirical studies do not always capture the rich theoretical arguments and the multidimensionality of the construct.

In this study, we would treat absorptive capacity as a multidimensional construct which goes beyond the dyad level. There may be an interactions effect between absorptive capacity, sender willingness to transfer technology and social ties and technology transfer effectiveness.

It is clear in the extant literature that recipient's absorptive capacity is a necessary element of successful knowledge acquisition. In this study, we adopt Zahra and George's (2002) suggestions that absorptive capacity can be divided into: potential and realized. Potential absorptive capacity includes the capability to acquire and assimilate knowledge. Knowledge acquisition refers to the recipient's ability to identify and acquire vital knowledge to its operational use from the outside source, and knowledge assimilation refers to the recipient's capability to analyze, process, interpret, and understand the knowledge obtained from outside source (Szulanski, 1996). Zahra and George (2002) further point out that a high potential absorptive capacity does not necessarily imply enhanced performance; what is important is the possession of realized absorptive capacity in making effective use of the acquired knowledge by integrating it into the recipient's operation.

The above discussion has shown that there are still some open questions regarding the concept of absorptive capacity, and whether it is the potential capacity or the realized capacity which one is important for knowledge transfer and its effectiveness.

These points lead us to the following research question.

What is the role of the recipient's absorptive capacity in the process of technology transfer and its effectiveness? How absorptive capacity is developed at the recipients end?

The following section discusses inter-organizational dynamics.

4.5 Inter-organizational dynamics (social ties and trust)

In this section the concept of inter-organizational dynamics will be explored in terms of social ties and trust. In the past, researchers have investigated either social ties to the sender of the knowledge or only on trust dimension in explaining knowledge transfer and much attention has been paid to the latter (Adler and Kwon, 2002; Dhanaraj *et al*., 2004; Levin and Cross, 2004; Szulanski *et al*., 2004). We argue that since two parties are involved in the technology transfer process, therefore, it is important to have a good understanding about the inter-organizational dynamics of the parties involved in the transfer process, therefore, social ties and trust need to be investigated together to see whether there is any variations caused by any one of these construct in knowledge transfer and its effectiveness. Thus social ties and trust as the main indicators of inter-organizational are discussed in the following section.

4.5.1 Social ties

This section deals with the inter-organizational dynamics of social ties within the realm of social context. In this research special emphasis is place on social ties between recipients and assemblers. It is assumed that assemblers and suppliers interact at various levels. The level at which interpersonal and other non-technological ties are articulated goes a long way in shaping technological transfer and its effectiveness. This interaction can be seen in various forms and situation, for example, personal-informal, managerial, organizational department and socio-politico level.

Tasi (2002:188) point out that research is needed that focus on, ''systemic understanding of the social processes that underlie how organizational units learn from each other''. Several researchers have pointed towards inter-organizational relationships as conduits of knowledge acquisition and exploitations (Dyer and Singh, 1998; Lane and Lubatkin, 1998). Through these social relations, organization can acquire external knowledge and combine it with their own knowledge stock for competitive advantage. However, these studies have not explored the interactions of social ties and absorptive capacity or which one is more important.
Some have argued that strong ties are the conduits of technology transfer whereas some have pointed out that week ties give the recipients more useful knowledge (Hansen, 1999; Levin and Cross, 2004).

Therefore, we still lack clear understanding when it comes to studying technology transfer in the developing countries context. For example, some scholars have called for a more focus on the types and nature of inter-organisation relationships that can facilitate or hinder one's access to technology resources, and in turn promote innovativeness at the recipient's end (Meyer, 2004; Moran and Ghoshal, 1999). However, researchers from the development and automotives continue to debate the relative value of a firm's ties to international assemblers (Sako, 2004; Schmitz, 2004; Stanley and Helper, 2006).

In uncertain environments, social ties have strong effects on actors' decisions to engage in the diffusion of innovations (Rogers, 2003). Furthermore, social ties can facilitate access to useful knowledge, ideas or resources and increase the probability and amount of knowledge transfer from senders to recipients (Reagans and McEvily, 2003). For example, most recently, McDermott and Corredoira (2010) have suggested that even few social ties with assemblers were beneficial for local Argentina's auto parts suppliers to do product and process up gradation.

Greater level of social ties provide organisation with access and insight to specialised business processes and structures of the exchange partners, resulting in the exchange of specialized information, language and know-how (Dyer and Singh, 1998; Lane and Lubtakin, 1998). Several scholars have suggested that informal, social ties between members of the same firm (Hansen and Lovas, 2004) or even different firms (Bell and Zaheer, 2007) are superior conduits of knowledge transfer between geographical distant locations. For the purpose of this research, social ties are operationalised in terms of informal and ceremonial exchanges between suppliers and assemblers as may be seen in the practice of gift giving on different occasions.

Above discussion has shown that we still need more empirical evidence to support whether strong, weak, or informal social ties are in fact give access to both the tacit and explicit knowledge. Moreover, the above research has not focused on the role of social ties and the transfer of the whole package of technology and its effectiveness.

The above discussion leads us to the development of the following research question.

What extent social ties facilitate technology transfer and its effectiveness from assemblers to their Pakistani suppliers?

The following section discusses trust as an important aspect of inter-organizational dynamics.

4.5.2 Trust

Trust is an important dimension of inter-organizational dynamics, because of its potential to affect inter-organizational knowledge transfer and knowledge creation (Doz, 1996; Dodgson, 1993). Mayer *et al*. (1995:712), define trust as "the willingness of a party to be vulnerable."

Trust plays an important role in the willingness of sender of technology to share technology. A lack of trust may lead to competitive confusion about whether a partner firm is an ally or not (Powell, *et al*., 1996). Several scholars in the field of trust have pointed out that trusting relationship between parties lead to greater knowledge transfer (Dirks and Ferrin, 2001; Mayer *et al*., 1995). When trust exists between the parties, people are more willing to provide useful knowledge (Andrews and Delahaye, 2000; Tsai and Ghoshal, 1998) and are more willing to listen to and absorb others' knowledge (Carley, 1991; Mayer *et al*., 1995).

Therefore, an atmosphere of trust contributes to the free transfer of knowledge between the partner firms, because decision-makers do not feel that they have to protect themselves from others' opportunistic behaviour (Jarillo, 1988; Blau, 1964).

We also strongly argue that in the emerging economies, i.e., of Pakistan, state institutions are weak; therefore, partners have to rely on trust to safeguard against opportunistic behaviour and honour commitment and contract. For instance, trust has also been found to be more important for performance outcome in uncertain markets (Luo, 2002) and environmental instability (Aulakh, Kotabe, and Sahay, 1996). When the relationships between exchange partners are embedded with trust, firms may be more willing to share valuable knowledge and accept the risk of spillover to competitors (Dyer and Singh, 1998), and trust is important for the receipt of tacit knowledge (Dhanaraj *et al*., 2004; Levin and Cross, 2004).
However, research is lacking in respect to the role of trust and the whole package of knowledge. We argue that sender may be willing to take risk by transferring a one type of knowledge, i.e. product-related compared to the whole package, for example, product, process and managerial-related.

We also argue that in the context of the automotive industry, a relationship between an assembler and component (part) suppliers built on short-term contract may not suffice for an effective technology transfer to occur. Although legal contracts identify the boundaries of partners commitments, relational contract go beyond these legal contracts. Relational capital, such as trust overcomes barriers and promotes learning by creating common identity facilitating free flow of knowledge, and reduces the costs of acquiring knowledge (Dyer and Noebaka, 2000).

Although previous studies have argued that trust increases knowledge transfer between exchange partners, however, some studies have cost doubts and indicated that a greater level of trust may also create blindness between the knowledge transfer partners and may hinder the successful transfer of knowledge (Lane *et al*., 2001; Yli-Renko *et al*., 2001). In addition, prior research has also not looked at the role of trust in the transfer of whole package of technology and its effectiveness.

On the basis of the above discussion, the following research question will be explored in the context of the automotive industry of Pakistan.

What is the role of trust in technology transfer and its effectiveness?

Following section discusses technology transfer effectiveness.

4.6 Technology transfer effectiveness

According to the resource-based view of the firm, hard to imitate resources leads to sustainable competitive advantages (Barney, 1991), and knowledge has emerged as one the key resource for sustainable competitive advantage (Grant, 1996; Gupta and Govindarajn, 2000; Kogut and Zander, 1992). The application of this transferred knowledge increases the competitive position of firms in terms of its performance and innovative capability (Dhanaraj *et al*., 2004; Kotabe, *et al*., 2003; Lyles and Salk, 1996).

Previous research has equated technology transfer with successful transfer in terms of cost, budget and time, whether the technology was deemed useful by the recipients (Levin and Cross; Szulanski, 1996), and speed (Zander and Kogut, 1995), the amount of knowledge transferred (Gupta and Govindarajan, 2000), or the value it created in young technology based firms (Yli-Renko *et al*., 2001).

Although these measures are useful, however, they do not capture the full extent of this concept by their nature of unidimensionality. Lately, scholars (Bhagat *et al*., 2002; Van Wijk *et al*., 2008) have been calling for adopting more fine tuned measures for technology transfer effectiveness. In this research, we consider technology transfer effectiveness as an outcome of the actual transfer of technology which may impact the recipients' dynamic capabilities in terms of breadth and depth of learning and exploitative and exploratory innovations. We may see an interactions effect of sender's willingness to transfer technology, type of technology, and recipient's absorptive capacity and learning intent on technology transfer effectiveness. This interaction will also impact by inter-organisation dynamics, i.e. social ties and trust.

The above discussion leads to the following important research question which will be investigated in the context of the automotive industry of Pakistan.

What extent technology transfer was effective in terms of breadth, depth of learning and exploitative and exploratory innovations and what are the determinant factors which influence technology transfer effectiveness?

The conceptual framework is shown in figure 4.1

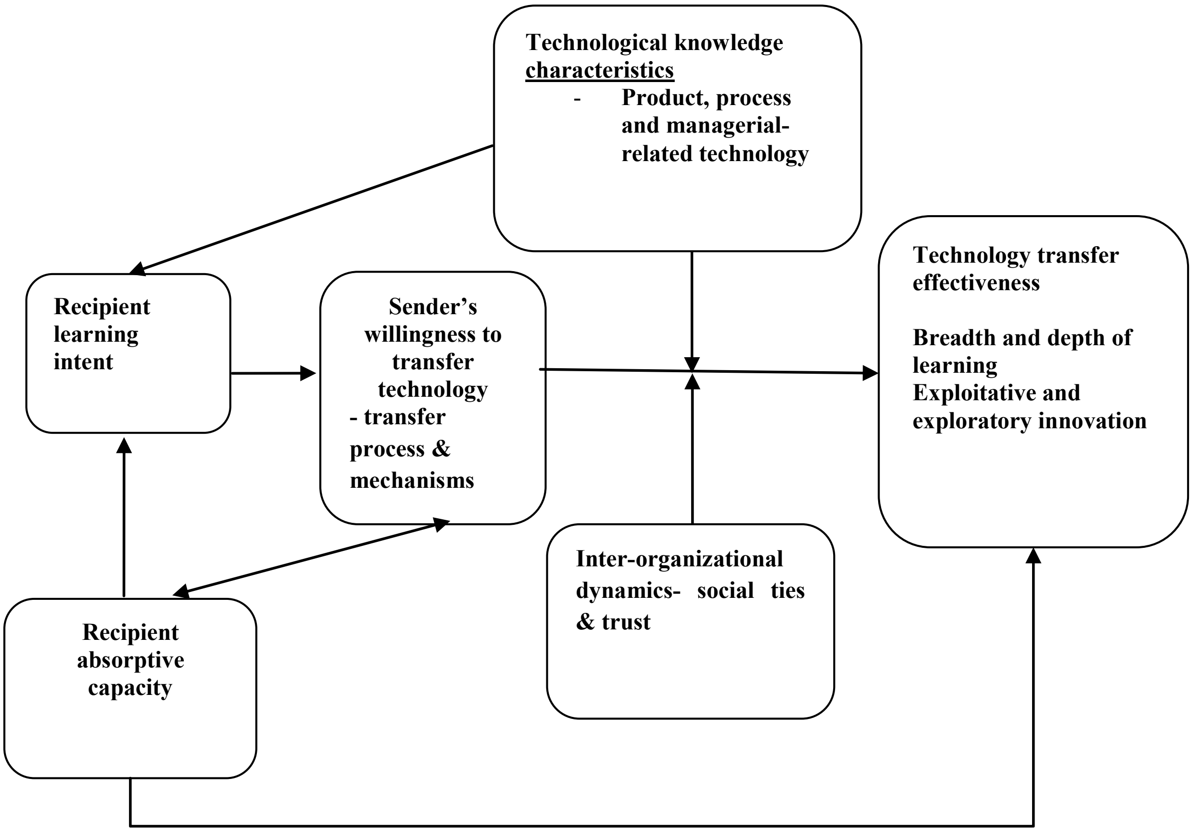


Figure 4.1: Conceptual Framework

Conclusion

The purpose of this chapter was to develop and provide an overview of the conceptual framework of the research. The discussions about the conceptualisation of various concepts show that characteristics of knowledge can have important implications for the actual transfer of technology to take place from sender to recipient. Some technological knowledge is easier to teach, whereas some knowledge is complex and tacit, and therefore, is difficult to teach and transfer. This type of knowledge transfer requires the sender's willingness to teach and the recipient requires a high level of learning intent and absorptive capacity to assimilate this type of knowledge. It is also clear that inter-organisational dynamics in the form of trust and social ties are important facilitators for the actual transfer of technology to take place, along with its effectiveness for the recipient. Chapter 5 goes on to discuss the automotive industry of Pakistan which is the empirical setting of this research.

CHAPTER 5: THE AUTOMOTIVE INDUSTRY OF PAKISTAN

Introduction

This thesis focuses on technology transfer effectiveness from international joint ventures (IJVs) established in the automotive industry of Pakistan to their Pakistan-based (owned) component suppliers. Therefore, it is imperative first to explore the global automotive industry and the history of the automotive industry of Pakistan to understand the context of this research. The main focus of this chapter will be to explore the origin and evolution of the automotive industry of Pakistan; the role of the various Government of Pakistan policy measures will also be explored. The chapter will then highlight the component suppliers segment of Pakistan to get a better idea about the working nature of the components industry.

This chapter consists of eight sections, including the introduction. Section 5.1 deals with the global automotive industry. In section 5.2, the origins and present history of Pakistan's automotive industry is discussed. Section 5.3 deals with the current status of the automotive industry of Pakistan. In section 5.4, the analysis of Pakistan's automotive policy is presented. Section 5.5 discusses the nature of the component suppliers' segment with particular focus on Pakistani component suppliers. In section 5.6, the production processes and quality control mechanisms are highlighted with reference to the Pakistani context. Section 5.7 explores the institutional structure of the Pakistani component suppliers with particular focus on suppliers' associations; the last section concludes the chapter.

5.1 The Global Automotive Industry

The automotive industry is an important player and sector in international trade; because of its share and contribution for the growth of international trade, it has emerged as one of the largest segments of world trade. The automobile industry was recognized as the 'the industry of industries' in the twentieth century and most recently is considered to be one of the important industries of the global economy (Dicken 2007). The global automotive industry is concentrated mainly in North America, Asia and Europe and with increased globalization, cross border flow of foreign direct investment (FDI), and the emergence of global production networks in the late 1980s have all contributed to the growth of the global automotive industry (Sturgeon *et al*., 2009).

The global automotive industry itself is very unique and distinctive compared to other industries, such as the pharmaceutical industry for example, because of its concentrated firm structure. Eleven major firms from three countries: America, Germany and Japan are the major players based in the North and South. Over the last two decades the automotive industry has consolidated itself through mergers and acquisitions (M&A) (see table 5.1). The financial problems of mainly Japanese and Korean automakers during the 1990s accelerated this process. The current financial crisis of 2008-09, has also pushed the industry towards radical changes with a wave of mergers and acquisitions taking place in the industry. For example, Fiat's acquisition of Chrysler was one major merger.

Table 5.1

Mergers and acquisitions in the automotive industry, 1990-2009

Year	Acquirer company	Acquire company	% acquired
1990	GM (USA)	Saab (Sweden)	50%
1990	Ford (USA)	Jaguar (UK)	acquired for $2.5 billions
1991	VW (Germany)	Skoda(Czech Republic)	30%
1994	Daewoo (South Korea)	Oltcit/Rodae (Romania)	51%
1995	Fiat (Italy)	FSM (Poland)	90%
1996	Daewoo (South Korea)	FS Lublin (Poland)	61%
1997	BMW (Germany)	Rover Group (UK)	

(Continued)

Table 5.1 (Continued)

Mergers and acquisitions in the automotive industry, 1990-2009

Year	Acquirer company	Acquire company	% acquired
1998	Hyundai (South Korea)	Kia (South Korea)	
1998	VW (Germany)	Rolls Royce (UK)	100%
1998	Daimler Benz (Germany)	Chrysler (USA)	paid $37 billion- biggest auto merger
1999	Ford (USA)	Land Rover (UK)	acquired for $2.96 billion
1999	Ford (USA)	Volvo (Sweden)	acquired for $6.45 billion (car operations only)
1999	Renault (France)	Nissan (Japan)	38.6%
2000	DaimlerChrysler (Germany)	Mitsubishi Motors (Japan)	34%
2009	VW (Germany)	Porsche (Germany)	Merger agreed, would merge in 2011.
2009	Fiat (Italy)	Chrysler (USA)	20%
2009	VW (Germany)	Suzuki (Japan)	20%

Source: Various newspapers reports

Traditionally and historically, the leading automotive assemblers, for example, Toyota, Ford, General Motors and BMW based in the Western countries produced 60-70% of the cars components in-house while also controlling the design process, marketing and financing (Humphrey, 2003). However, this organization of the automotive supply-chain is changing. Particularly, the assemblers based in the North and Europe have outsourced an increasing proportion of vehicle production; global first tier suppliers- systems suppliers have taken on much greater role of design and processes technologies. The automotive industry is considered by many as the producer driven value chain where the lead assemblers play a key role in coordinating and organizing the whole production network (Dicken, 2003).

Component suppliers play an important and integral role in the manufacture of vehicles. It is estimated that around 66% to 75% of value added vehicle content is purchased by the automotive manufacturers from their suppliers (Holweg and Pil, 2004). The engineering complexity of automotive manufacturing has created different tiers of suppliers, for example, first tier-global suppliers produce systems design and specialized systems supplies, for example, heating and cooling devices and brake systems. These suppliers are then supported by 2^{nd} and 3^{rd} tiers of suppliers.

In Europe and Latin America, the automotive industry value chain is organized according to these tiers of suppliers. The lead firm- assembler concentrates and deals directly with the first tier suppliers, i.e. Toyota and Denso. Auto assemblers and these global first tier suppliers have formed relationships which cut across the globe. These global first tier suppliers are then responsible for coordinating activities with the 2^{nd} and 3^{rd} tiers of suppliers.

This work organization saves times and creates close collaborations and knowledge exchange between the lead assembler/s and its first tier suppliers, and therefore gives access to unique network resources.

Several scholars have argued that by involving suppliers in the product and process design and development buyers (assemblers) could gain faster product development, lower costs and high quality products. Numerous studies concluded that assemblers should foster high intensity relationships with their suppliers (Womack *et al*., 1990; Clark and Fujimoto, 1991). Suppliers are now involved in early design and development of vehicle and have formed more interdependent longer relationships with auto assemblers (Fujimoto, 1999). This supply arrangement has resulted in knowledge sharing networks (Dyer and Hatch, 2006).

In the context of the automotive industry, and specifically in the automotive component suppliers context unique resources which are hard to imitate and rare (Barney, 1991) can be considered to exist in the form of technological and managerial knowledge which many automotive companies possess, e.g., the Toyota production systems. Therefore, in this study, we can see that automotive component suppliers can develop and exploit competitive advantages by combining their internal resources (current firm knowledge) with outside resources (technological know- how provided by other firms, i.e., Toyota, Honda, Suzuki, etc.

Several researchers have pointed towards inter-organizational relationships as conduits of knowledge acquisition and exploitations (Dyer and Singh, 1998; Lane and Lubatkin, 1998). Through these social relations, organization can acquire external knowledge and combine it with their own knowledge stock for competitive advantage. For example, Dyer and Hatch (2006) found that suppliers who were part of the Toyota network received valuable knowledge from Toyota. Similarly, McDermott and Corredoira (2010) have suggested that even few social ties with assemblers were beneficial for local Argentina's auto parts suppliers to do product and process up gradation.

The global automotive industry is dependent upon radical innovations, for example, fuel efficient and electrical cars which can create a sustainable competitive advantage for these auto firms. It is therefore, logical for the automotive suppliers to examine their industry position and partnerships with key automotive firms to acquire access to technology and partner resources thus filling important strategic and operational gaps. For example, Vekstein (1998) point out that in the automotive industry the complementary use of external and internal developed knowledge is a key source of competitive advantage.

The automotive industry is characterised by increasing technological changes, so we might expect the component suppliers to continuously scan for external knowledge from auto assemblers and the same might be the case for auto assemblers. However, in the process of scanning the relevant industry for knowledge, Phene *et al*. (2006), argue that firms usually limit their searches for outside knowledge to extent of technology that are familiar to them. This argument fits well with the notion of the 'absorptive capacity concept'.

Over the years, first tier suppliers have gained increasing responsibility for design, technology development, especially in high complexity technological components, such as engine parts, transmission, braking and electronic components. They have also grown in size and globally connect and are almost as comparable in the size to the larger automotive manufacturers. Table 5.2 compares the world's leading components suppliers in terms of their revenue in 2000 versus 2008.

Table 5.2
World's leading components suppliers in terms of revenue 2000 versus 2008 (revenues $ billions)

Suppliers	2000	2008
Robert Bosch (Germany)	29.1	58.5
Denso Corp. (Japan)	18.2	40.3
Johnson Controls (USA)	17.2	35.9
Aisin Seiki (Japan)	8.9	27.1
Magna International (Canada)	10.5	23.7
Delphi (USA)	29.1	18.1
Eaton (USA)	8.3	15.4
Lear Corp (USA)	14.1	13.6
Valeo SA (France)	8.9	11.4
Visteon (USA)	19.5	9.5

Source: Forbes & companies financial data

Table 5.2 shows that component suppliers are an important part of auto assembly, as is evident through their revenue generations from auto assemblers. Therefore, the discussion of

component suppliers is important together with auto assemblers, because the performance of auto assemblers is closely linked to that of the component suppliers. The problem of a single component of a fully assembled vehicle can incur high costs for both the auto manufacturer and component supplier. Also, structural changes in the component suppliers are linked to the auto manufacturers. And since the focus of this research is on technology transfer effectiveness from the automotive assemblers to their Pakistani components suppliers, thus the component suppliers' segment deserves special attention.
These above changes have affected the global automotive industry and the location of activities in different parts of the world.

The automotive industry is becoming more regional in nature with the final assembly of the products taking place in the end markets; because of political pressures on the industry to source locally and follow local contents policies and technology transfer requirements. For example, South Africa, Mexico, India, China and Pakistan have all, from time to time, had local contents requirements in place to promote the local assembly and the component suppliers' industry. All the above factors have contributed towards the dispersion of final assembly that now takes place in many more countries than it did 30 years ago (Sturgeon *et al*., 2009).

The volume of assembly of light vehicles will grow from 66 million units in 2008 to 93 million units in 2016, with emerging markets contributing around 95% of this growth (Price Waterhouse Coopers Auto Facts, 2010). Table 5.3 shows world motor vehicle production by number of units. This trend will offer many business opportunities for both assemblers and component suppliers, as demand is expected to increase in emerging economies. It also presents many challenges for both auto assemblers and their suppliers to work together for a sustainable growth strategy and to streamline the under-developed supply chain in emerging economies. The issue of supplier's capability development and technology transfer becomes even more important in the context of these economies.

Therefore, it offers a good scholarly opportunity to explore technology transfer effectiveness from the assemblers to their local component suppliers in the emerging economies context.

Table 5.3

World motor vehicles production (in units), 2000-2009

Year	Cars	Commercial vehicles	Total no. of units	% change
2000	41,215,653	17,158,509	58,374,162	3.8%
2001	39,825,888	16,479,037	56,304,925	-3.5%
2002	41,358,394	17,635,924	58,994,318	4.8%
2003	41,968,666	18,694,559	60,663,225	2.8%
2004	44,554,268	19,941,952	64,496,220	6.3%
2005	46,862,978	19,619,461	66,482,439	3.1%
2006	49,918,578	19,304,397	69,222,975	4.1%
2007	53,201,346	20,064,715	73,266,061	5.8%
2008	53,025,081	17,794,376	70,819,457	-3.7%
2009	47,952,995	10,393,774	58,346,803	-12.47

Source: OICA Production Statistics various years. (http://oica.net/category/production statistics/)

The above table shows worldwide car and commercial vehicle production. As is evident from the table, the automotive industry is one of the largest manufacturing industries in the world. The unit of production of all vehicles (cars + commercial vehicles) reached 70 million units in 2008. In 2009, the volume of production dropped and worldwide car and commercial vehicle production reached 58 million units. This drop could be attributed to the financial crisis and to worldwide automotive industry consolidation. The financial crisis caused global new vehicles sales to drop enormously. Compared to the first six months of 2008, vehicles sales in the first six months of 2009 for 8 of the world's top 10 auto assemblers declined from 10% to 31% (see table 5.4). As the industry emerges from the crisis, the need to streamline supplier networks, invest in R&D and produce fuel and environmental-friendly vehicles is felt even more important across the globe.

Table 5.4

Global vehicles sales during the first 6 months of 2008 versus the first 6 months of 2009

Companies	6 months 2008	6 months 2009	% change
Toyota Corp.[1]	4,815,442	3,564,105	-26%
General Motors Co.*	4,541,125	3,552,722	-21.8%
Volkswagon AG**	3,265,200	3,100,300	-5.1
Hundai-Kia	n.a.	2,153,000	n.a.
Ford Motor Co.***	3,093,000	2,145,000	-30.6%
PSA Peugeot Citeroen	1,844,700	1,586,900	-14%
Honda Motor Co.[2]	20,222,000	1,586,000	-21.6%
Nissan Motor Co.	2,013,611	1,545,976	-23.2%
Suzuki Motor Corp.[3]	1,283,000	1,152,000	-10.2%
Renault SA	1,326,164	1,106,989	-16.5%

*Includes Wuling; ** Excludes Scania; ***Wholesale only; 1, 2, 3 IJVs in Pakistan, n.a. = not available.

Source: Automotive News Data Centre

Some of the major issues of the global automotive industry are: fuel efficiency, overcapacity, strategic alliances, innovations and a long-term investment focus on new products and process technologies. These issues in a sense also require long-term collaborations and technology transfer in the automotive industry. Table 5.5 shows the major issues of the automotive industry for the last seven years.

Table 5.5

Major issues of the Automotive Industry, 2004-2010

2004	2005	2006	2007	2008	2009	2010
Consolidation is expected throughout the industry	Global overcapacity- not as much of a worry	The auto growth is shifting from the West to Asia and Eastern Europe	Fuel efficiency now tops the list of consumer preference	Alliances and mergers are seen as significant for industry restructuring and new market entry	Innovation is more important than direct overhead cost reductions	Overcapacity is seen to be very high over the five year period in the Triad markets
Luxury vehicle sales will continue to grow in market share	Safety is organic to the industry and will be an ongoing major focus	Global over capacity	Strategic Alliances	Industry is regrouping to meet fuel efficiency and clean energy	Host costs and declining economies- drive restructuring	Emerging markets- major growth driver
Investment in safety innovations	Fuel efficiency	Biggest gains in market share for small vehicles and hybrids for fuel efficiency	SUVs and Pickup trucks are on the wane	Demand for hybrids vehicles as a result of the high cost of fuel and environmental concerns	Fuel efficiency and alternative propulsion	Strong concerns over the emergence of automotive overcapacity in the BRICs countries.
Fuel efficiency will be the major consumer purchase criteria	New technology as a key to attracting customers	OEMs to be the most profitable segment, with captive finance companies right behind	Winners in global market share will be Chinese, Indian and other Asian brands	China will rival U.S. car sales within five years	Global economy and financing costs as the key challenges	Long-term investment focus remains on new products and new technologies
Quality is the number one industry issue		Main reasons for investing in China is still to sell to Chinese consumers, rather than for export	Major reason for investing in China shifted to cost-efficient manufacturing	Most important innovations will be related to hybrid systems and fuel-cell technology		Fuel efficiency is the most significant consumer buying issue

Source: KPMG's Global Auto Executive Survey 2010

The above discussion have shown that global automotive industry is going through fundamental changes and final design and sourcing activities are taking place closer to the end markets. Against this backdrop, the emerging economies are becoming very attractive location for the automotive industry.

The next section deals with the automotive industry of Pakistan, as this is the empirical context of the research.

5.2An Overview of the Automotive Industry of Pakistan

The automotive industry plays a vital role in the development of local economies in terms of a valuable source of revenue generation, human resource development and, moreover, technology transfer through vertical suppliers' relationships. In Pakistan, the automotive industry employs 192,000 workers and contributes $3.6 billion to the GDP of Pakistan; therefore it is considered to be a pillar industry in Pakistan.

The development of the automotive industry of Pakistan has clearly been shaped by the circumstances of Pakistan's wider political, socio-economic factors. The automotive industry of Pakistan has evolved through various phases. In this section, the evolving history of the industry is considered in terms of three key phases of evolution and development: **the 1950's phase**; **the 1970's nationalization phase**, and **the phase of liberalization.**

5.2.1 The 1950's Phase

At the time of independence, Pakistan did not inherit any industrial base that could play an important role and form the basis of a local automotive industry in Pakistan. The local demand for trucks, buses, cars and motorcycles was met through imports. This phase can be characterized by automobiles that were mainly imported, and very little effort was initiated in

Pakistan to manufacture cars locally. During this phase, General Motors was one of the first pioneers in the auto industry to set up National Motors Limited in Pakistan to assemble cars and Bedford trucks mainly through semi-knocked kits at their Karachi plant (UNIDO, 2006). This plant also subsequently started the assembly of light trucks, buses and cars. The localization of components was around 20% of the total components procured by this plant.

5.2.2 The 1970's Nationalization Phase

This phase of the automotive industry of Pakistan is characterized the nationalization phase. By the end of 1970s practically all automotive assembly in the country had ceased. In 1972, all basic industries including the automotive industry were nationalized by Pakistan's government, which to some extent, had a negative impact on the overall growth of the industry. During the 1970s, a total of nine automotive plants were in operation when the government decided to nationalize the industry and set up the Pakistan Automobile Corporation (PACO). It took almost eight years for the Pakistan Automobile Corporation to finally implement its automotive industry development related programmes. In order to meet the local car demand, PACO launched the Suzuki project that started production in 1983-84 with the introduction of FX 800 cc Suzuki car. The industry was highly regulated until the early1990s. The 1990's onward phase is called the liberalization phase of the automotive industry of Pakistan. These phases, and the historical evolution of the automotive industry of Pakistan, are summarized in table 5.6.

Table 5.6

Various phases and the historical evolution of the Pakistan's automotive industry

Year/Phase	Manufacturing Operations	Vehicles	Company
1950's (Private sector).	SKD assembly	Bedford trucks/buses.	General Motors.
1970's (Nationalization).	SKD/CKD assembly	Bedford trucks, buses, and cars.	Pakistan Automobile Corporation (PACO)
1990's onward (Privatization & entry of major Japanese Assemblers).	Progressive manufacturing of cars under industry specific deletion Programme (ISP)	Suzuki, Toyota, Honda,	Pak Suzuki Motor Company, Indus Motor Company Ltd, Honda Atlas Ltd.

Source: Engineering Development Board of Pakistan (EDBP)

5.2.3 The liberalization Phase

In 1992, the government of Pakistan started various privatization programmes, and under the umbrella of these programmes many units of the 1970s nationalized Pakistan Automobiles Corporation were privatized. After deregulation and privatization, major Japanese auto assemblers entered the Pakistani market through joint venture arrangements with local companies (see table 5.7) and, to some extent, these new entrants have created some competition in the local market. During this phase, Suzuki cars (1984), Toyota (1993), and Honda (1994), entered the Pakistani market, once the government had introduced the deregulation programmes. This phase can be characterized by three dimensions: an increase in the volume of production, an increase in the availability of different brands, and also the development of the local supply chain networks. The table 5.7 summarizes the major International Joint Ventures (IJVs) established in the automotive industry of Pakistan and their major products.

Table 5.7

International Joint Ventures in the Automotive Industry of Pakistan

Assembler	Joint Venture Partners	Major Products
Atlas Honda	Atlas Group, Pakistan & Honda, Japan	Honda Civic-1493cc-1800cc; Honda City-1300cc -1500cc
Indus Motor Company	House of Habib, Pakistan, Toyota & Daihatsu, Japan	Toyota Corolla-1300cc - 2000cc; Daihatsu Cuore - 850cc
Pak Suzuki Motor Company	Pakistan Automobile Corporation & Suzuki, Japan	Suzuki Liana-1300cc; Suzuki Swift-1300cc; Suzuki Cultus-1000cc; Suzuki Alto-1000cc; Suzuki Mehran-800cc

*Source: Pakistan Automotive Manufacturers Association (PAMA) (*http://www.pama.org.pk)

5.3 Current status of the automotive industry

In this section various phases, related to the current stat of the automotive industry of Pakistan are discussed.

5.3.1 Preparation Phase

The 1985-2005 time period was highlighted as the **''preparation phase''** of the automotive industry of Pakistan (AIDP 2008). The objective of this phase was to promote localization/indigenization of cars and their component manufacturing. This localization of component manufacturing was based on two different types of localization/deletion plans- the Industry Specific Deletion Plan (ISDP) and Product Specific Deletion Plan (PSDP) (AIDP 2008). Under these plans, the assemblers were supposed to set annual targets for each of their assembled vehicles, and the Engineering Development Board of the Ministry of Industries and Production would have to conduct annual audits of the assemblers to assess the achievement or shortfall of deletion targets. In case of a shortfall in targets, assemblers would be penalized by charging the CBU rate of duty on the value of the components that were not indigenized in that period (AIDP, 2008).

According to the Ministry of Industries and Production (MOI&P) report, the economic objectives of these localization/deletion plans, for example, were: import substitution, job creation, investment in original equipment manufacturing (OEM), and to some extent, suppliers' development, and had been achieved by the end of the automotive industry preparation phase in 2005 (AIDP, 2008). After this period, the industry entered the next phase, which is development.

5.3.2 Development Phase

In 2005, the automotive industry started the **''Development Phase''**. This phase will last until 2012 (AIDP, 2008). During this phase, the Government of Pakistan is determined to provide an enabling environment and strategy to the industry to develop a high value additional capacity, which will shape the industry in the new competitive environment. The replacement of localization/deletion programmes with the Trade Related Investment Measures (TRIMS) and WTO compliant Tariff Based System (TBS) in July 2006 was a major shift for the automotive industry. The TBS gives assemblers the choice to buy components at competitive prices, to enhance quality and improve the supply chain. During this phase, the issues of acquisition of technology, the development of human resources, competitiveness, investment in R&D, and innovation have gained more importance. The Government of Pakistan has also envisaged a third phase for the automotive industry.

5.3.3 Global Era Phase

The period from 2012 onwards is dubbed as the ''**Global Era''** for the automotive industry. During this period, the Pakistan automotive industry will re-position itself through enhancing value added production to become a competitive global player (AIDP, 2008). During this phase the industry will also have sufficient first and second tier suppliers who will have the design and tooling capacity to develop components through in-house efforts, or through collaborations with other component suppliers.

According to the Ministry of Industries and Production of Pakistan, by the start of this phase, the expectations are that the automotive industry will achieve the economies of scales due to high production volumes, supported by the increase in size of the GDP worth of $210 billion by 2012 and a per capita income reaching $1,300. It is also expected that the industry will contribute to foreign exchange and will be one of the leading foreign exchange providers through the export of components and Completely Built Unit (CBU). Due to these reasons, the overseas joint venture partners in the automotive industry of Pakistan are expected to take the Pakistan market as a regional hub for manufacturing and for the export of components and vehicles (AIDP, 2008).

It is clear from the above discussion that the government views the automotive industry as a pillar and star industry, and has strong expectations of the auto assemblers to develop the under-developed supply chain by means of investment and transfer of technologies. Therefore, with this backdrop, the topic of current research becomes even more important in the context of Pakistan. The following section deals with the automotive policy of Pakistan.

5.4 Analysis of the automotive policy (2006-07)

Pakistan's government considers the automotive industry as a pillar industry, and introduced a major initiative for the development of the automotive industry in Pakistan, in the form of the

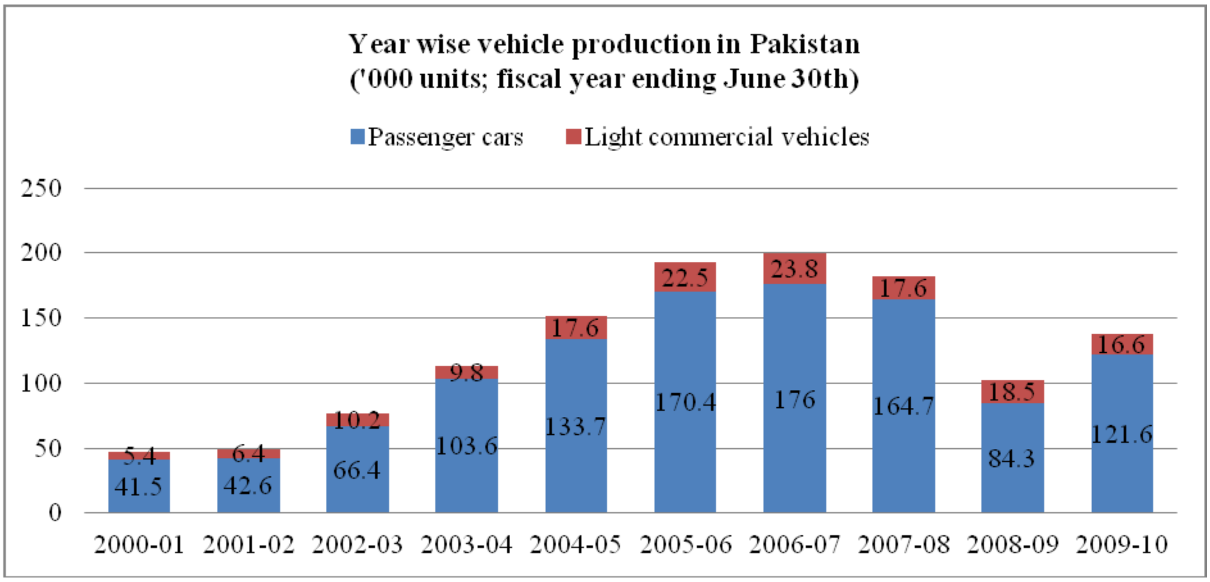
Auto Industry Development Programme (AIDP), which was approved in 2007. The plan presented a policy of the automotive sector for a period of five- years. Under this plan, the aim is to increase the production in the country to 500,000 vehicles per year by 2012. The AIDP also allows new entrants to enter the market, allowing them to import 100% completely knocked down (CKD) kits at the rate of 32.5% for three years without using any locally made components.

