A Proposed Model for the Management of Knowledge Flows in the International Automobile Industry Supply Chain

Approaches and methodologies with special reference to DaimlerChrysler and Mercedes-Benz Technology Centre

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Declaration

I, the undersigned, hereby declare that the work contained in this assignment is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature

Date

Abstract

This paper discusses concepts concerning the flow of knowledge between organisations. Specifically investigated is the situation concerning global Original Equipment Manufacturers and their suppliers.

The increasing importance of knowledge as a strategic resource for Original Equipment Manufacturers forms the background to this study. Knowledge as resource, if used correctly, enables organisations to create a sustainable competitive advantage within a competitive global business environment.

The analysis applies to Mercedes-Benz Technology Centre as representative organisation. Relevant issues related to the topic and the problem as stated are discussed, with the concepts of knowledge and knowledge management analysed from a theoretical and practical perspective. As a background to an understanding of knowledge management at Mercedes-Benz Technology Centre, knowledge management at Chrysler Corporation, Daimler-Benz and DaimlerChrysler is discussed respectively.

Concepts relating to knowledge flows within the parameters of Original Equipment Manufacturer supply chains are discussed. Differences in the supply chain parameters of Eastern and Western organisations are shown, and the role of knowledge management in supply chains is analysed. Influencing factors within such parameters are also identified. Opportunities and threats emerging from the flow of knowledge between organisations are analysed, while an investigation into trends at automobile suppliers provides insight concerning future expectations.

The necessitating influence of some strategic management issues regarding the need for a model to guide the implementation of a knowledge-sharing programme is discussed. Models and tools for knowledge management in Original Equipment Manufacturer supply chains are analysed and the current models and tools of Mercedes-Benz Technology Centre are used as a benchmark. Against this background a model is proposed for the implementation and management of a knowledge-sharing programme between Original Equipment Manufacturers and suppliers, with specific reference to Mercedes-Benz Technology Centre.

Opsomming

Hierdie werkstuk bespreek konsepte wat die vloei van kennis tussen organisasies betref. Spesifiek van belang vir hierdie studie is die situasie met betrekking tot internasionale voertuigvervaardigers en hulle verskaffers.

Die toenemende belangrikheid van kennis as strategiese bron vir internasionale voertuigvervaardigers vorm die agtergrond tot hierdie studie. Indien dit korrek gebruik word, stel kennis as strategiese bron organisasies in staat om 'n volhoubare, kompeterende voordeel binne 'n globale besigheidsomgewing te behou.

Die analise gebruik die Mercedes-Benz Tegnologiesentrum as verteenwoordigende organisasie. Relevante kwessies met betrekking tot die onderwerp en die gestelde probleem word bespreek, terwyl die konsepte van kennis en kennisbestuur uit 'n teoretiese en pratiese oogpunt bespreek word. Ten einde 'n agtergrond te skep vir 'n beter begrip van kennisbestuur by die Mercedes-Benz Tegnologiesentrum, word die kennisbestuurprosesse van Chrysler, Daimler-Benz en DaimlerChrysler onderskeidelik ondersoek.

Konsepte met betrekking tot kennisvloei binne die parameters van internasionale voertuigvervaardigers en hulle verskaffingskettings word bespreek. Verskille in die verskaffingskettings van Oosterse en Westerse voertuigvervaardigers word geanaliseer. Faktore wat 'n invloed het binne hierdie parameters word ook identifiseer. Geleenthede asook gevare wat uit die vloei van kennis tussen organisasies voortspruit word bespreek, terwyl die ontleding van tendense by verskaffers in die internasionale motorbedryf insig bied in moontlike toekomsverwagtinge wat vervaardigers kan koester .

Strategiese kwessies wat dui op die behoefte aan 'n model om kennisvloei tussen organisasies te bestuur word bespreek. Kennisbestuur in die internasionale motor-vervaardigingsektor se verskaffingsketting word geanaliseer en die huidige modelle en werkswyses van die Mercedes-Benz Tegnologiesentrum word as punt van vergelyking gebruik. Teen hierdie agtergrond word 'n logiese model vir die implementering en bestuur van 'n samewerkingsooreenkoms vir die uitruil van kennis tussen organisasies in die internasionale voertuigvervaardigingsektor voorgestel. Die model het spesifiek betrekking op die Mercedes-Benz Tegnologiesentrum en hulle verskaffingsketting.

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List of Abbreviations

CoP	Community of Practice
E-BoK	Engineering Book of Knowledge
IT	Information Technology
KM	Knowledge Management
MTC	Mercedes-Benz Technology Centre
OEM	Original Equipment Manufacturer
R&D	Research and Development
TQM	Total Quality Management

Chapter 1: Introduction

1.1 Background to the Study

The background to this study is the continuous transformation of the business world, where the right answer at any one time and within a certain context, can become the wrong solution for another time and context (Malhotra 1999). Business organisations have come to realise that in order to sustain a competitive advantage they must actively manage their intellectual resources.

In a global and dynamic business environment, the explosion of unselected information is posing a challenge to organisations. From various literature sources it emerges that possession of the correct information and knowledge will give organisations a leading edge towards sustainable competitiveness (Mann at al 1991, Megill 1997, Prusak 1997, and Rukstad and Coughlan 2001). Aggressive, efficient knowledge management (KM) has become the new mantra for many corporations (Update 1998).

In the pursuit of competitive advantage through innovation, according to Drucker (1993), organisations are finding that knowledge has become "the resource" rather than "a resource" (see also Teresko 1999 and Thurow 1999). In contrast to that, Phaneuf (1996) argues that it is not the knowledge itself that creates a competitive advantage, but the capacity instead to transform knowledge into competencies.

In knowledge-based economies, Malhotra (2000) argues, "everything is up for grabs, including all tried and tested thumb rules, best practices and business models." To remain competitive, organisations should emphasise investment in knowledge and education while constantly searching for new sources of innovation and sustainable competitive advantage (see Teresko 1999, Beijerse 1999, and Audretsch et al 1997). Globalisation depends on managing distributed knowledge, and knowledge assets form an increasing percentage of market valuation. Therefore the Karboul Board Report (2000) argues that the new e-business world is all about leveraging knowledge of customers and suppliers. By having superior intellectual resources, organisations can supply more value to their customers than their competitors can (Leibold 2001).

Although much of the focus on KM has been on the capturing, codifying and sharing of knowledge, the value of KM lies mainly in a focus on learning and innovation (Finerty 1999). Finerty argues that historical borders are toppling and that the efficiency of knowledge flows and learning within an organisation is paramount to competitive advantage. Within a global business environment the scope of potential knowledge sources from which innovation and competitive advantage can be derived is much vaster than the internal parameters of organisations.

It is paramount for global organisations to be aware of their knowledge resources and the effect of the respective environments on these resources. Organisations are also beginning to experience pressure to be attentive to possible innovation-enabling knowledge that exists outside the direct parameters of the firm.

1.2 Scope of the Study

The study will focus on the knowledge flows between Original Equipment Manufacturers (OEM's) and suppliers, with specific reference to Mercedes-Benz Technology Centre (MTC). Academic- and internal documents from DaimlerChrysler will be used extensively, supplemented by research obtained from consultant firms and international business studies. The research done is meant primarily to be applicable to supply-chain relationships in international manufacturing organisations. Medium small enterprises might show some similarities, but it was not the intention to establish such parameters and findings should not be viewed from this perspective.

1.3 Defining the Problem

In view of the importance of knowledge it is essential to identify specific areas of operation where possibilities exist to gain knowledge and therefore promote innovation. From numerous literature resources, the argument emerges that organisations need to be able to generate learning in their business environments, tap knowledge resources outside their own parameters and embrace knowledge sharing instead of knowledge hoarding (see Malhotra 1996, Grayson and O'Dell 1998, and Greengard 1998).

The firm's knowledge base includes its technological competencies, its knowledge of customer needs, suppliers and its way of doing business (Rukstad and Coughlan

2001). Knowledge strategy cannot, however, be formulated in isolation from what competitors are doing, and Zack (Leibold 2001) emphasises that organisations must look at the overall flow of industry knowledge within their business environment.

The extensive links between OEM's and their suppliers is one area where definite possibilities for knowledge innovation exist. Of specific interest is the possibility for and extent of knowledge flows that exist within the international automobile industry supply chain, with specific reference to passenger car development and MTC.

The need to create innovation and competitive advantage through knowledge sharing may however be easier articulated than it is practically implementable. Confusing knowledge and information can cause organisations to spend vast resources that yield only marginal results (Sveiby 1997), while the human part of KM might be the toughest hurdle for organisations to overcome (Martiny 1998). This can be illustrated by citing a survey specially conducted for ITM/Chrysler group in which it was found that information is not as well categorised or organised as people would like it to be, making it more difficult to find information that is readily available and therefore also to share it (Falvey 2000). Knowledge flows and the resultant sharing of knowledge may also have considerable political considerations, which might influence the effectiveness of knowledge sharing programmes (Davenport 1998).

When considering the flow of knowledge between organisations in a supply chain, together with possible influencing factors, the situation becomes complex. Organisations should have a well-structured overview concerning the flow and management of knowledge in their respective business environments. With MTC as the basis of analysis and as representative of OEM's, the following points of discussion can be identified:

- *Relative concepts need to be identified and described*

  In order to comprehend the flow and resultant sharing of knowledge, a clear understanding of all applicable concepts is needed. The state of knowledge management in OEM's in general and MTC specifically should also be analysed.

- *Parameters must be established*

  To enable analysis of applicable knowledge flows, the parameters within which such flows occur need to be established. Relevant influencing factors within

these parameters need to be identified and discussed as well. The identification of common knowledge between entities can reveal tremendous insights into the reasons that, and methods by which, knowledge sharing either succeeds or does not (Dixon 2000). Common knowledge between entities is, however, at the core of a very difficult concept within the KM realm. Dixon emphasises that organisations must be heedful of the fact that not all knowledge can be shared equally. Therefore the identification of benefits from and the establishment of guidelines for reaching set goals for knowledge-flow and sharing programmes are important.

- *Specific strategic management issues must be identified*

  It must be established to what extent current strategic management issues underline the need for knowledge-flow and collaboration programmes. Trigg (1999) argues that some issues are especially relevant for KM areas such as laboratory experimentation and research, specifically applicable to MTC.

- *Models and tools must be identified*

  The management of knowledge flows in the supply chain of an OEM requires models and tools. Existing models and tools used by OEM's need therefore to be identified, and specifically those methods and tools used by MTC as representative of OEM's. Models that might form the basis for the implementation of knowledge-flow and sharing programmes need also be identified or proposed.