This plan was very helpful when increasing foreign direct investment to the automotive industry, but domestically very little progress has been made, given the government's other priorities since 2007, and the severe challenges that the country's industrial sector faces. Indications are that the plan's ambitious production targets will not be met. For example, in 2009-10 total cars production stood at 122,000 units, while total sales were 124,000. The market size is estimated at 145,000 new units in that year, but buyers often have to wait for months before receiving their new car, and late delivery along with high premiums charged on locally assembled cars, remain some of the major concerns and dissatisfaction with the industry amongst Pakistani buyers. Assemblers have confirmed their commitment to ongoing investment and expansion projects aimed at raising production levels, but on the evidence of current trends, the official production target of 500,000 units per year by 2012 is very unlikely to be achieved. Figure 5.1 shows vehicle production from 2004-2010 vis –a- vis their installed capacity (table 5.6).

The three major assemblers: Suzuki, the Indus Motor Company and Honda Atlas have different levels of annual plant capacity, and all these assemblers have shown willingness and announced plans to increase their production volumes over the next few years, keeping in mind the demand level in the country, but these plans have yet to come to fruition, and late delivery along with high premiums still remain the major sources of dissatisfaction amongst consumers. Table 5.6 shows the annual plant capacity of these three assemblers.

Figure 5.1

Pakistan vehicle production



Source: Author's calculation based on PAMA's production data.

Figure 5.1 shows that since 2003-04 passenger cars and light commercial vehicles production has increased and assemblers have been increasing their plants' capacity, as shown in table 5.8.

Table 5.8

Three Assemblers Annual Plant Capacity*

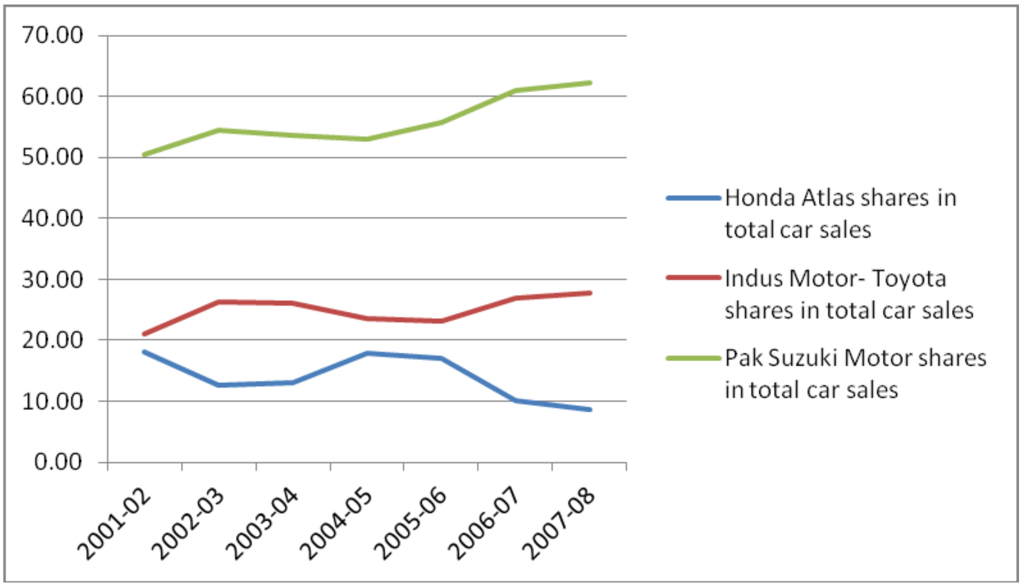
Company	2005	2006	2007	2008	2009	2010
Atlas Honda	30,000	50,000	50,000	50,000	50,000	50,000
Indus Motor (Toyota)	44,298	53,040	53,040	53,040	53,040	-
Pak Suzuki Motor	120,000	150,000	150,000	150,000	150,000	150,000

Source: PAMA; *capacity in Nos.

Table 5.8 shows that Pak Suzuki has more annual plant capacity, and is the market leader in the smaller car segment followed by Indus Motor and Honda Atlas. Figure 5.2 shows the market share of these three assemblers since 2001-2008.

Figure 5.2

Market share of the three assemblers in (%)



Source: Author's calculation based on PAMA's data.

Figure 5.2 shows the market share of the three major assemblers in Pakistan since 2001. It is clear from the figure that, over the years, the market share of Pak Suzuki Motor's market share has increased by almost 12% over a seven year period, and it is clearly a market leader in Pakistan. Indus Motors, the makers of Toyota vehicles in Pakistan market share has increased by 7% during the same time period. However, Honda Atlas has the lowest market share and the shares have declined by around 10% since 2001.

Before this policy, Pakistan has the deletion programme for the automotive industry which started in 1983, with a revised policy announced in 1987 (Engineering Development Board

2005). Under this plan assemblers who wanted to set up their assembly units in Pakistan were required to replace imported components through local sourcing. In 1995, the government of Pakistan also initiated Product Specific Deletion Programme (PSDP), which the assemblers had to follow for the initial localisation of components. In 1996-2001, this programme was replaced with Industry-Specific Deletion Programme (ISDP), which was phased out in 2005. This deletion/localization/indigenization policy stipulated that the assemblers' compulsory use of a certain percentage of locally manufactured components. With the signing of the WTO, Pakistan moved away from the deletion policy to the Tariff- Based System (TBS) in 2006. Under this system, protection is provided to the local component suppliers through tariff measures. Table 5.9 shows the five year tariff rates for the automotive industry that was approved by the government during the 2007-08 budget (AIDP, 2008). TBS was developed with the following objectives to:

1- make the automotive industry TRIMs compliant
2- encourage indigenization of parts and components
3- discourage roll back through a transparent and predictable system
4- preserve & promote technologies that have been developed
5- protect present job structures in the auto industry
6- promote job creation
7- Protect the existing & planned investment by OEMs & component suppliers
8- Promote new investment
9- Expand the consumer base to create economies of scale

Table 5.9

Five year tariff rates for the automotive industry of Pakistan - Cars segments

Product category	2007-08	2008-09	2009-10	2010-11	2011-12
CKD					
Localized Components	50%	50%	47.5%	45%	45%
Non -Localized Components	35%	32.5%	32.5%	30%	30%
CBU					
cars 800cc	50%	50%	50%	50%	50%
801 -1000cc	55%	55%	55%	55%	55%
1001-1500cc	60%	60%	55%	55%	55%
1501-1800cc	75%	75%	70%	70%	70%
above 1800cc	90%	90%	85%	85%	85%

Source: Engineering Development Board of Pakistan

Table 5.9 shows that if an assembler wanted to import those components that are localized up until 2005, they will must pay a duty rate of 50% of the imported price, whereas if the component is not localized, the assembler can import that particular component at 32.5% of the import duty. Over the period of time and up until 2012, these tariff rates will come down, as is shown in table 5.9. All these programmes were aimed to help develop the local component suppliers market segment and to facilitate technology transfer from assemblers to their component suppliers. The main objectives of the AIDP are to:

1- encourage investment in the automotive industry

2- encourage growth

3- promote domestic competition

4- enhance competitiveness

5- stimulate innovation

6- encourage further localization/indigenization of components

7- facilitate the automotive industry's integration into the global value chain

8- regulate the used vehicles import policy to avoid impeding the growth of local industry, whilst protecting consumer interest

The 2006-07 automotive industry development programme (AIDP) offers encouragement and strategic direction to the industry. For example, instead of local content regulations, this policy provides a five year tariff based structure to the industry to promote and develop technologies and source components on the basis of competitive price and quality. However, the data from secondary sources reveals that so far, the government has not implemented the auto industry development policy in letter and spirit. One of the leading newspapers in Pakistan reported that the Pakistan Association of Automotive Parts and Accessories Manufacturers (PAAPAM) chairman was not happy with the non-implementation of the steps mentioned in the AIDP. According to the Pakistan Observer report:

> ''*In a letter sent to the Ministry of Industries & Production, Government of Pakistan, Tariq Nazeer, Chairman of PAAPAM, regretted that "unfortunately, due to reasons unknown to us, none of the steps of implementation of AIDP, that were envisaged to be enforced with effect from July 1, 2010 were incorporated in the Federal budget 2010-11. This has left the industry directionless and unsure of the fate of AIDP*" (Pakistan Observer, 2010).

There are also concerns about the strict monitoring of the tariff based system (TBS), as the new industrial policy draft of the Government of Pakistan pointed out that, although TBS is officially in use, it is, effectively, in abeyance. The policy draft recommended strictly enforcing TBS, because it is critical for local industry. The draft further stated that in the absence of effective monitoring, the progress of Pakistan's automotive industry will be impeded (Pakistan Industrial Policy, 2010).

The above discussion shows that the automotive industry is lagging behind its production targets. It is clear from the actual production figures, shown above, that the volumes are way behind the AIDP projected level, and have instead gone down, thereby upsetting the economies of scale. This has also resulted in no further investment and localization of components, particularly for complex technological components, such as power steering, engines and transmission, etc. The secondary source data also indicates that there is strong dissatisfaction amongst the key stakeholders about the overall outcome of this automotive policy.

The below table provides brief summary of the above section and highlights related to the automotive industry development policy.

Table 5.10

Brief Summary of the Automotive Industry Development Policy (AIDP)

Auto Industry	Policy's major highlights
• Pakistani Government considers the automotive industry as a pillar industry • Industry has moved through various phases such as preparation phase, development phase and global era phase • WTO and Tariff-based systems impact	• Developed various policy measures such as product related localisation and industry specific localisations • Under these policy measures assemblers' were to compulsory use of a certain percentage of locally manufactured components • With the signing of the WTO, Pakistan moved away from the deletion policy to the Tariff- Based System (TBS) in 2006 • Under this system, protection is provided to the local component suppliers through tariff measures • Launched a comprehensive auto policy in 2006-2007 • Encourages investment in the automotive industry • Stimulate innovations • The policy the aim is to increase the production in the country to 500,000 vehicles per year by 2012. • However, the production is below target

Source: Author's summary based on the information in section 5.4

The below section discusses the institutional structure of Pakistan which provides support and facilitate the automotive industry.

5.5 Institutional Set-up available to the Automotive Industry

Various Government departments, entities provide institutional support to the automotive industry and these are briefly explored in the following sub-sections.

5.5.1 Pakistan Board of Investment

Pakistan board of investment (BOI) facilitate the foreign investors who intend to set up their businesses in Pakistan by providing policy packages and incentives to the foreign investors to encourage investment in various sectors, i.e., manufacturing and services sectors. The board of investment provides variety of services to investors, such as information related to the investment opportunities available in various sectors. BOI also facilitates companies who are interested in setting up joint ventures with Pakistani companies. The table 5.10 shows the general policy package provided to foreign investors setting up their businesses in the manufacturing sector.

Table 5.11

Government of Pakistan's General Policy Package

Policy Parameters	Manufacturing Sector
Government permission	Not required except for specific industries[1]
Remittance of capital, profits, dividends etc.	Allowed
Upper limit of foreign equity allowed	100%
Custom duty on import of Plants, machinery and equipment	5%
Tax relief (initial depreciation allowance % of plant, machinery and equipment cost	50%

1= specified industries are Arms and ammunition, high explosives, radioactive substance, Security printing, currency and mint

Source: Pakistan Board of Investment- www.pakboi.gov.pk

5.5.2 Ministry of Industries and Production

The Ministry of Industries and Production of Pakistan facilitate economic development; provides information and analytical insights to industries thus creating an enabling environment for the promotion of industrial development in Pakistan. It also promotes investment in industry and gives prescription and review criteria for the assessment of spare parts and raw materials for industries including the automotive industry. Ministry of Industries and Production have initiated several initiatives such as Small and Medium Development Authority (SMEDA) for the promotion and development of small and medium enterprises in Pakistan.

5.5.3 Engineering Development Board of Pakistan

Engineering Development Board (EDB) main objective is to strengthen the engineering goods and services sectors. EDB has undertaken several initiatives for the development of export and increasing the competitiveness of the engineering sectors. EDB formulates and coordinate Government of Pakistan's initiated policies related to the engineering sector including the automotive industry. One of the main functions of this board is develop a long-term vision for the development of automotive industry and to monitor the localisations programmes related to the automotive industry.

The table 5.11 briefly highlights the main functions of these government run entities.

Table 5.12

Institutional supports agencies and their main functions

Institutional Supports Agencies	Main functions
Pakistan Board of Investment (PKBOI)	• Promotion of investment in all sectors • Facilitates foreign and local investors willing to invest in Pakistan • Enhance Pakistan's international competitiveness through FDI • Contributes to the economic and social development of Pakistan by promoting FDI in all sectors of the economy • Acts as a focal point of contact for perspective investors
Ministry of Industries and Production	• Provides information and analytical insights to industries for the industrial development of Pakistan • Promotion of investment in various industrial sectors • Promote value addition and exports of industrial products around the globe • Enhance the global orientations of Pakistani industries • Focuses on the human resource development, technology acquisition, business support services including infrastructure to increase the productivity of industries
Engineering Development Board of Pakistan (EDBP)	• Strengthen the engineering sectors of Pakistan and integrate it with the global value chain and world market • Improve production technologies of the engineering sectors • Promote sector wise international exposure to relevant trade fairs • Facilitates the participations of auto components suppliers in local and international trade fairs and exhibitions, for example, Hannover Germany and Euro Mold • Monitor the localisations programmes related to the automotive industry

Source: Author's interpretations of the available information on the respective agencies websites. www.pakboi.gov.pk; www.moip.gov.pk ; www.engineeringpakistan.com

The following section discusses the Pakistani component suppliers, as this is the main focus of the present research.

5.6. Pakistani component suppliers

The major reason behind developing and promoting the automotive industry is to develop component manufacturing in Pakistan. Growth of the component suppliers segment in Pakistan is led by the three major vehicles assembly plants of Pak Suzuki, Indus Motor (Toyota) and Atlas Honda. The component suppliers segment in Pakistan is organised in such a manner that global first tier suppliers, Pakistani first tier suppliers, 2nd tier and 3rd Pakistani suppliers do business directly with the assemblers, unlike in the West and Latin American where only the global first tier suppliers deal directly with the assemblers (see section 5.2).

Like auto assemblers, the Pakistani auto component suppliers, or better known as auto vendors in the Pakistani segment, are also going through a transitional period. There are around 2,000 components suppliers in the auto components segment (PAAPAM, 2006; Automark, 2008). Although the number of component suppliers in Pakistan seems a lot, the scale of most of their operations is small. The component suppliers segment constitutes 90% of small and medium family owned enterprises (SMEs), of which around 95% are self-financed (Small Medium Development Authority of Pakistan; European Commission, 2007). From 2000-2007, the component suppliers segment had seen an annual growth of about 35% with the backdrop of strong demand for automobiles in the country.

As already discussed in this chapter, the Engineering Development Board of Pakistan (EDBP), under the Ministry of Industries and Production, has set a 20% annual compound growth target for the industry for the next five years-2007-2012. The EDBP’s projections indicate that by 2011-2012, the production of cars including light commercial vehicles (LCV) would achieve a target of 500,000 vehicles, up from almost 193,000 vehicles in 2005-06. This growth would provide additional direct employment approximately to 300,000 individuals. The component suppliers’ segment contribution to GDP alone is projected to increase from 2.8% in 2005-06 to 5.6% by 2010-11.

If this projected level of growth that Pakistan will produce at least 500,000 vehicles by 2012 is to become a reality, then the industry must take radical steps to reach the required levels of development. Furthermore, the need to mature and develop will become even stronger if export ambitions from the industry are taken into account. In this scenario, these growth expectations require the industry to put high pressure on, and give top priority, to the areas of technological know-how, R&D, capacity improvement, availability of latest machinery and products, and process and managerial technology. Developing the capability in these areas requires close co-operation between the Pakistani-based auto assemblers and their local (Pakistani) component suppliers.

Therefore, the process of technology transfer, the mechanisms used to transfer the technology, the willingness of assemblers to transfer product, process and managerial technology, learning intention of local component suppliers, absorptive capacity of local suppliers, and inter-organizational dynamics in the forms of trust and social ties, become even more important in the context of the automotive industry of Pakistan. Along with technology transfer effectiveness, the items listed above are some of the issues that are the focus of this research.

When analyzing the automotive industry in developing countries, a central question that needs an answer is to what extent the components are imported, and whether the content of local sourcing is increasing, or what the future trends are in regard to the industry in terms of component sourcing behaviour (Holweg, Luo and Oliver, 2009).

In Pakistan, at least 78% of local demand for automotive components is being met through imports whilst Pakistan's component suppliers cover the remaining 22% (EC, 2007). The assemblers are importing most of the knowledge-intensive components, for example, power train, engines and transmission components, etc. The components sourced from local suppliers are mostly labour intensive and low-value added, such as, door handles, door beams, instrument panels and wire harnesses, etc (see chapter 7 findings). As discussed earlier in this chapter, that in line with Pakistan's commitments to WTO, the tariffs on components are now compliant with WTO regulations (see table 5.9). The TBS has increased the attractiveness of imported components unless remedial measures are taken at industry level. Therefore, through technology transfer from auto assemblers to Pakistan's component suppliers and through local efforts, the local suppliers could break into the global value chain circle.

The supplier's segment in Pakistan is very fragmented and can be categorized into two distinct groups. First, there are about 750 first tier units belonging to the formal/organized sector. This group of suppliers is directly registered with the OEMs, i.e., auto assemblers and supply directly to them, and ***this group of suppliers are the main focus of this research***. This group of component suppliers are fairly large (over 100 employees). These first tier Pakistani suppliers are, in turn, then supported by 1,220 units of second and third tier suppliers.

This second group of suppliers belongs to the unorganized/informal sector and caters to the aftermarket (replacement) market. This group have neither economies of scale nor R&D capacity and generally provide low- quality components to the aftermarket.

The table below provides an overview of the Pakistani suppliers segments.

Table 5.13

Pakistani Component supplier's brief profile

No of Suppliers	**Major clients**
Around 2000 suppliers, 750 are in the organized sector and remaining in the un-organized sector- serving replacement market	• Indus Motor Company (Toyota) • Pak Suzuki Motor company • Honda Atlas
Local sourced components	**Imported components**
Labour intensive components such as wire harness, door handles and instrument panels	Complex technological components such as power- train and engine parts
Around 22% of the components are sourced locally	78% of components are imported

Source: Author's interpretations based on the information in section 5.5

5.6.1 Indigenous capabilities and components being manufactured

The component suppliers segment possesses a wide range of capabilities for manufacturing different components, for example, pistons, engine valves, gaskets, camshafts, shock absorbers, brake drums, door handles, wheel hubs, vehicle instruments, radiators, indicators, lights, doors, door locks and air conditioners to name but a few. The indigenous capabilities are in the areas of:

- Interior rims: Being manufactured for all models
- Plastic components: Front and rear bumpers, interior and exterior components, exterior Door mouldings.
- Forgings: Several suppliers exist.

•	Casting	Several small to large scale suppliers present.
•	Machined components	Several companies present performing simple machining to CNC machining
•	Rubber components	Extruded weather-strips and various small to large moulded components.
•	Wire Harness	Complete Technology available

Source: Engineering Development Board of Pakistan

5.7 Production Processes

The production processes used to manufacture components available in Pakistan can be broadly categorized as follows:

1- Designing

2- Forging

3- Casting

4- Machining

5- Plastic & Rubber moulding

6- Fabrication

7- Press Work

8- Electrical & Electronic component assembly

9- Mould and Die manufacturing

10- 3-D Laser Scanner

11- CAD/CAM

5.7.1 Quality Control Mechanisms

The first tier component suppliers are quite quality conscious. Since these suppliers are registered with OEMs (assemblers), therefore, they must maintain and follow the quality standards of their components. Most of these suppliers are ISO 9001-9002 certified. These suppliers apply quality control philosophies and theories, for example, quality circles, 5-S, and QCD etc., theories. The quality standards being followed are mainly:

1- Japan Industrial Standards (JIS)
2- Society of Automotive Engineers, USA (SAE)
3- International Standards Organization (ISO)

However, those suppliers who are catering for the aftermarket, and are in the un-organized sector, don't follow any specific quality standards. Their main focus is to reduce the cost in order to sell the part to the price-conscious aftermarket (UNIDO, 2006).

5.8 Institutional Structure- Suppliers Associations

The component suppliers of Pakistan have only one industry association, Pakistan Association of Automotive Parts & Accessories Manufacturers (PAAPAM). PAAPAM was founded in 1988 as the main institutional structure to represent and protect members' interests and provide training, and technical and management consultation to them. In 1999, the association achieved recognition from the Government of Pakistan and today is represented in many government and semi government, as well as private, institutions by its member suppliers. PAAPAM is also a member of the Federation of the Pakistan Chamber of Commerce & Industry (FPCCI).

Since the formation of PAAPAM, it has attained an indispensable and extremely effective link between the policy-making departments, for example, the Ministry of Industries and Production of Pakistan and its member suppliers. The association takes up the problems related to policy, fiscal, technical or commercial issues of the component suppliers segment and rigorously pursues these problems with the respective government departments, for example, the Engineering Development Board of the Ministry of Industries and Production. PAAPAM also organizes various training workshops, seminars and commercial exhibitions for its members.

The association is a professionally managed body at national level and has members all over Pakistan. The association has two offices in the two main cities of Pakistan, one in Karachi and the other in Lahore, because three assemblers are also based in these two cities. Most of the component suppliers are located in Lahore and Karachi, Pakistan. Only registered components suppliers with OEMs can become a member of PAAPAM.

According to PAAPAM, the main aims of this association are:

1- To encourage, promote, stimulate and protect the business interests of Pakistan 's automotive parts manufacturers in Pakistan
2- To create a spirit of cooperation, goodwill and unity amongst the members of PAAPAM
3- To represent the Association's point of view to local, provincial, central and other Government authorities
4- To eradicate all sorts of malpractices wherever these are found and to promote honest and fair dealings amongst the members of PAAPAM and the automotive industry in Pakistan as a whole
5- To co-operate with Government organizations, and other associations and Chambers of Commerce & Industry of Pakistan in the mutual interest of industry
6- To assist the members in resolving their differences and disputes and offer arbitration for settlement of disputes amongst parties

The table below provides a brief summary of the institutional support available to the Pakistani component suppliers.

Table 5.13

Institution Support for the component suppliers

Institutional Support for suppliers	**Main functions**
Pakistan Association of Automotive Parts & Accessories Manufacturers (PAAPAM)	• Protect the business interests of its member suppliers • Promote goodwill and unity amongst its member suppliers • Organises seminars and trainings for its members to enhance their productivity • Represent the association's members point of view at the regional and national level • Provides technical and management support to its members • Provides focal link between policy making entities of Pakistan such as ministry of Industries and Production, Engineering Development Board and Pakistan Board of Investment and the component suppliers

Source: Author's interpretations based on www.paapam.com/

Conclusion

The purpose of this chapter was to provide the background information and context of the automotive industry of Pakistan. The automotive industry is a key player in world trade and can also act as a catalyst for the development of engineering and other supporting industries due to its vertical and forward linkages potential, not only in the global context, but also with reference to Pakistan.

Pakistan's automotive industry has evolved over the years and has become one of the major contributors of economic growth and local suppliers' development. With a view to develop the local manufacturing and industrial base, Pakistan has pursued various product related and industry specific deletion/indigenization programmes. The main objectives of these programmes were to develop the local supplier's base.

The Government of Pakistan considers the automotive industry as a pillar industry and, because of this status, has developed a comprehensive automotive industry development programme that the government approved in 2007. The auto industry development programme covers five year 2007-2012 road-map of tariff and non-tariff measures shows the keenness of the Government of Pakistan to position the industry in the global value chain. So the transfer of technology related to product, process and managerial and its effectiveness is critical from assemblers to Pakistani suppliers.

The entry of the Pakistan automotive industry into the global value chain will depend on it acquiring the know-how, R&D and transfer of technologies from assemblers to local suppliers as part of suppliers' development effort at the country level. To sum up, the acquisition of technological knowledge in the area of product, process and managerial, the development of suppliers' absorptive capacity and consistent automotive industry-related policies are the key for Pakistan's automotive industry to progress towards realizing the potential of becoming a global player and export hub. Chapter 6 discusses the research methodology and data collection approaches for this research in the context of the automotive industry of Pakistan.

CHAPTER 6: RESEARCH METHODOLOGY

Introduction

The aim of this chapter is to discuss the methodology, research approach and methods used for data collection for this study. In order to attain robustness, this research adopts a multi-site, multi-source hybrid research methodology (Harrigan, 1983). The chapter consists of six sections. In section 6.1 of the chapter an attempt has been made to provide the general setting and context of this research. Section 6.2 explores the research paradigms with reference to philosophical assumptions. Section 6.3 discusses the difference between qualitative and quantitative methods and their strengths and weaknesses in the context of social research. Section 6.4 deals with the reasons why the two approaches should be employed in combination. Section 6.5 discusses the sampling procedures and processes of data analysis. In the last section of this chapter the issues of reliability, validity and trustworthiness are discussed.

6.1 Empirical Setting and Context

The empirical setting and context of this research is the automotive industry of Pakistan. The main focus is on a local suppliers segment as the recipient of technology from three IJVs, and its subsequent effectiveness in terms of exploitative/exploratory innovations, and breadth and depth of learning. Chapter 2 provides detailed descriptions of the industry. This setting is appropriate for a number of reasons:

1- It includes manufacturers of a large number of different components requiring extensive supply chains. A multinational's investment in assembly plants may have a significant impact on local component suppliers in the industry.

2- The auto industry, due to its multiplier effect and strong backward (materials such as steel, copper, aluminium, plastics, glass, paint and electronics, etc.) and forward linkages (dealerships, credit & financing, advertising, repair & maintenance, petroleum products, insurance and service parts) is considered a key industry.
3- It is a unique industry in Pakistan-dominated by Japanese assemblers (Toyota, Honda and Suzuki) with substantial FDI.
4- All three have formed joint ventures and control 95-98% of the market share.
5- Around 800 organised and registered suppliers with OEMs (assemblers) and 1200 unorganised component suppliers.
6- Focus is on the organised suppliers' segments as the main recipients of technology.

In addition to the reasons given above, the use of a single industry setting and context helps keep a narrow focus of research.

6.2 Research Philosophies and Paradigms

The term 'paradigm' means the advancement and progress of scientific inquiry based on philosophies and assumptions people attach to the world and the nature of knowledge itself (Collis and Hussey, 2003). The choice relating to the philosophical assumptions or paradigms about the nature of social reality are critical to understanding the whole perspective from which the research is designed and carried out. According to Lincoln and Guba (1994:105), ''paradigms are the basic belief system or world view that guides the investigations''.

Qualitative and quantitative research approaches are based on different paradigms. These paradigms can be called positivism and interpretivism, and these represent the two major epistemological approaches available to researchers for conducting their chosen research (Burrell and Morgan, 1979).

A research paradigm is based on a number of assumptions, and these assumptions arise mainly from the researchers understanding of the philosophy in terms of ontology and epistemology.

Each of these philosophies have different assumptions, and these assumptions then affect the way a researcher approaches the research process.

The first of these assumptions is the issue of ontology. An underlying assumption of ontology is the nature of reality in terms of its objective nature-out in the world vs. subjective – socially constructed phenomenon. Therefore, when adopting this assumption, it is necessary to consider how people view their world and their understanding of reality. Creswell (1994), suggests that multiple realities exist in any given situation, those of the researcher, individuals under investigation, and the reader or audience interpreting the study.

If reality is viewed as a given in the world then it can be investigated and measured through the use of an instrument and quantitative approaches (Meyer, 1997). Reality generally relies on the existence of a priori fixed relationships between certain variables through the use of theory testing. However, if the reality is considered as socially constructed and subjective then the use of a qualitative approach is justified (Cohen et al., 2005).

The second assumption is concerned with the question of the nature of knowledge and the relationship between the knower and the known. Based on these assumptions, researchers have been using two major research paradigms: positivism and interpretivism (Morgan and Burrell, 1979; Patton, 1990). These two paradigms are explored in section 6.2.1.

6.2.1 Positivism Paradigm

Researchers who subscribe to this paradigm view reality as objective and independent of the researcher. This research approach relies on such procedures as those related to inferential statistics, hypothesis testing, mathematical analysis and experimental design (Lee, 1991; Saunders et al., 2000). As Guba (1990:9), states: ‘‘it is concerned with discovering the true nature of reality and how this reality truly works’’.

This approach also maintains that the methods of natural science constitute the only legitimate methods for use in social science research advocating explicitly the "natural-science model" of conducting social-science research (Behling 1980; Schon, Drake and Miller 1984; Burrell and Morgan 1979).

The logic behind the application of a natural science model is to match the social science research, including organisational and business management research with the achievements of natural science research through explanations, control and predictions. Using this approach, observers will have no effect on the topic being investigated.

Quantitative oriented studies have found strong support with the positivism paradigm.

In sum, the positivism paradigm involves the manipulation of theoretical propositions using the rules of formal logic and the rules of hypothetico-deductive logic, so that the theoretical propositions satisfy the four requirements of falsifiability, logical consistency, relative explanatory power and survival (Lee, 1991:343).

6.2.2 Interpretivism Paradigm

This paradigm generally views reality as subjective. It is concerned that the reality cannot be independent and detached from researchers and the main focus of the research should be based on the meanings that people attach to the world. Intrepretivism approaches typically attempt to consider words as opposed to numbers as the major element of data. This paradigm therefore tries to focus on subjective data collected mainly through interviews rather than focusing only on objective numerical value free data (Patton, 1990).

Researchers who subscribe to this school of thought believe that human behaviour cannot be understood in the context of natural science laws. The interpretive approach to management research generally considers that the methods of natural science are inadequate for understanding social reality. This school of thought typically takes the position that people, and the physical and social artefacts that they create, are fundamentally different from the physical reality examined by natural science.

In a nutshell, the interpretive studies view that people create and associate their own subjective and inter-subjective meanings, as they interact with the wider world. Researchers who follow this paradigm position their research within the cultural context.

The above discussion shows that both paradigms view social reality in different ways and both have certain pros and cons. Therefore, in this study, we will incorporate elements from both paradigms to provide a richer and better picture of technology transfer and its effectiveness from IJVs to their component suppliers, because the technology transfer process and its effectiveness is difficult to measure. As Pérez-Nordtvedt et al (2008), suggest that future studies on technology transfers need to move beyond survey measures to combinations of research methods in order to fully capture the richness and social context of the technology transfer process. Guba and Lincoln (1991), also support the view that research methods stemming from both paradigms are desirable for understanding the social reality. Similarly, Bryman and Bell (2003), and Shah and Corley (2006), also suggest that management research can gain much by combining both qualitative and quantitative research approach.

In order to achieve the research objectives that are discussed in the first chapter, this research views hybrid methodology based on multi-site and multi-sources with more emphasis on qualitative methods to be an appropriate choice for understanding the technology transfer process and its effectiveness in the context of the automotive industry of Pakistan.

6.3 Quantitative and Qualitative Research Approaches

Scholars generally agree that there are two major research approaches for data collection: quantitative and qualitative (Bryman and Bell, 2003; Bernard, 2006). The conduct of any research requires a great deal of consideration as to the appropriateness and validity of any chosen research approach, since both approaches will influence the outcome of the study (Denscombe, 2003; Saunders *et al*., 2000).

It is also worth noting that there is no right or wrong approach to undertaking a research. Research objectives can be accomplished using a variety of methods. However, as discussed earlier in this chapter, these methods are generally classified into two distinct research paradigms: positivism and interpretivism. These two paradigms are known by their quantitative and qualitative research orientations (Creswell, 1994).

The quantitative method, for example, uses experimental methods and surveys that are designed to test hypothetico-deduction. In this type of research, the researcher views the phenomenon being study objectively. Quantitative methods emphasise the measurement and analysis of causal relationships between variables (Denzin and Lincoln, 2000). Researchers have limited control in this type of research. This view is supported by Creswell (1994), who suggests that in the quantitative approach, researchers should remain distant and independent from the phenomenon being studied. The main focus of this approach is on the quantification of data in terms of numbers and percentages.

Denzin and Lincoln (2005:3), define qualitative research as: ‘‘situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self. At this level, qualitative research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them’’.

Qualitative methods are designed to observe and understand social interactions and people’s perspectives in particular cultural and institutional contexts. As Denzin and Lincoln (2005), state that qualitative approach emphasises the process of meaning, which cannot be measured empirically. The emphasis of this type of research is on the collection of solid contextual data based on words to understand a social reality. This view is also supported by Creswell (2009:8), who states, “Humans engage with their world and make sense of it, based on their historical and social perspectives. Thus, qualitative researchers seek to understand the context or setting of the participants through visiting this context and gathering information personally. They also interpret what they find, an interpretation shaped by the researcher's own experiences and background''.

This type of research yields non-numeric data, for example, words. As Pope and Mays (1995), indicate, qualitative research is reaching the parts other methods cannot reach. In other words, qualitative methods do not make any attempt to measure, count or classify, but rather try to capture the full nature of social reality through descriptive analysis that focuses on the details and meanings of people's words and action. Therefore, qualitative research is usually informal and semi-structured, allowing people to contribute and share their views in a conversational friendly format.

Quantitative and qualitative approaches then can be differentiated by the underlying assumptions about them (Creswell, 1994). These assumptions relates to the following five issues: the nature of the reality under research; the role of the researcher in the study or the relationship of the researcher to that being researched, the role of values in the study, the rhetoric of the research, and the methodology being used. These are summarized in Table 6.1.

Table 6.1

Main assumptions about quantitative and qualitative approaches

Assumptions	Quantitative approach	Qualitative approach
Ontology- nature of reality	Reality is objective in nature, "out there", and independent of the researcher	Multiple realities exist in any given situation. Reality is subjective with meanings and actions attached to it
Epistemology consideration -the relationship of researcher to the study	The researcher's aim should be to remain distant and independent of study	The researcher interacts with the research participants to minimise the distance
Axiology- the role of values in the research	The values of the researcher do not become part of the study	The values of the researcher become a part of the research
Rhetoric - language	The language used in the research is formal, and based on well constructed concepts	Language is informal based on rich contextual information
Methodology	Hypothetical-deductions logic	Mainly inductive form of logic to build theory from the data .

Source: Author's summary based on Creswell (1994)

Researchers who rely on quantitative methods often employ survey based instruments to capture the data. The data collected through survey based methods is highly standardised because it is based on real-world observations (Denscombe, 2003). Survey methods are also less costly and time consuming. Despite its advantages, the survey approach has come under severe criticism in recent times, because the use of statistical tools and other quantitative techniques are seen as providing misleading information (Strauss and Corbin, 1998).

Although qualitative methods have gained increasing acceptance in the field of social research, they are also not problem-free. On the one hand, many scholars are acknowledging the benefits and contribution of interpretivism, as being a more in-depth qualitative approach to research. For example, Strauss and Corbin (1990), argue that qualitative methods can be employed in research to better understand any phenomenon about which very little is known. Miles and Huberman (1994), suggest that the very nature of the conversational style of qualitative methods brings the researcher directly in touch with participants and provides a means of getting 'beneath the surface' of attitudes and behaviours, and this leads to a depth of understanding of issues within the study context. According to Miles and Huberman (1994:1):

> ''Good qualitative data are more likely to lead to serendipitous findings and to new integrations; they help researchers get beyond initial conceptions and to generate or revise conceptual frameworks... the findings from qualitative studies have a quality of undeniability. Words, especially organized into stories and incidents, have a concrete vivid, meaningful contextual flavour that often proves far more convincing to a reader - another researcher, a policy maker, a practitioner - than pages of summarized numbers''.

With all the underlying qualities and features of qualitative methods and despite their growing acceptance, there have been concerns about the validity and reliability of qualitative methods (Silverman, 2000; Mays and Pope, 1995). In this type of research, data collection and data analysis can be time consuming and results are difficult to generalise in other contexts.

On the basis of the above discussion, it can be said that research methods themselves are not good or bad. Both approaches are useful, depending on the nature of topic and the context being studied. Both view the role of the researcher differently. Quantitative research stresses the need for the researcher to remain objective and distant from the research, whilst in qualitative research the role of the researcher is viewed as subjective and participant.

Because of these characteristics, some researchers view that quantitative and qualitative methodologies cannot be combined owing to their different underlying assumptions. However, some scholars maintain that these methods should be combined and used wherever appropriate (Creswell and Clark, 2007; Tashakkori and Teddlie, 1998). Mixed methods is a research design that combines both the quantitative and qualitative methods in a single or multi-phased research (Creswell and Creswell, 2005; Tashakkori and Teddlie, 1998).

6.4 Rationale for the choice of methods for the current study

As stated above, this research adopts a hybrid research approach based on multi-site, multi-source and qualitative and survey questionnaire methods (Harrigan, 1983; Jick, 1979). The rationale behind using this approach is that there is no previous research conducted on the topic of technology transfer and its effectiveness in the context of Pakistan.

As Hunnerinta-Peltomdki and Nurnmela (2004:162), suggest: ‘‘the aim of mixing methods is to capture a complete, holistic picture of the subject matter ... with a view to uncovering something that might have been missed with a simpler research design’’.

The above discussion shows that both approaches have distinct advantages and disadvantages. In other words, research methods themselves are not good or bad but the quality of the research depends on how these research approaches are utilised and manipulated by the researchers to achieve their research objectives. As Creswell (1994), argues that research approaches should not be viewed as an end but rather as means to achieve the study objectives; therefore, their appropriateness and relevance need to be carefully treated

Keeping in view these considerations, the use of qualitative, semi-structured interviews supplemented with questionnaire surveys and extensive use of documentary evidence were considered the most appropriate methods for the present study. The combination of these methods will allow us to triangulate between the data sources and increase the richness of the data (Eisenhardt, 1999; Yin, 2003). This will also ensure that any bias inherent in any one particular research approach and data sources is neutralised when used in combination with other research methods and data sources (Jick, 1979). This, in turn, will ensure the validity and reliability of the findings.