1.4 Objective of the Study

The objective is to enhance understanding of knowledge flows in the relationship between OEM's and their suppliers, and to propose a model for the management of a knowledge-flow and collaboration process, with specific reference to MTC and its suppliers.

1.5 Methodology

An enhanced understanding of knowledge flows within the automobile industry supply chain can only be established by forming a basis for analysis first. The

properties of KM within this industry will provide exactly that. For the purpose of examining these properties, both the popular academic literature and practical studies on internal practices are analysed. The scope of the literature review is extensive. Many of the reports that form part of this study are unpublished internal research reports from MTC.

Although the focus is mainly on the most recent literature and available sources, the background to this study contains groundbreaking principles that were established earlier. The literature review aims to establish the current state of research on this topic within the academic realm, while internal documents and processes are utilised to find synergy between practical and theoretical issues regarding the flow of knowledge in OEM supply chains.

This research has been conducted in cycles with intentionally overlapping stages to ensure logical continuance. Therefore, although the various chapters have been researched and handled as individual topics, the study is meant to form a continuous and unbroken picture of the current state of knowledge flows within the supply chain of MTC.

1.6 Framework of the Study

Chapter one introduces the background and aims of this study. This chapter also indicates the areas of concern. The specific focal point is identified, the scope outlined, and possible shortcomings identified. The methodology intends to give the reader an overview of methods and processes used to achieve the stated objective, while ultimately the framework guides the reader through the arguments that follow.

Chapter two forms the basis for the discussion of the problem. The properties of KM within the applicable arena are discussed to create a theoretical base. Practical points are outlined to the extent that the development of KM within the MTC realm is discussed. The current status of KM within MTC forms a base from which the influences of industry supply chains on knowledge flows are discussed.

Chapter three establishes the extent and parameters of the applicable supply chain. The role of KM within the boundaries of supply chains is also examined. Opportunities and threats in this environment are identified and analysed, while

expected trends within the supplier sphere are also identified and the possible influences thereof are discussed.

Chapter four is a review of the current methods and tools used within supply chains. The tools and models used by MTC are also analysed. Two strategic trends indicating the need for a knowledge-collaboration programme provide background for this analysis.

Chapter five discusses a logical and practical model for the management of knowledge flows and a knowledge collaboration programme between organisations. This model is developed with particular reference to MTC and their suppliers.

Chapter six consists of conclusions and recommendations that flow from the study. Attention is given to implications for the MTC supply chain. Opportunities and threats revealed by the study form the basis for specific recommendations.

Chapter 2: Knowledge Management Concepts, with Particular Reference to DaimlerChrysler and Mercedes-Benz Technology Centre

2.1 Introduction

In order to analyse the problem (see 1.3) initial parameters for discussion are essential. A clear understanding of the applicable concepts will provide a logical starting point. Therefore, the analysis of knowledge flows between entities requires a clear grasp of what knowledge entails.

Numerous perspectives on KM have been put forward, as is evident from the literature reviewed. An enquiry into the meaning and depth of all of these will raise a multitude of issues that cannot be covered within the scope of this study. Therefore only an overview of relevant concepts and definitions in the industry will be given. Knowledge flows in the automobile industry will be analysed, with specific focus on MTC.

Some organisations might assume that knowledge is readily available to those who need it, and that the dissemination of such knowledge occurs as a matter of course. However, Duffy (2000) rightly argues that many elements of KM are not systematic and that such a misconception can be costly. Organisations must therefore know what their knowledge sources consist of and to what extent knowledge flows influence these sources. This will enable them to optimise innovation possibilities and therefore to gain competitive advantage.

2.2 Properties

In order to understand the relevant concepts it is helpful to divide this section into two different parts. The first part will focus specifically on knowledge and its properties, and the second part will deal with the management of knowledge.

2.2.1 Knowledge

Knowledge and information are not the same thing. Knowledge is recognised in most definitions as being more than information (Weggeman 1997, Hertog et al 1997, Beijerse 1999, and Duffy 2000). According to Duffy (2000) information is a commodity and easy to obtain, while knowledge is information enriched through interpretation, analysis and context. This view is supported by Davenport and Völpel (2001), who point out that humans add insight, interpretation, context, experience and wisdom to information in order to form knowledge. The differences between data, information and knowledge can be summarised as follows:

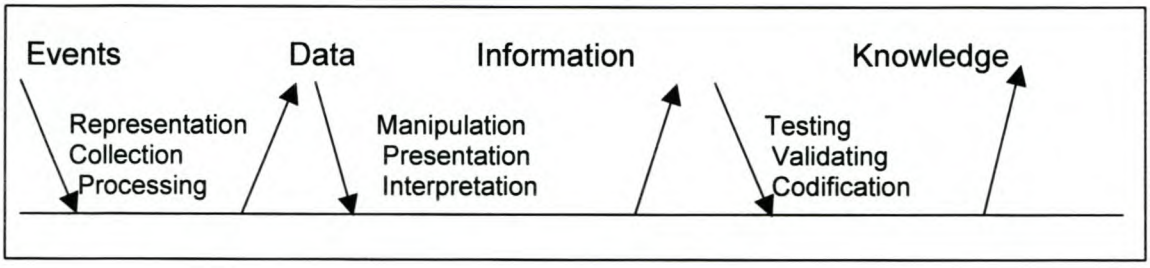
Table 2.1 Data, Information and Knowledge

Data	Information	Knowledge
Simple observations of states of the world	**Data endowed with relevance and purpose**	**Valuable information from the human mind. Includes reflection, synthesis and context**
• Easily structured • Easily captured on machines • Often quantified • Easily transferred	• Require units of analysis • Need consensus on meaning • Human mediation necessary	• Hard to structure • Difficult to capture on machines • Often tacit • Hard to transfer

Source: Davenport and Prusak (1997)

Skandia a leader in KM, defines and conceptualises knowledge in a way that supports the above. However, Koulopoulos and Frappaolo (2000) argue that organisations must be careful not to draw too broad a distinction between knowledge and information. They argue that knowledge-driven enterprises are often only as effective as the information from which they learn.

Figure 2.1 Conceptualising Knowledge at Skandia



Source: Prusak (1997 (b))

Knowledge, as an independent concept, has been described as early as 1958 as having two different realms, namely tacit and explicit knowledge (Polanyi 1958). This two-fold classification was further analysed and explained in the authoritative work of Nonaka and Takeuchi (1995). The authors state that assets such as intangible insights, intuitions, hunches, gut feelings, values, images and metaphors are often overlooked by management, but that mining these resources can be of huge value to organisations. They divide tacit knowledge into two segments. The first contains the technical 'know-how' that a master craftsman might have, for example. The second segment concerns the cognitive dimension that consists of schemata, mental models, beliefs and perceptions. While tacit knowledge is difficult to describe, explicit knowledge on the other hand is normally well documented.

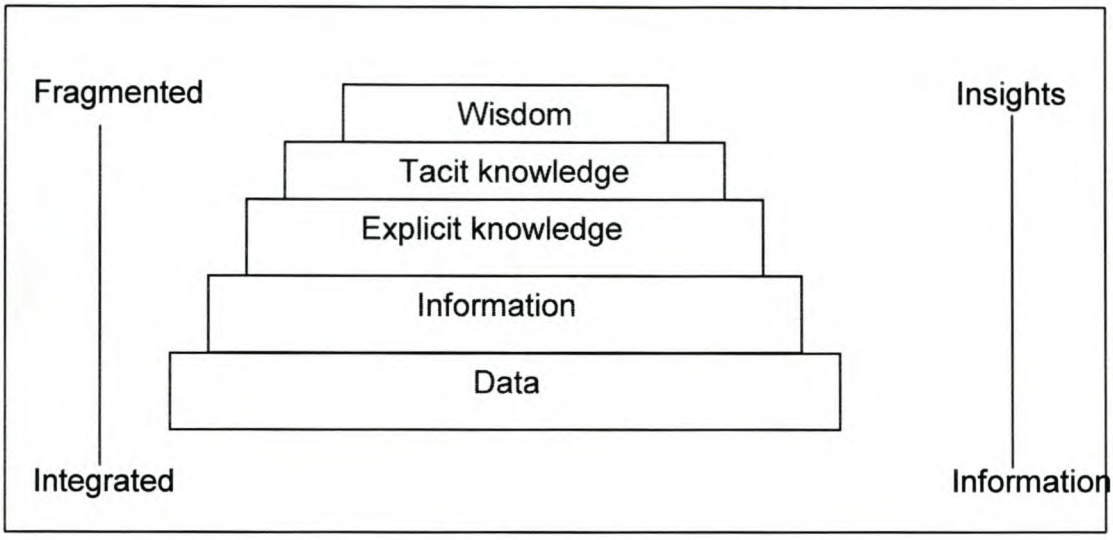
Table 2.2 Two Types of Knowledge

Tacit Knowledge **(Subjective)**	**Explicit Knowledge** **(Objective)**
Knowledge of experience (body)	Knowledge of rationality (mind)
Simultaneous knowledge (here and now)	Sequential knowledge (there and then)
Analogue knowledge (practice)	Digital knowledge (theory)

Source: Nonaka and Takeuchi (1995)

Figure 2.2 contains a visual depiction of the different concepts of knowledge.

Figure 2.2 Hierarchy of Knowledge



Source: Rajan (1999)

Tacit and explicit knowledge leads to a distinction between codification and personalisation, which according to Hansen et al (1999) involve an organisation's primary approach to knowledge transfer. Codification approaches rely primarily on explicit knowledge, while personalisation implies that knowledge transfers are mainly effected by the direct interaction among people.

For people, knowledge never becomes obsolete according to Duffy (2000). He argues that people do not unlearn what they already know. The same cannot in my view be said about organisations, especially if much of the organisation's 'know-how' is embedded in its employees, key employees may be lost. In support of this view, Krackhardt and Hanson (Prusak 1997) argue that the informal organisation and interaction of employees form the central nervous system of organisations, and through the wise use of codification and personalisation beneficial knowledge flows can be established.

However, people do not always know to what extent their expertise is essential to an organisation. Especially with regard to individuals that interact within supply chains, it is important that an organisation should know who possesses what knowledge, what

new knowledge they may obtain, and that it should have a good knowledge management framework.

2.2.2 Knowledge Management

Using the definition of Daft (1993), management as independent concept can be said to be the "attainment of organizational goals in an effective and efficient manner through planning, organizing, leading and controlling organizational resources".

Knowledge as independent concept has also been identified and defined, and these two concepts can now be integrated to form a synergistic whole.

KM is not a new process per se, and organisations have been trying to harness their internal processes and resources for some years with various management drives such as Total Quality Management (TQM), expert systems and core competencies (Gupta et al 2000, see also Liebowitz 1999).

KM enables organisations to improve organisational performance by acting more "intelligent" (Wiig 1993). The term KM is commonly used with reference to information and the utilisation thereof within organisations. Knowledge and information are not the same thing however, and therefore in organisations where KM has become important (in the new knowledge economy), it is much more than information management (Duffy 2000).

Various definitions of KM have been put forward. From these definitions it becomes clear that strategy and the realisation of specific identified goals are essential to KM. Beijerse (1999) identifies four elements of knowledge management, which consistently appear in definitions of this concept:

- The formulation of strategy
- Realising the strategy
- The organisation serves as a tool in fulfilling these functions
- It is people who manage and who are being managed

Definitions of Knowledge Management

"Knowledge management is concerned with the exploitation and development of the knowledge assets of an organisation with a view to furthering the organisation's objectives."

Davenport et al (1998)

"Knowledge management is a process for acquiring, organising, documenting, sharing and applying knowledge."

(Mahaffie 1999)

"Knowledge management is the strategy-driven motivation and facilitation of people, aimed at reaching the organizational goals."

(Beijerse 1999)

Natarajan and Shekhar (2000) argue that **knowledge management entails the management of the collective knowledge of individuals in an organisation, which need to be identified, tapped, organised and retrieved.**

"Knowledge management embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings."

(Malhotra 20001)

Sources: Davenport et al (1998), Mahaffie (1999), Beijerse (1999), Natarajan and Shekhar (20000, and Malhotra (2001)

KM is not, however, viewed from only one perspective. Rowley (1999) correctly states that it is important to notice the different perspectives on KM. According to Beckman (1998), the following perspectives on KM can be identified:

- Conceptual

  This perspective is concerned with defining and describing the foundations and frameworks of KM (Beckman 1998). Subjects that are covered include the definitions, dimensions and typologies of knowledge and its management (Turban 1992, Sowa 1984, Wiig 1993, Grant1999).

- Process

  Beckman (1998) argues that in order to transform knowledge into a valuable organisational asset, knowledge, experience and expertise must be formalised, distributed, shared and applied. Thus KM is seen as a fundamental part of the strategy to use expertise in the creation of a sustainable competitive advantage (Liebowitz 1999). Probst (1998) provides a very authoritative and well-structured model with regard to the process of KM in organisations.

- Technology

  While Beckman (1998) supports the value of information technology in KM, Liebowitz (1999) notes the significant difference of opinion regarding the value of information technology and expert systems to enable KM to work. From the technology perspective, however, neural networks, computer simulations, databanks and other technologies are considered important for the management of knowledge.

  From numerous literature resources it emerges that KM is moving away from a technological perspective towards a more people-orientated view (Jensen 1998, Lamb 2001, Sveiby 2001). Sveiby argues that the "people-track", although old in theory is still very new in the field of KM, but that the issues are the creation of new knowledge and also the conductive sharing of knowledge.

- Organisational

  From this perspective, the organisation and the reciprocal influence between structure and KM are looked at. A number of authors have written about specific organisational forms that are better equipped for KM and the sharing of knowledge (McGill and Slocum 1994, Davenport and Prusak 1998).

  Characteristics of the knowledge organisation include that it is a high-performance, customer-driven, improvement-driven and excellence-driven organisation; high in flexibility and adaptiveness; with high levels of expertise and knowledge; and high rates of learning and innovation. It is also an innovative, IT-enabled, self-directed, managed, proactive and futurist organisation; which values expertise and sharing of knowledge (see Liebowitz 1999 and Beckman 1998).

Although very hierarchical, MTC does posses a significant number of these attributes, making KM programmes both easier and more viable to implement.

- Management

  According to Liebowitz (1999) "[m]anagement must, if needed, change the existing culture and mindsets so that they are receptive, supportive, and committed to the precepts of the knowledge organisation". Therefore, to create an effective and proactive KM environment, it is essential that managers understand KM's importance and their influence on the organisation's ability to create such an environment.

- Implementation

  This includes the different factors that predict and facilitate success (Liebowitz 1999). It also entails the practical inhibition to KM implementation as it occurs in the corporate environment.

Taking this into account, DaimlerChrysler's MTC can be used as basis, for the analysis of knowledge flows in the supply chain.

2.3 Knowledge Management at DaimlerChrysler AG

Automobile manufacturing is a complex process. DaimlerChrysler builds many models of vehicles with distinctive features. At MTC innovative ways must be found to utilise and combine knowledge, to ensure top research and development (R&D). However, formal knowledge management processes have been implemented in recent years only. To understand the evolution and current status of KM at MTC, the evolution and current status of KM at DaimlerChrysler need to be analysed.

The KM system of both DaimlerChrysler and MTC is built on the principle of Tech-Clubs. Tech-Clubs are officially known as communities of practice (CoP), and a short theoretical background in this regard will enhance an understanding of the KM programme of MTC.

2.3.1 Communities of Practice

There is a unified idea of what communities of practice (CoP's) consist of. The principles of CoP's can be summarised as follows:

- Networks of people form groups or communities
- Within these communities there are information and knowledge flows
- The relationship and structure are mostly informal
- Everyone is part of at least one community
- Communities can evolve and change
- Communities often cross traditional boundaries

Lave and Wenger first introduced the concept in 1991. According to them CoP's are "a set of relationships among persons, activity, and world, over time and in relation with other tangential and overlapping CoP's". Manville and Foote (1996) argue that CoP's are: "a group of professionals informally bound to one another through exposure to a common class of problems, common pursuit of solutions, and thereby themselves embodying a store of knowledge". CoP's "house the valuable knowledge and practise of how things really get done in an organisation and where people really learn" (Cohen and Prusak 2001).

Communities of practice exist in every organisation and are not bound by affiliations, because membership is based on participation (Wenger 1998). The author states that these communities can be found within businesses, across business units and across company boundaries. This argument is supported by Lesser and Everest (2001), who argue that CoP's differ significantly from other types of organisational structures, by being primarily informal. They state that communities of practice emerge from existing networks of individuals, often crossing traditional boundaries (see also Jubert 1999).

Communities of practice emerge from a common desire amongst their members to achieve change (Wesley and Buysse 2001). The authors argue that CoP's provide regular opportunities for collaborative reflection and inquiry through dialogue, and ultimately develop common tools (see also Wenger and William 2000). Adams and Freeman (2000) further argue that communities of practice evolve just as human

relationships do. The global influence on a corporation like DaimlerChrysler also reflects the possibility of virtual CoP's, where communities exist and interact electronically. In order for engineers and scientists to share their experiences across national boundaries and within organisations, a tool like the Intranet is becoming increasingly important.

A distinction need however be made between CoP's, international teams and project teams. International teams are seen as an effective and flexible means of bringing both skills and expertise to specific problems, and they are increasingly being used by organisations (Hildreth et al 2000; see also Castells 1996, Lipnack and Stamps 1997, and West et al 1997). The authors recognise, however, that CoP's are more than teams. It is specifically the formal nature of interaction within teams that differentiate them form CoP's. Wenger and Snyder (2000) also emphasise that managers create teams, while communities are informal (see also Burk 2000). Hildreth et al (2000) state that teams can evolve into CoP's, as informal relationships develop and the source of legitimisation changes in emphasis. The distinction between communities of practice and project teams is that project teams have direct responsibility for the production or completion of a specific task within a given time-period (Lesser and Everest 2001). A CoP sets its own agenda over its life span, defining itself by the needs of its members.

CoP's are not an isolated phenomenon and are everywhere. Involvement within different communities may differ, but we are all part of them and knowledge sharing is central to their existence. However, as CoP's are formed they create boundaries between those who engage in the practice and those who do not (Wenger 1996). This can lead to the creation of new knowledge pockets and organisations should be careful not to defy the purpose of CoP's by isolating knowledge. Active management of the soft assets of the organisation is therefore essential to ensure that knowledge does not stay stagnant, but becomes transparent throughout the firm.

The distinction between "bottom-up" communities and "top-down" communities is also important. The difference lies in the point of departure of a specific community (Fontaine 2001). Communities of practice can either evolve from a core group who meet informally and in such a way are absorbed from the bottom into the company, or they can be deliberately created through conscious management of an organisation's soft assets. At MTC, it will be shown, there is mostly a "top-down"

implementation of CoP's, but this ensures cooperation and beneficial knowledge flows.

At MTC Tech Clubs are formally organised in order to create beneficial knowledge sharing. They are created to last longer than one specific project, and McDermott (2000) makes a valid point when he argues that, as CoP's are different from traditional organisational structures, there is a need to support these communities through the use of teams. Therefore the emphasis should not only be on the creation of CoP's for knowledge flows and knowledge sharing, but also on methods to support and sustain CoP's.