As Scandura and Williams, 2000: 1249), state: ‘‘it may well be true ... that it is not possible to do an unflawed study. Any research method chosen will have inherent flaws, and the choice of that method will limit the conclusions that can be drawn. It is therefore essential to obtain corroborating evidence from using a variety of methods".

These methods are further discussed in the next section.

6.5 Methods Used in this Study

In the present study, data was collected through qualitative interviews questionnaire surveys and through the use of documentary evidence throughout the research process. These methods are discussed in the following sub-sections.

6.5.1 Qualitative semi-structured interviews with components suppliers

Qualitative interviews can be classified as three types: structured-standardised interviews, un-structured interviews and semi-structured interviews (Denscombe, 2005; May, 1997; Yin, 1994). Embedded in this classification is the idea of how much control the researcher will have over the discussion. Along this continuum, a structured interview format offers greater control compared to un-structured interviews. However, un-structured interviews give more flexibility.

One of the key aspects of conducting interviews is that it enables the researcher to have close interaction with the participants to get an in-depth understanding through open discussions (Alvesson, 2003). As King (1994:14), indicates the goal of the interview: ''is to see the research topic from the perspective of the interviewee and to understand how and why he or she comes to have this particular perspective''.

Semi-structured interviews can be an effective way to understand: "behaviours that derive from the cultural and ideological identities of the speaker" (Lindlof, 1995: 165–166). Through the use of this method, the researcher is able to gather very rich contextual and nuanced data about the study. Semi-structured interviews revolve around an interview or topic guide. The interview guides help the researcher to cover all the planned topics and also to have probing purposeful conversations about the emergent themes. This can give a structure to the conversation as well as some flexibility.

For this research, semi-structured interviews were conducted with the owners, CEOs, the Technical Director, and top-level managers of fifty component suppliers, three of the assemblers belonging to the automotive industry, and with officials from the Ministry of Industries and Production of Pakistan, contributing to what Lee (1999:152), suggests is "ecological validity" in the study's design. The selection of this sample relates to component suppliers and is discussed in section 6.5.1.2 of this chapter. These interviews were conducted through the use of an interview guide covering the topic areas related to this study. The topic guide is given in Appendix A, and is briefly discussed in the sub-section below. It is important to note that a large part of the data for this study was collected through the use of semi-structured interviews.

6.5.1.1 Interview guide

As mentioned earlier, in semi-structured interviews, before conducting the interview, the researcher can prepare and use an interview guide that consists of a set of questions or topic areas (Denscombe, 2003; Oka and Shaw, 2000), and this guide helps to structure the interview allowing the researchers to generate their own questions around any interesting topics of inquiry during the interview (Flick, 1998). This will then ensure the focus of the interview around specific topic areas. For this research, an interview guide was prepared to ensure the focus of the research yet including flexibility. The interview guides also ensure that the same topics were covered with all the respondents (Burgess, 1984).

In total two interview guides were prepared, one for the component suppliers and one for the assemblers. The main idea behind doing so was to ask more focused questions from both sides and to listen to the points of view of both assemblers and suppliers in order to minimise bias. This technique was very useful for comparing the authenticity of the data and also resulted in triangulations. These guides were pre-tested through the means of a pilot study, which was conducted with three suppliers' managers and one of the assemblers in the city of Lahore, Pakistan. All these companies were interviewed again as part of the whole research process. The interview questions were also sent to two academicians and one industry expert to get their feedback. This resulted in modifying some of the questions and adding some prompt questions to the guide. The interview guide format with some of the topic areas of this research is shown in table 6.2.

Table 6.2

Semi-structured interview guide

Topic areas	Questions
Technology transfer process	• What was the process of technology transfer from assemblers to your firm? • How was this process was initiated? • Who initiated this process? • What sort of activities were arranged to support the technology transfer?
Technology transfer mechanisms	• What mechanisms were used to transfer technology? • Why were these mechanisms used and were you satisfied with these mechanisms? • What mechanisms have been useful and for what kind of technology • How do different mechanisms/ modes influence the transfer of different type of technological knowledge from your firm to your suppliers?
Type of technology transfer	• What type of technology was transferred from assemblers to your firm and why? • Why is your client reluctant to transfer a particular type of technology to your firm? • What were the benefits your company saw in transferring the technological knowledge to your component suppliers?

Table 6.2 also highlights an important point, that structuring the interview guide around the above topics ensured continuing focus on the research questions and objectives of this research, and importantly, allowed consistency in data collection. In this way, the qualitative researcher can provide what Alvesson *et al*., (2000), consider as consistent interpretations of the data.

Since the nature of the semi-structured interview requires a great deal of engagement with the respondents, some level of flexibility is also required within the interview guide. Therefore during this process of data collection, the researcher was flexible in terms of the order and number of topics and questions that needed to be covered with respondents. Although the researcher's goal was to cover all topics related to the technology transfer and its effectiveness, the number of issues and questions varied from respondent to respondent. In some cases, the order and flow of topic areas and questions did not remain according to the interview guide shown above.

Unlike questionnaires, semi-structured interviews, by nature, often last longer. They also vary in duration from respondent to respondent and are affected by the overall engagement of the researcher. These interviews normally took between 60 minutes to 90 minutes.

Some of the interviews even lasted about 2-3 hours, because in Pakistani culture people would like to know more about your personal and family background and kinship before they open up. So the cultural and institutional context plays an important role and may determine the length of the conversation and thereby the duration qualitative interviews.

27 out of the 50 interviews conducted with the component suppliers were digitally recorded using an Olympus WS-650 voice recorder. 23 of the suppliers' managers were not willing to

be recorded during the interviews, and in some cases they said they would have to ask their assemblers for permissions to participate in recorded conversations. This shows the kind of power the assemblers have on their component suppliers in a developing country context like Pakistan. In these cases, notes were taken during the interviews. The interviews conducted with the three assemblers and with officials from the Ministry of Industries and Production were not recorded; however, notes were taken throughout the interviews. This allowed the respondents to express their opinion freely and honestly.

6.5.1.2 Sample selection for semi-structured interviews

There is no strict role for the selection of the sample for qualitative types of studies. Scholars argue that random sampling is an inappropriate approach for qualitative studies (Danscombe, 2003; Glasser and Strauss, 1967; Ritchie *et al*., 2003). In random sampling every unit of the target population has an equal chance of being selected. However, in non-random sampling a different set of criteria is applied to select the respondents. In qualitative research, scholars have termed this approach as purposive, or theoretical sampling, which is based on a certain criteria (Bryman and Bell, 2003; Danscombe, 2003; Ritchie *et al*., 2003).

In this research, two types of non-random sampling, purposive and snowball were used to select the respondents for the semi-structured interviews. Through the use of purposive sampling, research candidates are purposely selected since they are likely to produce contextually rich and relevant data sets, and they will also fit well with the topic being studied. In snowball sampling, respondents are asked to propose others who meet certain criteria related to the research. This sampling procedure was very useful because five companies shared the contact details of around eleven of their fellow component suppliers. In addition, the snowball technique is considered complementary with purposive sampling procedures (Danscombe, 2003). Furthermore, it is argued that this technique is also helpful in minimising the bias that may result if all the component suppliers were introduced by the Ministry of Industries and Production and assemblers, or Pakistan Association of Automotive Parts and Accessories Manufacturers (PAAPAM).

In identifying potential component suppliers for this research, the following criterion was used:

1- The Pakistan Association of Automotive Parts and Accessories Manufacturers (PAAPAM), and the Ministry of Industries and Production (MOI&P) were the basis for the sampling frame. Component suppliers with at least 100 employees and having a direct business relationship with one of the three assemblers were chosen.
2- Through this procedure 200 suppliers were identified, and an introductory letter outlining the research was sent to the President/Owner of those selected component suppliers, asking them to provide the names of their main contacts of any company who are directly responsible for that company's supply relations with the auto assemblers.
3- At this stage 75 component suppliers expressed their willingness to participate in the study, and provided the details of a manager to contact. A personalised letter was then sent to that manager explaining the nature of the research. The managers were promised that they would receive a summary of the research and that any company information would remain confidential. Out of these 75 suppliers, only 50 of the suppliers were interviewed due to time and logistical limitations, it was not possible to interview the remaining 25 suppliers.

Besides these suppliers, three major assemblers were also interviewed, as discussed in section 6.6. Chapter 5 provides detailed information about the operation of these assemblers. Interviews were conducted in Karachi (North zone suppliers) and Lahore (South zone suppliers), Pakistan, because two of the assemblers are based in Karachi and one in Lahore. About 850 first tier suppliers are based in these two cities (PAAPAM, 2008). Figure 6.1 shows the map of Pakistan and the location of this research. The sample characteristics and component suppliers' profiles are shown in table 6.3 & 6.4.

Table 6.3

Sample Characteristics

Job Title	No of Interviewees	No of years in current Position
President/CEO	15	15.80 Years
Senior Vice President	4	9.78
Deputy Managing Director	15	8.45
Operations Manager	7	7.85
Manager Product Development	4	7.25
Director Technical	5	8.50

Source: Author's interviews

Figure 6.1

Map of Pakistan and location of this research

Figure 6.1 shows the research locales of the present study. The cities are underlined where this research was conducted. It is also clear that Pakistan has a strategic location in the region and the automotive industry can use this location as its exporting hub. These two cities serve as the major supply chain for the automotive industry. The profiles of the component suppliers are shown below.

Table 6.4

Profile of Sample Components Suppliers

Component suppliers	Year of Establishment	ISO Certification	Products	No. of Employees
1	1987	16949 2002	Brake discs, brake drums	450
2	1967	9001 14001	Wheel hubs & drums, steering knuckles	570
3	1987	9002	Engine Mountings, Thermo vacuum forming, Cooling fan	515
4	1982	9001 2000	Steering Wheels, door trims, door handles	270
5	1988	9002	Seats, sheet metals, chassis frame, door trim, sun visors	475
6	1979	9002	Drum rear brake, Axle, Crankshaft, Shock absorber	389
7	1981	9001 9002	Wiring harnesses, horns, switches (light ignition)	645
8	1995	9002	Door locks, panels Wire harness	607
9	1990	9001-2000	Propeller shafts, gear box shafts	285
10	1983	9002	Plastic & rubber parts	215
11	1993	9001-9002	Gear shift control lever, hub front axle	315
12	1981	9001, 2000, TS 16949	Shock absorber, struts, steering box, door locks, camshafts	475
13	1991	9002	Axle casing, dual clutch assembly	450
14	1950	9001-9002	Fuel tank, exhaust muffler pipes, body attaching parts	300
15	1979	9001-2000	Sheet metal parts, axles	200
16	1989	9002	Control cables, hand brakes	175
17	1990	9001-2000	Wheel hubs, rims	325

(Continued)

Table 6.4 (Continued)

Profile of Sample Components Suppliers

Component suppliers	Year of Establishment	ISO Certification	Products	No. of Employees
18	1991	9002	Steering boxes	215
19	1985	9001- 9002	electrical parts, cooling system, fuel filter	200
20	1990	9002	Door mouldings, trunk seals, bonnet seals, edge trim	280
21	1986	9002	Seats, chassis frame, roof headlining, fender liner, armrest	556
22	1948	9001	Clutch pressure plate, rotor	233
23	1977	9002:2000	Exhaust manifold, panel side, Door handles	133
24	1984	9002	sheet metal components	260
25	1985	9001-2008	Overflow tank, auxiliary tank, plastic components	175
26	1975	9001-2000	Suspension parts, engine mountings, chassis and body parts	120
27	1960	9001:2000	Case cover thermo assembly, fuel lift pump	113
28	1989	9001-9002	Expansion joints, air cleaners, pressure tubes, pulleys	139
29	1994	9000, 14001:2004	Bracket engine mountings, Hub front, rear axle, hub front wheel, steering knuckle	117
30	1971	9001	Gear, shafts, axle shafts	322
31	1997	9002	Instrument panel, cap fuel tank, fan	105
32	1990	9000, 9001	Bumpers, interior& exterior trims, wheel caps, plastic parts, door handles	113
33	1998	9002	Lamp, indicator, lighting parts	120
34	1980	9002	Gaskets, generators parts	111
35	1986	9001:2000	Steering brackets, mounting, rubber parts	133

(Continued)

Table 6.4 (Continued)

Profile of Sample Components Suppliers

Component suppliers	Year of Establishment	ISO Certification	Products	No. of Employees
36	1993	9002	Forging, casting parts	160
37	1962	9001-2000	Air conditioning system, Interior rims, cooling system	780
38	1981	9002	Ball joints, tie rod ends, suspension parts	106
39	1985	9002	dash board insulator, floor mats	143
40	1980	9002	Wheel rim, disc wheel	435
41	1988	9001	Brake drum assembly	550
42	1995	9002	Steering case set	130
43	1996	9001	Spark plug	225
44	1951	9002	Aluminium components, fly wheel sub-assembly, cylinder	415
45	1966	9001	Bearings, fasteners, steering hoses	190
46	1997	9002	Sheet metal components, door beams	170
47	1979	9000, 9002	Oiling system, instrument cluster, panel	185
48	1963	9001	Seats	363
49	1961	9001-9002	Forging	279
50	1973	9001-2000	Precision machined parts	215

Source: Author's Survey

6.6 Semi -Structured interviews with the three assemblers

As discussed earlier in this chapter (section 6.5.1), semi-structured interviews were also conducted with the three assemblers. The information about the operation of these three assemblers is discussed in chapter 2. The purpose of interviewing assemblers was to cross-check the responses of the component suppliers to increase the reliability and validity of this research, and moreover, to listen to both sides about technology transfer and its effectiveness. Unlike previous research on technology transfer, which has focused mainly on the recipient side (see for example, Bresman *et al*., 1999; Duanmu and Fai, 2007; Lyles and Salk, 1996; Ivarsson and Alvastam, 2004; Nobeoka *et al*., 2002; Perez Nordtvedt *et al*. 2008; Simonin, 1999; 2004), the nature of this approach is different in the sense that it takes the view of both the sender of the technology, and the recipients of technology, in presenting the findings. This also increases the reliability of this research.

Senior level managers, e.g. the Managing Director, the Deputy Manager of Supplier's Development, the Purchasing Manager, the Chairman and Managing Director, the Deputy Managing Director, the Senior Design Engineer, the Supply Chain Manager, and the Operations Manager of the assemblers were interviewed. The interviews with the assemblers were also conducted through the use of an interview guide (see Appendix B & section 6.5.1.1 of this chapter). The interview questions with the assemblers' managers began with some general questions and moved to more specific questions related to this research, for example, what are the major motives behind your investment in Pakistan? What kind of component (parts) is your firm sourcing from local suppliers/vendors? And what are the long-term strategic plans of your investment in Pakistan? The specific questions mainly related to, for example, what type of technological knowledge/technology has your firm transferred to your component suppliers? What was the process of this transfer, etc.? (For details see Appendix B).

6.7 Interviews with the Ministry of Industries and Production

In addition to the semi-structured interviews with the suppliers and assemblers, during the process of the data collection of this research, interviews were also conducted with the Ministry of Industries and Production. The purpose of conducting interviews with the

Ministry of Industries and Production was to collect data on all available institutional arrangements that support technology transfer arrangements between assemblers and suppliers. It is worth mentioning here that the automotive industry directly comes under this ministry. The ministry is also responsible for the automotive industry development policy in the country and deals directly with both assemblers and suppliers. The information collected through ministry of Industries and Production was used to supplement other sources of data. The data collected through the ministry was also used to triangulate data obtained from the interviews with component suppliers and assemblers.

The interview questions, for example, focused mainly on the problems and opportunities the automotive industry is facing in Pakistan with reference to development and technology transfers. The kind of barriers the local components suppliers are facing in regard to technology transfer. How the process of technology transfer could be made more effective. What were the roles of various policies, i.e. local content requirements in technology transfer? What is the future for Pakistan's component suppliers to integrate in the global value chain, etc. The following section discusses the data analysis process of this study.

6.8 Data Analysis-Qualitative Phase

The analysis of the qualitative semi-structured interviews follows the recommended steps in existing literature. The following procedures were considered: (i) summarising the data to become familiar with it (ii) coding the data (iii) presenting, counting and drawing conclusions. The interviews data were coded and analysed by using the suggestions of Miles & Huberman (1994). This process consisted the coding of individual interview data to identify major themes and categories. For this purpose, Microsoft Excel 2007 spreadsheets were utilised to manage and separate the data according to its various categories, for example, the technology transfer process, the types of technology transfer, social ties and learning intention etc. This process is shown in figure 6.2. The Excel spreadsheet was a useful tool for storing, organising, coding, cross-checking and searching the interview data. Using the spreadsheet record system to support the qualitative interview data analyses also enhanced the efficiency of the data analysis process.

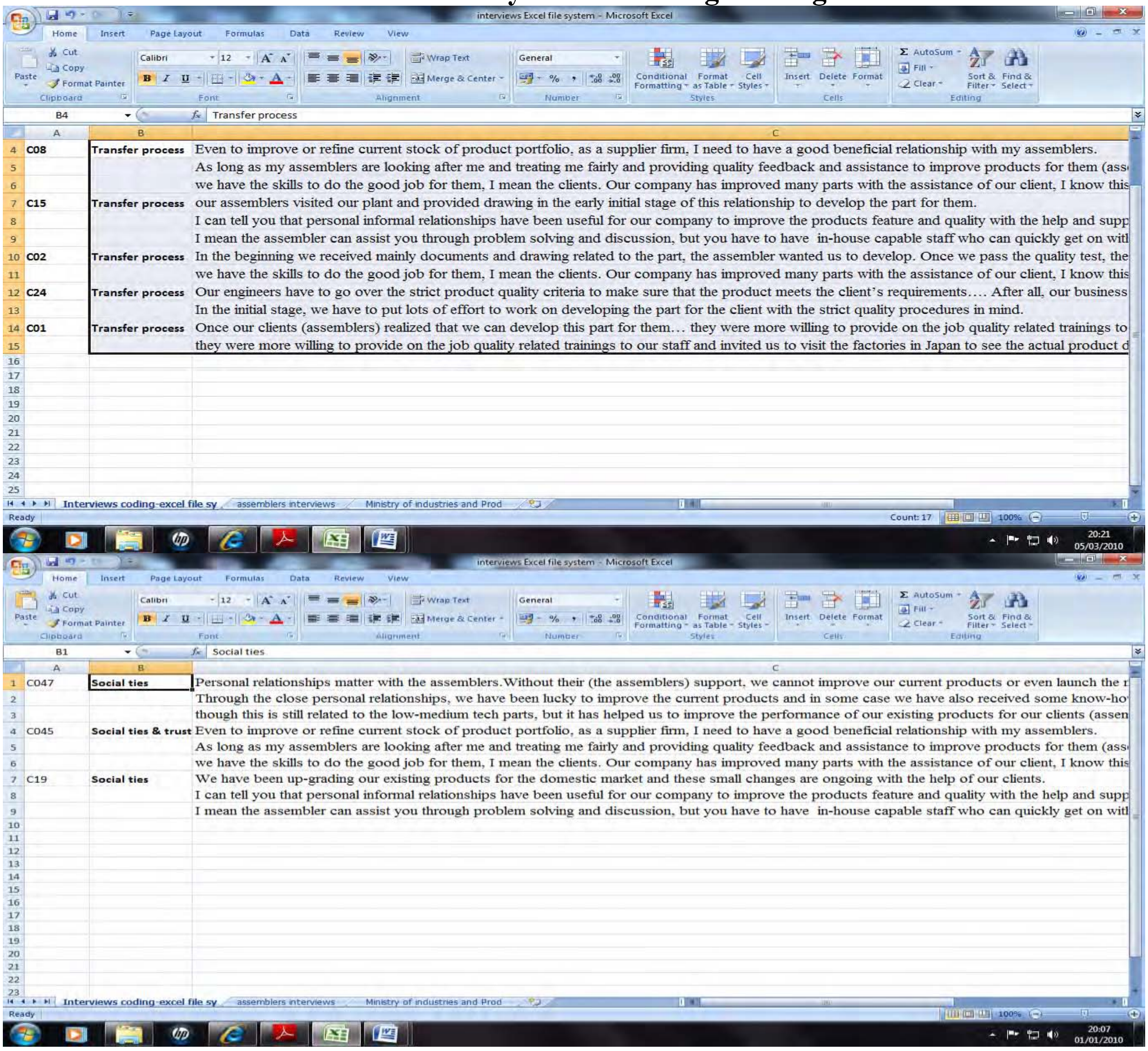
The researcher also used the help of an organisational anthropologist and a management scientist to audit and cross check the coding schemes. Auditing consisted of verifying the process (the steps followed by the coder) and the product of data coding. There was some area of disagreement during the audit process that was subsequently removed by revisiting the interview notes and in some cases this resulted in revising the categories. Through this approach, the goal was to attain what Kvale suggests as "dialogical intersubjectivity" (1994: 152); this is a form of reliability attained via discussion and cross checking of data regarding complex phenomena.

The data was then structured to address the research issues defined (Yin, 1994), including the technology transfer process, mechanisms used for this transfer, suppliers' learning intention, a sender's willingness to transfer technology, absorptive capacity, trust, social ties and technology transfer effectiveness. Cross referencing between interviews, and between primary data and secondary data, was carried out to establish connections amongst themes and to further verify the validity of the data by triangulation. Interview summaries were also made available for circulation amongst the participants to verify overall accuracy of the data. This process also enhanced the validity and reliability of the data.

It is also important to note that for the purpose of specificity in the presentation of the results (see chapter 7- Findings) counts of the number of times interviewees mentioned a particular theme are included, for example, the technology transfer process, the types of technology transfer, trust and technology transfer effectiveness etc. Therefore, in reading the results of this study, it is important to remember that the intent of counting the number of times interviewees mentioned a particular phenomenon is not to rigorously document frequencies, but to suggest a range of interviewee's responses across a particular research issue of this study. Section 6.9 describes the survey approach applied for data collection for this research.

Figure 6.2

Interviews record system according to categories



6.9 Questionnaire Survey with the components suppliers

As stated earlier in this chapter, the questionnaire survey was conducted to supplement the findings of the semi-structured interviews. This also resulted in increasing the robustness and reliability of the overall findings of this study.

The questionnaire covered the topics of: types of technology transfer, mechanisms used to transfer the technology and their usefulness, trust, major motives for the Pakistani components suppliers to form business relationships with the assemblers, institutional linkages, educational level of the employees, technological capabilities, and technology transfer effectiveness in terms of exploitative/exploratory and breadth/depth of learning (see Appendix B).

All the items of the questionnaire were measured on a nominal scale YES/NO, except the motives for forming business partnerships with the assemblers and technological capabilities which were on 1-3 and 1-5 scales, where 1= very important; 3= not important and 1= basic technological capability; 5= advanced technological capability respectively. Measures of all these items were developed based on reviews of the literature on technology transfer and semi-structured interviews conducted with the component suppliers and assemblers.

The survey questionnaire was checked by two academics in the field of Management Sciences from a top ranked university in Pakistan, and one industry expert based at the Lahore office of the Small and Medium Development Enterprise Authority. The purpose was to take the opinions and feedback of these experts and to subsequently revise and finalise the questionnaire design before distribution amongst the suppliers.

The questionnaire was also piloted with four suppliers in the city of Lahore, Pakistan. The suppliers' feedback and suggestions on the questions and format of the survey were used to make any necessary adjustments to the final questionnaire (see Appendix B).

Although the survey was anonymous, suppliers' managers were asked to provide some general information, for example, year of establishment of the company, the number of employees, and the north or south zone location of the supplier. The main purpose of this background information was to track the variability of responses within the sample for further investigation through the means of explanatory in-depth interviews with that particular supplier. The sample size and the selection of the sample is considered in section 6.9.1

6.9.1 Sample Size and Selection

Sampling is a key step in any survey-based research. A random sampling is normally desirable in a survey-based research in order to make statistical inferences. Due to resource and time constraints, the random sampling technique was not followed in the present study this could be considered as one of its limitations. It was recognised during the process of this research that gaining the trust of the managers of the suppliers was important, so the sample was kept the same as for the semi-structured interviews. The advantages of this approach are: (1) the researcher built a trust with the managers during the process of this research (2) a high and accurate response rate (3) the detection of any misleading data amongst the same participants and robustness of the data. The survey approach and its administration are discussed in section 6.9.1.2

6.9.1.2 Survey Approach and Administration

Often survey-based research is hampered by the low response rate and unwillingness of the selected respondents to complete and return the survey. The survey can be administered via phone, postal, email, web-based or face to face depending on the context of the study. A number of factors were considered for the administration of this survey, for example, the resources required, the time and response rate. Keeping in mind these factors, this survey was administered face to face during the months of August- September 2009 to benefit from a higher response rate. This approach is very useful, because the researchers do not need to send out constant reminders to the participants to respond to the survey, and moreover, it ensures that the maximum of knowledgeable informants will complete the survey.

In all cases, the survey was completed by the most knowledgeable manager about the component supplier's relationship with their assemblers, as well as with technology transfer-related information, for example the Deputy Managing Director, the Techincal Director, or the owner etc. In some cases, multiple managers were present during the administration and completion of the survey. This process also resulted in minimising the key informant bias (Huber and Power, 1985; Kumar, Stern, and Anderson, 1993). The next section describes the analysis techniques used for the questionnaire survey.

6.10 Data Analysis-Questionnaire Survey

The quantitative data gathered through the questionnaire survey often produces a lot of numerical information that can be analysed and presented through the mediums of graphs, charts or mean or standard deviations. Further advanced data analysis techniques, for example, multiple regressions, partial least square and factor analysis can also be employed to describe the key patterns and relationships amongst different variables. However, many quantitative survey questionnaires can be analysed and answered through the use of simple descriptive statistics.

Therefore, to make the analysis simple, Excel 2007 was used for processing the questionnaire data. Simple descriptive statistics are presented as percentages of responses to each question; for example, the type of technology transferred, trust, technological capability, and technology transfer effectiveness etc., (see chapter 7- Findings). Furthermore, it is worth mentioning that this simple analysis in the form of a percentage of the questionnaire data was not aimed at testing theory, but rather to describe and explore the data as a means of providing further supportive supplementary information for the qualitative semi-structured interviews. Section 6.11 discusses the comparative matrix across three assemblers and their 50 suppliers.

6.11 Comparative multidimensional matrix analysis

To make the analysis more robust and see patterns across three assemblers and their 50 suppliers, a comparative multidimensional matrix is also used to organise, display and analyse the data on different dimensions, for example, learning intent, absorptive capacity, trust, social ties, senders' willingness to transfer technology and package of technology. The qualitative interviews data is converted on 1-5 scale where 1 being low and 5 being the high and the responses are shown in percentage from 0-100%. Through this process, the important factors are also rated on 1-5 scale where 1= not important and 5= very important factor for technology transfer effectiveness (see chapter 7 section 7.10 for detail).

The reliability and validity of this study are discussed in section 6.12.

6.12 Reliability and Validity

Although the conventional criteria of reliability and validity are difficult to apply to qualitative research, it is still important to show why the findings of a qualitative study are representative of the phenomenon of interest (Lee, 1999). The nature of this study, the numerous sources of data, and the hybrid methods of data collection meant that the researcher constructed the narratives not through some idiosyncratic impression he gained, but through a rigorous procedure that made full use of the wealth, complexity and the quality of the data.

In addition, the researcher presented the findings of this research at internal seminars arranged by the Department of Management and Centre for International Business and Organisations Research (CIBOR), Birmingham Business School, University of Birmingham, UK. Findings were also presented at Birmingham-Aston doctoral colloquium, and also submitted (accepted) the work in the form of an article with positive feedback for presentation by the Academy of International Business (AIB) annual meeting- 2011, Nagoya, Japan. These presentations and the acceptance of this work also increase the reliability and validity of the findings of this study, or what Guba and Lincoln (1980, 1985), termed ‘‘trustworthiness’’ containing four aspects of: credibility, transferability, dependability, and confirmability. In sum, the discussion throughout this chapter has demonstrated these four aspects.

Conclusion

The aim of this chapter was to present the research methodology and research approaches adopted for this study. The chapter makes the case of utilising a hybrid multi-source, multi-method, multi-site research approach for investigating the topic of technology transfer and its effectiveness. This approach has been adopted with a clear understanding that such a hybrid approach greatly enriches the understanding of the complex topic of technology transfer effectiveness that cannot be totally documented from only a qualitative or quantitative methodological lens. The chapter also shows that this approach is, to some extent, the major strength of this study. The next chapter presents the combined findings of these approaches.

CHAPTER 7: FINDINGS

Introduction

In chapter 6, we have presented the detailed research methodology and data collection techniques for this research. The purpose of this chapter is to present the qualitative interview findings, supplemented with the questionnaire survey. Section 7.1 documents the technology transfer process. In section 7.2 the type of technology transferred is presented. In section 7.3 the sender's (assembler's) willingness to transfer technology is explored. In Section 7.4 mechanisms used by the assemblers (IJVs) to transfer the technology are discussed. The next section deals with the issue of trust between the assemblers and their component suppliers. Section 7.6 of this chapter explores the social ties aspect. In section 7.7 the recipient's (component supplier's) learning intent is documented. The following section explores the absorptive capacity of the recipient (component supplier). Section 7.9 documents technology transfer effectiveness. The conclusion of this chapter is presented in the final section.

For the sake of brevity, we have separated the component suppliers' and assemblers' quotes, denoting C for the component suppliers and A for the assemblers. Throughout this chapter, we will use component and parts interchangeably. Also, we will use technological and absorptive capacity interchangeably.

7.1 Technology transfer process

The question addressed in this section relates to the process of technology transfer from the car assemblers to component (parts) suppliers of Pakistan's automotive industry.

The interview data from component suppliers and assemblers suggested a three phase technology transfer process from automotive assemblers to the component suppliers of

Pakistan's automotive industry: (1) **Qualifying Stage**, (2) **Evaluative Stage**, and (3) **Interactive Stage** of technology transfer. This is in contrast to Szulanski (1996), who found four stages of the technology transfer process. The fourth stage that of integration, being absent may be due to a number of reasons. One reason behind this finding might be that technology transfer process phases vary from industry to industry, and also depends on the type of technology being transferred. However, in this study these three phases represent the complete transfer of technology from the start of the relationship to the on-going transfer. The qualitative interview findings, according to these three stages of technology transfer process, will be documented.

7.1.1 The Qualifying Stage

The qualifying stage was characterised by a prequalification selection of the key suppliers who meet the auto assemblers' criteria by having adequate machinery, plants, ISO certifications and manpower. This selection process is completed by a team (committee) of assemblers comprising of the Heads of Production Engineering in the Supply Chain and Quality Assurance who select the component suppliers for a business relationship, and who (suppliers) can be the potential candidate for technology transfer. The committee recommendations for the selection of these component suppliers are approved by the Deputy Managing Director and Managing Director of an assembler.

As one Operations Manager from an auto assembler stated:

> ''The prequalification selection of the suppliers started from our team visit. Our team comprising of heads of Production, Supply Chain and Quality Assurance visited the potential suppliers and we were satisfied with this initial assessment... so during our visit we identify some potential suppliers from whom we can get a component (parts) and who can also be a potential candidate for technology transfer, and after this visit, and getting approval from both the Deputy Managing Director and Managing Director, we sent the parts drawings to the selected suppliers to do the product prototype for us'' [Operations Manager- A02]

During this phase, assemblers transferred product drawings to the suppliers and a little social interaction or communication took place between the product development team from the supplier side and engineering and design team of the assembler's side. Here are comments from our respondents from the component suppliers' side who describe this qualifying stage of technology transfer.

> ''We remember in the initial stage of this business partnership, our client started sending us a bunch of drawings… it was like pouring a jug of water on an empty head''. [Deputy Managing Director - C03]

> ''Our customer started sending us a pile of drawings to go through and develop the product for them'' [Manager, Product development unit - C05]

Our interviewees from the component suppliers' side also reported many challenges during the qualifying stage of the technology transfer. The first challenge was that during the initial transfer of drawings, there was lack of interaction between the suppliers' Product Development Department and the client's Engineering and Purchasing Department. As one of the respondents summed up:

> ''if our engineer has any problems or wants to have a joint meeting with our client's engineer to go over the drawings, it is very difficult to get hold of the client's engineers''[Product development Manager - C08]

Another interviewee reported:

> ''Sometimes these drawings are developed by the Japanese suppliers and the local assembler wants us to clarify issues with them… the level of understanding at our end is totally different'' [Deputy Manager Procurement- C13]

During this stage, the technological knowledge was transferred mainly through drawings, for example, assemblers provided component drawings on paper. This stage was characterised by just a one way technology transfer from three auto assemblers to the Pakistani auto component suppliers. On the basis of the drawings provided, suppliers must develop a prototype and once the part has passed the test, suppliers were selected for the business relationship. The development of the business relationship is characterised as a signal of the completion of the qualifying stage of the technology transfer.

During this qualifying stage very little communication took place between the assemblers' and suppliers' staff members. The flow of communication was also one way, from assemblers to suppliers. In this stage, assemblers provided basic, explicit (codified) drawings to the suppliers.

The interviews with the assemblers pointed out that, due to the local content requirements, they initiated the technology transfer process with their Pakistani suppliers. The data suggests that technology transfer was part of the requirement of their investment in Pakistan. Interviews with the assemblers indicated that the major motives behind their investment in Pakistan were to bring in automotive manufacturing technologies, enhance the utilisation of underutilised capacities in the automotive sector, save foreign exchange through import substitution and indigenisation of components, create employment and enhance manpower skills through training and development and achieve self- reliance in automotive component manufacturing.

As one purchase manager at the assembler's mentioned:

> ''Government in Pakistan required us to localise parts, so we have to initially provide drawings to selected suppliers to see if they can develop a required part for us. In this stage, our role is kind of laid back and the local suppliers have to be more active if they want to be part of this relationship'' [Purchase Manager - A01]

During this qualifying stage, no evidence was found of any other direct assistance being provided to the suppliers, such as advice on machinery and improving production processes. Several researchers have found that the nationality of the MNC can also influence the extent to which MNCs give their local suppliers knowledge and other technical assistance during the beginning of the business relationship (Helper and Sako, 1995). Lately, Giroud (2000), and Duanumu (2006), have documented that Japanese MNCs are very passive in providing assistance to their suppliers in the early stages of the technology transfer process and relationship building, because of their limited knowledge of the capabilities of the suppliers. An auto assembler's supply chain manager said:

> ''We don't have any problem with providing assistance to our local component suppliers.... we are happy to do this. In the initiation stage we provide them just parts drawings and would like to see the suppliers develop the prototype for us keeping in view our standards....., so it is their job to work out the way they want to develop the prototype, and once their part has passed the test, we will automatically know their position and will assist them down the road. They should not expect more help during the early stages of this business relationship'' [Manager Supply Chain- A03]

Those suppliers whose prototypes failed the testing were dropped from the business relationship.

Unlike Szulanski (1996, 2000:13), no evidence was found of initiation 'stickiness' during the qualifying stages of technology transfer: ''the difficulty in recognising opportunities to transfer and in acting upon them''. International joint ventures (IJVs) established in Pakistan's automotive industry are clear on what Pakistan's automotive market has to offer as a source of cheap labour and a growing domestic market. Government pressure to localise parts motivate these IJVs to source parts from Pakistan's domestic suppliers, therefore, there is a need for these IJVs to look for domestic component suppliers with whom to form business relationships.

It was found that there were distinct phases within each stage of the technology transfer process. In the case of the qualifying stage, the distinct phase was providing drawings to the local suppliers and on the basis of these drawings suppliers developed the prototype. Once the prototype passed the test, suppliers formed a business relationship with the assemblers.

The next section deals with the evaluative stage of the technology transfer process.

7.1.2 The Evaluative Stage

In the evaluative stage of the technology transfer process, those suppliers whose prototypes passed the test formed a business relationship with the auto assemblers. During this stage, the auto assemblers provided detailed product specifications with clearly laid out parts' dimensions, quality parameters and some technical information about the required component, and, in some cases, advice on machinery and tools.

A CEO of a leading component supplier suggested:

> ''Initially, our clients were not sure whether we can develop the part for them, so we received only drawings with no other assistance, but once we have passed the product testing, during this phase we have received detailed client specifications about the component and quality parameters '' [CEO- C04]

During this stage of the technology transfer, Pakistani suppliers were expected to follow the assemblers' product-related specifications and ensure the quality of the part. One auto assembler's supplier's development manager said:

> ''As we are progressing with our business relationship, we are providing detailed parts specifications with strict quality guidelines, and some technical advice on machinery and tools. Our suppliers have to follow our requirements to be part of this relationship'' [Suppliers Development Manager- A02]

Interviews with the component suppliers also point out that they must follow strict quality standards and must have strict quality control systems at their plants to ensure that the final components meet the clients' expectations.

One CEO from the component suppliers remarked:

> ''Our engineers have to go over the strict product quality criteria to make sure that the product meets the client's requirements…. After all, our business depends on them'' [CEO- C24]
>
> ''In our country, nobody would care about the quality, but it is important if you want to be part of the international market…therefore, we have to develop a strict quality system at our end'' [Operation Manager - C04]

This relates closely to the ramp-up phase of Szulanski's (2000), study on the intra-firm best practice transfer. As during this stage, suppliers were expected to ramp-up from prototypes to pass the test to a large scale production of components, by having adequate quality systems in place.

Interview data also suggests that the selected Pakistan's component suppliers need to have acquired the required quality certification, for example, ISO 9000, 9001 etc. In this study, all 50 suppliers have ISO 9000, 9001 in place to satisfy their clients' (assemblers') quality requirements.

The evaluative stage end point was the production of the final localised component. The distinct phases during this stage were the provision of detailed product specifications with clear part dimensions and quality requirements, and the development of the final localised part by Pakistan's component suppliers.

Unlike Szulanski (1996), Duanumu and Fai (2007), and Simonin (1999, 2004), this study identifies distinct phases during the evaluative stage of the technology transfer process. This finding emphasises the need to understand the distinct phases of technology transfer, which can perhaps shed some light on why the expectations of immediate technology transfer payoffs are usually misplaced (Inkpen, 2008).

Those suppliers whose final localised parts met the requirements of the assemblers were progressed further and assemblers started providing on-the–job training, thus signalling the beginning of the interactive stage of technology transfer. The next section deals with the interactive stage.