2.3.2 Chrysler Corporation

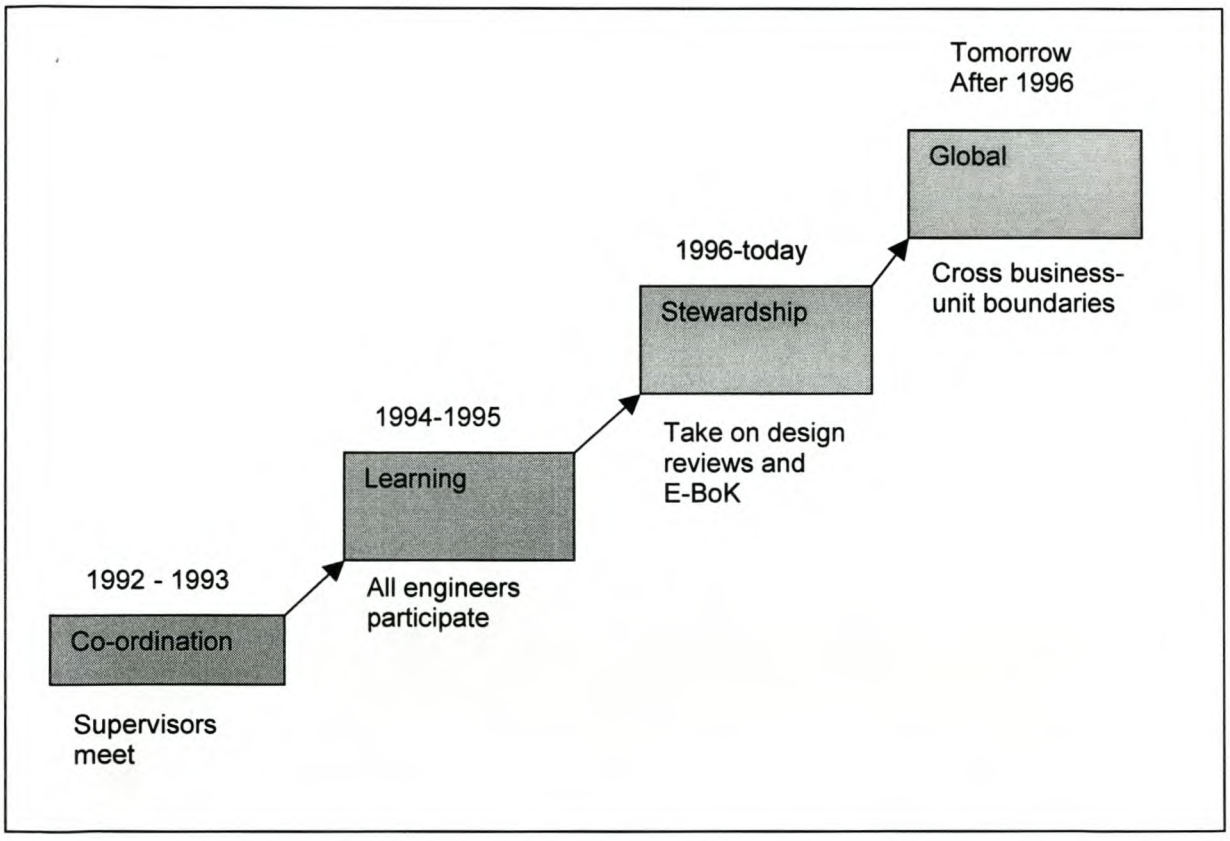
In the early 1990s Chrysler's awareness of KM issues was heightened by financial trouble (Rukstad and Coughlan 2001). Under the leadership of the head of engineering, Francios Castaing, the company instituted a number of "heavy teams" with the cross-functional responsibility of building vehicle platforms for all classes of production (Rukstad and Coughan 2001). This allowed them to use the same chassis to build many outwardly different automobiles. The shift to heavy teams also led to problems, however. According to engineers, " It was as if Chrysler was forgetting its own solutions and procedures on how to build cars" (Jacobson 1997).

This led to a three-step solution. Firstly, engineers mapped out knowledge "pockets". Secondly, Castaing ordered informal cross-platform "Tech Clubs" to be created, which facilitated interaction between all interest groups within a specific area. Thirdly, the engineering book of knowledge (E-BoK) was created to capture knowledge being created within this Tech Clubs. This cross-functional approach enabled the organisation to become skilled in discovering markets and to rapidly meet emerging needs (Rukstad and Coughlan 2001).

True to the nature of CoP's, Tech Clubs are not stagnant. Since its incorporation at Chrysler in the early 90s Tech Clubs went through certain distinct phases: In the first few years supervisors from sub-speciality areas would meet to discuss certain issues related to parts, suppliers, and new technologies. They realised that the learning taking place could be enhanced and leveraged if all engineers in a given speciality area participated. Clubs started to invite representatives from purchasing, warranty analysis and scientific labs. As the Tech Clubs matured, they took more active

responsibility for their area of expertise. It was in that time (1996) that Jack Tompson came up with the idea of creating an engineering book of knowledge (E-BoK). Currently Tech Clubs face the challenge to broaden participation across functions and business units. At present it is realised that closer links with functional areas such as manufacturing, sales and marketing, and quality management will be beneficial.

Figure 2.3 Development of Tech Clubs at Chrysler



Source: DaimlerChrysler internal documents

2.3.3 Daimler-Benz AG

Daimler-Benz did not suffer the same problems as Chrysler. According to Rukstad and Coughlan (2001), "Germany's tradition of vocational training for skilled workers, technicians and engineers provided a built-in structure for the exchange of tacit knowledge from one generation of engineers to the next". The authors state, however, that Daimler had problems, which related to creativity and flexibility. In an

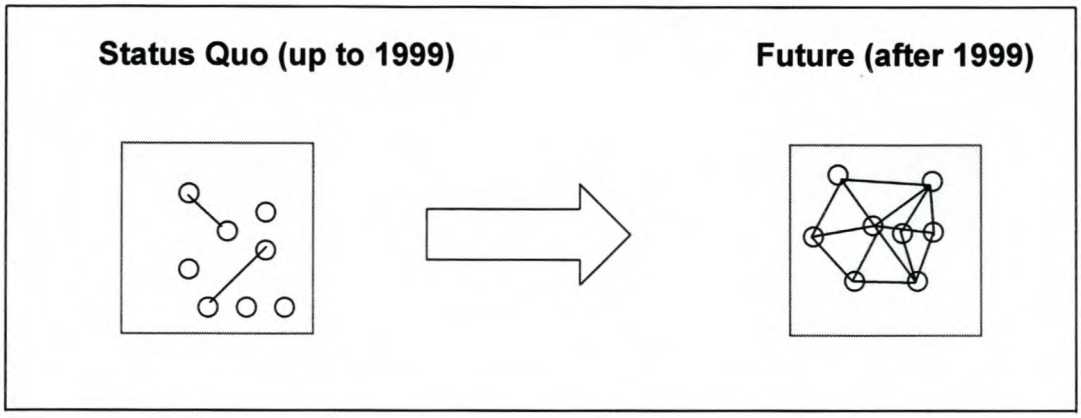
attempt to thwart the threat of stagnating demand for their products, a resurgent currency and quality improvements by competitors, they made some awkward attempts to enter new markets (Rukstad and Coughlan 2001). In this process they encountered a lot of setbacks and problems, resulting in a survey by Arthur D. Little to compile a list of lessons learned. Daimler learned a valuable lesson. According to Oesterle (Rukstad and Coughlan 2001) the knowledge managers of Daimler-Benz concluded that the workers who would benefit most from specific knowledge were the ones who were supposed to gather it, and not "learning champions" or specialists. Daimler-Benz wanted the same system as Chrysler's Tech Clubs and E-BoK programme. While Daimler-Benz did not develop a formal KM programme before the merger, they did establish Daimler Corporate University, with the purpose of instructing corporate executives in strategic thinking (Rukstad and Coughlan 2001).

2.3.4 DaimlerChrysler AG

Daimler-Benz and Chrysler merged in 1998, according to Rukstad and Coughlan (2001) with the objectives of containing three central threats: global overcapacity, changing markets and rising costs. According to the authors most people were able to recognise the value of KM once the merger was completed (see also Irish et al 1999). Rukstad and Coughlan (2001) state that especially two projects outlined the value of sharing knowledge across company borders. The first was a project to demonstrate how engineers from both companies may learn from each other, and the second a project aimed at corporate management and the sharing of knowledge.

In 1999 a number of business units were already implementing KM initiatives, but the (Project team Irish et al 1999) proposed that the company move to a more integrated approach. Instead of separate knowledge pockets a more unified and standard approach was proposed. The Project Team (Irish et al 1999) envisioned such an approach as the direction that KM should take.

Figure 2.4 Knowledge Evolution at DaimlerChrysler



Source: Irish et al (1999)

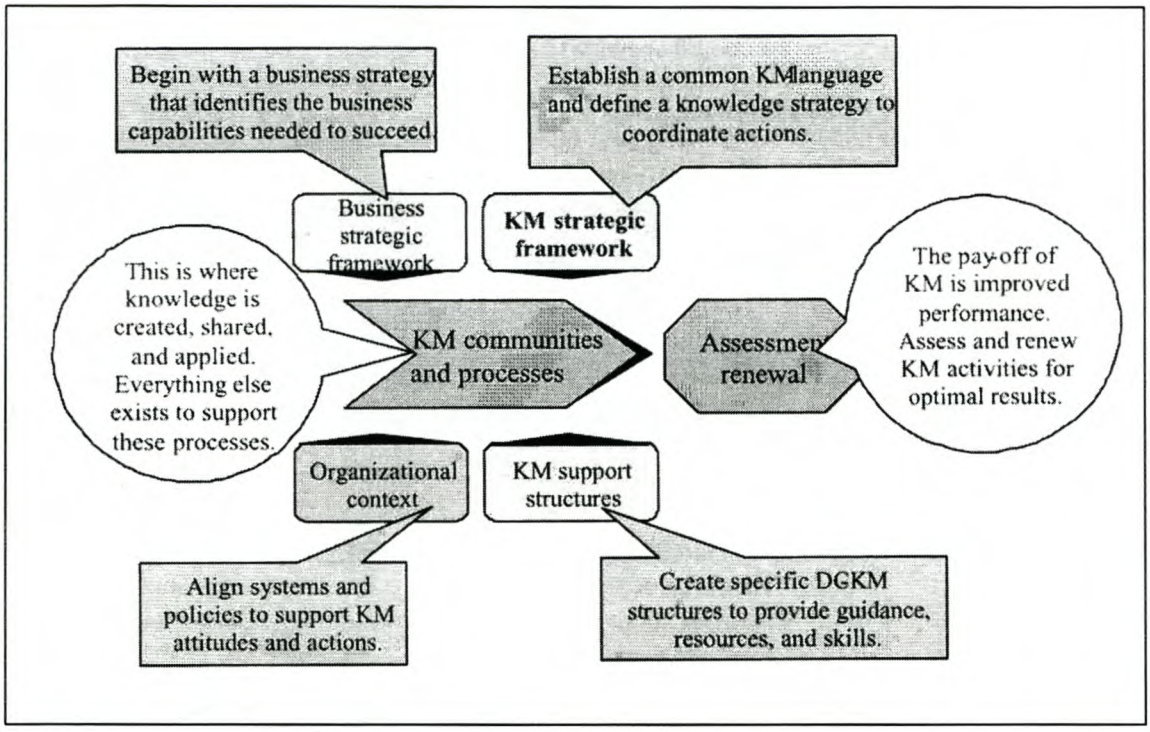
DaimlerChrysler aimed to identify specific areas of critical knowledge around the company. The communities of practice involved in these areas, were to build, share and apply knowledge (Rukstad and Coughlan 2001). The authors state that these groups would meet to share knowledge, solve problems, exchange best practices and build knowledge bases, tools and standards.

The need for a Corporate Knowledge Management Community of Practice (KM CoP) was also recognised and was founded in October 1999 with the following mission statement. "The DaimlerChrysler KM community helps DaimlerChrysler to build, share, and apply the best knowledge available to achieve superior business results."(Internal documents).

2.4 Mercedes-Benz Technology Centre

After the merger, Tech Clubs or CoP's were set up in Germany too. Figures 2.5, 2.6 and 2.7 demonstrate the extent to which KM is implemented within the organisation and what the structure of knowledge management is.