7.1.3 The Interactive Stage

In the final stage of the technology transfer process, out of those 50 interviewed suppliers, 39 (or 78%) stated that during this stage their component development staffs has received quality related training, and managers also received training related to quality, along with factory visits to the assemblers' home country (Japan). For example, the Managing Director of one of the suppliers suggested:

> ''Once our clients (assemblers) realised that we can develop this part for them… they were more willing to provide on the job quality related trainings to our staff and invited us to visit the factories in Japan to see the actual product development and quality assurance system at work'' [Deputy Managing Director - C01]

Results here also suggest that during this final process the assemblers were more willing to assist those suppliers who were able to develop the parts. During this stage much interaction took place and this turns into personal relational ties and suppliers were regularly audited to ensure that they met the assemblers' quality requirements. As one of the respondent said:

> ''We have come a long way; ... Now we know our client's (assembler's) staff and management on personal basis. We attend each other's social functions and this personal relationship is always helpful when you are in a weak position and want to gain something from the strong partner. I must say that personal ties have helped us and many other suppliers I personally know through our suppliers association in getting this technology from our clients… though this technology is still in the standard form… at least we have received something due to this personal relationship with the clients'' [President and CEO- C38]

Several Scholars, for example, Levin and Cross (2004), Hansen (1999), Szulanski (1996), and Uzi (1996, 1997), have suggested that relational ties are helpful in the receipt of tacit technology. Our findings confirm their observations, because during this stage, we found some evidence of tacit technology transfer taking place. Our interviews with the component suppliers suggested that they have been receiving standard technologies in the form of documents, drawings and specifications, on-job training (OJT) and factory visits to Japan. This suggests that both explicit and tacit technology transfer took place during this late stage of the technology transfer process.

Whereas, the intra-firm best practice transfer study of Szulanski (2000), and inter-firm technology transfer study of Duanmu and Fai (2007), did not document whether relational ties developed during their ramp-up and developing stage of technology transfer or not. This study contributes to this line of literature by identifying that relational ties develop during the latter stages of technology transfer and is a gradual process that takes time.

The interview data suggests that these relational ties were helpful in providing access to the assembler's technology, as the previous quote on page 10 from the President and CEO suggests. Our results also suggest that in the interactive stage, assemblers also provided assistance to link up some of Pakistan's local suppliers to their networks first tier suppliers based in Japan.

Out of the 50 suppliers, 9 (or 18%) received technology through technical assistance/collaboration agreements and the assemblers played a major role in the initiation and facilitation of this process.

Our interviewee stated:

> ‘‘either we, the local component suppliers, get the technical expertise related to product, process and management know how by our own experiences or we can enter a technical collaboration with Japanese suppliers, but in the latter case our costs will be much higher and we will always be depending on the provider of that technological knowledge. Our clients are willing to initiate the technology transfer dialogue with their first tier suppliers in Japan’’ [Director Planning and Operation - C22]

> ‘‘we are going through the learning curve by virtue of our own experiences or by going through the client provided drawings, specifications and quality performance criteria’’ [Product Design Engineer - C09]

> ‘‘Our company is making electrical parts for our client and we have joined hands, I mean technical collaboration with a leading Japanese electrical components supplier. This process was initiated by our client (assembler). The assembler played an initiator and facilitator role for this transfer. All our communications and agreement took place with the help of our client’’ (Manager Product Development- C19)

Our interviews with the assemblers also pointed out the help and facilitation they have provided to the local component suppliers in linking them up with their first tier suppliers based in Japan.

One of the interviewees said:

> ‘‘Our firm has played an important role as a facilitator and mediator of technology transfer to Pakistan-based suppliers. As you can see we have a good business relationship based on mutual trust and durable relationships with our tier one suppliers in Japan and elsewhere in the world. Using our relationship leverage we acted as a facilitator in linking up our local suppliers with our first tier suppliers in Japan…. As you can see without our assistance those first tier suppliers based in Japan were reluctant to transfer technological knowledge to Pakistani suppliers’’ [Deputy Manager Supplier’s development - A01]

The table below shows the component suppliers’ technical collaboration in different components, which was achieved with the help of the three auto assemblers.

Table 7.1

Pakistan component suppliers' technical collaborations

Components	Collaborating Partners
Shock Absorbers	Showa, Kayaba, Japan
Radiators	U.E. Radiators, Toyo Radiator, Japan
Car A/C	Sanden , Denso, Japan
Radio Cassette Player	Panasonic Thailand
Lamps	Koito, Japan
Spark Plugs	NGK, Japan
Glass	NGS, Japan
Steering case set	I.S. Seiseki, Japan
Brake drum assembly	Nissin Kogyo, Japan

Source: Author's Interviews

The table 7.1 shows the Pakistani component suppliers' technical collaborations with mainly Japanese suppliers, which was achieved with the initiation and facilitation of the three auto assemblers. The three phases given above of the technology transfer process are summarised in Figure 7.1.

Figure 7.1

Three phases of technology transfer process from Pakistan's automotive assemblers to their component suppliers.

Technology Transfer Process Phase 1: Qualifying Stage

- **Prequalification/Selection of the key suppliers**
- **Provided parts drawings to the suppliers (Explicit knowledge)**
- **Suppliers develop the prototype**
- Testing of the part
- **Selected suppliers join the business relationship**
- Little social interaction
- Little communication

Technology Transfer Process Phase 2: Evaluative Stage

- **Assemblers provide parts detail specifications (Explicit knowledge)**
- Quality parameters
- **Assemblers provided some technical information, tools and advice on machinery**
- **Suppliers develop the final localized component (part)**

Technology Transfer Process Phase 3: Interactive Stage

- Assemblers provided quality related training to suppliers' staff
- **Suppliers' management get more training and factory visits to the assemblers home country (Japan) (tacit & explicit technology)**
- **Mediator and facilitator role**
- **Relational ties developed (social interaction and communications developed)**
- Regular audits

Note: Bold text indicates distinct phases in the technology transfer process.

7.2 Type of Technology transferred

Another aspect of technology transfer concerns the type of technology being transferred from car assemblers to component suppliers in Pakistan's automotive industry.

90% of the respondents indicated that they have received some form of technology over the past 1-2 years.

The management literature generally suggests at least three types of technology: product related technology, process-related technology, and managerial-related technology. In our interviews with the component suppliers and auto assemblers of Pakistan's automotive industry, data was collected on these three types of technology by utilising the framework of UNCTAD (2001). This allowed a holistic picture to be produced and to document the technology that is being transferred more frequently in comparison to other types.

The table below summarises the key technology received by Pakistan's local component suppliers. The type of technology was based on UNCTAD, 2001.

Table 7.2

Type of technology transfer to Pakistan's component suppliers (50 Suppliers)

Type of Technology transfer	Yes	No	No Response
1. Product related			
(a) Provision on product designs and technical specifications	41 (82%)	7 (14%)	2 (4%)
(b) Provision, advice, or financial assistance to obtain raw materials and components	28 (56%)	12 (24%)	10 (20%)
(c) Regular feedback on product performance to improve existing product technology	35 (70%)	10 (20%)	5 (10%)
(d) Technical consultations on product characteristics to master new product technology	2 (4%)	42 (84%)	6 (12%)
(e) Organized R&D-collaboration in product-related areas	0 (0%)	48 (96%)	2 (4%)
2.Process/Production related technology			
(a) Provision, advice, or financial assistance to obtain machinery and equipment	2 (4%)	45 (90%)	3 (6%)
(b) Technical support to improve existing production technology	28 (56%)	21 (42%)	1 (2%)
(c) Technical consultations on machinery operation to master new production technology	0 (0%)	48 (96%)	2 (4%)
(d) Advice on production layout and organisation	2 (4%)	48 (96%)	0 (0%)
(e) Assistance with quality assurance systems (e.g., ISO	9 (18%)	37 (74%)	4 (8%)

Type of Technology transfer	Yes	No	No Response
certification, TQM, etc.)			
3. Training programmes for suppliers' personnel			
(a) In-plant training for managers/ technicians at the supplier site	35 (70%)	10 (20%)	5 (10%)
(b) Training for managers/ technicians at assemblers site	0 (0%)	49 (98%)	1 (2%)
(c) In-plant training for workers at the supplier site*	35 (70%)	10 (20%)	5 (10%)
(d) Training for workers at assemblers site	0 (0%)	49 (98%)	1 (2%)
4. Managerial related technology			
(a) Market know-how	0 (0%)	47 (94%)	3 (6%)
(b)Financial Planning & Management	2 (4%)	47 (94%)	1 (2%)
(c) Project Management	0 (0%)	49 (98%)	1 (2%)
(d) Inventory control	0 (0%)	48 (96%)	2 (4%)
(e)manufacturing cost control and delivery systems	0 (0%)	46 (92%)	4 (8%)

Source: Author's Survey.

* Mainly quality related training programs.

As shown in table 7.2, IJVs established in Pakistan's automotive industry provide more assistance in the area of product related technology, than process and managerial related technology. By far the most frequently cited form of technology received from assemblers was related to product technology. Out of the 50 suppliers, 41(82%) have received an explicit form of technology, mainly in the form of product specification and drawings. This falls under the area of product-related technology.

As one of our interviewees indicated:

> ''our company is developing parts for the assemblers… in this development phase the assemblers share their drawings, standards and product specifications… we call it technology transfer…. We are not talking here from the perspective that we go into a joint venture or technical assistance agreement to get all the process details, machines and manpower training from them under the domain of this joint venture or technical assistance agreement;… we received specifications and we have to develop the part accordingly'' [Senior Operations Manager - C29]

From the above table, it is clear that most technology transfer (82%) has taken place in the area of product-related technology, mainly in the form of product specification and drawings.

Of the 50 suppliers, 28 of them (56%) have received assistance and provision on obtaining raw material and components, i.e. steel. In addition, out of the 50 suppliers 35 of them (70%) received on-going support to improve product performance.

As our interviewees said:

> ''We talk to our clients on a monthly basis, but if there is a quality related issue… we receive a phone call from our clients right away and they suggest the ways to improve the quality of the part'' [President and Owner – C49]

> ''We have ongoing dialogue with our clients in regard to bringing improvements in the product quality, and I must say that joint discussions and suggestions with the clients have been very helpful in improving our parts quality and performance'' [Manager Product Development - C12]

It is also evident that there is no organised R&D related collaboration between Pakistani suppliers and assemblers in the area of product development and design. This is because all three car assemblers conduct R&D in their home country (Japan), and with their established first tier suppliers based in Japan. This finding is not surprising as these three assemblers import most of the parts from their established suppliers based in Japan and Thailand.

With regard to the process-related technology, there has been very little assistance being provided to Pakistan's component suppliers. Out of the 50 suppliers, 28 of them (56%) have received assistance to improve their existing production technology and very few have received assistance on production layout and organisation. In addition, out of the 50 suppliers, 9 of them (18%), have received assistance in regard to the quality and ISO certifications.

Our respondents said:

> ''Japanese auto assemblers only want to help with the product-related technology by providing standard specifications, but they don't want to help with the process or management areas of technology'' [President - C48).

> ‘‘We want to have access and need help in the process areas like financial assistance to obtain the machinery and access to the production technology, but so far we are not able to get this from our clients’’ [Managing Director - C41]

This table indicates that there are training programs to improve quality for senior managers and product design engineers but there is no training in place for product development engineers to learn about product design and manufacturing.

In the area of managerial-related technology, the evidence is very clear that there is also very limited assistance being provided to master the managerial technology.

As one of the interviewees highlighted:

> ‘‘As a business owner, I would like to learn the best practices of automotive industry from my clients because they have a stock of knowledge in the area of marketing, branding, project management and controlling the costs…but so far I have not received any substantial assistance in these areas. As you know to manage the business … knowledge in these areas is vital for my business’’ [President and Owner - C35]

Out of the 50 suppliers, only 2 (4%), have received assistance related to managerial technology in the forms of financial planning and management. The interview data suggests that personalised managerial ties were helpful. These two component suppliers have also been investing in R&D and have close ties with Government run training and development centres, for example, the Small and Medium Enterprise Development Authority (SMEDA) and the Skills Development Council, and are outwardly mobile.

As one of the leading components suppliers’ CEOs indicated:

> ‘‘We have received help in better financial planning and management from our client (assemblers) because of our personal connections. Last month, I went to Japan to attend the wedding function of our client’s son. But moreover, we have also invested in house on our manpower skills and we have 120 hours of training during the year for our employees, so they can stay up-to-date with the changing trends of automotive industry. Our firm has also set aside 1% of the budget for R&D activities. I personally feel that client help is important in technology transfer, but we have to have in-house efforts and without a skilled manpower, we can’t take advantage of the transferred technology. Our company has a good

> engineering base and we are continuously striving to manufacture new components or improve the functionality of the existing components. We have also skill development programmes with Small and Medium Development Enterprises Authority (SMEDA), and various other Government run training centres, for example the Skills Development Council, and from time to time we bring auto experts to our company and they deliver tailor made programmes to our engineers. We have also been attending international trade fairs and we have just returned from one of the world's largest fairs in Hannover Messe… I mean Germany. These fairs are a good platform to build relationships and personally observe what new trends are happening in the auto industry'' (CEO- C15).

The interview with the Deputy Manager, from the Ministry of Industries and Production also confirmed the extent of participation in various international exhibitions, especially Hanover Messe, Germany and Midest France during the last five years.

The Deputy Manager, from the Ministry of Industries and Production stated:

> ''So far we have exposed around 150 engineering companies including auto sector to Hannover Messe, Midest France and Euromold trade showcases. In addition to these, we have also made delegation level participation to various engineering including auto fairs in Turkey and Korea and through these visits some of our component suppliers were able to develop contacts with foreign delegates. These visits have been very useful for some of our component suppliers to improve their business thinking'' [Deputy Manager, Ministry of Industries and Production]

The interview data shows that each area of technology has its individual role to play in the technology transfer process, but the whole **'package'** consisting of the above three areas of technology has much more to offer than an individual area of technology.

Out of the 50 respondents, 43 of them (85%), stated that in order to enter the global auto market, whole packages of technology are better suited to their needs. From the interviews, it has also emerged that in order to measure the amount of technology transferred, one has to look at the whole package of technology.

From the interview results we can identify **three** main categories of ‘technology package.

1. A basic package consisting of drawings, specifications and design of the product (product-related technology).
2. An intermediate package consisting of the provision of the design, specifications and help with the ISO certifications, quality-related training and consultation on machinery (product + process related technology).
3. An advanced package consisting of product, process and managerial-related technology.

This is summed by a manager from the Product Development Unit:

> ‘‘As you know tit bits of the technology would not help us much…. as a developing country supplier we need the entire ...whole package of this technology to move up the ladder and, moreover, to design the state-of-the-art components you have to master product, process and management technological package’’ [Product Development Manager- C 48]

The above section has highlighted that auto assemblers are, to some extent, selective in transferring product, process and managerial-related technology to their Pakistani component suppliers. The next section deals with the senders’ (auto assemblers’) willingness to transfer technology to their Pakistani component suppliers.

7.3 Assemblers’ Willingness to Transfer Technology

To what extent auto assemblers are willing to transfer technology to the Pakistani component suppliers constitutes another aspect of current research. Automakers’ willingness and motivation to transfer technology is a key aspect for the technology transfer to be effective at the recipient’s (supplier’s) end. Several Scholars, for example, Szulanski (1996), Husted and Michailova (2002), Michailova and Husted (2003), Ko *et al*. (2005), and Becerra *et al*. (2008)

have pointed out that a senders' willingness to transfer is a key factor of the extent of technology transfer to recipients.

The interviews with the auto assemblers and their component suppliers indicated that only three IJVs established in the Pakistani automotive industry are willing to transfer technologies related to low-medium technical parts and generic types of knowledge. And so far no advanced technology for the manufacturing of advanced (high precision) parts has taken place. Our data also suggests that component suppliers were receiving standard and simple product-related technology and there was no assistance coming from the auto assemblers for the technology related to advanced parts.

Our interviewees said:

> ''…we joined hands with our client in a hope to learn world class systems of auto industry;… but look, we have been receiving only drawings and specifications for standard low tech parts; we want to get product design and manufacturing and managerial knowledge from these assemblers… since they are spread all over the world…. It means we have to keep relying on drawings and we depend on our client'' [Manager Product development department - C23]
>
> ''… we want to get the whole package of technology and develop state of the art product which we can export or provide to other global automakers;… what in fact we have received is bits of knowledge in the form of drawings and specifications and requirements for quality performance for the low tech components'' [Senior Manufacturing Engineer - C08]
>
> ''they (auto assemblers) are only transferring generic type of knowledge; look we have developed this product (shock absorbers) for another client and the drawings and specification are also useful for other clients'' [Manager Procurement: C06]

Out of 50 suppliers, 40 (80%), stated that auto assemblers are only interested in procuring standard (low-medium tech parts) and labour intensive parts from them and for the labour intensive parts they are willing to transfer technology. However, they are not willing to pass on the advanced technological knowledge to their Pakistani component suppliers.

Our respondents said:

> ‘‘our clients (assemblers) who have localized their components (parts) give drawings, specifications and product quality performance criteria….unless the part has been exclusively designed by their tier 1 supplier and he doesn't want to give the information to suppliers in other countries’’ [Deputy Director - Planning and Development- C28]

> ‘‘ the client does provide us with technology for medium and low tech products; … for the advanced high tech parts technology they are reluctant to pass on this knowledge and in some cases they (auto assemblers) want us to form a joint venture with their tier one suppliers in Japan; … as you know it's a costly process of going into JV and to be honest these tier one suppliers based in Japan and other developed countries are reluctant to go into a JV with local Pakistani suppliers due to the fear of losing their value and piece of the pie;… even though we are part of this relationship, but still we are not part of the whole network’’ [Director Planning and Product development- C23]

> ‘‘Any assembler in the world would be willing to transfer standard technology for those parts which are labour intensive, as I can give you examples of wire harness and other accessories...., wire harnesses is a labour intensive job and if these assemblers get it done in their home country, the cost is much higher...., so the first thing these assemblers do, they localise these parts to satisfy the local contents requirements and save cost, and this is what we have been receiving here in Pakistan... in the name of technology transfer’’ [Operation Manager - C12]

The interviews with the assemblers' managers suggested that that there are various reasons for not transferring the high tech advanced parts technology. It depends on the type of the components and, moreover, we also look at the local suppliers' technological and absorptive capability.

Our respondents from the auto assemblers' side stated:

> ‘‘look the business environment has changed a lot, so we have to look what kind of technology we can transfer to our components suppliers, after all it is a decision which our company takes on a component to component basis, and for this depending on the nature and type of the component, we make the decision whether to transfer the technology for that particular component or not’’ [Senior Engineer - A01]

> ‘‘After all, you have to look for quality and cost and there are certain quality issues which we are dealing with at the components (parts) suppliers end… and moreover, the level of understanding of the technology is also different… some of our suppliers lack absorption capability for know-how of the critical parts to be transferred’’ [Deputy Director Purchase- A02]

The interviews with the component suppliers suggested that there is no issue of technological capability and local component suppliers possess the necessary expertise to manufacture any car part, keeping in view that OEMs facilitate them in technology transfer.

One of the interviewees said:

> ''Well, Pakistan's Government did not follow the deletion (local content) program diligently and if there was strong monitoring in place we would have been exporting cars from Pakistan with 100% local components. The Pakistan market has become a paradise for the Japanese auto assemblers, which hardly transfers technology to us, I mean their local vendors (suppliers) to manufacture deleted parts locally. We (the suppliers) have adequate in-house engineering facilities and technological capability to produce high precision parts. I can give you the best example of Massey Ferguson (Tractors) UK. They have achieved deletion over 90 per cent of their parts. This shows you that the technological capability exists in the country, but in the case of the auto assemblers, they are intentionally diverting to their principals for import of parts and avoiding the deletion programme in Pakistan'' [Director Planning and Development -C20]

The table below shows the technology contributed by the three IJVs to their Pakistani component suppliers.

Table 7.3

Technology Contributed by the three IJVs to their Pakistani Component Suppliers

IJVs	Technology contributed to local (Pakistan) component suppliers
A-01 (IJV)	Low-medium tech parts technology (40-60%) of parts are localised. Still imports high precision parts. Good technology base in the small-medium compact size car, i.e., 800cc-1000cc. Has been established in the local market since the 1980s.
A-02 (IJV)	Low-medium tech parts technology (25-35%) of parts are localised. Imports advanced technology parts. Excellent Production System and technology base in the 1000cc-1300cc cars. Has an excellent premium global presence. Established in Pakistan's market in the 1990s. Views Pakistan as a good potential market.
A-03 (IJVs)	Low tech parts (10-25%) of parts are localised. Mostly rely on imported parts. Good technology base in engine transmission and 800cc, 1000cc, 1300cc cars. Global network of around 507 subsidiaries. Local presence since the 1990s.

Source: Author's interviews

Interview data with the assemblers also suggests that there are market-related factors that prevent the three auto assemblers from transferring the complete technology to their component suppliers.

As a chairman and managing director of an auto assembling unit stated:

> ''…when it comes to transferring the whole package of technology; there are several decisions to be made and looking at the market… this market is not large enough to transfer the bundle of technology'' [Chairman & Managing Director - A03]

> ''Complete localisation of components can only be done once the volumes of production increase and we see a lot of potential in this market as compared to other countries'' [CEO and MD: A02]

Our interviews with the components suppliers also pointed out that auto assemblers in Pakistan enjoy high tariff protection. They (assemblers) are receiving this protection on the condition that, eventually, these assemblers would localise and produce 100% of parts in Pakistan, but so far the transfer of technology is very slow. The interviewees also mentioned the reluctance of these assemblers (OEMs) to transfer technology to their component suppliers for the localisation of critical parts, i.e. engine, transmission and power train parts. Out of the 50 suppliers, 33 of them (66%), indicated that they have the necessary capability to develop *any* auto part.

As one of the respondents said:

> ''We have the machinery and in-house engineering capability to produce any kind of car part, but we need help and facilitation from our OEMs. If they provide us with detail specifications and drawings of the high precision parts which these OEMs are importing we can develop those parts here locally. After all OEMs need to understand that it is in their interest too to localise critical parts to save costs, and ultimately customers will benefit as well'' [President - C11]

On the other hand, some of the respondents from the component suppliers indicated that there is a cost involved in this process of technology transfer, depending on the type of technology, and the technological knowledge associated with it.

Our respondents mentioned:

> ''there is a cost attached to the transfer of information … sometimes tier 1 suppliers charge us a cost or we have to pay to the mother OEM'' [Deputy Managing Director - C01]

> ''Sometimes, if we want to modify or adapt the technology we have to pay for this adaptation to the assemblers' or their business partners... I mean their tier 1 suppliers in Japan'' [Manager Operations - C30]

This is also in line with the study of Teece (1977), who found that there were substantial costs involved in transferring technology to overseas US subsidiaries.

In the interview data, the issues of control, power and strategic decision making can also be seen, which can influence the type of technological knowledge to be transferred along the value chain. Our interviewees were of the opinion that auto assemblers have substantial control over their component suppliers in Pakistan and they have lot of say in the business operations of their Pakistani component suppliers.

The interviewees mentioned that auto assemblers want to control critical parts technology and the strategic decision making that so is also with their principals in Japan and the Japanese managers whose decision is final and binding on all parties. Out of the 50 suppliers, 24 of them (48%), stated that since three auto assemblers strategic decision making is based in their home country – Japan, it is up to the principals to decide whether to transfer any particular component technology to their local Pakistani parts suppliers or not.

A substantial number of interviewees complained saying:

> ‘‘we have been receiving mainly product specifications and quality-related instructions… but at the end of the day it is still the client (assembler) side which controls our fate and the stock of knowledge… maybe if we acquire this know-how from them… the equilibrium can reverse and we can be in the position of power…. These are global players …. And since knowledge is power that’s why we are in a sort of weak position’’ [Project Manager Product development unit - C09]

> ‘‘Our engineers were facing some problems with our component steering boxes for one of our clients and we discuss this issue with the client and one of the Japanese Managers said ....’well your engineers need to figure it out.... we cannot help with this .....’, because this is then mean transferring know-how and technology. We have fixed this problem on our own through our company initiated learning and problem solving methods’’ [Manager Product Development-C18]

On the other hand, interviews with the component suppliers indicated that Government policies can also play an important role in regard to the type of technology transfer. In the case of Pakistan, both the Government and the OEMs are responsible for the slow transfer of technology to component suppliers. The interviews point out that there is no legal implementation in place with regards to the Government policies, and auto assemblers pressurize governments to achieve favourable concessions. They also point out that the Government has not diligently followed the local deletion level and has not put pressure on the assemblers to transfer technology to the Pakistani component suppliers. As from 1994-2000 there were 30 different policies in place for the automotive industry but the enforcement was flawed.

One of the leading Components Supplier’s CEOs stated:

> ‘‘I believe government policies play a major role… the problem with our government policies is that they are very weak and no enforcement mechanisms are in place… look at the local content policy… even still these assemblers are importing parts from Japan when these parts can be made locally… and moreover,

> nobody in the world is willing to transfer technology unless they have to'' [CEO - C05]

Our interviewee also said:

> ''See under the auto industry development program (AIDP), it was the government's responsibility to implement tariff-based systems for the import of auto components (parts) that were not developed in Pakistan..., and the tariff for the imported parts were to be progressively increased to encourage the localisation of those parts. The tariff was supposed to be increased for these parts from 30 to 50% in 2009, but the increase in the tariff was deferred due to pressure from auto assemblers (OEMs)...., and I have serious doubts if it can be even increased and legally implemented in this current year or even in the next fiscal year.... I mean in 2010'' [Managing Director - C11]

The interviews with the component suppliers also point out that the non-implementation of the auto industry development program (AIDP) has resulted in a sense that the three influential IJVs established in Pakistan's automotive industry are being given a free hand for massive rollbacks during the process of car model change and /or the launch of a newer model. The suppliers' respondents also stated that the three IJVs have forced local component suppliers to reduce their prices or they will import these parts from the international markets. The interview data also suggests that auto assemblers wanted to keep the local suppliers at a distance and these assemblers have more control over their (component suppliers') business outcomes than the component suppliers themselves.

Out the of the 50 components suppliers, 24 (48%), also indicated that under the auto industry development policy OEMs made the commitment that they will increase and contain the local content or there will be no roll back. In addition, the OEMs also committed to the further enhancement of the local content which will lead to more technology transfers and will promote the technology base of their component suppliers.

Our respondents indicated:

‘‘Under the so-called Auto Industry Development Program (AIDP), OEMs were supposed to transfer technology for high precision components,... for example, alternators, starter motors, water pumps, power steering, engines and transmissions, but after the passage of almost 2-4 years, these OEMs have failed to facilitate the local vendors (suppliers) in transferring and acquiring the technology and know-how for these parts. We local suppliers are very distressed by the outcome of this policy’’ [Owner - C23]

‘‘Auto industry policy has failed to achieve its stated goals and it has in fact facilitated the powerful OEMs, and moreover, auto assemblers have in some instances forced us to cut prices on locally made parts and have reversed the local content in new model cars’’ [Manager Planning & Development - C07]

‘‘we are kind of waiting for instructions from these assemblers;… we even can’t set the prices for our components;… they buy components from us at a price lower than the market rate and due to their power position there is limited advanced knowledge which we can get from this deal’’ [Manager Planning- C16]

From the assembler’s point of view, policy issues were also pointed out as the main hurdle behind the slow transfer rate of technology. One of our interviewees pointed out:

‘‘I know, Auto Industry Development Program (AIDP) is important and necessary. Its implementation is overdue and from time to time we need amendments in AIDP in order to make the technology transfer effective. If governments allow the import of used cars under new policy, it will have adverse impact on the local industry. Our principals (in Japan) are watching this situation very carefully, and if government change the policy and allow used cars in the market it will affect the current investment and transfer of technology’’ [Senior Vice President - A01]

Interviews with officials from the Ministry of Industries and Production of Pakistan (MOIP) also suggested that despite having the big brand name and global access, the three OEMs have facilitated a contribution of taxes and trained manpower in the country, but so far have remained net importers.

As the Deputy Secretary of the Ministry of Industries and Production said:

‘‘The OEMs based in the auto sector of Pakistan have not used our market as the export base and remained ‘net importers’, despite having edge such as managerial excellence, special systems, latest technology, globally acceptable brands, access to premier markets, global connect and well established markets around the globe. We are in touch with the OEMs to localise the high precision parts and once the

> volumes improve we are hoping they will do it'' [Deputy Secretary, Ministry of Industries and Production]

On the other hand, some of the respondents indicate that the auto industry is suffering from low levels of competition as three Japanese IJVs control 98% of the local Pakistani market. According to the interviewees, since there is no competitive pressure on these IJVs, they do not see transferring complex technology to their Pakistani-based component suppliers as their strategic priority. Interviewees were of the view that due to low competitive pressure on the auto assemblers they are not willing to transfer advanced part technology to the local (Pakistani) component suppliers.

As one of the respondents stated:

> ''Pakistan auto industry lacks competitive environment and seems like Japanese brand have monopolistic position in the Pakistan market....., I know there are some Korean and French auto assemblers who are willing to enter in our market, and if the government let them and facilitate them, they will be willing to transfer technology to us. We need to create more competition in the market, otherwise I don't see any incentive for the Japanese assemblers to pass on the advanced components technology to us'' [Chairman - C36]

The official of the Ministry of Industries and Production of Pakistan (MOIP) also pointed out that there is concern over the low level of competition in the auto industry of Pakistan.

The official stated:

> ''Over the period of time it has been observed that the present scenario is not only hampering further technological improvements of critical components, but also resulted in lack of competition and as a consequence prices of the locally (Pakistani) assembled vehicles are considered to be on the higher side. I know, the present state of affairs is being criticised for providing undue protection to the existing Japanese assemblers, creating an impediment for new investment in the Pakistan's auto industry and creation of a monopolistic situation'' [Deputy Manager, Ministry of Industries and Production, Pakistan]

The Competition Commission of Pakistan (CCP) recently reported that the auto industry of Pakistan has also criticised the local auto assemblers of Pakistan for creating a monopoly in the market. The Commission has made recommendations to the Government of Pakistan to allow imports of used and new cars of all categories on a competitive import duty in the country to promote competition in the auto industry. The report highlighted the issues related to the car prices and production fall and rise together of the auto sector of Pakistan, and it also points out that there was a need to closely review whether it was done deliberately or there were other factors behind this phenomenon. The representative of the CCP was of the view:

> ‘‘The industry must move from a reactive demand based model to a just-in-time supply based model. The report also stated that the auto industry of Pakistan was facing the problem of low volumes/under utilization of capacity, high prices, late delivery, premium and slow transfer of technology. The Competition report further added: ‘‘the need for competition is much more pronounced now than ever before, to keep the industry afloat’’ [Daily Times of Pakistan 10 Jan. 2010]

This section has indicated that assemblers are reluctant to transfer the advanced components technology to their Pakistani suppliers due to a number of reasons. For example, the size of the market is an important consideration when it comes to transferring technology for advanced parts. The sender’s decision to transfer the technology also depends on the nature of the part, because for some parts the underlying knowledge is easy to teach. However, some parts, such as engines parts, transmissions and power trains are based on complex engineering, and require huge investment, time and motivation of both the senders and the recipients for this type of transfer to take place. The strategic decision making which is being done in Japan also play an important boundary spanning role for the transfer of technology. In the next section, the main mechanisms used by the auto assemblers for the technology transfer are explored.

7.4 Main Mechanisms used for technology transfer

Various modes were used to transfer technology from car assembler to the component suppliers of the Pakistan automotive industry.

The interviews and survey data suggests that, multiple mechanisms were used to transfer technology from the car assemblers to the component suppliers. The main mechanisms adopted to transfer the technology were through face to face meetings, documents such as drawings, blueprints, detailed product specification, seminars, vendor conferences, company visits, training and overseas correspondence with first tier suppliers and machinery providers. Interviewees indicated that they received the technology mainly through quality related training, documents and meetings. Some of the component suppliers have joint technical committees and the technology was transferred through communications and joint meetings.

Of the 50 suppliers, 48 of them (96%), stated that they received technology through documents.

As one of the respondents said:

> ''Our client has transferred this technology through documentation to our firm. This option is well suited for their requirements as they don't have to transfer their engineers and product design consultants to us'' [Managing Director - C25]

Interview data also suggests that car assemblers haven't transferred technology by sending skilled engineers to their supplier's plants. The transfer of engineers may be a more effective mechanism to transfer context specific, and complex technology, where close interactions are needed between the sender's and the recipient's firms. Engineer transfer is a common practice in Japan where assemblers send their engineers to be based at the supplier's plants. This practice allows the recipients to access the sender's stock of tacit technology (Fahey and Prusak, 1998).

One of the interviewees stated:

> ‘‘These assemblers operating in Pakistan are the big names in the market.. Our staff can learn engineering and design know-how from their engineers, but our client doesn’t transfer her staff to our plant… they are happy to provide us documents and arrange seminars for our engineers’’ [President - C14]

The main mechanisms and their usefulness for the transfer of technology to the components suppliers are shown in table 7.4.

Table 7.4

Main Mechanisms for the Transfer of Technology to Pakistan’s Component Suppliers (50 suppliers)

Mechanisms	Yes	No	No response	Useful mechanism (Yes/No)
Face to Face meetings	45 (90%)	2 (4%)	3 (6%)	Yes
Documents	48 (96%)	0	2 (4%)	Yes
Engineers Transfer	0	48 (96%)	2 (4%)	Yes
On-the-Job Trainings (OJTS)	33 (66%)	13 (26%)	4 (8%)	Yes
Seminars/presentations	35 (70%)	12 (24%)	3 (6%)	No
Vendor’s conferences	40 (80%)	5 (10%)	5 (10%)	No
Overseas Correspondence*	15 (30%)	28 (56%)	7 (14%)	Yes

Source: Author’s interviews and Survey data

* Supplier’s own initiated mechanism

It is clear from the table above that face to face meeting and documents were the main mechanisms used to transfer technology by the car assemblers to their component suppliers in the Pakistani automotive industry. It is also evident that car assemblers do not transfer their engineering staff to their supplier’s plants. Several scholars have suggested that a significant portion of the technological knowledge that organisations seek to acquire is embedded in individuals. When these individuals move between organisations, they can apply this knowledge to new contexts, thereby effectively transferring the knowledge across firms (Argote and Ingram, 2000).

The usefulness of various mechanisms of technology transfer to components suppliers was also explored. Interviewees pointed out face to face meetings, documents, engineers transfer, on-the-job training and overseas correspondence as the most useful mechanisms for the transfer of technology to their plants. Interview data also suggests that auto assemblers transferred simple and codified technology through documents and on-the-job (OJT) training. In a similar vein, Hansen (1999) suggests that on the job training is effective when it comes to transferring less-complex and codified knowledge.

Seminars and vendor conferences were recognised as the least useful mechanisms for transferring technology. This is also in line with the argument of Holtham and Courtney (1998), who found informal mechanisms, like unscheduled meetings and seminars, may be effective in promoting socialisation but may hinder broad information dissemination.
Previously, Dutton and Starbuck (1978) also found that face to face meetings and conferences were strongly related to the amount of diffusion of highway related computer simulation technology. But in this research it was found that face to face meetings are a more useful mechanism compared to conferences.
As one of the interviewees stated:

> ‘‘our engineers have found the face to face meetings and in-house on-the-job trainings to be an effective way of learning because they have witnessed the real operation instead of just looking it in a book or in a document’’ [Manager Operations - C14]

Another important mechanism that emerged from the interviews was overseas correspondence, which is rarely mentioned in the extant literature. Of the 50 suppliers, 15 of them (30%), have received technology through this mechanism and these 15 suppliers noted it as an important mechanism of technology transfer.

One of our interviewees said:

> ''we have had a particular problem with the dimension of the wheel hub and it couldn't fit on to our client's new model…. we tried different ways to get over with this particular problem with no success and finally it was through foreign correspondence that we come to know the solution to this problem… we realize ah it could be used for the future problems as well'' [Technical Director - C17]

However, several respondents stated their concerns with regard to the training that was being provided to their staff by the assemblers. One interviewee indicated:

> ''Some of the seminars and trainings are very general in nature'' [Planning & Development Manager - C31]

The component suppliers' managers were of the view that in their environment, on-the–job and face to face interactions were important ways of transferring technology, instead of relying more on western ways of transferring the technology, like video conferencing and faxes. Therefore, the local context variable is important for devising a particular mechanism of technology transfer.

The next section deals with an important inter-organisational aspect of technology transfer: Trust.

7.5 Trust

Trust is an important element in the organisation of social relations. This is also apparent in the technological processes investigated in the present study. How inter-organisation dynamics affect technology transfer to Pakistani component suppliers are, to some extent, shaped by trust between various organisational actors.

Interviews with the suppliers indicated that the trust between the auto assemblers and suppliers is very important for the transfer of technology. The suppliers point out that having trustworthy relationships with their assemblers is advantageous for both the assemblers and suppliers businesses.

Suppliers interviewed point out that assemblers have more authority in the outcome of their businesses than the suppliers themselves, and the three assemblers always dictate their terms and conditions to them.

They were also of the opinion that the assemblers always pressured their local Pakistani component suppliers to cut the price of their parts, or they would begin importing that particular part from their foreign suppliers. Of the 50 suppliers, 24 (48%), of the interviewees also mentioned that there is limited assistance being given to the suppliers by the assemblers. As one of the interviewees stated:

> ‘‘We the (suppliers) have made so much investment in machinery, human resources for our clients (assemblers) in a hope to get more business and technical know-how from our clients, but so far our clients are asking us to cut prices or they will ask our competitors to develop the part and or they will go with importing that part... we have also received no assistance to control manufacturing and inventory costs.. I don’t think we can get more out of this relationship, because so far our clients are looking only at their side and taking care of their needs and requirements without having any sympathy for us... I mean the suppliers’’ [Vice President Marketing & Sales- C40]

Interview data also suggested that there is a trust deficit between the local components suppliers and three assemblers. They point out that assemblers do not consider the local suppliers as their strategic partners and therefore do not involve them in product design decisions.