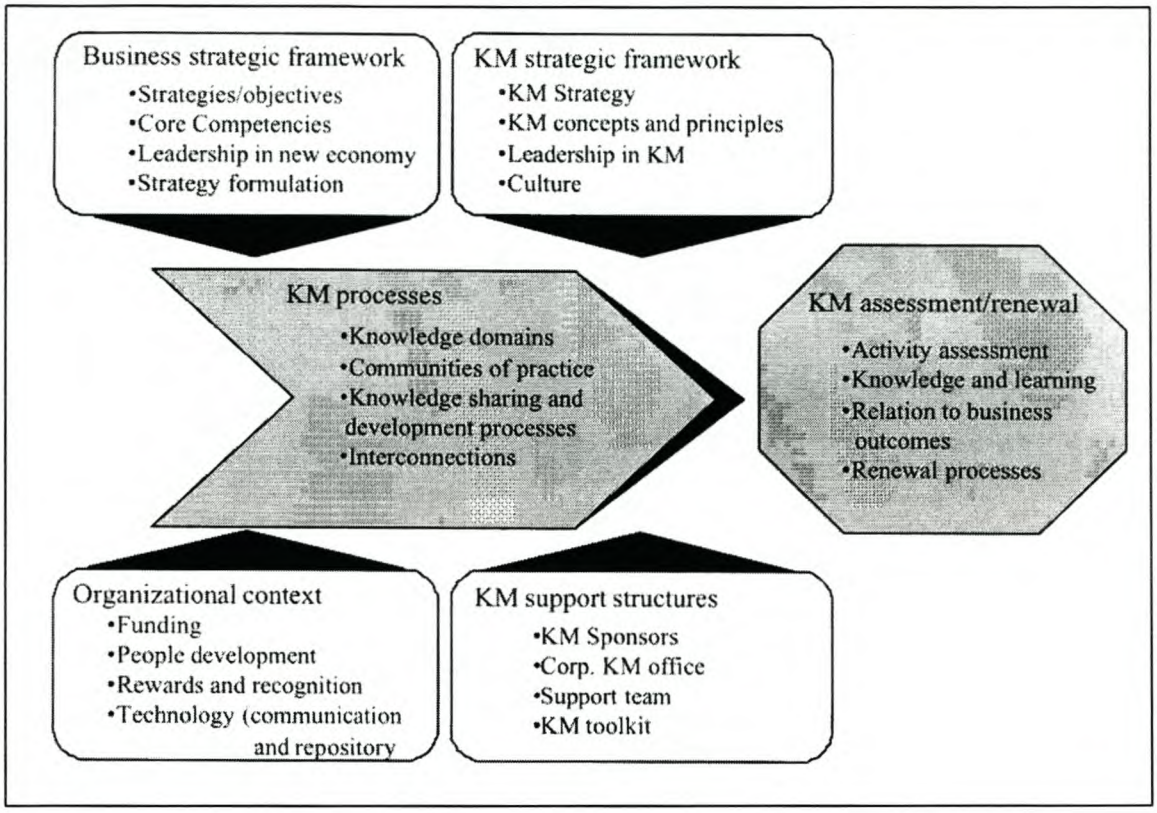
Figure 2.5 Structure of KM at DaimlerChrysler



Source: DaimlerChrysler Internal documents

Knowledge sharing is at the core of the KM process within the company. At present the role of the formal KM department of MTC is shifting to a supportive role for the different Tech Clubs that have been implemented in recent years. Support for these communities is essential in order to ensure that the organisation will improve its knowledge sharing and thus its performance even further.

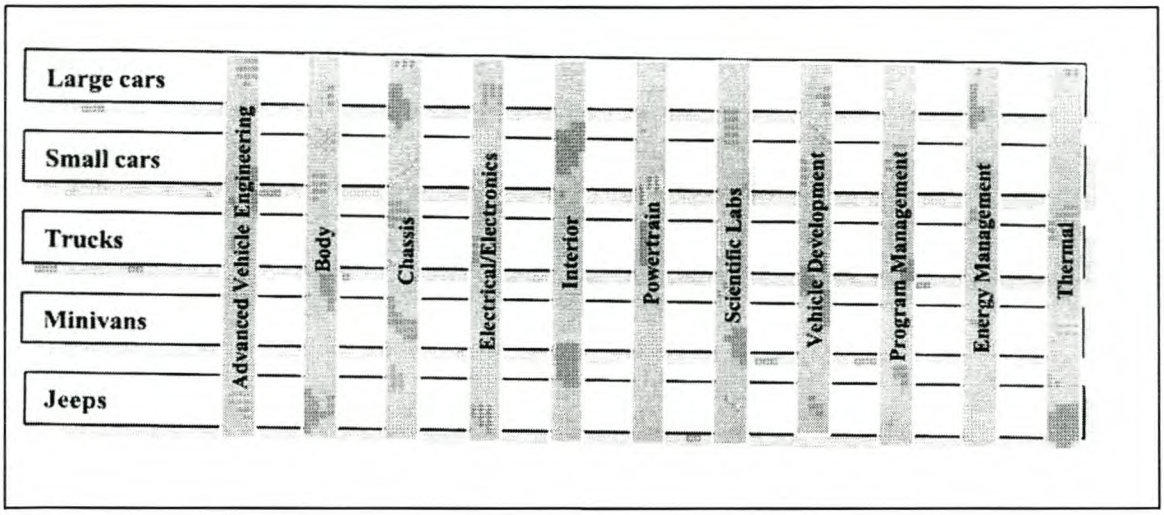
Figure 2.6 Key Elements of Knowledge Management at DaimlerChrysler



Source: DaimlerChrysler Internal documents

From the key elements of KM in MTC the specific focal points of the knowledge strategy can be identified. One area that needs to be specifically mentioned is the role of the E-BoK. The E-BoK plays an essential role in KM at MTC. With this tool all relevant knowledge and lessons learned are captured in such a fashion that they are easily accessible. Employees who experience a problem in a field can access this vast source of knowledge, to either gain the necessary insight from someone that also had the problem, and found a solution, or alternatively to find someone with whom the problem can be discussed. Tech Clubs are under an obligation to insert knowledge and experience gained into the E-BoK. The E-BoK is logically structured and designed to be user-friendly and to produce beneficial results.

Figure 2.7 Structure of Tech Clubs



Source: DaimlerChrysler internal documents

Tech Clubs have been formed across the eight main disciplines in product development. Roles associated with the Tech Clubs and the E-BoK include the following:

- Executive Tech Club members select Tech Club chairs and E-BoK co-ordinators, review decisions and recommendations, identify E-BoK topics, and assign book owners.
- Tech Club chairs organise meetings, set agendas, coach presenters, follow up on decisions, co-ordinate with other groups, and network with members to identify issues and build community.
- The Tech Club E-BoK co-ordinators ensure that all E-BoK sections have a peer review and formally approve new sections for release to the readers.
- Book owners co-ordinate the writing of E-BoK chapters for their discipline, identify sections, assign section authors, follow up on feedback, and monitor progress.
- Section authors write E-BoK sections and respond to feedback; they may be assisted by a team of reviewers from each platform.
- Readers provide feedback and suggestions for new contents.

Not only has KM been implemented in the organisation, it is also an ongoing process. Specific tasks have been set for the Corporate Knowledge Management Community of Practice. These tasks serve to support the background sketched, and also give an indication of the direction of KM in following years.

The tasks set out for the KM CoP from the year 2000 includes:

- Defining company-wide guidelines and roadmaps for KM
- Establishing metrics to measure the value-added qualities of KM
- Provision of start-up support for KM efforts in different business units and staff functions

Source: DaimlerChrysler Internal documents

2.5 Summary

The concept of knowledge has been defined, and the differences between knowledge, data and information have been clearly shown. These differences essentially keep a clear distinction between soft assets and useless data or information.

For the purpose of this study, knowledge can be regarded as all relevant know-how; codified and non-codified knowledge that is possessed by knowledge agents, who are interacting within the supply chains involved. Knowledge agents might lead MTC to anticipate future trends, make forecasts and to generally improve performance. KM as a concept, has also been identified and its relevant aspects outlined. Understanding these concepts allows for better comprehension of knowledge flows involved in supply chains.

With regard to the properties of CoP's a unified idea emerges from the literature. It is clear that although they are formally known as CoP's, Tech Clubs also have other attributes. They seem to posses combined attributes of CoP's, teams and project teams. Tech Clubs are both formal and informal and created by management. Tech Clubs do not operate under time constraints like project teams, but do work towards the integration of knowledge and solving of specific problems as a specific goal.

Knowledge as an asset only became formally important to management during the past decade, and the concept's increasing importance since its incorporation at

Daimler in the early 1990's is clear. Testimony of the benefits of soft asset management at MTC, is the vast improvement in development times through the use of knowledge tools such as the E-BoK system.

Chapter 3:Knowledge Flows in Supply Chains with Particular Reference to DaimlerChrysler and Mercedes-Benz Technology Centre

3.1 Introduction

Knowledge, the management thereof and the status of KM at MTC have been discussed. It is essential to comprehend the boundaries between which knowledge flows will be analysed.

An overview of relevant supply chains creates a parameter for the study of knowledge flows. The specific role of KM in supply chains serves as a guideline to understand and analyse supply chain relationships and also corresponding knowledge flows.

Within the European automobile market, value chains in different territories exhibit different operational requirements. Different positions in one supply chain give rise to different operational requirements (Harland 1997). Therefore it is argued that KM will also have different levels of importance in different areas of the supply chain.

The term, supply chain, involves such a huge field to be analysed that its scope needs to be narrowed down. As a background for the analysis of knowledge flows the relationship between MTC and its suppliers will be used as representative of OEM's. In order to obtain an overview of the supply chain, relevant academic and internal studies will be looked at. Although there might be many similarities with other supply chain relationships, it is not the intention to establish broad supply chain principles and thus be misleading. The purpose is to establish the parameters of the supply chain in the automobile industry only, with specific reference to MTC.

The focus will be on basic-level knowledge that is mutually beneficial to all parties involved. More sensitive knowledge and flows thereof, like innovation and specific know-how, will not be analysed, as it is not the intention of organisations to share such knowledge. Apart from the flows of knowledge, the factors that influence these flows, with the resulting opportunities and threats, are also relevant. The possible influence of future trends in the supply chain on knowledge flows and innovation will also be analysed.

The objective of this chapter is to create a picture of the relevant knowledge flows within the supply connection of MTC and its suppliers as representative of OEM's. By identifying areas of knowledge flows and the knowledge specific to these areas, the aim in the following chapter is to identify and establish a methodology with which to create, enhance and manage mutually beneficial flows of knowledge.

3.2 Overview of Supply Chains

The production and delivery of automobiles involve multi-tiered supply processes. Parts are fabricated, combined and finally assembled into a car. Value-added services expand the manufacturing organisation's ability to compete beyond traditional measures of manufacturing competitiveness, such as cost, quality, flexibility, and delivery (Youngdahl and Arvinder 2000). Organisations must find innovative ways to continuously improve performance and to add value, and supply chains offer such possibilities.

A review of supply chain definitions presents an overview of the parameters within which knowledge flows will be analysed.

The APICS dictionary (Cox et al 1995) describes the supply chain as: "The process from the initial raw materials to the ultimate consumption of the finished product linking across supplier-user companies; and secondly the functions within and outside a company that enable the value chain to make products and provide services to the customer".

The Supply Chain Council (1997) uses the following definition: "The supply chain encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer." (See also Monczka et al 1998 and Jones and Riley 1985.) Quinn (1997) identifies planning, sourcing, making and delivering as the basic processes involved in the supply chain.

From an extended review of the literature, Lummus and Vokurka (1999) supply a summary definition: "All the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer, and the information systems necessary to monitor all of these activities".

A supply chain can thus be seen as the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.

The factors that the Boston Consulting Group (2000) considers as important to a supply chain are shown in table 3.1. These factors should be well integrated into a whole in order to prohibit supply chain "indigestion". These factors also provide a good summary picture of a supply chain ecosystem.

Table 3.1 Elements of Supply Chains

Element	Description
Volume	Scale of, for example, factories, warehouses, and distribution. Volume of products flowing through the system.
Velocity	Speed, as measured by, for example, lead times, order-to-delivery times, inventory turns, and product development times.
Variety	Product variety, including product configurations, stock-keeping units (SKU's), platforms, component SKU's, and brands. Process variety, including number of production lines, facilities, and processing technologies.
Volatility	Demand variability, inventory variability, schedule stability, supplier reliability, and production yields.
Value	Price realisation adjusted for markdowns, incentives, and obsolescence. Amount of cost built into inventories and work in process, including materials, value added, facilities, handling, and financing.

Source: Boston Consulting Group (2000)

For current purposes the supply chain relationships applicable are only those between MTC as customer and the direct suppliers involved in the supplying of materials and components. The organisation then uses these suppliers to create value and in their turn supply that to the end user. The focus therefore falls on a small

part of the entire supply chain and specifically on knowledge flows within this parameter.

3.2.1 Mercedes-Benz Technology Centre

MTC has near to 900 different suppliers (internal documents), but the top 20% of those suppliers are responsible for 80% of the resources delivered to the organisation. It is therefore logical to assume that knowledge flows between MTC and some specific organisations are more relevant than between MTC and others. A distinction must therefore be made between different forms of suppliers in the MTC supply chain. The organisation does categorise its suppliers into three groups namely Tier 1, 2 and 3 suppliers (internal documents) according to the amount of business done with a supplier. Therefore the flow of knowledge between MTC and Tier 1 suppliers can be assumed to be most relevant.

3.2.2 Western and Eastern Approaches

From research it emerges that OEM's from Eastern cultures and specifically Japanese automobile manufacturers tend to have fewer suppliers, and the link between these OEM's and suppliers is much closer. According to Karlsson and Norr (1994) it is unusual for Japanese OEM's to change their suppliers. Instead, they regard their suppliers as "external manufacturing units" and argue that the buyer function fulfils an important role in supporting their suppliers both financially and in other ways (Karlsson and Norr 1994).

Japanese automobile manufacturers have networks of suppliers of which some are affiliated and others independent (Kim and Michell 1999). (This information is supported by Storey 1994). Within these boundaries three types of suppliers exist. The first type comprises a small category of suppliers, which are very close to the manufacturer (Kim and Michell 1999), and are generally subsidiaries or affiliated companies. The second category is bigger (Kim and Michell 1999), and according to an earlier study by Asanuma (1993) consists of between one and four hundred suppliers, which are not limited to the inner group but also include independent companies. The third group represents second tier supplier associations, and

suppliers in this group tend to manufacture more standardised parts (Kim and Michell 1999) (see also Smitka 1991).

However, in the West and specifically in the US, according to Womack (1990), OEM manufacturers maintain arms-length arrangements with suppliers. This distant approach results in manufacturers sharing a large number of suppliers. Dyer et al (1996) investigated the suppliers of three US and two Japanese automotive manufacturers. They identified and categorised the suppliers according to the most independent and the closest relational suppliers. It was found that in the US there was no significant difference between the two categories except in the duration of contracts. This supply chain consists, therefore, not necessarily of classes of suppliers but rather of many different organisations, who might even deliver overlapping material to OEM's in different areas.

In Japan, however, both categories presented very high levels of trust. It was already argued by Whitley et al (1992) that the level of trust in this environment is not dependent on the buyer-supplier relationship but is embedded in society. Echeverri-Carroll (1999) also states that Japanese and "traditional" US firms differ with regard to their inter-firm knowledge systems. In particular the author states that Japanese firms tend to exchange information more frequently with their main suppliers.

The difference shown is clear. The Japanese focus is on relationships and correspondingly knowledge flows, as opposed to a more Western approach with MTC as representative. It is generally acknowledged within the industry that Japanese automobile manufacturers have faster developing times than their Western counterparts, while developing costs are low and quality is high. It might be exactly the attitude and approach of Japanese manufacturers that may give them the leading edge in the race for innovation and quality through knowledge.

3.3 The role of Knowledge Management in Supply Chains

Numerous studies (Stiglitz 1987, Lundvall 1992, and Freeman 1994) seem to support the argument that innovation in firms is a function of interactive learning that occurs in the context of formal and informal relationships between firms. This argument is also apparent in the work of Kim and Mauborgne (1997) who state that the creation and sharing of knowledge are essential to fostering innovation, the key challenge of the knowledge economy.

At present it is recognised that an organisation may structure its supply chain in a manner that resembles an alliance (Blois 1996, Kaufman et al 2000). Knowledge-sharing networks are increasingly important to the competitive success of OEM's because 70 percent of the value of a vehicle is produced within the supply chain (Dyer 1999). Toyota provides a good example. Dyer (1999) states that Toyota and its suppliers have superior knowledge transfer mechanisms. These mechanisms enable them to increase value while keeping developing times and costs low.

Firms are able to expand their opportunities and capabilities by applying knowledge, and especially external knowledge originating from suppliers, customers and competitors (Peters and Becker 1998).

Table 3.2 External Sources of Technology Information for Automobile Industry Suppliers Innovation

External Sources of New Knowledge		**Percentage of Firms with Valuation of**			
		Mean	**Standard deviation**	**No importance (1)**	**High importance (5 to 7)**
Inter-industrial sources	Customers	5.07	1.5	1.7	69.4
	Suppliers	4.22	1.65	4.7	47.2
Intra-industrial sources	Competitors	3.29	1.55	12.5	23.8
Non-industrial sources	Universities	3.21	1.64	16.6	22.4
	Professional associations	3.01	1.58	20.6	20.6

Source: Peters and Becker (1998)

As opposed to the traditional view of the supply chain as a network of entities through which materials flow, Lummus and Vokurka (1999) argue that the management of bi-directional flows of information and knowledge is recognised as the most important aspect of managing the supply chain (see also Lang 2001). Such knowledge flows allow firms to bring complementary assets and know-how from these relationships to

generate new products and services (Tucci et al 2000). Lang (2001) states that after years of re-engineering, many streamlined companies are outsourcing processes they perceive as non-essential to their core competencies, forming industry-wide collaborative networks with their supply chain partners. According to the author supply chain networks are really "networks of value system core competencies". The function of management is to shift the focus away from the "four walls of the bricks-and-mortar enterprise" to an aggressive strategy of real time supply chain collaboration (Lang 2001).

With the high level of outsourcing within aerospace engineering and manufacturing, the effective use of knowledge across supply chains is acknowledged to be crucial to the success of any project (Ip-Shing et al 2000). The shifting of supply chain management responsibility down the supply chain may therefore see more first and second tier suppliers needing to build up their supplier engineering integration capability (Ip-Shing et al 2000). German automobile manufacturers for example changed their strategies in the sense that a lot of the R&D innovation and production activities formerly done internally are currently being outsourced. This is evident in the extent to which automobile manufacturers are even outsourcing whole production processes of specific models. For example, BMW's new X5 model will be built by the Austrian unit of Canadian supplier Magna International. Magna International also assembles versions of Mercedes M and G class sports utility vehicles as well as versions of Chrysler's Jeep Grand Cherokee (Reuters 2001).

The level of collaboration and knowledge flows between Ford Motor Corporation and International Truck and Engine Corporation and their suppliers are enabling them to optimise their supply chain links and production (Konicki 2001). Ford emphasise that they are only able to do this by having visibility into their supplier's capabilities and by giving suppliers visibility into their actual demand (Konicki 2001). Ford Motor corporation however also found that barriers had developed with regard to getting timely information to decision-makers, and this problem became worse when it came to collaboration with outside suppliers (Eisenhart 2001).

Knowledge is a key competitive advantage and therefore it is the purpose of KM in the supply chain to find relevant knowledge, methods with which to capture and share such knowledge, and finally ways to transform this resource into increased competitiveness. With the sharing of mutually beneficial knowledge, organisations

and specifically large OEM's can succeed in becoming more dynamic, improve quality and process innovation, and generally improve performance.

3.4 Knowledge Flows

A unified idea of knowledge and a clear picture of a supply chain have been provided. Reasons for sharing knowledge and knowledge flows are numerous and may be circumstantial. Firstly, however, it is important to understand what is meant by the term 'knowledge flows'.

Research on knowledge flows derives from earlier research on information processing and organisation design (Schultz 2001). Definitions of knowledge flows differ to some extent, but there is recognition in later definitions that knowledge flows are not the same as information flows. Definitions of knowledge flows have become clearer too, despite the use of different terms for the same concept. In earlier definitions the term "transfer" gave the idea of a one-directional flow. In some definitions the terms knowledge sharing and knowledge flows are also used to describe the same concept.

Information-processing theories (Galbraith 1973) regard information flows as an organisational response to task uncertainty. Gailbraith defines task uncertainty, as the difference between the amount of information needed to perform a task and the amount of information already present in an organisation.

Huber (1991) refers to the knowledge transfer process as "grafting" whereby organisations increase their store of knowledge by internalising knowledge not previously available within the organisation. Knowledge flows are seen by Gupta and Govindarajan (1994), as the transfer of skills and technology between units within organisations, while Darr et al (1995) regard knowledge flows as a multistage process that may involve initiation, implementation and integration.

Davenport and Prusak (1997) take the sharing of knowledge in the supply chain even further. They argue that if a value chain strategy entails partnerships, relationships and sharing of knowledge, this strategy must also include broader parameters such as the retailers who sell the products. This is a very relevant source of information and knowledge, because both manufacturers and their suppliers will be able to identify and learn from the customer.