Our respondents said:

> ‘‘As you know auto industry is a dynamic industry and it needs sort of strategic relationships between two parties, I mean the assembler and their components suppliers. In our case there is a trust deficit between us and our client. Somehow, we feel that our client is not serious enough and transparent to build long term partnerships. The client uses various tactics for example playing our competitors against us and always asking us to reduce the prices below the market rate. We feel that our clients are only interested in safe guarding their interests without having any concern for our business’’ [Deputy Head, Operations & Planning-C36]

> ‘‘Our assemblers have global reach and they often squeeze us.... I mean the suppliers by pressing them hard to reduce the prices and the assemblers always increase the prices of their various models of cars, but rarely transfer the benefits to us the suppliers. In this case we have to think whether our partners (assemblers) are trustworthy even though we are doing business with them for so long...’’ [President- C33]

Interviews with the suppliers also indicated that the reason for the low level of trust with the assemblers was that assemblers have not fulfilled their promises of assisting the local Pakistani component suppliers in acquiring the latest technical know-how. The suppliers pointed out that trust can be built through concrete actions and ongoing dialogue between the assemblers and the suppliers. As one of our respondents indicated:

> ‘‘During our various meetings with the Ministry of Industries & Production and the assemblers officials it was decided that our assemblers will transfer the technology for the parts to be locally produced, but so far we have received very limited assistance in terms of documents. We have to wait and see whether our clients can really fulfil their promises of complete localisation of parts and the transfer of know-how, but so far even after the auto industry development plan (AIDP) we haven’t seen any concrete steps from our client side... they are still importing parts which are even localized’’ [CEO-C44]

Interviews with suppliers also confirmed that they are in a very weak bargaining position relative to their clients (assemblers) and are forced to cut prices and show loyalty to their clients (assemblers). Our data also suggested that suppliers trust those assemblers who are willing to provide them with assistance in product design, process up gradation, manufacturing & inventory cost control and quality management.

One of our respondents stated:

> ‘‘As you know there are many faces of trust, but if my assembler is helping and willing to assist me in the design of the product, streamlining the process and help with controlling cost then it shows that my client (assembler) really looking after me.. This will generate a good will gesture and positive image of the client in our mind and we can feel that wow this client is really trustworthy and willing to go the extra mile in this relationship’’ [Senior Vice President, Operations – C42]

It emerged from the data that there are frequent changes of government in Pakistan and there is no stability in successive governments’ policies towards component suppliers, and, moreover, government policies protecting the big corporations. It also emerged that there is generally little or no legal protection in place for small component suppliers.

Every government of Pakistan has failed to formulate a legal framework and set up regulations to protect the component suppliers and other small-medium enterprises in their business dealings with powerful multinationals. As a result of the weak enforcement of policies and without the existence of laws and regulations, component suppliers are at a relative disadvantage when doing business with the assemblers. Assemblers are usually in a position of control to dictate the terms of agreements and the overall relationships. Even for conflict resolution, the client’s (assembler’s) decision is final and binding on the supplier.

As one of the component supplier’s Managing Director stated:

> ‘‘We are at the mercy of our clients (assemblers)... we cannot set the prices for our components, our clients are in a strong bargaining position because of their business position in the industry. We are sort of in a weak position, and they (assemblers) are the ones who can always force us to go along with their wishes, after all our business depends on them, the assemblers and there is no-to-little

> legal protection for us. If the conflict arises, our client's decision is final and binding on us'' [Managing Director- C17]

On the other hand, out of the 50 suppliers, 26 (52%), stated that their clients (assemblers) treat them fairly and the assemblers follow through their promises. Our interviewees indicated that they have received low to medium technical parts technology purely on the basis of having established and personal relationships with their automotive assemblers.

As one of the interviewees stated:

> ''We have received product-related technology through our long- term personal interactions with our clients. At the end of the day, our clients understand that we will not pass on this technology to other competitors. As you know, personal connections are always helpful for even seeking simple technical advice. You only share the technological knowledge with those members who you trust that they will use it only to meet the clients need, and the established trust gives our clients the needed confidence to transfer the technology and bits of know-how to our company'' [Director, Technical- C26]

In the case of Pakistan's component suppliers who have successfully received codified and some tacit technology, all enjoyed good relationships with their assemblers (for example, C15, C19, C37). The suppliers' managers also pointed out that successful technology transfer mainly depends on the willingness of the senders (assemblers), and local suppliers technological capabilities, rather than having written contracts between the suppliers and the assemblers.

The data also suggested that ongoing support received from the assemblers in the form of improving the performance of the product, solving quality related issues, providing training to the suppliers' personnel and the provision of financial help were considered as important elements of suppliers' trust in the assemblers.

One of the interviewees suggested:

‘‘Assemblers ongoing support in the form of technical advice and financial assistance are good indicators to suggest that our client (assembler) cares about our business and well-being. This all helps in building the norms and cooperation and shows that our client is committed to this relationship and in our case client does help us’’ [Owner- C11]

The table below shows the level of suppliers’ trust in their clients (assemblers).

Table 7.5

Level of trust of component suppliers have in their assemblers

Measures of trust	Yes	No
You (Suppliers) assume that the assemblers will always look out for your interests	13 (26%)	37 (74%)
You (Suppliers) assume that the assemblers would go out of their way to make sure you were not damaged or harmed	12 (24%)	38 (76%)
You felt like your clients (assemblers) cared what happened to you	10 (20%)	40 (80%)
You trust your assemblers to treat you fairly	24 (48%)	26 (52%)
You think that the assemblers have a reputation for trustworthiness (following through on promises and commitments) in the supply community	12 (24%)	38 (76%)
Given the chance, you perceive that the assemblers will take unfair advantage of you	22 (44%)	28 (56%)

Source: Survey Questionnaire

It is clear from the above table that Pakistani components suppliers’ level of trust in their assemblers is very poor. Around 80% of the suppliers feel that their assemblers would not care much whatever happened to them. Only 30% of suppliers feel that their assemblers will treat them fairly in their business dealings. Around 72% of the suppliers feel that if given the chance, the assemblers would take unfair advantage of their suppliers. 76% of the suppliers feel that the assemblers have a negative reputation, that of not following through on their promises and commitments.

Interviews with the assemblers also highlighted that trust is an important ingredient for effective technology transfers. The interview data with the assemblers' executives also suggested that having a reliable and trustworthy recipient is important in order to have a meaningful transfer of technology. As one of the respondents suggests:

> ''You share knowledge or secret with your close associates who you know will not turn their back on you, and in the case of our suppliers, we know through our dealings and social interaction who to transfer this technology. After all, technology cannot be freely transferred to every supplier. In our relationships with our suppliers, we evaluate them very carefully and then we make the judgement who is reliable and trustworthy for our technology'' [Chairman- A03]

Interviews with the assemblers' executives also indicated that they have helped some of their Pakistani component suppliers, with whom they have good relationship and trust, by linking them with their established Japanese Suppliers for technology transfer assistance.

One of the managers from the assembler's side said:

> ''We have built relationships with our Japanese and North American suppliers on the basis of mutual benefits and personal ongoing ties and it is not an easy process, you have to invest your time, financial resources and energy to maintain these ties. It is on the basis of these personal ties that we have been able to link some of our Pakistani component suppliers with our Japanese suppliers for technical collaborations'' [Senior Vice President, Operations- A01]

The above section highlights the important role of trust in the technology transfer process. From the above findings it is clear that there is a trust deficit between Pakistan's component suppliers and their assemblers. However, some of the suppliers, who have established trustworthy relationships, are in a better position to receive the technology from the assemblers. In the next section, a further important aspect of inter-organisational dynamics- that of social ties is explored.

7.6 Social Ties

How social ties affect the transfer of technology from assemblers to Pakistan's component suppliers has been specifically addressed in this research. In this regard interviews with the suppliers' managers suggested that from time to time assemblers and suppliers arrange cricket and football matches to increase the level of social interaction between their staff and the suppliers' staff. Out of the 50 suppliers interviewed, 11 (22%), indicated that assemblers also arrange excursion trips, sports and social gatherings to facilitate communication and network between their staff and suppliers' staff. According to the data, social ties and personal connections have been helpful for the acquisition of codified and tacit technology.

As one of the component supplier's Project Manager indicated:

> ''Playing matches together and going on excursion trips, our employees have built personal connections with the assemblers' staff. We have realised that these personal connections are important to receive technology and it is basically calling the person in your inner circle to discuss if you are facing any problem and receiving the timely feedback'' [Project Manager, Product Development- C19].

Out of the 50 suppliers, 24 (48%), indicated that they don't have any social activities with their assembler's staff and, moreover, their staff members don't communicate regularly with their assembler's staff. The interviewees were of the view that assemblers keep them at a distance and do not organise any social events with their staff members. Our interviews with suppliers also suggested that there is little social interaction between the suppliers and the assemblers and this has resulted in limited technology transfer mainly in the form of documents.

Other interviewees stated:

> ''If you ask us to name some of the assemblers' staff, we don't have any personal connections with them and we don't know them well. I guess strong connections are important to get the technology know-how; we have realized, that it is simple in the business dealings who do you know'' [Manager, Supply Chain- C39]

> ‘‘I am sure friendship and close associations are important to know the trick of the business, and in our case we don’t have good interactions with the assemblers and maybe that’s the reason we are only receiving simple drawings’’ [President & Owner- C23]

Our interviews with the components suppliers also suggested that informal social relationships play any important part in technology transfer. The interviews were of the view that knowing the assemblers top managers on an informal basis was useful for receiving the technology.

As one of our respondents said:

> ‘‘When you know someone on an informal basis you build up trust with that person. In our business, informal relationship matters, because then the other person is willing to give you useful tips and knowledge about the business and how to improve it. On the other day, I was attending the birthday party of my client manager’s son and all of a sudden during the function he said that he is going to help and facilitate us in developing the AC for their newer model car. If I am facing any product development problem, I always pick up the phone and talk to this friend, and he arranges his engineers to come and look at the problem and provide solution’’ [Vice President, Operations- C37]

It is clear from the above discussion that social ties also play an important role to get access to the sender’s stock of technology. Low levels of social ties were only useful for the receipt of standard forms of technology, mainly in the form of documents and drawings, whereas personal ties were useful for the receipt of codified and tacit type of technology (Components Suppliers #15, 19 & 37). The next section deals with the recipient’s related learning intent factor.

7.7 Recipients’ Learning Intent

How recipient’s learning intent influences technology transfer is also an important element of technology transfer and its effectiveness.

Scholars in management literature suggest that organisations may have different motives for forming alliances (Faulkner, 1996; Kauda, 2002). Some also show that it is not an automatic process that organisations entering into alliances will learn and acquire the needed technology from their alliance partners, unless the recipients possess learning intent and subsequently allocate necessary resources to support the transfer (Hamel, 1991; Inkpen and Crossan, 1995; Lyles and Salk, 1996; Inkpen, 2000). In the inter-organisational knowledge transfer context, recipients' learning intent (Hamel, 1991), shows the self desire and will of an organisation to learn from its partner when entering into an alliance.

In the case of Pakistan's component suppliers, it was also found that acquiring the technological know-how was one of the principle motives for forming business relationships with the Pakistan-based auto assemblers.

As one of the component supplier's Technical Director suggested:

> ''The primary motivation to form the business partnership with our client was the desire to acquire technological know-how and to learn the best practices and knowledge about the global automotive industry'' (Director Technical - C17).

Out of the 50 suppliers, 39 (78%), stated that they have committed physical, organisational and human resources to support the technological learning and sharing of technology from their clients (assemblers) to their firm.

One of the interviewees mentioned:

> ''As you know, in order for us to learn our partner's technology we have to have strong commitment of learning and dedicated resources to utilise this technology. Without strong commitment, I do not think we can get anywhere'' [Senior Vice President HR Planning & Development: C30]

The interview results suggest that component suppliers' employees attended the company sponsored and assemblers led training programmes with dedication and commitment.

Two of the assemblers also indicated that their suppliers' employees have shown a great desire and attitude to learn their technology.

As one of the interviewees said:

> ''When we engage our suppliers' employees in quality related training, we have seen very positive and upbeat kind of attitude on their part. This shows to our quality led trainer that the suppliers' employees are willing to learn the training material'' [Supplier's development Manager - A02]

The table below shows some of the main motives behind forming the business relationships with the auto assemblers based in Pakistan.

Table 7.6

Main motives for Pakistani automotive component suppliers for forming business relationships with Pakistan-based automotive assemblers.
(50 Suppliers)

Main Motives	Very important	Important	Not important
Acquiring technological know-how	47 (94%)	2 (4%)	1 (2%)
Entering into global value networks	46 (92%)	3 (6%)	1 (2%)
Learn global automotive best practices	40 (80%)	6 (12%)	4 (8%)
Sharing the risk of new product development	30 (60%)	8 (16%)	12 (24%)
Develop technological capabilities	45 (90%)	3 (6%)	2 (4%)

Source: Author's survey and interviews

As we can see from table 7.6 above, 94% of the responding suppliers suggest that acquiring the technological know-how was one of the most important motives for forming business relationships with the IJVs established in the automotive industry of Pakistan. Besides the acquisition of technological know-how, entering into the global value network was the second most important motive behind business relationships.

Out of the 50 suppliers, 45 (90%), mention the development of their technological capabilities as one of the most important motives for forming business relationships with assemblers. So from the table, it is clear that accessing the technological know-how from the assemblers was a very important learning intention behind the business relationship. For example, Perez Nordtvedt *et al*. (2008), suggest that learning intent is critical to the success of technology transfer.

The above findings relate to recipients (component suppliers) learning intent indicates that learning intent is indeed critical for successful technology transfers to take place. A reluctant recipient will be in a difficult position to get any technology from senders. The following section deals with another important aspect related to the recipients of technology: recipients' absorptive capacity.

7.8 Recipients' Absorptive Capacity

The recipient's absorptive capacity plays an important role for the effective utilisation of transferred technology.

In management literature, several scholars have discussed the importance of a recipient's absorptive capacity on technology/knowledge transfer success (Lane *et al*., 2001; Gupta & Govindarajan, 2000; Lyles and Salk, 1996).

In the case of the component suppliers, the interview findings suggest that not all firms possess a strong absorptive capacity. Out of the 50 suppliers, 48 (96%), suggested that as a recipient of technology, they must have the in-house capability to receive the technology.

As one of the interviewees said:

> ''Even if my client (assembler) transfers simple techniques and technology, there is no use of this technology within my firm, if we don't have the capability, commitment to receive and learn this technology; … As you know recipient must be capable of receiving technology,… I strongly believe this is one of the most important factors which can play an important role to make the transfer more efficient and effective from my client (assembler) to my firm and we are continuously building our engineering and R&D capabilities'' [President and Owner: C33]

The interviews with assemblers also demonstrate that not all of their suppliers possess a strong capability to absorb the technological know-how.

One of the interviewees indicated:

> ‘‘We have been transferring the technology for the low-medium tech parts, and even for this we have been seeing lots of defects in the final product… we have come to know that our components suppliers’ staff lack necessary skills to absorb the advanced part technology… if the suppliers raise the level of skills of their engineers than it is a totally different story and ball game’’ [Managing Director - A03]

The interview findings also reveal that not all of the suppliers consider this an issue. Out of the 50 suppliers, 24 (48%), point out that since their clients (assemblers) were transferring documents and specifications related to product development, they thereby have the necessary in-house skills to utilise this technology.

One of the interviewees indicated:

> ‘‘Adapting and utilizing our client’s (assembler) technology is not a big deal. We have the necessary trained manpower to deal with this, and we have been continuously upgrading our employees’ skill through in-house training programs… mainly through our own efforts, but the problem is we are not receiving any client’s skilled engineers who can be based at our site, and work closely with our engineering personnel and assemblers are also reluctant to help us in the skills up- gradation of our staff ’’ [Managing Director - C21]

The interview results suggest that the problem with a low level of absorptive capacity with the recipients (component suppliers) was low level of investment in R&D and employees skills up gradation through the help of local institutions and auto assemblers. As Cohen and Levinthal (1990), argue, the firm’s ability to utilise external knowledge is often a by-product of R&D investment.

16 (32%), out of the 50 suppliers stated during the interviews that after forming the partnership with the auto assemblers, they have set aside 0.5% to 1% of the budget for R&D.

Out of the 50 suppliers, 47 (94%), were of the view that Pakistan's education system is not producing well trained and educated engineers. They also pointed that most of the universities in Pakistan do not offer automotive engineering courses, and that university graduates lack necessary project management and manufacturing skills. There is also a lack of interaction between the industry and the universities, which is a big hurdle in the development of necessary skills.

A number of respondents stated:

> ''Our education system is not producing well groomed automotive engineers… the graduates of our universities have only theoretical knowledge, but they lack the application'' [Manager HR - C32]
>
> ''Of course there is a greater need to put emphasis on developing skills of our workers through an alliance of the Government- run skills development centres and components (parts) sector,... but the problem is that neither government nor our clients (assemblers) help us in skills development of our work force'' [Owner and President - C34]
>
> ''To progress further, as a components manufacturer you need to have a base..... a pool of skilled workers and moreover strong linkages with the R&D centres and our local universities, but so far our universities don't understand our industrial problems and we are not aware what kind of research our universities are conducting...., so I am a bit concerned that there is no alliance between our local universities and components manufacturers to develop joint knowledge... in this way we are not going to search for knowledge through other sources which at the end of the day can be very expensive for us'' [Director Planning- C21]
>
> ''Whoever (component suppliers) or the Government officials you talk to..., there is this consensus that we receive lack of institutional and assemblers support in terms of technical assistance and our workers training'' [Manager Product Development - C16]

Our interview data also suggests that component suppliers view local R&D and Centres of Excellence as an important network of partners from where they can have access to technology and develop the absorptive capacity of the staff.

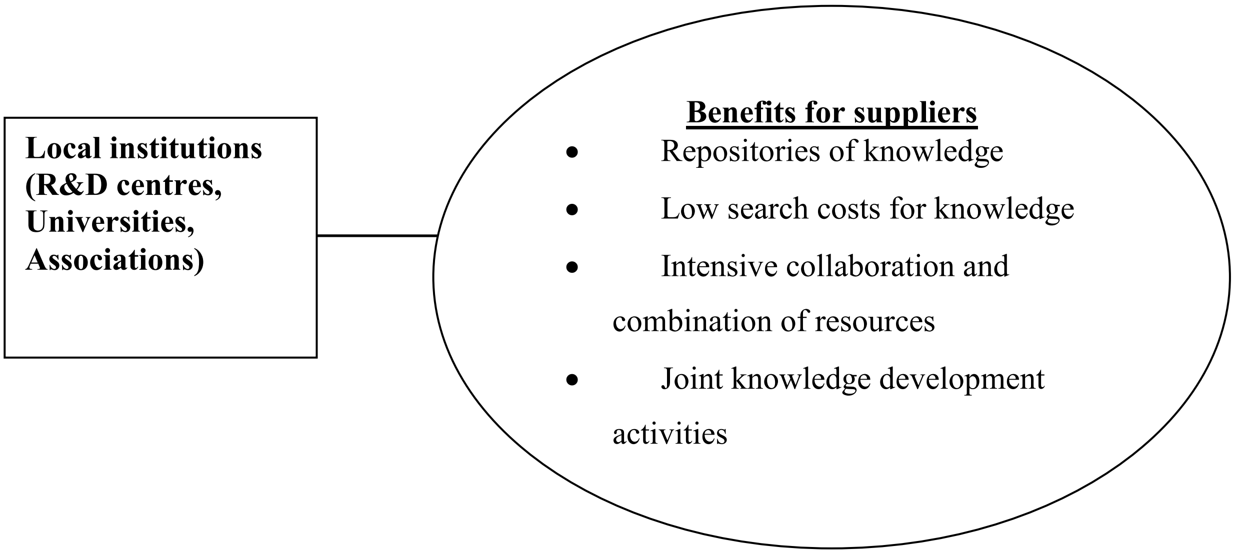
One of our respondents said:

> ‘‘Local R&D centres and universities can be beneficial for us in terms of locating the key technology and sources of knowledge, but unfortunately in our country local institutions and private sector don’t view each other as key partners..., our universities don’t even consult with us when designing their courses, so there is very little which we can get from our institutions in terms of our staff skills development’’ [Business Development Manager – C07]

The below figure show the benefits of having linkages with local institutions based on the comments of the interviews.

Figure 7.2

Linkages with local institutions and benefits for components suppliers



Our data also suggest that very few, around 22% or 11 out of the 50 components suppliers, have received support through institutional linkages with the existing linkages being very weak with regard to the development of absorptive capacity. As one of our respondents stated:

> ‘‘The support from the local institutions is non- existent, and to build strong supply base we need to have strategic linkages and partnership with our institutions for skills development and training, because at the end of the day local experts understand local industry problems and they can tailor solutions according to the local business conditions. In our case we have try to link up with the government run skills development centres, such as SMEDA and Skills Development Council and we have also sign an agreement with few engineering

universities for internships programmes and our engineers capacity building''[Operations Manager - C14]

The table below shows the institutional support and linkages the component suppliers have with local institutions in Pakistan.

Table: 7.7

Institutional support and linkages the component suppliers have with local institutions (50 Suppliers)

Institutional Linkages	Yes	No
Your firm received support for R&D activities from local institutions	4 (8%)	46 (92%)
Your employees received specific training by local academic institutions, including Government-run skills development centres	11(22%)	35 (70%)
Your firm received benefits from academic institution research activities	2 (4%)	48 (96%)
Your firm collaborates with any Government R&D institutions	0	50(100%)
Your firm has any internship programmes with the local universities	6 (12%)	44 (88%)
Your firm has received support in technological knowledge development activities from local institutions, including Government-run centres	5 (10%)	45 (90%)

Source: Author's Survey

The above table shows the institutional support and linkages with the component suppliers; around 22% of the survey suppliers' employees had received training through the local institutions, including Government- run skills development centres.

Out of the 50 suppliers, 4 of them (8%), stated that they have received support for R&D activities through local institutions, and only 4% mentioned that they have received benefits from the research activities of the local universities. This finding is not surprising as very few academic staff in Pakistan share their research findings with the industry.

The survey results also indicate that none of the component suppliers collaborate with any Government run R&D institutions and 12% of the surveyed firms stated that they have formed internship programmes with the local universities.

Out of the 50 suppliers, 5 (10%), have received support in technological knowledge development activities through local institutions. These results show that there is very little support that the component suppliers can receive from Pakistan's institutions in developing their employees' absorptive capacity.

The interview and survey findings also suggest that none of the 50 suppliers have any employees with a PhD degree. The table below shows the level of education.

Table 7.8

Level of education of component suppliers' employees (50 Suppliers)

Level of Education (completed degree)	Yes	No
Have staff with PhDs	0	50 (100%)
Have staff with Master degrees, including Engineering degree	19 (38%)	31 (62%)
Have staff with Bachelor degrees	35 (70%)	15 (30%)
Have staff with diplomas	42 (84%)	8 (16%)

Source: Author's Survey

The level of education is shown in table 6.8, 84% of the suppliers' employees possess only diplomas, whereas 70% of the employees hold bachelor degrees. Out of the 50 suppliers, 19 (38%), have employees with a Masters degree, including the subject of engineering.

Out of 50 suppliers, 37 (74%), have designed in-house training programs for their employees to enhance the absorptive capacity of employees. The interview findings suggest that these in-house training courses cover the area of quality improvement, quality control, problem solving methods and soft skills like communication and working in a team environment. Out of the 50 suppliers, 31 (62%), have focused on improving the basic production capacity of their employees by mainly focusing on quality-related training, soft skills and problem solving methods.

One of the interviewees stated:

‘‘Our clients (assemblers) have put a lot of pressure on us to improve the quality standards; As you know, to them, I mean our clients quality is a big deal, so now we have to keep on training our production staff on the quality related issues’’ [Manager Quality Assurance - C28]

Some of the suppliers pointed out that they have benefited from the training courses arranged by the Pakistan Association of Automotive Parts and Accessories manufacturers and Small & Medium Enterprise Development Authority (SMEDA).

Our respondents said:

‘‘Our members component suppliers have been continuously developing their capabilities through indigenous efforts.... from time to time, we have been arranging seminars & workshops on various topics which are interest to our members’’ [Chairman, PAAPAM- Suppliers Association]

‘‘Our staff has benefited through the training of Small and Medium Development enterprise with the help of JICA... I mean Japan International Co-operation Agency and with their help we have achieved good results in productivity improvement, cost control and skills up-gradation, but these are very few initiatives that are being implemented and we need to have more sort of these schemes’’ [President - C15]

The interview data also suggests that the Government of Pakistan has initiated several Government-run skills development and training centres, for example, Government Poly-technical Institute, Technical Education and Vocational training Authority (TEVTA), Auto Industry Skills Development Company (AISDC), Technology Up-gradation and Skill Development Company (TUSDEC), Skill Development Council, and Pakistan Industrial Technical Assistance Centre (PITAC). Most of these centres either lack modern machinery or competent staff, and, moreover, there is a need to have a legal implementation of these initiatives, so that small and medium component suppliers can get access to their services and develop local capacities and capabilities through public-private collaborations.

Not all suppliers possess the depth (how specialised the capability is) and breadth (which areas they cover) of absorptive capacity, which is due to the absence of solid linkages with government-run training centres to receiving no assistance from auto assemblers to upgrade their absorptive capacities. The following table shows the depth (how specialised) and breadth (which areas they cover) of component suppliers' capabilities. Product engineering, process engineering, project management, manufacturing, R&D and design capability areas were surveyed according to how specialised the component suppliers are in each of these areas. The component suppliers' managers were asked to rate their firm's technological capabilities on a 1-5 scale 1= Basic, 5= Advanced. The respondents were asked to focus on the past 1-2 years, when answering these questions.

Table 7.9

Technological capabilities of Pakistan's component suppliers (50 Suppliers)

Capability Area	Basic	Intermediate	Advanced	No Response
1- Product Engineering				
How specialised your firm's capability is in terms of:				
• Your firm possesses the capability of assimilation of product design, minor adaptation to market needs.	40%	30%	22%	8%
• Product quality improvement, licensing and assimilating new imported product technology.	44%	28%	20%	8%
• In-house product innovations and basic research.	42%	24%	22%	12%
2- Process Engineering				
• Debugging, quality control preventive maintenance, assimilation of process technology.	38%	24%	22%	16%
• Equipment stretching, process adaptation and cost saving.	46%	28%	18%	8%
• In-house process innovation.	36%	30%	20%	14%
3- Project Management				
• Successful completion of projects on time, schedule and budget.	32%	36%	25%	7%
• Allocation of required resources on a project.	45%	20%	25%	10%

(Continued)

Table 7.9 (Continued)

Technological capabilities of Pakistan's component suppliers (50 Suppliers)

Capability Area	Basic	Intermediate	Advanced	No Response
4- Manufacturing				
• Understanding of manufacturing processes and capability to improve the manufacturing processes.	39%	32%	25%	10%
• Manufacturing flexibility.	46%	30%	20%	4%
• Low operating costs.	42%			
• Component manufacturing.	44%	28%	23%	7%
• Supply chain management and production	42%	26%	30%	0
scheduling.		21%	27%	10%
• More efficient production system.	43%	26%	25%	6%
5- R&D and Design				
• Skill in conducting applied R&D.	34%	32%	25%	9%
• Ability to transform R&D results to products.	45%	26%	22%	7%
• Ability to upgrade existing products.	40%	30%	26%	4%
• Ability to improve the overall design and functionality of the components.	43%	27%	24%	6%
• Ability to frequently enhance product quality.	42%	30%	27%	1%

Source: Author's Survey

The table above shows the different capabilities of Pakistan's component suppliers according to the particular area of capability. The survey data indicates that the majority of the suppliers possess basic capabilities and only a handful of suppliers possess advanced capabilities in the different areas. The qualitative data suggests that intermediate and advanced capability suppliers are in a better position to benefit from the transferred technology. The data suggests that suppliers who possess advanced capabilities have developed exploitative, and to some extent exploratory, innovative capabilities. These advanced capabilities are the result of having in-house training programmes and strategic linkages with government-run training development centres and personalised ties to the auto assemblers.

The findings identify three important actors in the development of absorptive capacity: auto assemblers, components suppliers and government-run training centres. The level and intensity of their co-operation is an important element in the development of local suppliers' absorptive capacities. Our findings also point out the importance of public-private collaboration as an important conduit for the development of local suppliers' absorptive capacities. The findings related to absorptive capacity also suggest that both assemblers and their suppliers have different perceptions about the supplier's absorptive capacity.

The next section deals with technology transfer effectiveness, which is the main emphasis of this thesis.

7.9 Technology Transfer Effectiveness

Answers to the question of the effectiveness of technology transfer from assemblers to Pakistan's component suppliers were varied, revealing differential outcomes.

Interviews with component suppliers suggested that transferring technology is one side of the story, but the overall effectiveness of transferred technology matters along the value chain. Our interview data suggests that component suppliers' view is that, since auto assemblers in the Pakistani auto industry have developed different governance relationships with the suppliers, this has an effect on the overall effectiveness of transferred technology.

Out of the 50 suppliers, 24 (48%), indicated that they have contractual/commercial relationships with their assemblers, and assemblers can influence the overall outcome of their business. The interviewees were of the view that in this type of relationship no party is dedicating enough resources to the other party, and the relationships can be terminated by any party with a single stroke of the pen.

In this type of relationship which shall be called contractual/ commercial governance, the component suppliers have received limited technology in the form of documents and there is limited social interaction taking place between the component suppliers and the assemblers' staff (for example, Components suppliers # 39 & 23). The suppliers in this category also point out that they do not receive any ongoing assistance in regard to product development or improvement of their processes. The interview data of component suppliers also suggests that there is a low level of trust (for example, component suppliers 40, 36, 33, 44, 17, 42, 24 &31) between the suppliers who fall into this relationship and their assemblers.

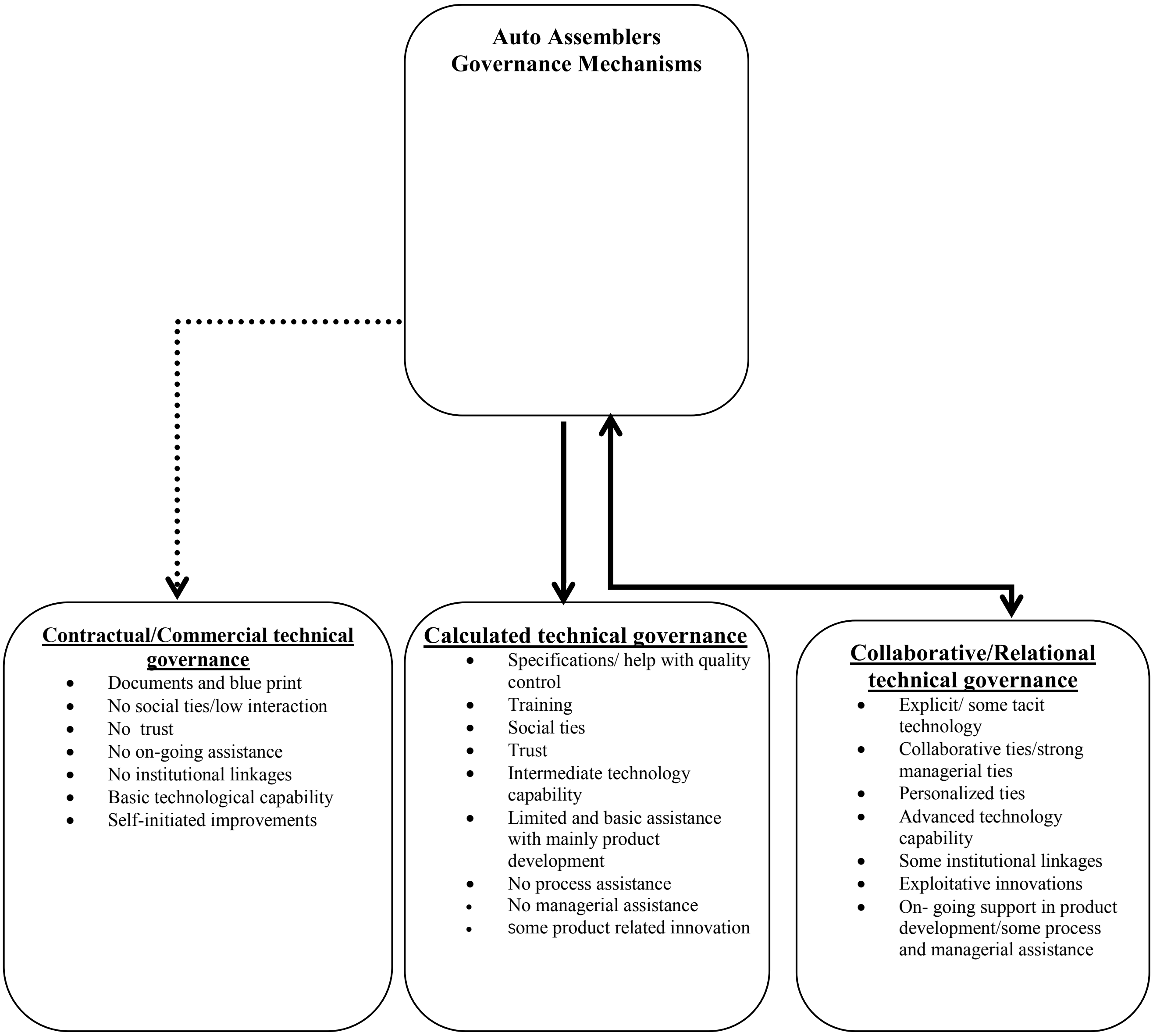
Our interviewees suggested:

> ‘‘ We have been stuck in this relationship and this is not going any where... we feel that our clients (assemblers) is always using their power and negotiating prices with us, but when it comes to providing technological assistance, their I mean the client attitude is not serious enough. If we don't give them the prices of our parts according to their liking, the client tells us that they will go ahead with another supplier. We also feel that our clients are not keeping their word and we have no social links with them, I mean we don't attend each other social function’’. [Manager Marketing- C24]

> ‘‘As you know to launch state-of- the-art products for this market (Pakistan) or to develop new parts for the foreign market we need to have strong two way relationships based on mutual understandings and sharing the benefits, but in our case we are standing on a one way street, and we cannot launch new products on our own, even though we have the resources, when there is no help coming from our client's side, and it is not just the client, but our government's institutional structure is not good as we do not have links with the government's institutions. You can only launch new products for the local market and for the foreign with the close associations and help of various actors playing their part together’’. [Director, Operations & Planning- C31]

The figure below shows the auto assemblers' various governance mechanisms with their Pakistani component suppliers.

Figure 7.3
Pakistan's auto assemblers' governance mechanisms



Note: dash line indicates weak link, arrow pointing in one direction indicates one way relationship, and arrow pointing both ways indicate two ways relationship.
Source: Based on Author's interviews

Out of the 50 suppliers, 15 (30%), indicated that the assemblers are very calculated when it comes to transferring a particular technology to their firms. The managers of the component suppliers were of the view that their client assemblers are transferring product-related specifications to their firms, but do not want to go beyond this transfer relationship.

The component suppliers, who fall under governance 2, which we call calculated governance, have received product specifications and help with improving quality. In some cases they have also received quality control related training from their auto assemblers. The data also suggests that suppliers in this category also have social ties, and their relationship is based on trust with their assemblers. The suppliers possess intermediate technological capability and have been receiving limited and basic assistance with product development only. On the basis of this assistance, suppliers have been developing new products only for the local markets in Pakistan.

Our interviewees stated:

> ‘‘We are moving along the value network, though still we have a lot of ground to cover, but it all depends on our clients (assemblers) and the nature of their help. If they provide on-going help and continuous assistance, our firm will be in a position to develop and launch new or enhanced the existing products for the current market, I mean the local Pakistan’s market. We want to explore the international customers, but it is risky with current level of assistance coming from our clients, I don’t think we can develop new products for the international customers. To do this we need substantial assistance from our clients, and few social informal attachment with the clients have help us little to bring some changes to our current products and we think to develop products it depends on the nature of our relationships and collaborations with the clients ’’. [Owner- C05]

> ‘‘The way our customers, I mean the assemblers have set up the relationship has also affected our efforts to launch new products, they provide us limited help in developing our capacity and so far we have received simple product related specifications and drawings from our customers. On the basis of this relationship, I don’t think, we can even think about designing or updating the features of our current products, though we have done some minor modifications to our products’’. [Business Development Manager- C27]

Out of the 50 suppliers, 11 (22%), stated that they have a good relationship with their assemblers and the owners/managerial ties have helped them when receiving the technology. Suppliers in this category (firm # 19, 15, 11, and 37, for example) indicated that since their owners and managers have been participating in social events of their assemblers, they have developed close personal contacts with the Japanese managers.

The component suppliers' managers pointed out that on the basis of these personal, informal contacts, assemblers do view them as preferred suppliers and have helped them in the product, process and in some cases managerial technology. The data also indicated that suppliers who fall under this governance mode, which we refer to as collaborative/relational governance, also have some institutional linkages with the local R&D institutions and posses advanced technology capability/absorptive capacities because of their investment in training and R&D, such as component suppliers #15, 28, 14, 19, 43.

The interviews with the suppliers' managers also suggested that social relations and linkages with the assemblers and local institutions have helped them in bringing changes and improvements to their existing products for the local market.

As our respondents said:

> ''The close associations of our owner with the assemblers have been very useful for the good utilisation of this transfer technology. Look we have developed and upgraded the AC and propeller shaft for our clients. This has been done with the help and ongoing discussion with the client. We are proud to say that our client treats us as their network partner, though still we don't have the central position within this network, but we have been successful in developing these products with the help of our close relationships with the client. We also get little help from the SMEDA; I mean the Small and Medium Enterprise Development Authority, but this help is only in the form of training. I do believe that no suppliers can develop or upgrade the products without the help of the assemblers and all our products have been successfully developed with the close support of our clients''. [President- C14]

> ''We wouldn't have upgraded and developed the new parts without the assistance of our assemblers. I think their support is crucial and close relationships with the assemblers are also helpful for launching new products. I must say that we have been lucky to fall under this relationship which is based on respect and understanding of each others needs. It has taken our company over 15 years to develop this relationship, and along with the assemblers help, we have also invested a lot in training our staff up to the level where they can develop the products with the assemblers provided requirements and specifications. Our assemblers have also arranged visits to their Japanese plants and these interactions were good for the development of parts for the domestic market and clients, as our staff were able to get the know-how for the parts'' [Managing Director- C43]

In addition to these governance mechanisms, we also investigated the technology transfer effectiveness in terms of exploratory/exploitative innovations, and the breadth and depth of technological learning.

7.9.1 Exploratory and Exploitative Innovations

Following previous research in this field, we classify innovations into exploratory and exploitative innovations. Exploratory innovations are radical innovations that are designed to satisfy the needs of emerging markets and customers (Benner and Tushman, 2003:243; Danneels, 2002). These innovations offer new designs, create new markets, and develop new channels of distribution (Abernathy and Clark, 1985). These types of innovation require new knowledge or departure from the existing knowledge base (Benner and Tushman, 2003; McGrath, 2001; Levinthal and March, 1993).

On the other hand, exploitative innovations are incremental innovations and are developed and designed keeping in mind the needs and requirements of existing customers or markets (Benner and Tushman, 2003:243; Daneels, 2002). Several scholars, for example, (Abernathy and Clark (1985; Benner and Tushman, 2003; Levinthal and March, 1993; Lewin *et al*., 1999) have suggested that these types of innovation broaden the scope of existing knowledge and skills, expand existing products and services, improve current designs, and also increase the efficiency of existing distribution channels.

Interviews with the component suppliers' managers indicated that the transferred technology has helped only a few suppliers in developing their exploratory innovations capability. Only

4% (suppliers 15 &19), of the interviewed component suppliers have been engaged in exploratory innovations in terms of exploring opportunities in international markets.

As one of the component supplier's Export managers stated:

> ''We have very personal relations with the assemblers and I think close connection matters a lot to receive any technological assistance. We have also invested a lot in improving the skills of our engineers and we encourage our engineers to utilise company resources for their training needs. As you can see, currently we have some automotive experts from Germany and Switzerland providing localised training to our engineers and this is an on-going activity in our firm. Our company also sent engineers to Japan so they can work with the Japanese engineers to build up their knowledge and moreover we have close associations with the government run training centres, this is all part of our company culture to build a good base in developing components for our domestic clients and finding the opportunity in the international market, as you can see I am in charge of the department whose sole task is to find customers in the international market and through my personal experience I think we would not have looked at the international market if we did not have the technological support of our clients and our capability to develop the part for the international market '' [Manager Export- C19]

This quote highlights the importance of having both personal ties and the absorptive capacity to benefit from the transferred technology for exploratory innovations.

Out of the 50 suppliers, around 48 (96%), stated that they have not developed new products for the new or emerging markets. The suppliers' managers were of the view that to develop new products for the emerging market or for new customers requires taking risks, and they would need to have the strong support of local institutions and the assemblers. The data suggested that there are several issues related to this, for example, the complex nature of the technology, assemblers' readiness and the capability to transfer the whole package of technology. Strong and close ties, mutual trustworthy relations and, moreover, the individual supplier's willingness to learn and keep investing in human capital and strong local institutional linkages are the key ingredients that component suppliers require to develop this sort of capability.

Our interviewee stated:

> ‘‘We would love to explore new markets, I know, China, India and even Latin America offers good pay back, and these markets are the automotive supply hubs, but we need the complex technology and the readiness and capability of our assemblers matters, as without their willingness we cannot acquire the know-how to develop new parts which can serve the international markets. Though chasing new markets and customers is risky, but the reward is there to be part of that elite suppliers group. So far we have been receiving limited low-medium tech parts technology from our assemblers, and there are no linkages with our local R&D institutions, and I don’t think on the basis of this technology we can even think about serving China and India which are becoming lucrative auto supply markets’’. [Director - Planning and Development- C10]

> ‘‘Since our assemblers are interested in procuring standard low-medium tech parts from us and we don’t have central position with our assemblers network and the level of trust is very low. We, the suppliers’ community feel that our assemblers don’t want to help us with high tech, complex part technology and our institution’s support is also missing. In this situation, we cannot clap with one hand, we need the on-going assistance of the assemblers and government to develop the capability, and then we can start thinking about the international customers and markets’’. [President- C16]

> ‘‘We cannot think about designing new parts for the new customers or foreign markets on the basis of the documents and drawings which we have been receiving from our assemblers. To be frank, I think the package of technology will be the key to start thinking about designing the new parts. The technology which the assemblers are transferring is not enough to start the production of new parts for foreign markets. With the current level of interactions and the type of technology which we have received mainly in the forms of documents our firm is not there to serve the foreign market’’. [Deputy Manager Planning & Development- C25]

Therefore, it is clear from the data that the majority of suppliers are not involved in exploratory innovation, and hence they (suppliers) view that the transferred technology is not effective, in terms of upgrading the suppliers’ exploratory innovative capabilities and most of them are confined to the local market.

However, out of 50 suppliers, 26 (52%), stated that they have improved existing products for the local market or local assemblers through the help of their clients (assemblers).

The suppliers who have launched improved products for their existing customers have close social ties (for example suppliers #2, 15, 19, 37, 45, 47), and established trustworthy relationships with their assemblers. On this basis, assemblers from time to time provide them with assistance to improve the quality and efficiency of their products. The interview data also suggests that ongoing **assemblers initiated** product-related problem solving discussions and dialogue was helpful to develop the suppliers' capacity to work on improving the existing products for the local assemblers and local markets. The suppliers' managers pointed out that assemblers' willingness to assist their suppliers is very important and, moreover, suppliers need to have in-house capabilities to further improve the products for their assemblers.

Our interviewees stated:

> ''In my view, to improve the quality of the existing products or to bring in the small changes which will help our clients in their newer car model, long-term personal relations are important. In our case all the small improvements to our existing products were completed with the on-going assistance of our client. We feel that local training institutions for skills building are also important, but in our country the local institutional knowledge development support is missing, so we cannot really rely on the local training centres, we have to develop close mutual relationships with our assemblers'' [President- C02]

> ''We have been up-grading our existing products for the domestic market and these small changes are ongoing with the help of our clients. I can tell you that personal informal relationships have been useful for our company to improve the products feature and quality with the help and support of our clients, but the suppliers' capability also matters. I mean the assembler can assist you through problem solving and discussion, but you have to have in-house capable staff who can quickly get on with the task, so in our case our technical capability has also helped us along with the assistance of the clients for improving our products'' [Deputy Director, Supply Chain- C19].

> ''Even to improve or refine current stock of product portfolio, as a supplier firm, I need to have a good beneficial relationship with my assemblers. As long as my assemblers are looking after me and treating me fairly and providing quality feedback and assistance to improve products for them (assemblers), we have the skills to do the good job for them, I mean the clients. Our company has improved

> many parts with the assistance of our client, I know this would not have happened without the close relationship and trust of the both parties'' [Manager, Quality Planning- C45]

The data also suggests that the more social, personal relationships and trust the suppliers have with their assemblers, the more helpful they were to bring small adaptations to current products for the local market and local assemblers.

One of the respondents suggested:

> ''At the end of the day, personal relationships matter with the assemblers. Without their (the assemblers) support, we cannot improve our current products or even launch the new ones. Through the close personal relationships, we have been lucky to improve the current products and in some case we have also received some know-how from our clients, though this is still related to the low-medium tech parts, but it has helped us to improve the performance of our existing products for our clients (assemblers). I can also tell you through our experiences that along with the help of the assemblers, suppliers' in-house capabilities matter as well'' [Planning Manager- C47]

It becomes clear that the durability of the relationship with the assemblers is also a key to improving the existing products. The suppliers' managers pointed out that having long-term links with the assemblers was useful for their firms to get assistance from the assemblers.

The component suppliers' managers also pointed out that since the transferred technology is mainly explicit, it has also helped them to quickly understand the technology, and apply it for the improvement of the current products.

Interviews with the assemblers also indicated that the quality and functionality of components procured from local suppliers have increased over the last few years. The respondents from the assemblers' side suggested that even minor changes and adaptations were a direct result of the technological support and assistance provided to the local suppliers.

As one of the auto assembler's Managing Directors said:

> ''We have noticed that local (Pakistani) components suppliers are gradually improving their functionality and quality and it is good for us and other assemblers, because after all to stay the market leader you have to have quality products. I can give you an example of propeller shaft and wiper, though these are not very technological sophisticated parts, when we started procuring it from our local suppliers, there were quality and performance related issues, but now these parts are the improved versions of old parts, and these and many other components' quality and changes have achieved through our assistance and our product improvement initiated dialogue with the local suppliers, but moreover the improvements of components quality and functionality have also resulted through local suppliers' efforts to understand the problem and act upon the solution provided to them through our technology support services'' [Managing Director-A01]

The above interview highlights the role of a customer-initiated problem solving initiatives in exploitative innovations, and moreover, the role of the recipients to learn and improve the component.

However, our data also shows that some of the suppliers, for example, suppliers # 17, 18, 21 appear to be engaged in exploitative innovations and these improvements/upgrading activities are based on their own in-house learning efforts, rather than through social ties with their clients (assemblers), which seem to be non-existent. This is also shows that the recipient's absorptive capacity is important.

The table below shows technology transfer effectiveness in terms of exploratory and exploitative innovations.

Table 7.10

Technology transfer effectiveness from assemblers to component suppliers (50 Suppliers)- Exploratory and Exploitative Innovations

Technology transfer effectiveness in terms of:	**Yes**	**No**	**No Response**
1. Exploratory Innovations			
Technology transfer resulted in:			
(a) In the last 1-2 years, have your firm designed new parts for the new customers or emerging markets	0	47 (94%)	3 (6%)
(b) On the basis of the technology that your firm has received from your assemblers, has this resulted in opening up new markets	0	45 (90%)	5 (10%)
(c) Has technology transfer resulted in the introduction of a new generation of products	0	49 (98%)	1 (2%)
(d) Has technology transfer resulted in extending the product range for new customers or emerging markets	0	44 (88%)	6 (12%)
(e) Has your firm invented new products and	0	48 (96%)	2 (4%)
services	2 (4%)	46 (92%)	2 (4%)
(f) Has your firm frequently utilised new opportunities in new markets	0	45 (90%)	5 (10%)
(g) Has your firm commercialised products that are completely new to your firm			
2. Exploitative Innovations			
Technology transfer resulted in:			
(a) In the last 1-2 years, has your firm introduced or improved existing products for your local assemblers or local market	26 (52%)	20 (40%)	4 (8%)
(b) Has technology transfer resulted in improving the existing products' quality	30 (60%)	12 (24%)	8 (16%)
(c) Improved production flexibility	28 (56%)	21 (42%)	1 (2%)
(d) We frequently refine the provision of existing products.	26 (52%)	17 (34%)	7 (14%)
(e) We regularly implement small adaptations to existing products.	29 (58%)	16 (32%)	5 (10%)
(f) We improve our provision of efficiency of products	33 (66%)	10 (20%)	7 (14%)
(g) We increase economies of scales in our local market	27 (54%)	18 (36%)	5 (10%)
(h) We expand products for our existing clients	24 (48%)	20 (40%)	6 (12%)

Source: Author's survey

Table 7.10 shows that around 99% of the component suppliers are not engaged in any way with exploratory innovation. The table also shows that about 99% of suppliers' view that technology transfer from assemblers to suppliers has not resulted in opening up new markets for them, and, moreover, the transferred technology has also not resulted in launching new generations of products. Therefore, in terms of exploratory innovation, we can say that the transferred technology was not effective. However, there are only 2 or 4% of suppliers who are frequently utilising new opportunities in new markets. Our qualitative data suggests that the 4% of suppliers have developed personalised ties with the assemblers' managers and have also invested in their absorptive capacities (C15 & C19).

In terms of exploitative types of innovation, about 52% of the suppliers are engaged in exploitative types of innovation with the help of their assemblers. About 60% of the suppliers view that transferred technology resulted in improving the quality of their existing products, as assemblers provide quality related training to suppliers' staff. Hence, in terms of exploitative innovations, the transferred technology was effective.

The next section deals with the breadth and depth of technological learning by the component suppliers from their auto assemblers.

7.9.2 Breadth and depth of technological learning

The technology transfer effectiveness from IJVs to their Pakistani components suppliers in terms of breath and depth (Zahra *et al*., 2000) of technological learning was also investigated. Breadth of technological learning refers to the multiple areas in which a firm learns new technological skills (Teece, Rumelt, Dosi, & Winter, 1994), whereas depth of technological learning denotes a firm gaining mastery of new technological knowledge, evidenced by the acquiring firm's ability to draw new conclusions and find new links amongst diverse technological knowledge bases (Huber, 1991).

Out of the 50 suppliers, 37 (74%), indicated that they have acquired only narrow and limited technological learning from their assemblers. The suppliers' managers expressed that since the assemblers are only providing them with basic technology in the form of documents and drawings, the suppliers have acquired only very narrow technological learning in terms of designing new products and processes. The data also suggests that assemblers' on-going assistance and readiness to assist the suppliers are important ingredients for the broad learning to take place.

Our interviewees stated:

> ''Since we are getting very limited low-medium tech parts technology from our assemblers and on the basis of this technology we have developed an ok part for our client. Still we don't know how to design the new products, because we have not received this know-how from our clients. I feel we are also isolated within the network, if we have strong connection within the entire network then we will be able to get insights into designing new products and processes'' [Assistant Manager, Product development- C13]

> ''We have received a little bit of technological knowledge from our clients and as long as our clients don't transfer the entire technological package, I have doubts that we can broaden our base. If I have to rate the learning which we have gained from our assembler, I would say it is very little on a 1-5 scale'' [CEO –C20]

> ''I can tell you that the transferred technology has not helped us much in terms of manufacturing new products, we still lack this critical know-how. If the assemblers can help us in transferring the manufacturing know-how, our capabilities can go up and we will be able to stand among the top suppliers. As long as this know-how is missing, we are still at the bottom of the ladder, and our knowledge base will remained narrow'' [Director, Planning and Operations-C46]

From the data it appears that the transferred technology from assemblers to suppliers has resulted in suppliers developing basic and shallow technological learning capabilities in terms of designing new products and processes. The interview data suggests that assemblers are only willing to transfer the standard low-medium tech parts technology and this has resulted in the development of only the very basic capabilities amongst suppliers. The data also indicated that part of the reason for the development of this basic and shallow type of technological learning is that there is no support from local institutions and assemblers who only offer limited, short-term help to Pakistan's component suppliers.

Our interviewees suggested:

> ''As an owner I want to see my company develop advanced and much deeper understanding about the way a particular product is designed or even a process is set up and designed, but to develop this capability we need the support from our assemblers their top suppliers and of course the local training institutions help is also important. When we can combine the diverse and variety of ideas then we can be able to develop much advanced capability. In our country, assemblers are not interested in helping us (local suppliers) to develop the advanced capabilities and within the network the support for learning is also missing'' [President-C29]

> ''We have not mastered the design or how to manufacture a new part, because the assemblers are only interested in standard part and for these parts we have the basic capabilities to develop the part. Assemblers have not transferred the design know-how and the local institutions help is also very weak. We need the support of all these actors to develop the capacity and then we will be in a position to develop high precision parts for the foreign markets as well. I believe that personal association with assemblers and their top suppliers and training institutes are helpful in developing the advanced capabilities'' [Marketing Manager- C23]

> ''We have been stuck in the local market, because the transferred technology has only helped us in developing elementary skills which are only useful when you are selling the parts in the local market. I must say that on the basis of the received technology, we have not developed an advanced knowledge base and also we have non-existent linkages with our universities and R&D centres. The institutional set-up is also not helpful in gaining the advanced learning, and in our country there is low emphasis on R&D'' [Director Technical – C34]

> ''You have to be upwardly mobile and having close interactions with your assemblers, local institutions and global suppliers are all helpful to advance your knowledge base and thinking. As you can see we have started exporting the parts to Middle East, this has all come along through the close collaboration of our clients and my visits to Japan and attending other exhibitions abroad and it was through these visits and observing the processes personally that has helped my company to think out of the box'' [Chairman- C02]

The data indicated that long-term relationships based on mutual trust, the willingness of the assemblers to help the local suppliers and personal ties are helpful for developing advanced capabilities in designing new products and even processes. The data also shows that suppliers' in-house efforts are also important for taking advantage of the transferred technology and to develop deeper learning.

As one of the component supplier's Operations managers indicated:

> ''We have been investing in our engineering and design skills and our clients do view us as their preferred vendor (supplier), because we provide them with critical parts such as brake drums and AC. So our client has helped us in bit of both explicit and tacit know-how. Our on-going engagement with the clients was very useful for broadening our engineers' skills and thinking. Therefore, I must say that the receipt of this technology has helped our company'' [Manager Operations C-38]

The table below shows technology transfer effectiveness in terms of breadth and depth of technological learning. A scale of 1 to 5 was used to capture the suppliers' managers' responses on breadth and depth of technological learning.

It was explained to the respondents that 5 would mean that you believe your firm has learned broad/deep skills in a given area. A score of 1 would mean that your firm has learned only a few/shallow (or a narrow/ limited number of) skills in a particular area from Pakistan's auto assemblers.

Table 7.11

Technology transfer effectiveness from assemblers to component suppliers (50 Suppliers)- Breadth and Depth of Learning

Technology transfer effectiveness in terms of:	Narrow	Broad	No Response
Breadth of technological learning			
What extent your company has gained knowledge and new insights, or learned skills or capabilities from your clients (assemblers) in:			
(a) designing new products/processes	37 (74%)	9 (18%)	4 (8%)
(b) prototyping new products/processes	34 (68%)	11 (22%)	5 (10%)
(b) Timing new product/processes introduction	28(56%)	20 (40%)	2 (4%)
(c) Sequencing new product/processes	31 (62%)	18 (36%)	1 (2%)
(d) Customising products for local market	39 (78%)	11 (22%)	0
(e) Manufacturing	44 (88%)	2 (4%)	4 (8%)
(f) Organising the R&D function	43(86%)	7 (14%)	0
(g) Staffing the R&D function	38 (76%)	12 (24%)	0
(h) Determining R&D spending level	42(84%)	2 (4%)	4 (8%)
(i) Managing the R&D process	48 (96%)	2 (4%)	0
(j) Co-ordinating R&D with other organisational units (functions)	46 (92%)	4 (8%)	0
Depth of technological learning	**Shallow**	**Deep**	
How well (depth and quality) your company has learned or mastered new skills from your assemblers in each of the areas listed below:			
(a) Designing new products/processes	47 (94%)	3 (6%)	0
(b) Prototyping new products/processes	39 (78%)	9 (18%)	2 (4%)
(b) Timing new product/processes introduction	32 (64%)	16 (32%)	2 (8%)
(c) Sequencing new product/processes	36 (72%)	14 (28%)	0
(d) Customising products for local market	37 (74%)	9 (18%)	4 (8%)
(e) Manufacturing	47 (94%)	3 (6%)	0
(f) Organising the R&D function	46 (92%)	1 (2%)	3 (6%)
(g) Staffing the R&D function	41 (82%)	8 (16%)	1 (2%)
(h) Determining R&D spending level	44 (88%)	3 (6%)	3 (6%)
(i) Managing the R&D process	46 (92%	1 (2%)	3 (6%)
(j) Co-ordinating R&D with other organisational units (functions)	49 (98%)	1 (2%)	5 (10%)

Source: Author's survey (based on Zahra et al.2001)

In table 7.11, we have presented the results of the survey questionnaire about the breadth and depth of technological learning. As the results show, around 74% of the suppliers have gained only a few skills, or capabilities, in the area of designing new products and processes. Another 18% of the suppliers reported to have gained knowledge or new insights in the area of designing new products and processes from the assemblers. Around 68% of the suppliers reported that the transferred technology has resulted in their firm developing very few or narrow knowledge/insights in prototyping new products and processes, or timing the introduction of new products and processes.

Furthermore, over 80% of the suppliers indicated that they have gained a narrow or limited new skill or capability from their assemblers in regard to organising the R&D function and other R&D related activities, for example, staffing, managing the R&D process or even co-ordinating the R&D with other units within their organisations. Hence, we can say that the breadth of the transferred technology is very narrow, limited and general.

In terms of the depth of technological learning, over 90% of the component suppliers reported that transferred technology was not effective in terms of developing the deep and advanced capabilities of the local suppliers, and in fact have resulted in shallow capabilities. Around 6% of the suppliers reported to have gained deep and advanced knowledge, skills and capabilities from their assemblers, in regard to the designing and prototyping of new products and process.

Data analysis suggests that these 6% (including components suppliers #15, 19 &37) have developed personalised ties with the auto assemblers' managers and have invested in their employees' absorptive capacity through in-house efforts and strategic linkages with the government- run training centres. The interview data also indicates that the owners/managers of these component suppliers are outwardly mobile and have been attending various world level trade fairs, for example, Hannover Messe, Germany, Euro Mold, France, and have also been bringing foreign auto experts from Germany and Switzerland to their firms for their training needs.

In addition, over 90% of the suppliers indicated that they have not gained the deep and advanced technological knowledge in manufacturing new products or even organising the R&D function with staff from their assemblers.

Therefore, the survey results indicate and support the interview findings that the depth of the transferred technology is limited to the basic and shallow capability gained by the local component suppliers from assemblers, even though, some of the suppliers have close social ties with the assemblers. This finding suggests that social ties are ineffective where there is already a limited in-house technological capability present.

7.10 Comparative Multidimensional Matrix

This section discusses the comparative multidimensional data across three assemblers to provide more robust findings. The data is tabulated on various dimensions for example, learning intent, social ties, trust, absorptive, senders' willingness to transfer technology, etc. to see the key similarities and differences across sample suppliers. Table 7.12 shows the comparative analysis and table 7.13 provides important insights about the important factors for the technology transfer effectiveness.

Table 7.12

Comparative multidimensional matrix across three assemblers

Dimensions/variables	Supply to Honda (N= 10)	Supply to Toyota (N= 13)	Supply to Suzuki (N= 15)	Supply to Honda, Toyota and Suzuki (N= 12)
Learning Intent				
Low	20%	12%	20%	8%
High	80%	88%	80%	92%
Trust				
Low	85%	12%	17%	4%
High	15%	88%	83%	96%
Social ties				
Low	79%	15%	13%	8%
High	21%	85%	87%	92%
Absorptive capacity				
Low	83%	65%	62%	42%
High	17%	35%	38%	58%
Package of technology received				
Yes	0	0	0	2%
No	100%	100%	100%	98%
Assemblers' willingness to transfer technology				
Low complexity components	95%	88%	70%	62%
Medium complexity components	5%	12%	30%	38%
High complexity components	0	0	0	0
Institutional support				
Low	100%	100%	97%	88%
high	n/a	n/a	3%	12%
Parts localised	10-25%	25-35%	40-60%	n/a

Source: author's interview and survey data

Table 7.12 shows comparative data analysis across three assemblers. It is evident from this analysis that learning intent is high across three assemblers which suggest that regardless of the assembler, suppliers show high level of learning intent. Suppliers who supply to more than one assemblers even show much higher learning intent which indicate that supplying to multiple clients does enhance the learning intent of the recipients because of the diverse knowledge available through interacting with multiple clients. Trust and social ties are two important dimensions which are important for the receipt of technology and Honda's suppliers show low level of trust and social ties compared to Toyota and Suzuki. This finding is not surprising as it is also clear from the table that only 10-25% of Honda's parts are localised and Honda entered in the market in the late 1990s, so it is not well embedded in the Pakistani market. Absorptive capacity is low across three assemblers, however, those suppliers who supply to more than one assembler show high level of absorptive capacity which indicate that it is not a firm level construct rather a multidimensional construct.

Assemblers' willingness to transfer low to medium complexity parts technology is evident across three assemblers which suggests that three assemblers are willing to transfer low-medium complexity parts technology to their Pakistani suppliers. The table also shows that institutional supports available to suppliers are also low regardless of the assembler. The comparative data shows that Suzuki has more parts localized compared to Honda and Toyota, however, no assembler has transferred technology for the high complexity parts technology. Table 7.13 shows the important factors which were reported by the suppliers.

Table 7.13

Important factors for technology transfer effectiveness across suppliers (n=50)

Factors	Very important	Not important	Illustrative quotes
Learning intent	92%	8%	''as you know, in order for us to learn our partner's technology we have to have strong commitment of learning and dedicated resources to utilise this technology.''
Absorptive capacity	98%	2%	''even if my client (assembler) transfers simple techniques and technology, there is no use of this technology within my firm, if we don't have the capability, commitment to receive and learn this technology.''
Trust	95%	5%	''you share knowledge or secret with your close associates who you know will not turn their back on you.''
Social ties	98%	2%	''we have realised that these personal connections are important to receive technology and it is basically calling the person in your inner circle to discuss if you are facing any problem and receiving the timely feedback.''
Senders willingness to transfer technology	100%	n/a	''the client does provide us with technology for medium and low tech products; … for the advanced high tech parts technology they are reluctant to pass on this knowledge.'' ''We would love to explore new markets, I know, China, India and even Latin America offers good pay back, and these markets are the automotive supply hubs, but we need the complex technology and the readiness and capability of our assemblers matters, as without their willingness we cannot acquire the know-how.''

(Continued)

Table 7.13 (Continued)

Important factors for technology transfer effectiveness across suppliers (n=50)

Factors	Very important	Not important	Illustrative quotes
Package of technology (product, process and managerial technology)	100%	n/a	‘‘we want to get the whole package of technology and develop state of the art product which we can export or provide to other global automakers.’’
Governance mechanisms	99%	1%	‘‘to launch state-of- the-art products for this market (Pakistan) or to develop new parts for the foreign market we need to have strong two way relationships based on mutual understandings and sharing the benefits.’’ ‘‘We have very personal relations with the assemblers and I think close connection matters a lot to receive any technological assistance

Note: 1-5 scale 1= not important; 5= very important

Table 7.13 shows the important factors for technology transfer effectiveness reported by the sample suppliers along with illustrative quotes. It is evident that senders' willingness to transfer technology, package of technology consisting of product, process and managerial technology, governance mechanisms, social ties, absorptive capacity and trust are considered to be very important factors for technology transfer effectiveness. These factors are rated >95% of the suppliers which indicate the importance of these factors for technology transfer effectiveness.

Conclusion

In this chapter, we have presented in-depth qualitative interview findings, with survey questionnaires, to get an insight into the process of technology transfer from three international joint ventures (IJVs) established in the automotive industry of Pakistan, to their local Pakistani component suppliers. Our aim was to gain an overall picture of technology transfer effectiveness from the three auto assemblers to their component suppliers.

In regard to the process of technology transfer, our results pointed out that technology transfer processes from the assemblers to their Pakistani component suppliers consists of three stages of technology transfer, with each stage having distinct phases.

In terms of the type of technology transfer, we were interested to find out three main types of technology: product-related, process-related and managerial technology, to develop an understanding about which type of technology is being transferred most frequently. Our qualitative interviews and survey questionnaires indicated that local Pakistani component suppliers have been receiving product-related technology more often than process and managerial-related technology.

Another important finding that emerged was that assemblers have not transferred the whole package of technology consisting of product, process and managerial technology. Our data also indicated that the whole package of technology is very important for becoming a part of the global value network.

The assemblers are very selective in terms of the type of technology transfer to their Pakistani component suppliers. Their decision to transfer the low-medium and high complexity parts technology depends on the nature of the relationship the assemblers have with their component suppliers, and supplier’s technological capabilities.

Assemblers used various mechanisms, for example, on the job training (OJT), seminars and conferencing to transfer the technology to their local suppliers. The results show that the usefulness of these mechanisms depends on the type of mechanism being used. The results also show that the supplier's view of on the job training is an important mechanism for the technology transfer.

Senders' (assemblers') willingness to transfer technology is an important factor that affects technology transfer and its effectiveness. Previous research has paid more attention to the recipient's ability to learn and absorb the transferred technology, whereas our findings suggest that the sender's willingness is also critical for the transfer of the technology to take place. Our data suggests that in the case of Pakistan's component suppliers, the assemblers were reluctant to transfer the high complex parts technology to their local suppliers. There were various reasons behind this, for example, the size of the local market, the issue of the local suppliers' absorptive capacity, and the strategic decision making and component-related technology.

The data also indicate that recipient's related factors such as recipient's learning intent and absorptive capacity as important variables that affect technology transfer. In the case of the learning intention and absorptive capacity, we noticed that some, but not all, of the suppliers have dedicated organisational resources to take advantage of transferred technology. Our data also suggested that the development of absorptive capacity depends on not only the recipients' suppliers, but also the assemblers and local institutional arrangements.

Inter-organisational dynamics in the form of trust and social ties also influence the technology transfer and its effectiveness. In the case of Pakistan's suppliers, our data indicated that there is a low level of trust between the suppliers and their assemblers. The suppliers feel that their assemblers are not treating them fairly and providing low to minimum assistance in terms of technology transfer. The data also suggests that social relations are important conduits for technology transfer and having close relations with the assemblers often helps suppliers to receive technology.

Technology transfer effectiveness was hindered because of the various governance mechanisms that assemblers have put in place. The assemblers induced differentiation and diversities of suppliers are two important determinants of technology transfer effectiveness. The nature of relationships was found to be important for the technology transfer to be effective, and social ties were effective in cases where the suppliers already have in-house absorptive capacity. The data also suggested that the overall technology transfer was not effective, because suppliers have developed only exploitative innovative capabilities, and the breadth and depth of technological learning was also narrow and basic.

CHAPTER 8: DISCUSSION

Introduction

In chapter 7, we have presented the results of the qualitative and survey methodologies. The aim of this chapter is to present the discussion of the findings in the light of the literature reviewed in chapters three and four. Through a qualitative, and supplemented with a questionnaire survey methodology approach, this research has focused on technology transfer effectiveness from international joint ventures (IJVs) established in the automotive industry of Pakistan to their Pakistani component suppliers.

The purpose of this research was to apply the knowledge based view of the firm, the resource-based view of the firm, organisational learning and social capital theories to investigate technology transfer effectiveness in the automotive industry of Pakistan. In so doing, this research has examined the process of technology transfer, factors related to the senders of the technology, characteristics of technological knowledge, the type of technology transferred, transfer mechanisms, factors related to the recipients of technology and relational capital in the forms of trust and social ties, and technology transfer effectiveness. It was motivated by the need to develop an overall understanding of technology transfer effectiveness from international joint ventures to their Pakistani component suppliers, as previous studies have not looked at technology transfer effectiveness from international joint ventures to their component suppliers.

The following discussion of the results of this study as summarised in table 7.1 will:

(1) recap the main findings of this research by highlighting the process of technology transfer;

(2) outline the types of technology transfer;

(3) discuss transfer mechanisms adopted and their usefulness;

(4) show the willingness of the sender to transfer technology;

(5) discuss the role of the recipient's learning intent;

(6) discuss the role of the recipient's absorptive capacity in technology transfer;

(7) discuss the role of trust in technology transfer;

(8) explore the role of social ties;

(9) highlight technology transfer effectiveness.

The remainder of the chapter is organized per research question.

8.1 Technology transfer process

The results indicate that technology transfer is an on-going process consisting of three stages. The technology transfer process moved from the qualifying stage, through the evaluative to the interactive stage. The three stages that we identified in our results are, to some extent, similar to the intra-firm best practice transfer of Szulanski (1996), Szulanski (2000), and Bresnan *et al.* (1999), study of technological knowledge transfer in international acquisitions. Our results show three phases of technology transfer, whereas Szulanski (1996, 2000) found four stages of intra-firm best practice transfer and Bresnan *et al*. (1999) found two stages of technology transfer in international acquisitions. The reason behind this finding might be that the technology transfer process phases vary from industry to industry, and it also depends on the type of technology being transferred. However, in this study these three phases represent the complete transfer of technology from the start of the relationship to the on-going transfer.

Unlike Szulanski (1996, 2000:13), we did not find any evidence of initiation 'stickiness' in our findings. The reason for this finding can be attributed to the fact that IJVs established in the automotive industry in Pakistan are very clear about the market and the components they want to procure, so the auto assemblers have recognised the opportunity to transfer the technology to their Pakistani component suppliers.

Table 8.1

Summary and Overview of the Findings

Main Findings	Managerial and Practical implications	Research implications
<u>Technology transfer process:</u> Technology transfer is an ongoing process and has distinct phases within each stage of the transfer process. IJVs can also act as mediators and facilitators (boundary spanners) of technology by linking up the local component suppliers with their global first tier suppliers. Relational ties are important conduits for the technology transfer to take place and these ties are developed at the latter stages of technology transfer process	To transfer and receive technology, be cognisant of the stages of the transfer process and of its distinct phases within each stage. MNCs social capital should be widely utilised to gain access to the network stock of technological knowledge	The distinct phases within each stage of the transfer process needs to be formally recognised and investigated in future research, as well as the role of the MNCs as a mediators and facilitators of technology transfer.
<u>Type of technology transferred:</u> Advanced package of technology, i.e. product, process and managerial is rarely transferred, and whole package is important to enter in the global value chain	To receive the whole package of technology, relational and collaborative ties need to be strengthened and continuously developed	There is a need to integrate the whole package of technology in future research rather than investigating a single type of technology transfer and exploring the reluctance of firms to transfer the whole package
<u>Senders willingness to transfer technology:</u> Sender's willingness and motivation to transfer technology is one of the most important factors behind the successful transfer of technology. The senders' willingness to transfer technology depends more on their intrinsic and extrinsic	To receive tacit technology, technology sharing incentives should be built with the sender of the technology. Long- term trust and collaboration should be developed with the sender of the technology	Future studies should empirically investigate the size of the market, component related technology, competitive pressure and strategic decision-making as main factors for the sender of the

Main Findings	Managerial and Practical implications	Research implications
motivations than anything else. The main variables influencing the decision of senders to transfer technology were: size of the market, component-related technology, strategic decision making, competitive pressure and nature of knowledge, i.e. teachable and complex.		technology to transfer complex technology. The size of the market needs to be formally recognized as one of the important variables behind the decision to transfer technology.
Mechanisms for technology transfer: Main mechanisms used to transfer technology were multiple, i.e. face to face meetings, documents, engineers transfer, on-the-Job trainings (OJT), seminars, vendor conferences and overseas correspondence. Face to face meetings, documents, on-the –Job training and overseas correspondence were noticed to be useful mechanism of technology transfer compared to seminars and vendor conferences. Mainly explicit-teachable forms of technology were transferred through these mechanisms. IJVs don't transfer their engineers to their Pakistani component supplier's site.	To receive tacit, complex technology multiple mechanisms should be encouraged, promoted and widely used. Engineers transferred should be encouraged and asked for, as they carry context specific technological knowledge.	There is a need to look at these various mechanisms of technology transfer and the amount of technology received through each of these mechanisms. Future studies should pay more attention to informal mechanisms of technology transfer, i.e. overseas correspondence as a useful way of receiving technology.
Trust: Trustworthy relationships were found be important for the transfer of technology to take place. Levels of assistance provided by the assemblers were considered an important conduit for building trust. Informal commitment and social relationships were also indicators of developing trust	Focus on ways to improve trust by creating shared visions and investing in social relationships, i.e. strong managerial ties to gain technological know-how. Personnel transfer and employees interactions should be encouraged and facilitated for trust building.	Future studies should investigate trust and trust building at an institutional level, and the role of the informal commitment and technology transfer warrants further empirical attention

Main Findings	Managerial and Practical implications	Research implications
between the assemblers and their Pakistani component suppliers. Having trust between the assemblers and suppliers will not necessarily lead to the transfer of know-how.		
Social ties: Social ties and personal connections are important for technology transfer and its effectiveness. Low social interactions transferred explicit technology in the forms of documents. Social ties are only effective in cases where there is already some in-house technological capability present	Strong personal connections should be developed and promoted by attending social functions/trips. Inter-organisational communication mechanisms should also be enhanced and developed for building personal connections and receiving technological know-how	Strong vs. low social connections and their role along with the characteristics of technological knowledge transfer needs further scrutiny.
Recipients learning intent: Recipients learning intent- in the form of commitment of physical, organisational and human resources were found to be important factors for the effective transfer of technology	Proper resource allocations and emphasis on training encouraged employees learning intent, and hence effective technology transfer. Strong recipients' learning intent will also encourage the sender of the technology to transfer technology	Commitment of resources and the amount of technology learned and integrated needs further empirical investigation.
Recipients' absorptive capacity: Recipients' absorptive capacity is also important for the technology transfer to take place. There are three main actors for the development of recipients' absorptive capacity- The local supplier itself, local government and senders of technology. All three can play their role in developing the absorptive capacity of	Development of absorptive capacity is important and local institutional linkages should be encouraged and sought with the help of government. Joint training and R&D programs should be developed with local R&D institutions through the support of public-private partnerships (PPPs)	The interplay of three actors, senders of technology, recipients and government in developing the absorptive capacity of the recipients and the development of different types of absorptive capacity through the joint efforts of the three actors given above

Main Findings	Managerial and Practical implications	Research implications
the recipients. It was found that local suppliers have received little help and assistance both from the senders (auto assemblers) of the technology and the Government of Pakistan in developing their necessary absorptive capacity. Also sender and recipients have different perceptions about the recipients' absorptive capacity. Lack of absorptive capacity was linked to no assistance from the senders to low level of linkages with local Pakistani institutions		needs to be incorporated in future studies. The construct should not be limited only to the recipients, but the role of other actors should be acknowledged and empirically investigated.
<u>Technology transfer effectiveness:</u> Technology transfer effectiveness matters along the value chain. Different governance mechanisms have different implications for technology transfer and its effectiveness. Contractual /Commercial technical relationships hinder technology transfer and its effectiveness in terms of exploitative/exploratory innovations, breadth and depth of technological learning. Strong support of the assemblers and institution along with recipients' technological capability matters for exploratory innovations. Informal ties with the assemblers, and assemblers initiated problem solving discussions were helpful for exploitative innovations. Durability of the relationship with the assemblers is important for exploitative	Collaborative ties with the assemblers and local institutions should be developed and enhanced for developing exploratory and exploitative innovations, breadth and depth of technological learning. Long-term relationships should be sustained with the sender's the technology	Benefits of having more ties to local institutions and senders of technology, along with different governance mechanisms and their implications for technology transfer effectiveness needs further empirical attention. The exact nature of the governance mechanisms, diversity of suppliers and technology transfer effectiveness calls for further investigation. Instead of viewing technology transfer effectiveness in terms of time, cost and speed, the constructs of exploitative, exploratory innovations, breadth and depth of technological

Main Findings	Managerial and Practical implications	Research implications
innovations. Basic technology in the form of documents and drawings has resulted in narrow technological learning among the Pakistani component suppliers. Assemblers' ongoing assistance and readiness to assist the suppliers were found to be important for the breadth of technological learning. Missing institutional support along with the low level of assistance of assemblers also resulted in basic and shallow (breadth) technological learning. Long-term relationships based on mutual trust, willingness of the assemblers to help and personal ties are important for developing breadth and depth of technological learning and advanced capabilities.		learning needs to be formally recognised and integrated in future studies on technological knowledge transfer effectiveness.

Our results also show that IJVs have been transferring explicit and some tacit technology over the three stages of technology transfer process. The tacit technology was observed during the interactive stage of the technology transfer process. This finding is similar to the study of Bresnan *et al*. (1999), and Duanmu and Fai (2007), who also found that tacit technological knowledge is transferred during the latter stages of the business relationship. The main reason for the lack of tacit technology transfer during the first two stages of the transfer process, in our interpretation, was the lack of close social interaction, communication and personnel transfers from auto assemblers to their component suppliers.