In their study of knowledge flows between organisations Inkpen and Dinur (1998) found four critical processes: technology sharing, interaction between the firms, personnel transfer and strategic integration. The four processes share a conceptual similarity in the sense that each represents a knowledge connection, which creates the potential for individuals to share their observations and experiences. Importantly the authors argue that these processes provide an avenue for managers to gain exposure to knowledge and ideas outside their traditional organisational boundaries.

The degree of knowledge diffusion across organisations depends on certain driving forces (Appleyard and Kalsow 1999). According to these authors the knowledge diffusion depends on the degree of similarity in organisations' technical "prowess". They also found within the semiconductor industry that Intel's knowledge diffuses more quickly to organisations in Western Europe and Japan than to those in Taiwan and Korea. This suggests the existence of knowledge networks across countries. They model the flow of knowledge between firms on the principles of fluid dynamics and especially ocean currents. The motivation is that in both cases flows are involved and in both cases forces exist that drive these flows and dissipate them simultaneously. Although this is a useful concept with which to describe and understand knowledge flows between organisations, it is abstract, and lacks practical guidelines for implementation.

Clarke and Rollo (2001) support the argument that knowledge flows represent a constant flux and change, and underline the importance of interactions between people in the flow process. Transferring people will not only speed up the sharing of knowledge, but will also deeply enrich the process with regard to personal communication and input into problems.

A broader definition of knowledge flows, that will be used, is that of Schultz (2001): Knowledge flows is the " aggregate volume of know-how and information transmitted per unit of time". The author states that with this definition the intention is to capture all know-how and information transmitted between sub-units in all kinds of ways. For the purpose of this study the entities or 'sub-units' concerned are the different partners within the particular supply chain.

With regard to knowledge flows much of the literature focuses on knowledge flows within organisations. Knowledge flows in a supply chain between two organisations do not however concern the internal process of an independent entity. By knowledge

flows in this context, is meant the flow of existing knowledge of organisations that is relevant for both parties to enhance performance and create efficiency. It is not the intention to create flows of innovation, and crucial knowledge, but rather to identify and create the pathways within which basic knowledge that will aid the mutual business process may flow. The idea is for organisations to support each other, not to get involved in a knowledge eroding or total know-how transfer process. As Davenport and Prusak (1997) correctly state " It's a business truism that firms must achieve some level of "fit" or congruence with their external environment- a truism that applies to a company's information environment as much as to anything else."

3.4.1 Identification

Knowledge has been defined. Knowledge agents have also been identified, as consisting of every individual or tool that enables information and knowledge flows between the OEM and a supplier, or has the ability to enable knowledge flows in the supply chain.

To serve as a point of departure from where knowledge flows can be identified and monitored, organisations should first establish their own knowledge resources. A system like that of the US Navy may prove a helpful example in this regard. The US Navy have set up a number of knowledge "portals" to improve the dissemination of knowledge (Reneker and Buntzen 2000). These knowledge "portals" may however also serve as a reservoir for the inflow and outflow of knowledge. They further provide channels in which, and a destination to which knowledge can flow, and therefore simplify the identification of specific flows.

Reasons for developing knowledge collaboration partnerships proves helpful with regard to the identification of knowledge flows. Although there are no structures or rigid guidelines that identify or categorise knowledge flows, certain guidelines should aid management in identifying the existence of specific flows.

Powel (1987) suggests that information and knowledge collaboration agreements are particularly attractive in situations where there is:

- a need for efficient, reliable information
- a need for larger organisations to become more dynamic

- a need to provide stability in contractual dealings thereby permitting the supplier to invest for the long term

There are at least two specific technological dimensions or considerations for firm collaboration: Technological complexity and technological uncertainty (Dodgson 1991). Such knowledge necessitating circumstances serve as an indication of the existence of or possibility for knowledge flows.

Communication, explicit or implicit, is the method whereby understanding and therefore also knowledge are conveyed. The ways in which organisations communicate will therefore also contribute to the identification of knowledge flows.

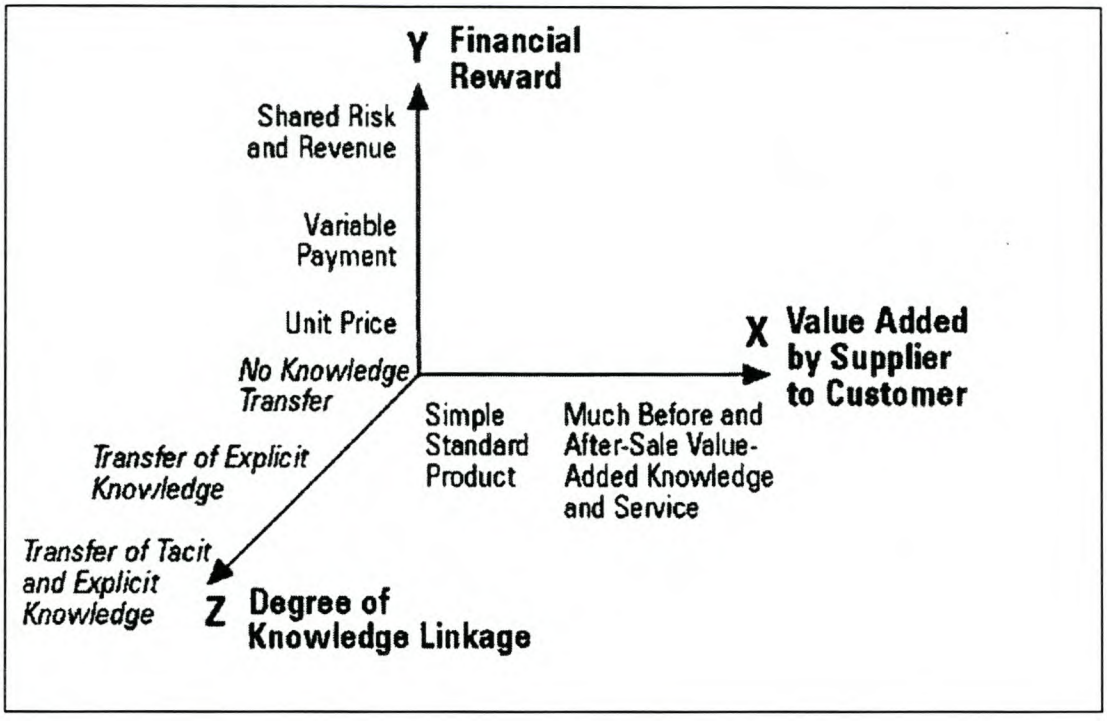
Communications in the supply chain are taken to include negotiations and the flow of information, not just communication channels (Anumba et al 2000). The authors identify at least four classes of communications within supply chains that enable and consist of knowledge flows:

- Transactional level information must be communicated
- Operational level there must be provisions to co-ordinate and control the transactions
- Policy execution level negotiate targets, agree operational procedures etc.
- Strategy level define roles and levels of participation in supply chain

Preiss (1999) identifies some specific knowledge flows that exist between organisations. He argues that mainly three major flows exist between organisations and these can be seen in figure 3.2. The X-axis represents the product or service passed from supplier to customer, and the Y-axis represents the flow of money. This money is the reward or payment made by the customer. However, in light of the global knowledge economy and for the sake of this study the Z-axis is the focal point within this figure. This axis represents the degree of knowledge transfer between companies. The process starts with disconnected processes, such as mail, fax and telephone to proceed through electronic data interchange of explicit knowledge, to a complete integration of knowledge processes. At the origin of the axis no knowledge is transferred. The product is simply bought and paid for. The central region of this axis shows the transfer of explicit knowledge such as product specification. Lastly, the outer region represents the flow of both explicit and tacit knowledge between people working in joint teams. It will be this form of knowledge flows that will enable

organisations to reap the benefits of each other's knowledge. It is interesting to note how the three axes must be jointly managed in order to derive greater value in one of the axis (Preiss 1999).

Figure 3.1 Enterprise Binary Relationship Model



Source: Preiss (1999)

Dixon (2000) has identified types of knowledge transfers of which four are applicable within the supply chain parameter. This is summarised in table 3.3. Although identified for the purpose of disseminating knowledge within the firm, the principles are also relevant for collaboration within the supply chain and serve as a good indication as to where what type of knowledge flows might exist. Much of the focus on international knowledge transfers has so far been on manufacturing and physical technology (Howells 2000). The author argues that this lack of concentration on soft assets may lead to the situation where crucial initiative for innovation is lost because of the neglected aspect of tacit knowledge transfers.

Table 3.3 Types of Knowledge Transfer

	Near Transfer	Far Transfer	Strategic Transfer	Expert Transfer
Definition	Explicit knowledge a team has gained from doing a frequent task is reused by other teams doing very similar work	Tacit knowledge a team has gained from doing a nonroutine task is made available to other teams doing similar work in another part of the chain	Collective knowledge of the organisation is needed to accomplish a strategic task that occurs infrequently but is critical to the whole organisation	A team facing a technical question beyond the scope of its own knowledge seeks the expertise of others in the organisation
Similarity of tasks and context	The receiving team does a task similar to that of the source team and in a similar context	The receiving team does a task similar to that of the source team but in a different context	The receiving team does a task that impacts on the whole organisation in a context different from that of the source team	The receiving team does a different task from that of the source team but in a similar context
Nature of the task	Frequent and routine	Frequent and nonroutine	Infrequent and nonroutine	Infrequent and routine
Type of knowledge	Explicit	Tacit	Tacit and explicit	Explicit
Design guidelines	Knowledge is disseminated electronically	Exchange is reciprocal	Knowledge needed is identified by senior-level managers	Electronic forums are segmented by topic

Source: Dixon (2000)

3.4.2 Direction and Speed

It is important for organisations to understand in which direction and to what extent knowledge will flow. This will enable them to obtain a better view of their situation, enabling better management thereof. "Collaborative knowledge is more than a data base, it is a dynamic communications hub" (Zimmerman 2001). Between two entities

the amount and speed of knowledge that flows will vary, but the direction of flow will be either one- or two-directional.

Womack (1990) argues that the desire to imitate the Japanese is an important factor driving Western organisations to collaboration and therefore influences the need for both two-way and speedy knowledge flows. The need for more co-operative relationships with suppliers to enhance the speed of knowledge flows is already evident in the implementation of technology (see Matthysens and Van den Bulte 1994).