Prior research has suggested that the technology transfer process is facilitated by frequent communication and interaction. Szulanski (1996), suggested that knowledge is even 'sticky' within the boundaries of the firm, the transfer process requires continuous interaction and communication between the sender of the technology and the recipient for a successful transfer to take place.

Sender-recipient interaction and communication appear important during the three stages of the technology transfer process, but the results here indicate that auto assemblers (senders) do not transfer their engineers to their component supplier's plants, and little social interaction took place between the supplier's product development team and the assembler's design engineers. Previous research has shown that personnel movement between organisations can take their tacit knowledge and apply it to the newer context, therefore, transferring technology across firm boundaries (Argote and Ingram, 2000; Song *et al*., 2003).

The findings of this research also indicate that IJVs have acted as facilitators and mediators of technology transfer for the Pakistani component suppliers by linking them with their first tier suppliers in Japan. This result is in contrast to the findings of Duanmu and Fai (2007), Ivarsson and Alvstam (2004, 2005), Dyer and Hatch (2006), Zhao *et al*. (2005), did not point out this mediator and facilitator role of MNCs and particularly that of IJVs in the transfer of technology, by linking their domestic component suppliers with their established network first tier suppliers, based in the developed countries as a key source of technology transfer. For example, the mediator and the facilitator role of IJVs seem critical for initiating the knowledge transfer process between the network members when the knowledge resides with other members of the network:

> ‘‘Our firm has played an important role as a facilitator and mediator of technology transfer to Pakistan-based suppliers. As you can see we have a good business relationship based on mutual trust and durable relationships with our tier one suppliers in Japan and elsewhere in the world. Using our relationship leverage we acted as a facilitator in linking up our local suppliers with our first tier suppliers in Japan…. As you can see without our assistance those first tier suppliers based in Japan were reluctant to transfer technological knowledge to Pakistan-based suppliers’’ [Deputy Manager Supplier’s development - A01]

Our results suggest that relational ties are conduits of technology transfer and these ties developed during the latter stages of the technology transfer process, in this way the parties making the transfer come to know each other gradually. However, our results also indicate that the receipt of tacit technology somehow also depends on relational ties. Several Scholars (e.g., Levin and Cross, 2004; Hansen, 1999; Szulanski, 1996 and Uzi, 1996, 1997), have suggested that relational ties are helpful in the receipt of tacit technology. Our findings confirm these observations, the results of this research point out that some tacit technology transfer is taking place through ties.

Our interviews with the component suppliers suggested that they have been receiving standard forms of technology in the form of documents, drawings and specifications and some tacit technology during the latter stage of the process of technology transfer. Therefore:

Proposition 1a*:* *Technology transfer is an ongoing process consisting of different stages of transfer and each stage has distinct phases in it***.**

Proposition 1b*:* *IJVs role as a mediator and facilitator (boundary spanners) of technology will help the local component suppliers to acquire technology through the network of first tier suppliers.*

Proposition 1c*:* *Relational ties are conduits of tacit technology transfer and these ties are developed at the latter stage of technology transfer process.*

8.2 Type of technology transferred

IJVs established in the automotive industry of Pakistan have been providing more assistance in the area of product-related technology compared to process and management related technologies (See table 7.2). This finding is contrary to the inter-firm study of Sammarra and Biggiero (2008), who found that collaborating partners transfer market, technological and managerial knowledge along the network.

The results of this study also suggest that around 82% of technology transfer has taken place in the area of product-related technology in the form of drawings and product design specifications.

The main reason behind the transfer of product- related technology, in present analysis is that different technologies have different characteristics, i.e. teachable, complex, tacit or explicit. Product-related technology has explicit characteristics compared to management-related technology. Previous studies (Shenkar and Li, 1999; Simonin, 1999; Lane *et al*., 2001) have suggested that managerial and marketing expertise is more tacit than product development and production technology. According to Zander and Kogut (1995), management-related technology is embedded and is not easily codified in formulas or manuals; this also cannot be reverse-engineered. Polanyi (1966), also notes that tacit knowledge is integrative, difficult to communicate and can be inferred in action.

The results of this research also indicate that IJVs established in the automotive industry of Pakistan do not collaborate in research and development with their Pakistani component suppliers, because the three IJVs conduct their R&D in their home country, Japan, and also with their Japanese first tier suppliers. This is in line with the lversson and Alvastam (2004), study on technology transfer from Volvo to Indian suppliers where Volvo did not have any R&D collaboration with the Indian suppliers. This finding is not surprising as three IJVs import most of their parts from established suppliers based in Japan and Thailand.

An interesting finding of this research suggests that there are three main packages of technology consisting of a basic package, an intermediate and an advanced package of technology. This finding is in contrast to the previous studies of Kotabe, *et al*. (2003), Iversson and Alvstam (2005, 2004), Dyer and Hatch (2006), Zhao, *et al*. (2004, 2005), Zhao and Anand (2009), and Duanmu and Fai (2007). The results of this study also indicate that the whole (advanced) package of technology consisting of product, process and management-related technologies is rarely transferred to Pakistani component suppliers, and the whole package of technology is critical for the local component suppliers to move up in the global value chain.

This finding has serious implications for the resource-based and knowledge-based theories of the firm, as they have always portrayed that competitive advantage can only be built on the basis of tacit knowledge; we acknowledge this observation, but with some caution as our finding highlights that a combination of technological knowledge consisting of product, process and management is important in moving up the value chain. The main reason for the importance of the whole package of technology in moving up the value chain, in our interpretation, was that different parts of technological knowledge are interconnected, so in order to improve the product quality, suppliers might also need assistance to improve their processes, and in some instances the management know-how about the working nature of that particular process. Hence, the whole package of technology has more roles to play than an individual technology area, for example, product-related or only process-related technology. Therefore:

> **Proposition 2*:*** *The package of technology is more important than the individual area of technology and the whole package of technology is necessary in moving up the value chain for a developing country suppliers.*

8.3 Senders' willingness to transfer technology

Our findings suggest that senders (auto assemblers) are very selective in transferring different types of technology to their Pakistani suppliers. The research results indicate that assemblers are willing to transfer the low-medium complexity parts technology to their Pakistani component suppliers, and they are reluctant to transfer the high complexity parts technology, such as engines or transmissions.

The data collected through qualitative interviews, and supplemented with questionnaire surveys, suggests that assemblers based in Pakistan are only interested in procuring standard parts from Pakistan's component suppliers, and for these parts the assemblers are willing to transfer the technology (see table 7.4).

The findings of this study also suggest that the sender's (assembler's) decision to transfer a particular technology depends on the type of component, for example, low complexity vs. high complexity. This finding is interesting, as no previous studies have paid attention to the component aspect of technology transfer (Dyer and Hatch, 2006; Zhao *et al*., 2005; Iversson and Alvstam, 2005, 2004; Chung *et al*., 2003; Duanmu and Fai, 2007; Young and Lan, 1997). One reason to transfer the component-based technology can be due to the fact that components may differ in technical complexity, for example, wire harness vs. pistons, or door handle technology compared to engines components. Door handles are a low complexity technological part, whereas engine components are based on high complexity engineering.
Secondly, the global strategic orientation of the firm may also play an important role in keeping certain advanced component technology in the firm's home country to prevent potential entrants of imitating the advanced component technology, or perhaps, auto assemblers do not wish to disrupt their existing global supply chain relationships and therefore, do not want to invest time and money in educating Pakistani component suppliers to learn the technology related to high complex engine or transmission components. Sun *et al*. (2010) also show through a model that choosing a subset of components to transfer, the MNC decision has an impact not only on the fixed entry cost of the imitators, but also on their post entry competition. Sun *et al*. (2010), further contend that the MNCs decision to transfer

component-based technology is based on two different types of strategies:- the *barrier-erecting* strategy and the *market-grabbing* strategy.

It also appears that the decision to transfer the high complex technological parts technology and the whole package of technology depends on the size of the market. This finding is in contrast to previous studies (Sammarra and Biggeiro, 2008; Blalock and Simon, 2009; McDermot and Corredoira, 2010; Lyles and Salk, 1996; Simonin, 2004; Chung *et al*., 2003; Dyer and Hatch, 2006 and Zhao *et al*., 2004, 2005). The consideration of the size of the market is an important and new finding, as previous research has not considered whether size of the market determines the actual transfer of low-medium and high complex technological components technology to the recipient country's firms.

Moreover, this research also highlights that the three (Japanese) auto assemblers in the auto industry of Pakistan enjoy power, control and strategic decision making that is being done in the home country (Japan) of these IJVs, and local managers have no say in decisions whether to transfer the technology. This finding highlights the important role the boundary spanners can play in the technology transfer. Our findings indicate that since the component suppliers' bargaining power is less compared to the assemblers' power and, therefore, due to a weak power position, the suppliers are not receiving high complexity parts technology. This finding supports the view of Wong *et al*. (2007), who found that technology transfer is more likely to occur from the less powerful unit to the more powerful unit. Thus in the case of Pakistani component suppliers, the power of the senders becomes more significant in the sense that they might dictate their terms and condition.

This finding has serious implications for the organisational learning and social capital theories that developing and emerging economies suppliers, due to their reduced bargaining power over the powerful MNCs, can gain limited technology even though these suppliers are part of the network and have a desire to learn the technology. Thus, research on technology transfer from IJVs to their component suppliers needs to address the potential drawbacks of IJVs power in hindering the transfer of high complexity technological parts technology to their suppliers.

The findings of this research suggest that strategic decision-making influences the sender's willingness to transfer technology. In the case of Pakistan's automotive industry, all the strategic decision making from procuring certain parts to transferring the technology rests with the principals who are based in Japan and their decision is important when it comes to transferring the type of technology. This finding is in contrast to the previous studies of (Zhao *et al*., 2005; Kotabe *et al*., 2003, Chung *et al*., 2003; Young and Lan, 1997; Simonin, 2004; Szulanski, 1996; Duanmu and Fai, 2007; Mesquita *et al*., 2008), as these studies did not discuss or highlight the role of strategic decision-making concerning the types of technology transfer to the recipients. Therefore, this finding highlights the important role of the boundary spanners in the process of technology transfer.

Research results also indicate that low competitive pressure in Pakistan's automotive market has resulted in providing an unnecessary monopoly to the three assemblers, and because of low competitive pressure, these three auto assemblers are not transferring any advanced (complex) technological parts technology to their Pakistani component suppliers.

In the FDI spillovers literature, many scholars (Blomstrom and Sjoholm, 1999; Blomstrom and Kokko, 2001), have suggested that competitive pressure from FDI is one potentially important determinant of technology spillovers. Competitive pressure would obviously force the existing players to become more efficient and hence transfer, or reveal, their knowledge to their suppliers. Chung, *et al*. (2003), also suggest that increased competitive pressure in the auto-sector was the main cause of overall productivity improvement, at least during the initial stages of FDI in the 1980s on the US automotive components industry. However, these authors have not linked the role of competitive pressure on senders to transfer different types of technology. Thus, research in the context of technology transfer from IJVs to their component suppliers needs to address the impact of competitive pressure on a sender to transfer technology.

It can also be said that the reason behind the slow transfer of technology from assemblers to their Pakistani component parts suppliers was the non-implementation of various government policies related to the automotive industry. This finding is not surprising, as in the case of Pakistan, a very weak institutional set-up is in place which can hinder technology transfers from senders (assemblers) to their component suppliers. Hatani (2009), suggests that emerging economies possess great market potential, but the transfer of technology is intercepted by underdeveloped institutions and biased regulations. In the case of Pakistan's automotive industry, during the past 30 years, there have been inconsistent government policies for the auto industry.

Present study also indicates that senders' (assemblers') reluctance to transfer certain component technology was one of the significant factors behind the slow transfer of technology. Szulanski (1996), empirically investigated the lack of willingness on the part of both the source and the recipient. Szulanski found neither the willingness of the recipient, nor the willingness of the sender, particularly influential in explaining knowledge transfer. Others have theorised and found a positive relationship between senders' willingness and technology transfer (Argote 1999; Simonin, 1999; Minbaeva and Michailova, 2004; Young and Lan, 1997; Ko *et al*., 2005). Some scholars have argued that these mixed findings may be a result of failing to consider the differential effects of intrinsic and extrinsic motivation on technology transfer (Osterloh and Frey 2000).

Hence, senders' willingness to transfer technology contributes positively to the previous mixed findings relating to the relationship between the willingness of the senders and technology transfers. Furthermore, our results in the area of senders' willingness to transfer technology provide more fine grained measure, for example, component-based technology transfers, size of the market, power, control and strategic decision making as important future measures for the senders' willingness construct. These measures are in contrast to the extant literature on technology transfer (Szulanski, 1996; Simonin, 1999; Gupta and Govindarajan, 2000). Thus, future research on technology transfer might need to consider these measures for the construct of senders' willingness to transfer technology, to further enhance this important construct of technology transfer. Therefore:

> **Proposition 3*:*** *Senders' willingness to transfer technology depends on the type of component, size of the market, the power and locus of strategic decision making.*

8.4 Mechanisms for transfer technology

Our results indicate that three IJVs have relied on multiple mechanisms to transfer technology to their Pakistani component suppliers (See table 7.5). The assemblers have most frequently relied on ‘on the job training’ (OJT), seminars, face to face meetings, documents, and vendor conferences to transfer technology. Our study shows that these mechanisms were used to transfer mainly explicit technology to the component suppliers. These results, both qualitative and survey questionnaires, suggest, that usefulness of these various mechanisms is context specific. A combination of these mechanisms allowed the three IJVs to transfer explicit technology to their Pakistani component suppliers continuously. These mechanisms look quite logical however prior studies show that numerous barriers to technology transfers often prevented companies from exploiting technology transfer opportunities (Argote and Ingram, 2000; Inkpen and Crossan, 1995).

Face to face meetings, documents, on-the–job training (OJT) and overseas correspondence were noted to be useful mechanisms of technology transfer compared to seminars and vendor conferences. One potential explanation for this finding is that due to the codified (explicit) nature of the underlying technology, ambiguity and complexity is limited. Several scholars (e.g., Hansen *et al.*, 1999; Nonaka and Takeuchi, 1995), suggest that codified knowledge is easier to store and transfer in technical and less rich media.

The results also show that three IJVs do not transfer their engineers to the Pakistani component suppliers’ site. The transfer of engineers may be a more effective mechanism to transfer context specific and complex technology where close interactions are needed between the sender’s and the recipient’s firms. Several scholars have suggested that a significant portion of the technological knowledge that organisations seek to acquire is embedded in individuals. When these individuals move between organisations, they can apply this knowledge to new contexts, thereby effectively transferring the knowledge across firms (Argote and Ingram, 2000; Fahey and Prusak, 1998). Transferring employees is generally seen as a powerful mechanism for facilitating technology transfer (Galbraith, 1990; Rothwell, 1978). Several scholars have also suggested that individual employees are also able to transfer both tacit and explicit knowledge to new contexts (Berry & Broadbent, 1984, 1987; Song *et al*., 2003; Argote and Ingram, 2000; Almeida and Kogut, 1999).

It is also found that seminars and vendor conferences were deemed as not very useful mechanisms to transfer technology through auto assemblers to their Pakistani component suppliers. This finding is in line with the argument of Holtham and Courtney (1998), who found informal mechanisms, such as unscheduled meetings and seminars may be effective in promoting socialisation but may inhibit wider dissemination.

The results of this research also indicate that applying a universal and standard set of technology transfer mechanisms without considering the local context has its limitations, as is made clear from the qualitative and survey questionnaires (see table 7.5). Instead, the overall usefulness of these mechanisms depends greatly on the utilisation of appropriate technology transfer mechanisms that help the transfer and promote understanding of the technology in the local context, for example on-the-job training(OJT), instead of video lecturing or sending a fax. This finding is in line with the study of Hong and Nguyen (2009), who found that knowledge is embedded in local context and universal sets of mechanisms might not be appropriate in certain contexts.

However, in contrast to these studies, which in general have focused on a single transfer mechanism in depth, in this thesis we have tried to place all these mechanisms "in context," exploring their usefulness relative to other mechanisms of technology transfer. Therefore:

> **Proposition 4:** *Relying on multiple mechanisms and keeping in mind the local context while transferring technology is very important for technology transfer and its effectiveness.*

8.5 Trust

The result of this study points out that there is a trust deficit (see table 7.6) between the Pakistani component suppliers and the assemblers, and this has resulted in low levels of technological assistance from assemblers to some of their component suppliers. The findings also show that there are two types of suppliers: one group of suppliers show low levels of trust towards their assemblers; whereas another group indicates that their relationships are good with the assemblers.

Interestingly, the first group of suppliers have received limited technology mainly in the form of documents, or mainly teachable technology, and according to the findings of this research, there is no on-going assistance being provided to this group of suppliers, and hence this group of suppliers tends to show low trustworthy opinion towards their assemblers. Whereas, the other group of suppliers show that they fully trust their assemblers.

One potential explanation for this finding could be that the assemblers have not fulfilled their promises to transfer the technological know-how under various government introduced auto industry-related policies. This non implementation of government policies has also resulted in a low level of trust between the assemblers and some of their Pakistani component suppliers.

However, in the case of this research, it might be due to the nature of the components being supplied by a particular group of suppliers, and this may have resulted in different types of social interaction and negotiation processes between the assemblers and their Pakistani component suppliers, which has in turn resulted in differences of opinion about trust.

On-going support received from the assemblers in the form of improving the performance of the product, solving quality-related issues, providing training to the suppliers' personnel and provision of financial help were considered important elements of trust building between the Pakistani component suppliers and their assemblers. This result supports the view of Dyer and Chu (2000), who argue that the auto assembler's assistance is an excellent indicator of goodwill and commitment, because it shows the assembler is genuinely concerned about the suppliers. One potential explanation for this finding is that in the case of Pakistan, and many other developing and emerging economies auto assemblers', on-going assistance is arguably very important, as the developing economies' suppliers lack the technological capability and there are very few institutional technological capability development mechanisms in place that the local suppliers can utilise to develop their technological capabilities. Hence, the assemblers' assistance is considered crucial for the suppliers to develop their technological capabilities.

Informal commitment and social relationships were also important indicators for the development of trust between the assemblers and their Pakistani component suppliers. This finding corroborates the findings of Wasti and Wasti (2008), who also found that assemblers' initial support, use of just-in-time delivery and informal commitments were positive indicators of suppliers' trust towards their buyers in the automotive industry of Turkey. Mudambi and Helper (1998), also suggest that informal commitment has a stronger attitudinal component and therefore is strongly related to trust. Whereas the economic and management literature on contract enforcement has focused on the use of formal, legally enforceable agreements those are the bases of formal commitment in business relationships (Choi, 1994). The significance of this finding may be further explained in terms of Pakistan's weak legal regulations, and market uncertainty, where social relationships and informal commitment become very important compared to formal agreements. Taken together, these findings further seem to support the idea of Doney *et al*., (1998), that benevolence is a more common, as well as a more valued, trust-building mechanism for collectivist, uncertainty- avoiding cultures.

The results of this research further indicate that having trustworthy relationships between the auto assemblers and their component suppliers were important for the effective transfer of technology to take place. This finding is similar to earlier research that shows that trust is correlated with effective technology transfer (Andrews and Delahaye, 2000; Dyer and Nobeoka, 2000; Inkpen, 1998; Inkpen and Pien, 2006; Kale *et al*., 2000; Lane *et al*., 2001; Levin and Cross, 2004; Lui, 2009; Nahapiet and Ghoshal, 1998; Park, 2010; Parkhe, 1998; Tsai and Ghoshal, 1998; Yli- Renko *et al*., 2001).

The qualitative interviews results also suggest that trustworthy relationships between the assemblers and Pakistan's component suppliers were important, and in some cases lead to the transfer of technological know-how (tacit) from assemblers to their suppliers. This finding is in line with the findings of most previous studies (Becerra *et al*., 2008; Dhanaraj *et al*., 2004; Dyer and Singh, 1998; Inkpen and Dinur, 1998; Inkpen and Tsang, 2005; Levin and Cross, 2004; Li *et al*., 2010; Nielson and Nielson, 2009; Tsai, 2000; Uzzi, 1996).

Therefore:

Proposition 5*: Ongoing support, informal commitment and social relationships will lead to the development of trust between assemblers and their suppliers and will promote the transfer of tacit technology, but in some cases also depends on the type of component technology being transferred.*

8.6 Social Ties

The research also suggested that having social and personal connections were important for the receipt of technology from auto assemblers to their Pakistani component suppliers. These ties were built by playing friendly cricket and football matches and through social gatherings. Findings suggest that arrangement of these matches between the assemblers' and suppliers' staffs were helpful in increasing the level of social interactions between the assemblers' and suppliers' staffs and resulted in the receipt of technology.

> *''Playing matches together and going on excursion trips, our employees have built personal connections with the assemblers' staff. We have realized that these personal connections are important to receive technology and it is basically calling the person in your inner circle to discuss if you are facing any problem and receiving the timely feedback'' [Project Manager, Product Development-C19]*

This statement confirms the findings of previous studies (Adler and Kwon, 2002; Bell and Zaheer, 2007; Hansen and Lovas, 2004; Inkpen, 2008; Nahapiet & Ghoshal, 1998; Noorderhaven and Harzing, 2009; Tsai & Ghoshal, 1998), that close social ties, or networking, have a significant, positive effect on promoting the transfer and sharing of technology between organisations. The findings of this research also suggest that informal social relationships play a crucial role in the receipt of explicit and tacit technology from auto assemblers to the Pakistani component suppliers. However, our results also indicate that low social interaction, and no social ties transferred limited explicit technology in the form of documents. This finding echoes the view of Uzi and Lancaster (2003), that different types of ties transfer different types of technological knowledge. Several scholars have suggested that strong social ties and interactions lead to greater technology transfer (Inkpen and Tsang, 2005; Tsai & Ghoshal, 1998; Hansen, 1999; Reagans and McEvily, 2003; Rowley *et al*., 2000; Yli-Renko *et al*., 2001).

Low social interaction and a lack of social ties do not promote the transfer and generation of new technology from auto assemblers to their component suppliers. This finding is contrary to the findings of (Hansen, 1999; Levin and Cross, 2004), which suggest that low social interaction in the form of weak ties provides access to useful non-redundant information. One potential explanation of this finding is that auto assemblers based in the Pakistani market are interested in procuring standard low-medium complexity technological parts, and for this there is less chance for the suppliers to receive useful non-redundant information through low interactions and, moreover, depends on the willingness of the senders rather than having weak ties per se to gain access to different types of technology, particularly the tacit technology.

In the case of Pakistan's automotive industry, this research has also shown that there are different groups of suppliers. On the one hand, one group of suppliers has developed personalised ties with the assemblers and has also invested in in-house technological capabilities, whereas the other group of supplier's data reveals low social ties and basic technological capabilities.

The findings of this research also suggest that social ties are only helpful and effective in those cases where the component suppliers already have in-house technological capabilities. The data indicates that some of the suppliers have been improving their products/processes by their own efforts and have no social ties. This is confined to only two or three cases of suppliers. This result shows that some suppliers can still bring improvements in their product/processes regardless of having more, fewer, or no social ties to the sender of the technology, but purely on the basis of their in-house learning efforts.

Therefore:

> **Proposition 6**: *Social and personal connections will promote the transfer of technology where the recipients already have some in-house technological capabilities, whereas low social interaction and no social ties will lead to the transfer of limited explicit technology in assemblers'/ suppliers' relationships.*

8.7 Recipient's Learning Intent

The overall findings suggest that recipient's (component suppliers') learning intent in the form of commitment to physical, organisational and human resources were found to be a key factor for the effective transfer of technology from auto assemblers to their Pakistani component suppliers.

The results indicate that acquiring the technological know-how was one of Pakistan's component suppliers' main motives for forming business relationships with the auto assemblers (see table 7.8). This finding confirms the work of several scholars who found that recipients' learning intent is the key determinant of technology transfer (Hamel, 1991; Inkpen and Crossan, 1995; Lyles and Salk, 1996; Inkpen, 2000; Inkpen and Dinur, 1998; Park and Ghauri, 2010; Perez - Nordtvedt *et al*., 2008; Simonin, 2004; Tsang, 2002; Wang *et al*., 2004).

The findings of this research suggest that suppliers' employees attended their company sponsored and assemblers' led training programmes with dedication and commitment. This finding is important in the sense that it shows that individual employees in organisations learn and share knowledge amongst other employees, and their learning intention is important for the utilisation of transferred technology. Firms (recipients) acquiring technology from senders of technology often suffer from what is commonly known as the 'not invented here' syndrome (Govindarajan and Gupta, 2001). This results in a low interest in learning from the senders of technology. Research has also shown that a lack of learning intent in acquiring technology leads to 'stickiness' in the technology transfer process (Szulanski, 1996). Thus:

> **Proposition 7***: The greater the commitment of physical, organisational and human resources and the willingness of the employees to learn, the more effective is the technology transfer from assemblers to their component suppliers.*

8.8 Recipient's Absorptive Capacity

The results indicate that a recipient's absorptive capacity is a key factor for the technology transfer to take place and its subsequent effectiveness. The findings of this study show that in the case of the Pakistani component suppliers, absorptive capacity varies. The data suggests that there are different types of supplier groups and they vary from basic, intermediate to advanced absorptive capacity. While one group of suppliers have advanced absorptive capacity (see table 7.8), on the basis of personalised ties have received teachable, and in some cases, complex technological knowledge, whereas the other group of suppliers have few or no social ties and have basic to intermediate absorptive capacity. The supplier's group that possesses advanced absorptive capacity and have close ties have developed exploitative innovations.

The findings suggest that there are three important actors in the development of absorptive capacity of Pakistan's component suppliers: auto assemblers, components suppliers and government-run training centres. The results suggest that all three (auto assemblers, components suppliers and government run training centres) can play their role in developing the absorptive capacity of the recipients (Pakistan's component suppliers). This finding is contrary to some of the earlier studies of (Cohen and Levinthal, 1990; Mowery *et al*., 1996; Mowery and Oxley, 1995; Tsai, 2001) who have identified R&D intensity as a main measure and source of absorptive capacity. However, our results suggest that it is not only the R&D spending per se, but the level and intensity of the co-operation amongst these three actors is an important element in the development of a recipient's absorptive capacity. In some ways, we extend the work of Dyer and Singh (1998), who suggest that absorptive capacity is not just the result of having in-house R&D, but also generated through interactions and collaborations with other firms. Our findings also indicate the importance of public-private collaboration as an important conduit for the development of a local supplier's absorptive capacity.

The findings of this study suggest that local suppliers have received little help and assistance both from the senders (auto assemblers) of the technology and the government of Pakistan in developing their necessary absorptive capacity. Furthermore, our results indicate that senders (auto assemblers) and recipients (components suppliers) have different perceptions about the recipient's absorptive capacity. This finding is surprising as previous studies have not acknowledged the different perceptions about the absorptive capacity of the recipient (Lane *et* *al.,* 2001; Lane *et al*., 2006; Lyles and Salk, 1996; Mowery *et al*., 1996). We attribute this finding to the fact that auto assemblers and component suppliers in the Pakistan market do not view themselves as long-term strategic partners, and often times due to the non-implementation of government policies, have resulted in low levels of trust between the assemblers and their Pakistani component suppliers and has therefore resulted in different perceptions about each other capabilities.

The lack of absorptive capacity of some of the Pakistan's component suppliers was linked to no assistance from the senders to low levels of linkage with the local institutions (see table 7.8). Our findings suggest that a recipient's absorptive capacity is important for the successful technology transfer to take place from senders to the recipients. This finding corroborates the findings of previous studies of (Blalock and Simon, 2009; Lane and Lubatkin, 1998; Lyles and Salk, 1996; Szulanski, 1996, 2000; Gao *et al*., 2008; Gupta and Govindarajan, 2000; Minbeava *et al*., 2003; Phene and Almeida, 2008; Song and Shin, 2008) that a recipient's absorptive capacity is an important factor for the successful transfer of technology. Thus:

> **Proposition 8***: Recipient's absorptive capacity is critical for the transfer of technology and three actors (senders of technology, the local government and the recipient of technology) intensity of efforts matter for the development of a recipient's absorptive capacity.*

8.9 Technology Transfer Effectiveness

The findings suggest that technology transfer effectiveness matters along the value chain, and especially from international joint ventures to the Pakistani component suppliers. The results indicate that different governance mechanisms or relationships (see figure 7.3) have different implications for technology transfer, and its effectiveness from auto assemblers to their Pakistani component suppliers.

The results of this study suggest that there are different types of suppliers in the automotive industry of Pakistan and they have received different types of technology and assistance depending on the nature of their social ties, the trust developed with the assemblers, and technological capabilities, and therefore, are confined to different segments, for example, commercial/contractual technical governance, calculated technical governance and relational/collaborative technical governance. This finding is important, as previous studies have not paid enough attention to these governance mechanisms and their implications on technology transfer effectiveness.

The findings suggest that the nature of relationships matter for the type of technology to be transferred and its subsequent effectiveness. As Dyer and Singh (1998), argue that firms establish governance mechanisms to monitor and minimise the opportunistic behaviour during knowledge transfer in order to maintain robust relationships.

Furthermore, the results indicate that contractual/commercial technical relationships between the sender of the technology and its recipients hinder technology transfer and its effectiveness in terms of exploitative/exploratory innovation, the breadth and depth of technological learning from auto assemblers to their Pakistani component suppliers. This finding somewhat supports the view of (Dyer and Hatch 2006; Helper *et al*., 2000; McDuffie and Helper, 2006) that suppliers, regardless of their tier or ownership, often vary in developing new capabilities, largely because of the types of collaborative relationship they have with other firms in the value chain. However, in some way, this study also draws our attention to the tier segment variable as an important way of looking at different technology transfers taking place and the development of different types of relationships between the senders of the technology and its recipients. So the tier segment becomes important when looking at the nature of the relationships between assemblers and their suppliers.

Under contractual/ commercial technical relationships, limited technology transfer, mainly in the form of documents, has taken place and the level of interaction and trust between the auto assemblers and their suppliers are also low, this hindered the technology transfer effectiveness. Furthermore, the findings indicate that under this governance mechanism, Pakistan's component suppliers have not received any on-going assistance for product development or the improvement of their processes, and hence this governance mechanism can also constrain the development of social capital. The findings also suggest that suppliers under this governance posses basic technological capability but also have no institutional linkages. However, there are very few suppliers under this governance mechanism who have been improving their product/processes purely on their in-house learning efforts without having many social links to the assemblers. This finding draws our attention that social ties are only effective in technology transfer effectiveness where the recipients already have an in-house technological capability.

Therefore, we argue that the choice of governance mechanisms depends on the type of technology to be transferred and the absorptive capacities of the local suppliers. This finding in some way supports the argument of (Hoetker and Mellewigt, 2009), that the choice of the formal and relational governance mechanisms depends on the type of assets involved in an alliance. Through this finding, we also believe that our study informs three underlying literatures: the knowledge-based view of the firm, organisational learning and the literature on relational governance.

The knowledge-based view of the firm is further advanced by highlighting that considering the various types of knowledge to be transferred in inter-organisational context, rather than just looking at only one type of knowledge transfer, is more useful and provides more useful predictions about the optimal choice of governance mechanisms for a specific type of technology to transfer in inter-organisational context.

Consistent with the literature on organisational learning, we find that absorptive capacities of the recipients play a critical role in helping recipients exploit the transferred technology. We also find that a recipient's absorptive capacities also play an important role for the choice of a particular governance mechanism: contractual/commercial or collaborative. Hence, in some ways we also advance the literature on transaction cost economics by showing that considering the absorptive capacities of the exchange partners, rather than just the level of potential opportunism, allows more precise predictions about the right choice of governance mechanisms for a particular transaction.

The findings of this research also suggest that in the case of Pakistan's auto industry, assemblers are very selective when it comes to transferring different types of technology to the three different types of suppliers. The results of this study indicate that suppliers who fall under the heading of calculated technical governance have received specifications and quality-related training from the assemblers, and the suppliers of this segment are in a better position to innovate than contractual/commercial technical governance suppliers.

Similarly as far as relational technical governance is concerned, we find that relational governance mechanisms play an important role in helping Pakistan's components suppliers to receive on-going support in product development, some process and managerial technology, and also promote the development of social ties and trust between the assemblers and their component suppliers.

Our results indicate that collaborative/relational technical governance mechanisms and some institutional linkages were useful for exploitative innovations. Furthermore, the results suggest that under this relationship Pakistan's component suppliers also received explicit and some tacit technology. This result tends to support the findings of (Dyer and Hatch, 2006; Helper and Kiehl, 2004; Helper *et al*., 2000; Li *et al*., 2010; McDermott and Corredoira, 2010; Mesquita *et al*., 2008) that collaborative relationships between suppliers and auto assemblers are associated with the transfer of tacit technology and innovation.

Overall, our results suggest that each governance mechanism is associated with the transfer of a different type of technology and its effectiveness, and collaborative/relational technical governance mechanism is conducive for exploitative innovations, but not necessarily for exploratory innovations. Therefore, our results further extend past studies of (Dyer and Hatch, 2006; Helper and Kiehl, 2004; Helper *et al*., 2000; Kale *et al*., 2000; Kotabe *et al*., 2003; McDermott and Corredoira, 2010; Mesquita *et al*., 2008), by highlighting three different types of technical governance mechanisms and their affect on technology transfer and its effectiveness in terms of exploitative and exploratory innovations. We also contribute to the debate on finding the balance between exploitative and exploratory innovation by highlighting the critical role of different governance mechanisms on exploitative and exploratory innovations in an inter-organisational settings. The senders of technology induced differentiation of suppliers and diversity of suppliers are the determinants for technology transfer and its effectiveness thus downplaying the characteristics of the technology.

The findings of this research also indicate that the different types of suppliers vary when it comes to exploitative/exploratory innovations, and the breadth and depth of technological learning.

The results of this study indicate that a group of suppliers who fall under collaborative/relational technical governance are in a better position to develop exploitative, and in some cases, exploratory innovative capabilities compared to the component suppliers who are under contractual/commercial technical governance.

The results suggest that the transferred technology has helped only a few suppliers in developing exploitative innovations capability, and the interviews and survey data also suggest that out of the 50 suppliers, only 4% of them were engaged in exploratory innovations on the basis of their in-house technological efforts and close personalised ties with the assemblers.

This finding has important implications for the resource-based and organisational learning theories, because the current research suggests that being ambidextrous is desirable to build competitive advantages (Ahuja and Lampert, 2001; Colbert, 2004; Gibson and Birkinshaw, 2004; Hamel and Prahalad, 1993; He and Wong, 2004; Jansen and Volberda, 2005; Levinthal and March, 1993). Levinthal and March (1993:105), suggest that long-term survival and success depend on an organisation's ability to "engage in enough exploitation to ensure the organisation's current viability and to engage in enough exploration to ensure future viability".

Strong support of the assemblers (willingness of the senders of technology) and linkage with the training and R&D institutions together with the recipient's absorptive capacity are critical for technology transfer effectiveness in terms of exploratory innovations. Previous research has traditionally focussed on formal organisational structures, leadership and internal organisation processes, whereas, we show that external sources of technology and their willingness to transfer technology, having linkages with the R&D institutions and possession of absorptive capacity, is fundamental for achieving exploratory innovations.

Our findings also suggest that informal ties with the auto assemblers, and assemblers initiated proactive problem solving discussions and dialogue with their component suppliers, were critical for technology transfer effectiveness in terms of exploitative innovations. This finding seems to support the view of McDermot and Corredoir (2010) that few social ties to international auto assemblers were beneficial for the Argentina's local auto parts suppliers, and regular disciplined discussions between the auto assemblers and suppliers were critical for product and process upgrading. Therefore, we contribute to the organisational learning and social capital literature by showing that informal ties and ongoing discussions with the senders of the technology are important for local component suppliers to develop exploitative innovations, whereas it is beneficial for the local component suppliers to have many ties to senders of the technology as well as local R&D institutions to develop exploratory innovative capabilities.

Furthermore, Pakistani component suppliers' relationship durability with the auto assemblers was critical for technology transfer effectiveness in terms of exploitative innovations. This finding in some way extends the argument of Kotabe *et al*. (2003), that link duration increases technology transfer, and technology transfer becomes beneficial if the assembler and supplier have interacted long enough. However, Kotabe *et al*. (2003), did not study the effects of link duration on technology transfer effectiveness in terms of exploitative innovations. Therefore, we contribute to this debate by highlighting that durability of the relationships really matters for exploitative innovations. This argument is consistent with prior studies of (Dyer and Hatch, 2006; Sako, 2004; McDuffie & Helper, 2006; McDermott and Corredoir, 2010; Dyer and Singh, 1998), that technology transfers, and capabilities development, depends on the quality and intensity of the relationships that suppliers have with their main auto assemblers. The underlying explanation is that durability of the relationship develops and promotes trust and stability in the exchange relationship which in turn helps the receipt of useful technology and hence exploitative innovations.

The transfer of low-medium complex technological components of technology in the form of documents and drawings from auto assemblers to their Pakistani component suppliers have resulted in narrow technological learning amongst Pakistan's component suppliers. Our results further indicate that auto assembler's ongoing assistance and readiness to assist the suppliers seems to be critical for the effectiveness of the technology transfer in terms of the breadth of technological learning. The findings of this study also suggest that low levels of assistance from auto assemblers to the lack of institutional support has resulted in basic and shallow (breadth) technological learning.

These results seems to coincide with current research emphasising the notion that emerging and developing market firms can gain new knowledge from personal social ties to MNCs and from participating in R&D programmes in local research universities, but that their local organisational and institutional environments may be too weak to offer relevant resources and information (Giuliani *et al*., 2005; Moran *et al*., 2005).

Overall, our results point out that long-term relationships based on mutual trust, willingness of the senders (assemblers) of technology to transfer the technology along with personalised ties with the senders of technology are critical factors for technology transfer effectiveness in terms of breadth and depth of technological learning and developing advanced capabilities. Therefore:

Proposition 9a*: Different governance mechanisms will transfer different types of technology and contractual/commercial technical governance mechanisms are not useful for technology transfer effectiveness, whereas collaborative/relational technical governance mechanisms will transfer explicit/tacit technology and are associated with technology transfer effectiveness.*

Proposition 9b*: Senders willingness to transfer technology and linkages with training and R&D institutions along with recipients' technological capability are critical for exploratory innovations.*

Proposition 9c*: Social and personalised ties with the senders of technology and recipient's in-house technological capabilities, and senders initiated problem solving discussion are conducive for technology transfer effectiveness in terms of exploitative innovations.*

Proposition 9d*: Durability of the relationship with the senders of the technology is critical for exploitative innovations.*

Proposition 9e*: Long-term relationships based on mutual trust, sender's willingness to transfer technology and personal ties are critical for the recipients for developing breadth and depth of technological learning.*

8.10 Comparative multidimensional analysis

The comparative data analysis shows that suppliers who are linked with more than one assembler are in a better position to receive more technology and in some cases the package of technology compared to those suppliers who have business relationships with only one assembler. This shows that supplying exclusively to one assembler might not be useful for the long-run. The data further indicates that supplying more than one assembler does enhance the absorptive capacity and learning intent of the suppliers. This finding might be due to the diverse knowledge available through multiple assemblers.

The findings also suggest that senders' willingness, package of technology, social ties, absorptive capacity, governance mechanisms and trust are some of the important factors for the technology transfer effectiveness and these factors are reported by the recipients of technology to be very important. The important finding which emerged from this analysis is that none of the suppliers mentioned the characteristics of knowledge to be important factor which suggest that it is the perception of the suppliers which determined whether the knowledge is tacit or explicit as over 90% of the suppliers mentioned the package of technology rather than a single type of knowledge as one of the very important factors for technology transfer effectiveness.

Conclusion

In this chapter, the findings are discussed in the context of the extant literature. The chapter has presented a brief summary of the research findings in a table format. The chapter has drawn our attention to understand the sender's side as well as recipient-related factors to build an overall picture of technology transfer effectiveness. The chapter also highlights the important role of inter-organisational dynamics in the form of trust and social ties to understand the process and effectiveness of technology transfer. Overall, it is clear that technology transfer should be viewed as a process taking place from the senders of the technology to the recipients of technology. Different mechanisms can be used to transfer technology and the usefulness of the mechanism varies from mechanism to mechanism. The chapter has also shown that the sender's of technology has not transferred the complete package of technology consisting of product, process and managerial technology to their component suppliers. It is also important to note that the underlying characteristics of technology play an important role for the transfer to take place. The understanding of the role of different governance mechanisms is important to gain a complete picture of technology transfer effectiveness. Social ties and trust also play key facilitator and enabler roles for the transfer of technology to take place. The next chapter concludes the thesis by presenting key contributions of this research, implications for managers and practitioners, policy implications and limitations and directions for future research.

CHAPTER 9: CONCLUSION

In chapter 8, the findings of this research were discussed in the context of previous studies on technology transfer. The goal of this chapter is to conclude the research by offering theoretical contributions, empirical, methodological, managerial and practical implications and implications for policy makers and finally limitations and directions for future research are discussed. The aim of this study was to explore the topic of technology transfer effectiveness through IJVs to their Pakistani component suppliers of the automotive industry of Pakistan in a holistic way.

This research adds new insight into a relatively underexplored area of research in the context of technology transfer effectiveness from international joint ventures to their component suppliers. It confirms and extends previous research suggesting the importance of technology transfer in general and technology transfer effectiveness, in particular from international joint ventures to their component suppliers of the automotive industry of Pakistan, is a totally underexplored context.

This research also adds to the resource-based view of the firm, the knowledge-based view of the firm, organisational learning and social capital literature by examining in some detail both senders of the technology and the recipients of technology-related factors and the important role of the local government in the technology transfer process and its effectiveness.

Scholars in the area of resource-based views of the firm (RBV), tend to focus on the internal resources of the firm as a source of competitive advantage, while downplaying the importance of those resources that are available to the firm through external actors. Conversely, social capital scholars tend to focus their attention on the role and value of structural, cognitive and relational ties, without considering the capabilities of the actors involved in the technology transfer. Scholars in the area of the knowledge-based view of the firm (KBV) tend to focus on the characteristics of the knowledge as the main source of sustainable competitive advantage, while paying less attention to the willingness of the sender to transfer a particular technology or the strength of the relationship between the actors. Furthermore, scholars of organisational learning focus their attention on the role of absorptive capacity and firm level learning, whilst downplaying the nature of the relationship under which the actors participating in the technology transfer are tied together. We show the importance of focusing on these four streams of research in studying technology transfer effectiveness from senders to recipients of technology.

Using the context of Pakistan's automotive industry, we show that considering technology transfer as a process, as well as the distinct phases within each stage of the transfer process, matter when explaining the entire process of technology transfer from senders to recipients.

We also show that the package of technology transfer is important from the recipient's point of view rather than a single technology, as the scholars in the area of the resource and the knowledge-based view of the firm has pointed out that it is the tacit knowledge that leads to the development of sustainable competitive advantage. However, we show that it is not the tacit knowledge per se, but the whole package of technology consisting of both tacit and explicit components that matter for entering the global value chain. Specifically, this study shows that the senders of technology rarely transfer the entire package, and thereby supports the view of the RBV that imitation barriers are partly located in resources. These results further show that hard to imitate resource firms like to keep their technology within the firm and do not easily transfer to other firms even within their own network.

This research also broadens our understanding of the role of the inter-organisational dynamics, for example, trust and social ties that are important constructs in the context of emerging and developing economies that are constrained by underdeveloped and weak institutions. Social ties in the form of personal connections/personalised ties are important to understand the nature of the relationship between the parties involved in the process of technology transfer and moreover can promote trust between assemblers and suppliers to understand each other's needs.

Technology transfer effectiveness is especially difficult to measure because of its characteristics. Previous studies have mainly used time, costs, budget, perceived benefit and satisfaction to measure the effectiveness on the assumption that transfer was effective if it meets any one of the above criteria. Whilst sufficient for many purposes, these measures do not adequately measure the transfer outcome. We suggest transfer effectiveness may be measured by using more fine grained measures, for example, the effects of different governance mechanisms, diversity of (recipients) suppliers, exploratory, exploitative innovations, the breadth and depth of technological learning that are relevant for affecting transfer effectiveness.

9.1 Theoretical Insights and Reflections

We believe that our research provides useful insights and reflections to the existing stream of literature by investigating technology transfer effectiveness from international joint ventures (IJVs) to their component suppliers of the Pakistani automotive industry, an understudied area and context.

Unlike previous research, we focus on the complete transfer of technology package: product, process and management that are the source of competitive advantage for the small-medium local suppliers and their pass for entry into the global value chain and highlight the importance of focusing on the package of technology rather than on only one type of technology transfer. This research highlights, that various types of knowledge should be analysed with reference to the whole package of knowledge rather than investigating only one type of knowledge transfer.

We explore the sender of technology's related factors, for example, willingness to transfer technology to their component suppliers, recipient-related factors in the form of learning intent and a recipient's absorptive capacity and inter-organisational dynamics in the form of trust and social ties between the senders (auto assemblers) and recipients (Pakistan's component suppliers) and technology transfer effectiveness. By focusing on the above factors in the inter-organisational context this gives us a clear and better picture of technology transfer effectiveness, as these concepts have not been simultaneously studied.

Unlike previous research that has focused mainly on the recipients' (students') ability to learn, this research shows that both sender (teacher) and recipients (students) are important to get the whole picture of technology transfer and its effectiveness. Therefore, it is important for researchers to give equal importance to both.

Previous research on technology transfer effectiveness has focused on time, cost and budget variables to study technology transfer effectiveness; we use new measures for example, exploratory, exploitative, depth and breadth of technological learning to study technology transfer effectiveness. Hence, this research contributes to the knowledge-based view of the firm, the resource-based view of the firm, organisational learning and social capital in nine principal ways.

First, the distinct phases within each stage of the transfer process sheds new light on the importance of knowing the distinct phases in the technology transfer process as Van Wijik *et al.* (2008), point out that there is a gap in the literature about the distinct phases in the technology transfer process. Therefore, this result underscores the need to formally recognise the distinct phases of technology transfer and the need for them to be investigated in future research, as well as the role of the MNCs as mediators and facilitators (boundary spanners) of technology transfer.

We also contribute to the existing research on technology transfers in general, and particularly on the automotive industry by highlighting the diversity of supplier groups and each group of suppliers are receiving different types of technology; the nature of the social relationship and absorptive capacities of these groups also varies in a single country and industry context. To get a robust understanding of technology transfer from IJVs to their local suppliers, different suppliers groups have to be differentiated alongside different type of technology transfer and its effectiveness. To some extent effectiveness of technology is closely linked with the diversity of suppliers. Our result suggests that suppliers rely on assemblers to access the whole package (product, process and managerial) of technology and in fact the transfer and effectiveness varied across suppliers, reflecting that the diversity of suppliers and senders induced differentiation of suppliers are important determinants of technology transfer and its effectiveness, rather than the characteristics of knowledge as highlighted by previous studies (Szulanski, 1996; Simonin, 2004). Therefore, the diversity of the suppliers and senders induced differentiation provides specific opportunities and constraints for technology transfer and its effectiveness (Cohen and Levinthal, 1990). Therefore, future research ought to study why these different suppliers develop different types of exchange relationships and innovative capabilities in a single industry and country context. A major conclusion of this research is that absorptive capacity is definitely affected by social ties.

This research also contributes to the social capital and organisational learning theories by empirically showing that social ties are useful even in the small suppliers' context, and are the only effective conduit of the receipt of technology where the recipients already possess technological capabilities. Furthermore, we also contribute to the literature on social capital by showing that personal connections and personalised ties are important mechanisms to access sender knowledge, but not the only mechanisms to bring innovations, as our results suggest, that very few suppliers were bringing improvements in their processes and products through their own efforts without having social ties and trust with the senders of the technology.

Organizational learning theorists (Argote, 1999; Wijk *et al*., 2008; Bhagat *et al*., 2002) have called for investigating a variety of learning outcomes which can add value to the firm's dynamic capabilities. We take a step in this direction by investigating technology transfer effectiveness in terms of breadth and depth of learning and exploitative and exploratory innovations an outcome of technology transfer; in so doing, we contribute to this line of literature.

This study contributes to the resource-based and knowledge-based views by highlighting the important role of the boundary spanners strategic decision making and technology transfers. The strategic decision making plays an important role when it comes to transferring a particular 'hard to imitate' resource and knowledge and the firm's decision to transfer a particular resource depends on the strategic nature of the underlying resource because knowledge has to move through the boundary of an organisation.

Besides these insights and reflections, this research has some new and original findings that are developed in the form of propositions (see chapter 8) for future research in this important area of research. Some of these findings are as below:

1- The distinct phases within each stage of the transfer process are important and new findings therefore ought to be recognised and investigated in future research, as well as the role of MNCs as mediators and facilitators- boundary spanners of technology transfer to resource-constrained developing countries' suppliers.

2- The identification and classification of different types of suppliers and the nature of their relationship is important to understand the type of technology being transferred and the resulting innovative capabilities of these different types of suppliers.

3- The component to component technology transfer is an important and new finding, and, therefore, future research needs to investigate the role of the sender's global strategy in the process of transferring different component technology and, moreover, by investigating why social ties and trust are not always conducive for the receipt of high complexity component technology.
4- Social and personalised ties do not always lead to the receipt of high complex component technology.
5- Sender's decision to transfer the complex technological component technology depends on the size of the market and technological capabilities of the recipients.
6- Low competitive pressure will lead to the transfer of low-medium complex technological component technology to the recipient's suppliers.
7- The issue of power and control are also important considerations behind the transfer of complex technological component technology, and therefore, needs to be incorporated in future research on technology transfers.
8- The absorptive capacity construct should not be limited only to the recipients (Zahra and George, 2002), but the role of other actors should be acknowledged and empirically investigated. The interplay of three actors, senders of technology, recipients and local institutional actors in developing the absorptive capacity of the recipients, and the development of different types of absorptive capacity through the joint efforts of the above three actors, needs to be incorporated in future studies.
9- Benefits of having more ties to local institutions and senders of technology, along with different governance mechanisms, and their implications for technology transfer effectiveness, are new findings in regards to developing exploratory innovations and needs further empirical attention.

10- The identification of different governance mechanisms and their impact on technology transfer effectiveness is a new finding, as previous research has not focused on the role of different governance mechanisms on technology transfer effectiveness. Therefore, the exact nature of the governance mechanisms and technology transfer effectiveness calls for further investigation.

11- Instead of viewing technology transfer effectiveness in terms of time, cost and speed, the constructs of exploitative/exploratory innovations, the breadth and depth of technological learning needs to be formally recognised and integrated in future studies on technological knowledge transfer effectiveness, as it can give a robust and complete picture of the transfer effectiveness.

The following section discusses methodological contributions.

9.2 Methodological Insights and Reflections

This study also provides insights in terms of research methodology. Whilst previous research (Perez-Nordtvedt *et al*., 2008; Lyles and Salk, 1996; Simonin, 1999, 2004) has mainly relied on quantitative research approach, this research has made use of the application of both qualitative and questionnaire survey methods giving us a more robust understanding of this complex phenomenon of technology transfer. By applying qualitative interviews as the main methods, and supplemented with questionnaire surveys has increased the reliability and validity of this research. In addition, by the utilisation of both of these methods, we have investigated technology transfer effectiveness in an understudied context. This approach has also given us a useful way of collecting data from three main actors of technology transfer, mainly: the sender's of technology (assembler's), the recipients (components suppliers) and the Ministry of Industries and Production (the Government of Pakistan's actor). Through the application of this research approach, the study has tried to triangulate various forms of data in order to develop a holistic picture.

9.3 Managerial and Practical Implications

This research also offers several guidelines for managers and practitioners about technology transfer effectiveness in nine main ways.

First, the research findings underscore the necessity for managers and practitioners to understand the process of technology transfer and be cognisant of the stages of the transfer process and of its distinct phases within each stage. As the different types of technology are being transferred at each stage of the technology transfer, it is important for the managers and practitioners to develop and utilise the social capital of MNCs in order to gain access to the network stock of technological knowledge.

Second, because different types of technology provide different competitive advantages and whole packages of technology consist of product, process and management technology is critical for firms to develop sustainable competitive advantage. Therefore, in order to receive the whole package of technology from the senders of the technology, managers need to continuously develop and strengthen the relational and collaborative ties.

Third, the study results point out that the sender's willingness and motivation to transfer technology is one of the most important factors behind the successful transfer of technology. These findings underline the need for a recipient of technology to consider the motivation of the sender of the technology. To take the best advantage of receiving tacit technology, managers need to develop technology sharing incentives with the sender of the technology, and, moreover, long- term trust and collaboration should be developed with the sender of the technology to receive tacit technology.

Fourth, to receive tacit, complex technology, multiple mechanisms of technology transfer should be encouraged, promoted and widely used with the help of the sender of technology. Staff transferred and rotation with the sender of technology should be encouraged and asked for, as they carry context specific technological knowledge.

Fifth, the research results indicate that trust relationships were critical for the transfer of technology from the sender to the recipient. These findings underscore the importance of focusing on ways to improve trust by creating a shared vision and investing in social relationships, i.e. strong managerial ties to gain technological know-how. To build mutual trust between the sender of the technology and the recipient, managers need to encourage and facilitate personnel transfer and employee interaction.

Sixth, it is found that social ties and personal connections are important for technology transfer and its effectiveness. Low social interaction results in the transfer of explicit technology in the form of documents. This finding underscores the necessity for managers and practitioners to develop and promote strong personal connections with the sender of the technology by attending social/cultural functions/trips. Inter-organisational communication mechanisms should also be enhanced and developed for building personal connections and receiving technological know-how.

Seventh, recipients learning intent, in the form of commitment of physical, organisational and human resources are important factors for the effective transfer of technology. Therefore, managers need to focus on proper resource allocations and emphasis on their employee training as it will also encourage employees learning intent, and thereby effective technology transfer. A strong recipient's learning intent will also encourage the sender of the technology to transfer technology.

Eight, the recipients' absorptive capacity is important for the technology transfer to take place. There are three main actors for the development of recipients' absorptive capacity: the local supplier, local government and the senders of the technology. It was found that all three actors can play their role in developing the absorptive capacity of the recipients. It was found that local suppliers have received little help and assistance from both the senders (auto assemblers) of the technology and the Government of Pakistan in developing the necessary absorptive capacity. The lack of absorptive capacity at the recipient's end was linked to no assistance from the senders to low levels of linkage with the local Pakistani institutions. These findings underscore the importance of the development of the recipient firm's absorptive capacity. Managers need to emphasise the importance and benefits of having local institutional linkages and these linkages should be encouraged and sought with the help of the government. Joint training and R&D programmes should be developed with local R&D institutions through the support of public-private partnerships (PPPs) for the development of the recipient's absorptive capacity.

Finally, the research results suggest that technology transfer effectiveness matters along the value chain. It was found that different governance mechanisms have different implications for technology transfer and its effectiveness. Contractual /Commercial relationships hinder technology transfers and their effectiveness in terms of exploitative/exploratory innovations, the breadth and depth of technological learning and can also constrain the development of social capital in the form of trust and social ties. Strong support of the assemblers and institutions along with recipients' technological capabilities matter for exploratory innovations. Informal ties with the assemblers, and assembler-initiated problem solving discussions were helpful for exploitative innovations and durability of the relationship with the assemblers is important for exploitative innovations. These findings underline the importance and need for a firm to consider the development of collaborative ties with senders of the technology and linkages with local institutions should be developed and enhanced for developing exploratory, exploitative innovations, and the breadth and depth of technological learning. Therefore, managers need to develop and sustain long-term relationships with the sender of the technology.

9.4 Policy Implications

The present research also offers policy guidelines to the top echelons of policy makers in Pakistan. This research has uncovered that MNCs will not transfer the whole package of technology to their recipient firms, therefore, this research calls for more coherent local efforts for technology development and transfers to local suppliers. The findings indicate that only a few suppliers have benefited through tie- ins with their assemblers, and these suppliers have close personal connections and in-house technological capabilities.

Against this background, the following policy measures are recommended:

1. In order to benefit from a multinational's technology, promotion of social relationships between the foreign investors/local recipient firms and strong in-house

capabilities are important to benefit from technology transfers. This may include cultural exchanges between both parties. Suppliers and assemblers should learn more about each other's values and norms by participating in cultural events.

2. As strong in-house capabilities are important to benefit from technology transfer, it is recommended that local suppliers' technological capabilities should be developed through public-private collaborations. For this purpose those government-run centres that help the local suppliers should be given more incentives for collaboration with the local suppliers.

3. Suppliers' traditional knowledge bases should be extended and organised in accordance with modern scientific expertise by placing specialists, preferably from higher academic institutions, for a period of 1-2 years at a supplier's site, so there can be close interaction between academics and suppliers. This measure will also facilitate more links between universities and industry.

4. Various government- run training and R&D centres should be brought under a single set-up. Therefore, there is a need for a new organisation, for example, a technology transfer agency aimed at handling matters related to technology transfers. Such an organisation can look into technology transfers and technology development work of already existing government-run training and development centres, for example, SMEDA, TEVTA and the Skills Development Council.

5. The role of the government should be to facilitate these training centres in acquiring modern industry specific machinery and must have legal implementations in place for close co-ordination with local component suppliers.

6. Legal and institutional structures should be made more efficient in order to ensure the implementation of various accords between suppliers and assemblers as well as at government level.
7. The Government should provide R&D funds to those suppliers who successfully innovate. This policy will also encourage the remaining suppliers to invest in training and development and bring improvements in their components in order to take advantage of this fund
8. The comparative data indicates that suppliers who supply to more than one assemblers are in a better position to develop absorptive capacity compared to those suppliers who are tie in only to one assemblers. Against this backdrop, the role of the government should be to encourage the tie-ins between multiple assemblers and suppliers by providing more tax and R&D related incentives to those firms which build business linkages with multiple suppliers. The institutional support and linkages with the suppliers are also week regardless of the assembler the supplier supply parts to. The government should promote institutional linkages and encourage public-private R&D related investment schemes which would enhance the absorptive capacity of the suppliers.

9.5 Limitations and future research directions

Like all studies, this research also has some limitations, which can be used as promising ideas for future studies on technology transfer and its effectiveness.

First, although the collection of data through the use of interviews and survey questionnaires from three auto assemblers, 50 of their first tier suppliers and the Ministry of Industries and

Productions provide valuable methodological contributions and the issue of political bias of some of the respondents cannot be entirely ruled out. However, the inclusion of respondents from the auto assemblers and the Ministry of Industries and Productions reduced our concerns. Nevertheless, future studies may consider the inclusion of 2nd and 3rd tier suppliers as a control group in order to better assess the contribution of technology transfers down the supply chain.

Second, this study is limited by its research setting in a single industry and as a unidirectional technology transfer from auto assemblers to their component suppliers. Whilst investigating technology transfer effectiveness from auto assemblers to their component suppliers increased the internal validity of this research, at the same time it sacrificed its external validity. Future research may need to extend these findings to other industries, or to cross country studies on the automotive industry would also provide more useful insights for corroboration. Future research may also need to study bi-directional technology transfer, because component suppliers are also sources of local market knowledge; therefore, it is logical to study bi-directional technology transfers and their impact on assembler-supplier performance.

Third, since this study focuses on structural and relational dimensions of social capital, future research may examine the impact of cognitive dimensions of social capital on technology transfer effectiveness.

Fourth, we did not test the relationship between different variables, for example, the durability of relationships helps in exploitative innovations, or the impact of different governance mechanisms on technology transfer effectiveness. Future studies may need to statistically test the relationship to see whether the relationship between these variables is significant or not. Therefore, the results of this study should be interpreted with caution because we cannot rule out the influence of other factors on technology transfer effectiveness.

Fifth, our study included exploratory, exploitative innovation, and the breadth and depth of technological learning to study technology transfer effectiveness. Future studies may also benefit by gathering performance data, for example, sales growth and market share.

Sixth, although this research provides new insight into technology transfer effectiveness from international joint ventures to their component suppliers, it does not address the role of leadership in initiating the process of learning or developing exploratory/exploitative capabilities. It would be useful to conduct longitudinal studies to better understand the role of leaders in the process of technology transfer effectiveness.

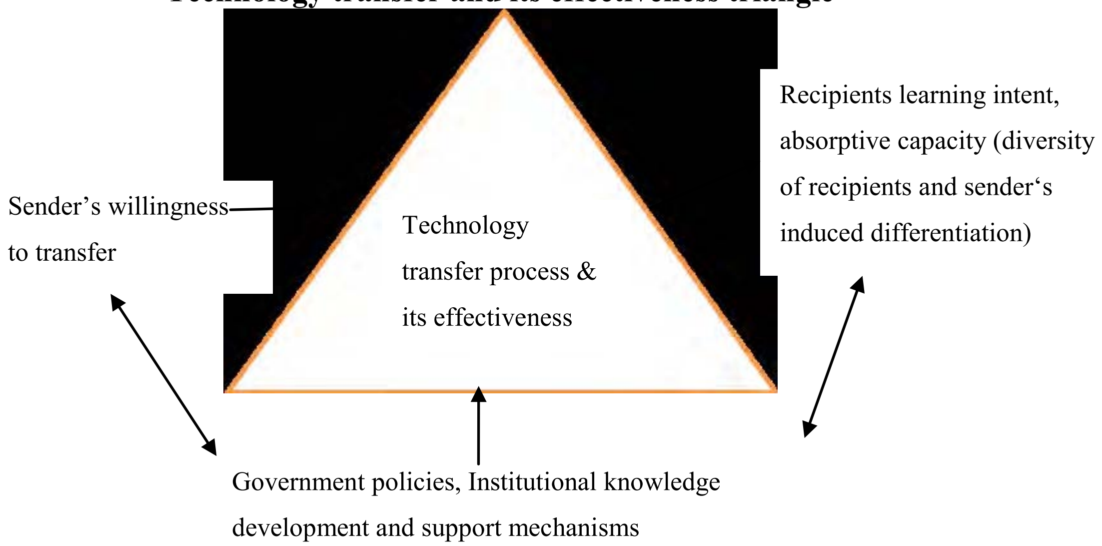
Seventh, the comparative data shows that suppliers who are tie in to more than one assemblers have much higher absorptive capacity and learning intent compared to the suppliers who supply only to one assembler, therefore it would be useful to investigate under what conditions supplying to more firms enhance the absorptive capacity and learning intent of the recipients.

Eighth, the comparative data also suggest that supplying parts to one assembler or multiple assemblers does not lead to the receipt of package of technology. Future research need to investigate the determined factors behind the transfer of package of technology.

Despite these limitations, we believe that our study highlights various theoretical, managerial and practical implications through providing new insights and increases our understanding of an area that has not been explored well in the context of international joint ventures to their component suppliers. The salient role of the local government along with the auto assemblers and component suppliers observed in this research also provides a promising direction for future studies. Future studies may benefit by studying the triangle of technology transfer and its effectiveness. The figure shown below is an initial step in this direction.

Figure 9.1

Technology transfer and its effectiveness triangle



Source: based on author's interviews

In sum, this thesis contributes to theories, practice and policy on technology transfer in general and technology transfer effectiveness specifically.

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APENDICES

APPENDIX A

Interview Guide – Suppliers

The purpose of this study is to find out the process of technology transfer to your company from your client (car assemblers), and its effectiveness. All the information provided will be kept confidential and will not be shared with any third party. The information collected from your company will be strictly used for the sole purpose of PhD research. Your support and cooperation will be much appreciated.

I will ask you a number of questions, which will take around 45 to 60 minutes of your time. Thank you very much for your co-operation.

Introductory questions

Name & Position of Interviewee, date of interview.

When was your company established? (How many years have you been in business? Have you always done what you are doing at present? How did you become involved in this type of business? Do you have other related or unrelated businesses? Who is your major client (car assembler)? What are your major products? No of employees?

Technology transfer related questions.

- What types of knowledge your employees need for their routine jobs?
- What sources and channels had been most useful and effective in acquiring the knowledge?
- In the past 1-2 years have you received any technological knowledge from your client (car assembler)?

- What benefits did your company see in understanding and learning the technology possessed by your client?
- Which type of technology you have received from your client?
- What was the process of technology transfer from assembler to your company?

- Are there areas of knowledge and technology that the client does not want to share and why this may be the case?
- What sort of learning, R&D or technological activity your firm was doing before you enter into this business partnership with your car assembler?
- Does your company collaborate with any Pakistani science, technology. R&D institutions that help your firm adapt or absorb the knowledge/technology from your client?
- Who participates in the technology transfer process and how do they participate in the transfer process? How does your client organize activities for effective technology/ knowledge transfer and sharing?
- What you do think are the distinct phases in the technology/knowledge transfer process from your client to your company? How much time was required for this process of technology transfer?
- What were the mechanisms/modes used to transfer this technology? How would you rate these mechanisms?
- What kind of transfer mechanisms were adopted for each type of technology transfer, i.e., product -related, process- related and managerial- related?
- Does your client have a socialisation team with your company employees?
- The technology, that was transferred from you client, was complete enough that you were able to become proficient with it?
- Was the transferred technology well understood within your company?
- How has the technology transfer resulted in improving your products/services in the local market or abroad?

Any other information would you like to add or any comments about the interview questions.

Thank you for your time.

APPENDIX B

Interview Guide- Assemblers

The purpose of this study is to find out the process of technology transfer from your firm to your components (parts) suppliers and its effectiveness. All the information provided will be kept confidential and will not be shared with any third party. The information collected from your company will be strictly used for the sole purpose of PhD research. Your support and cooperation will be much appreciated. I will ask you a number of questions, which will take about 40 to 60 minutes. Thank you very much for your co-operation.

Introductory questions

- When was your company established? (How many years have you been in business?
- What are the major motives behind your investment in Pakistan?
- Number of employees.
- Major products.
- What kind of components (parts) your firm is sourcing from local Suppliers/Vendors?
- What is the long- term strategic plan and competitive advantage of your firm?
- What are the business plans for the next 2 years?

Technology transfer related questions

- What type of technological knowledge/technology has your firm transferred to your component suppliers?
- What was the process of this technology transfer from your firm to your components suppliers?
- Who initiated this transfer process?
- How many people were involved?
- What were the benefits your firm saw in transferring technological knowledge/technology to your component suppliers?
- How different mechanisms or processes influence the transfer of different types of technological knowledge from your firm to your suppliers?

- Does your firm provide training to your suppliers employees on regular basis? What kind of training you firm has provided to the suppliers' employees?
- Who participates in the knowledge transfer process and how do they participate in the transfer process?
- How does your firm organise activities for effective technology/ knowledge transfer and sharing to your suppliers?
- Are there areas of knowledge and technology that your firm does not want to share with the suppliers and why this might be the case?
- What are the major barriers/problems that your firm is facing in regard to technology transfer to your suppliers? And why this is the case?
- How often do your employees communicate with the suppliers? On a daily, weekly or monthly basis. Does this take place at senior, middle or production line management level?
- Does your firm have socialisation team with your suppliers' employees?
- What kind of ongoing support has your firm provided to your suppliers during this transfer?
- In your opinion, what are the main factors the make the technology transfer more effective from your firm to your suppliers?
- In your opinion, are your suppliers willing to learn your technological knowledge?
- What do you think about your supplier's competencies? Have suppliers possessed the necessary skills to absorb and implement your firm's technological knowledge?
- Is your firm business relationship based on mutual understanding or contract?
- How would you describe the nature of your business relationship with your suppliers?
- Do you ever have the feeling of being misled by your local suppliers? Why?
- How is conflict handled between your company and your supplier/s?

Any other information would you like to add or any comments about this interview

Thank you very much for your time.

APPENDIX C

Questionnaire Survey

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Technology transfer effectiveness from International Joint Ventures to their Components suppliers in the automotive industry of Pakistan
Please indicate what type of technology your firm has received from your assemblers. If a particular technology was received, select YES OTHEWISE NO. Your responses will be strictly used for the purpose of a PhD research, and this information will be kept confidential. Please complete all parts of this questionnaire.

<u>PART 1</u>

General Information:
Year of Establishment:
No of employees:

1. **Product related technology**

(a) Provision on product designs and technical specifications. YES ☐ NO ☐
(b) Provision, advice, or financial assistance to obtain raw materials and components. YES ☐ NO ☐
(c) Regular feedback on product performance to improve existing product technology. YES ☐ NO ☐
(d) Technical consultations on product characteristics to master new product technology. YES ☐ NO ☐
(e) Organized R&D-collaboration in product-related areas. YES ☐ NO ☐

2. **Process/Production related technology**

(a) Provision, advice, or financial assistance to obtain machinery and equipment. YES ☐ NO ☐
(b) Technical support to improve existing production technology. YES ☐ NO ☐
(c) Technical consultations on machinery operation to master new production technology. YES ☐ NO ☐
(d) Advice on production layout and organisation. YES ☐ NO ☐
(e) Assistance with quality assurance systems (e.g., ISO certification, TQM, etc.). YES ☐ NO ☐

3. **Training programs for suppliers' personnel**

(a) In-plant training for managers/ technicians at the supplier site. YES ☐ NO ☐
(b) Training for managers/ technicians at assembler's site. YES ☐ NO ☐
(c) In-plant training for workers at the supplier site. YES ☐ NO ☐
(d) Training for workers at assemblers' site. YES ☐ NO ☐

4. **Managerial related technology**

(a) Market know-how. YES ☐ NO ☐
(b)Financial Planning & Management. YES ☐ NO ☐
(c) Project Management. YES ☐ NO ☐
(d) Inventory control. YES ☐ NO ☐
(e) manufacturing cost control and delivery systems. YES ☐ NO ☐

PART 2

Mechanisms used to transfer the technology

(a) Face to face meetings. YES ☐ NO ☐

(b) Documents transfer related to component design or improves process. YES ☐ NO ☐

(c) Engineers transfer. YES ☐ NO ☐

(d) On the Job trainings. YES ☐ NO ☐

(e) Seminars/presentations. YES ☐ NO ☐

(f) Vendor's conferences. YES ☐ NO ☐

(g) Overseas Correspondence. YES ☐ NO ☐

PART 3

Trust

(a) You (Suppliers) assumed that the assemblers will always look out for your interests. YES ☐ NO ☐

(b) You (Suppliers) assumed that the assemblers would go out of her way to make sure you were not damaged or harmed. YES ☐ NO ☐

(c) You felt like your clients (assemblers) cared what happened to you. YES ☐ NO ☐

(d) You trust your assemblers to treat you fairly. YES ☐ NO ☐

(e) You think that the assemblers have a reputation for trustworthiness (following through on promises and commitments) in the supplier's community. YES ☐ NO ☐

(f) If given the chance to your assemblers, you perceive that the assemblers will take unfair advantage of you. YES ☐ NO ☐

PART 4

Main Motives for Pakistan's automotive components Suppliers for forming business relationships with Pakistan's based Automotive Assemblers.

Indicate the below motives on a 1-3 scale. 1= Very important; 2= Important; 3= Not Important

(a) Acquiring technological know-how. ☐

(b) Enter in the global value networks. ☐

(c) Learn global automotive best practices. ☐

(d) Sharing the risk of new product development. ☐

(e) Develop Technological Capabilities. ☐

PART 5

Indicate the institutional support and linkages your firm have with local Institutions on a YES or NO scales.

(a) Your firm received support for R&D activities from local institutions. YES ☐ NO ☐

(b) Your employees received specific training by local academic institutions, including Government-run skills development centres. YES ☐ NO ☐

(c) Your firm received benefits from academic institution research activities. YES ☐ NO ☐

(d) Your firm collaborate with any Government R&D Institutions YES ☐ NO ☐

(e) Your firm has any internship programs with the local universities. YES ☐ NO ☐

(f) Your firm has received support in technological knowledge development activities from local institutions, including Government-run centres. YES ☐ NO ☐

Educational level of your employees.

Have staff with PhDs. YES ☐ NO ☐ If YES then number of employees with these qualifications.

Have staff with Master degrees, including Engineering degree. YES ☐ NO ☐

Have staff with Bachelor degrees. YES ☐ NO ☐

Have staff with diplomas. YES ☐ NO ☐

Your firm technological capabilities on a 1-5 scale. 1= Basic; 5= Advanced

1- Product Engineering

How specialized your firm's capability is in terms of:

(a)Your firm possess the capability of assimilation of product design, minor adaptation to market needs.

(b) Product quality improvement, licensing and assimilating new imported product technology.

(c) In- house product innovations and basic research.

2- Process Engineering

(a) Debugging, quality control preventive maintenance, assimilation of process technology.

(b) Equipment stretching, process adaptation and cost saving.

(c) In-house process innovation.

3- Project Management

(a) Successfully completion of project on time, schedule and budget.

(b) Allocation of required resources on a project.

4- Manufacturing

(a) Understanding of manufacturing processes and capability to improve the manufacturing processes.

(b) Manufacturing flexibility.

(c) Low operating costs.

(d) Components manufacturing.

(e) Supply chain management and production scheduling.

(f) More efficient production system.

5- R&D and Design

(a) Skill in conducting applied R&D.

(b) Ability to transform R&D results to products.

(c) Ability to upgrade existing products.

(d) Ability to improve the overall design and functionality of the components.

(e) Ability to frequently enhance product quality.

PART 6

Technology transfer effectiveness

1. **Exploratory Innovations**

Technology transfer resulted in:

(a) In the last 1-2 years, have your firm designed new parts for the new customers or emerging markets. YES ☐ NO ☐

(b) On the basis of the technology which your firm have received from your assemblers, resulted in open up new markets. YES ☐ NO ☐

(c) Technology transfer resulted in the introduction of new generation of products. YES ☐ NO ☐

(d) Technology transfer resulted in extending the product range for new customers or emerging markets. YES ☐ NO ☐

(e) Your firm invent new products and services. YES ☐ NO ☐

(f) Your firm frequently utilise new opportunities in new markets. YES ☐NO ☐

(g) Your firm commercialize products that are completely new to your firm. YES ☐ NO ☐

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2. **Exploitative Innovations**

Technology transfer resulted in:

(a) In the last 1-2 years, have your firm introduced improved, but existing products for your local assemblers or local market. YES ☐ NO ☐

(b) Technology transfer resulted in improving the existing products quality. YES ☐ NO ☐

(c) Improve production flexibility. YES ☐ NO ☐

(d) We frequently refine the provision of existing products. YES ☐ NO ☐

(e) We regularly implement small adaptations to existing products. YES ☐NO ☐

(f) We improve our provision's efficiency of products. YES ☐ NO ☐

(g) We increase economies of scales in our local market. YES ☐ NO ☐

(h) We expand products for our existing clients. YES ☐ NO ☐

Thank you for completing this questionnaire.

APPENDIX D

Brief Profile of Assemblers

Pak Suzuki Motor Company Ltd.

Pak Suzuki Motor Company Ltd (PSMCL) was established in August 1983 as a joint venture between Suzuki Motor Corporation of Japan (SMC) and Pakistan Automobile Corporation (PACO) Government of Pakistan. The initial share holding of SMC was 12.5% which was gradually increased to 73.09%. Pak Suzuki is in the business of assembling, progressive manufacturing, marketing and distributing Suzuki brand vehicles, i.e. cars, pickups, vans and 4X4 vehicles in Pakistan. Pak Suzuki aims to manufacture/assemble cars for low income class in Pakistan. Pak Suzuki is the leading company in Pakistan in terms of market share.

Indus Motor Company (IMC) Ltd- Toyota

Indus Motor Company Limited (IMC) is a joint venture company set up by Toyota Motor Corporation, Toyota Tsushu Corporation and members of the House of Habib. The company was incorporated in Pakistan as a public limited company in December 1989 and started commercial production in May 1993. IMC is in the business of assembling, progressive manufacturing, marketing and distributing Toyota brand vehicles in Pakistan. All three parties have entered into a Technical Assistance Agreement. Pursuant to this agreement IMC has been granted a license to manufacture Toyota motor vehicles in Pakistan and the provision of technical assistance, know -how and advice to progressively manufacture the Toyota vehicles. Similarly the Diahatsu Motor Co. Limited (Daihatsu) has signed a Technical Assistance Agreement with IMC granting IMC a license to manufacture Daihatsu motor vehicles in Pakistan. Indus Motor Company's plant is the only manufacturing site in the world where both Toyota and Daihatsu brands are being manufactured. IMC's Product line includes 6 variants of the newly introduced Toyota Corolla, Toyota Hilux Single Cabin 4x2 and 4 versions of the Daihatsu Cuore.

Honda Atlas Limited

The third important player in the automobile market is Honda Atlas Limited (HACPL), a joint venture between the Atlas Group and Honda Motor Co. Ltd., Japan. The company was incorporated in November 1992 and a joint venture agreement was signed in August 1993. Atlas has signed a Technical Assistance Agreement with Honda to assemble, manufacture, market and distributes Honda cars in Pakistan.