The relationship between a manufacturer and a supplier directly influences the flow of knowledge between them. The policies for developing supplier-client relationships are directly inspired by strategic trends in industrial organisations (Merli 1991). There are four levels of supplier relationships and it is argued that the direction and speed of knowledge flows are directly linked to the level of these relationships. Knowledge flows will become increasingly open and free the nearer companies get to a level 4 relationship (Merli 1991). The level of a relationship will therefore give a good indication of the direction and speed in which knowledge flows can be expected.

Level 1: Conventional approach

This includes prices as priority, an adversarial approach between firms based on strength, supplier selection and rating based on price, reliability and also formal certification. The outlook in this approach is that suppliers are stores where you shop for the best prices. It can be expected that knowledge flows will be slow and one-directional depending on the relative strength of organisations. Presumably the stronger or more powerful organisation will be able to dictate the direction of knowledge flows.

Level 2: Quality improvement

This level of relationship tries to establish long-term relationships, experiment with co-development, have fewer suppliers and acquire systems rather than components. The outlook is to create quality in cooperation with suppliers. Knowledge flows can be expected to be more frequent and more two-directional than at the previous level.

Level 3: Operational Integration

At this level of relationship the focus is on supplier processes, widening co-development, joint research projects and the setting up of product and process co-design. Further joint improvement plans with suppliers and market feedback directly to suppliers is important. The outlook is that the production process begins in the supplier's departments. Knowledge flows can be expected to be much faster and two-directional at this level.

Level 4: Strategic Integration

This level of relationship includes joint business process control, global supplier rating, widespread product and process co-design and a business partnership with some important suppliers. Synchronised supply agreements at the highest levels and total quality assurance are very important. The outlook is that organisations at this level are doing business together. The close co-operation between organisations at this stage will result in almost continuous two-directional knowledge flows.

Merli (1991) states that of all automobile manufacturers studied the Japanese tended not to have supplier assessment systems. Instead, for example at Honda in America, improvement of suppliers depended on informal interaction between Honda engineers and the supplier's engineers. The Honda policy aims to understand how the supplier's engineers work everyday. This example of a level four relationship should result in fast and two-directional knowledge flows between the organisations. Such a relationship should in the end lead to results such as faster development times without sacrificing quality or cost. These benefits are already seen at Japanese manufacturers.

Buyer–supplier relationships are often represented on a "bi-polar" scale with one extreme labelled "adversarial" and the other as "collaborative" (Burgess at al 1997). The authors argue that relationships are however seldom located at one of the extremes and tend more towards the middle. Traditional relationships in Western economies are characterised as adversarial, with low price/cost as one of the key criteria in establishing brittle, short-term partnerships between purchasers and suppliers (Burgess et al 1997). The extent to which a relationship tends towards one end of the spectrum has a direct influence on the speed and direction of knowledge that flows between the organisations. In an adversarial relationship it can be argued

that knowledge will flow slowly between entities because no one will be willing to freely share knowledge.

The communication medium used is another factor that directly influences the direction and speed of knowledge flows (see figure 3.3). It is logical that the closer the relationship between organisations the more personal their communication would be, and therefore faster and more two-directional. Personal communication also enables the flow of tacit knowledge, while non-personal communication does not, which may cause a one-way flow. Organisations that wish to enhance innovation through the sharing of knowledge should therefore invest in close relationships with open and frequent communication. In the current business environment where electronic communication is increasingly important it is regarded in the same class as written communication. Although speedily delivered electronic communication does not guarantee a speedy reply, and it therefore doesn't necessarily prove to be explicitly more advantageous than written communication.

Figure 3.2 Speed and Direction of Communication Modes

Medium	Media Richness Capacity	Media Characteristics			
		Feedback	Cues/Channels	Intimacy	Language
Face-to-face	High ↑	Immediate	Multiple	Personal (visual, audio)	Natural
Telephone		Fast	Audio	Personal	Natural
Written addressed (letter, memo)		Slow	Limited Visual	Personal	Natural/Numeric
Written, unadressed	↓ Low	Very slow	Limited Visual	Impersonal	Natural/Numeric

Source: Daft and Huber (1987)

Seeley (2001) emphasises the importance of interactive two-way knowledge flows between entities, and therefore the importance of finding a balance between personal and virtual meetings. Industries with complex technologies, which include OEM's, are more open towards inter-industry knowledge flows (Plasmans and Lukach 2001).

This means that suppliers should form a cardinal part of the innovation process, but also that OEM's will be well advised to learn from other industries and firms.

Knowledge flows in the international arena are becoming much more of a two-directional flow than before, and horizontal structures of information have become more efficient than vertical ones (Howells 2000). This emphasises the need for knowledge sharing programmes between peers who need each other's expertise as opposed to knowledge flows via top-down structures.

3.4.3 Influencing Factors

It is important to note that there may be numerous factors and circumstances that might influence the flow of knowledge. In this section some of these factors will be discussed. The influence of these factors on the knowledge flows between two organisations should be judged against the level of their relationship, because the faster and the more bilateral the information flows, the bigger their potential influence.

3.4.3.1 Culture

In the global business environment organisations from numerous backgrounds and cultures compete or collaborate with each other. This paper is not concerned with the vast realm of cultural studies, however, but with organisational culture. Culture in this context refers to the parameters within organisations and not to different nationalities.

Terpstra and Yu (1988) list language, political systems, level of education and degree of industrial development as important elements in the "psychic" or cultural distance between organisations.

McDermott and O'Dell (2001) give the following definition of corporate culture: "culture is the shared values, beliefs and practises of the people in the organization". They state that its culture is reflected in the visible aspects of the organisation like its mission and values.

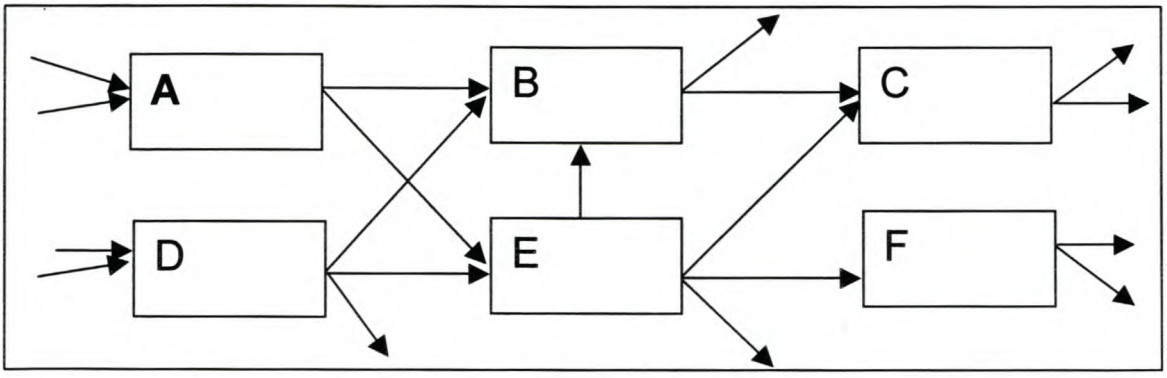
A knowledge-sharing process may fail if it is not supported by an underlying organisational culture (Liebowitz and Chen 2001), while culture is also often seen as the key inhibitor of effective knowledge sharing (McDermott and O'Dell 2001).

Of all cultural aspects that may influence the sharing of knowledge in supply chains, trust seems to be the most important (see Millington et al 1998, Ring and Lumley 1999, Anumba et al 2000, Liebowitz and Chen 2001, and Jacob and Ebrahimpur 2001).

For example, local assembly might result in significant efficiency gains, but these gains flow mostly to the OEM, while the local assembly unit carries much of the cost (Millington et al 1998). Local assembly units refer to the situation where motor component manufacturers are located close to a car assembly plant. Efficiency gains can be attributed to many factors, of which the easier flow of communication and knowledge is one. After the establishment of the local assembly unit significant possibilities for opportunistic withdrawal by suppliers exist, however. Therefore organisations can only truly collaborate and share if they trust that benefit is mutual (Millington et al 1998).

Fahey and Prusak (1998) argue that people have to be rotated in organisations to get deeply imbedded ideas and knowledge into circulation and to allow them to understand particular operations. Although the authors intended this rotation process for knowledge transfer within a global organisation, the same argument in my opinion is relevant within a well-established collaboration process between organisations. Such a process needs a well-structured guideline as well as a considerable amount of trust between both corporations. Therefore Anumba et al (2000) rightly argue that where people must operate with incomplete information, and use what is passed along the supply chain, trust in the companies with which one deals is cardinal if co-operation is to flourish. The importance of trust is illustrated in figure 3.4. Blocks A to F represent companies, linked by communication channels. The diagram illustrates two interlocking supply chains, one running to company C and one running to company F.

Figure 3.3 Section of a Generic Supply Chain



Source: Anumba et al (2000)

If Company F discusses costs of supplies with companies D and E, in principle Company F could pressure company E to reduce prices. Anumba et al argue that in federated systems such as these, trust in collaborating companies is critical if a competitive position in the marketplace is to be maintained, and they argue that it is the building and maintenance of trust that is crucial to success.

Pohlmann (2000) found that 48% of respondents saw sharing of information across their supply chain as their top priority, while 40% ranked trust as the key attribute to a collaborative partnership. The author suggests that OEM's should invest in external collaboration and that they must focus on trust through the improvement of partner management processes to support collaboration.

Certainly when a process of knowledge sharing is regarded as fair, participant organisations will be more willing to share their knowledge. Pohlman (2000) identifies three principles that constitute a fair process.

- Engagement

  Getting individuals involved in decisions by asking for their opinion and allowing them to refute the merits of one another's assumptions and ideas

- Explanation

  Helping everyone affected understand the reasons for the final decision

- Expectation clarity

  Making explicit the new rules of the game once the decision has been reached

Where the institutional systems of legal, technical and market rules are dense, as is the case in Germany, mutual trust and co-operation are more frequently established than in Britain where the opposite is true (Lane 1997). Common understanding of terms, language, common goals, shared benefits and integrity in relationships is what will build trust in the supply chain (Anumba et al 2000).

Lane (Dierkes et al 2001) argues that the development of interpersonal trust depends on geographical proximity, the opportunity for face-to-face relationships, and also the stability of the network relationship. If collaboration initiatives contain all the necessary principles to render knowledge sharing initiatives fair, trust between organisations will be enhanced. Once trust exists knowledge sharing will be easier facilitated.

That trust is an important cultural issue in knowledge sharing is clear, and the enhancement of trust in the supply chain parameters of a firm should be a priority. However, in their study of the principles applied by Buckman Laboratories, a leading international knowledge organisation, and other organisations where knowledge sharing is built into the corporate culture, Pan and Scarborough (1999) conclude that these organisations did not change their culture to match their KM initiatives. They rather adapted their approach to knowledge management to fit their culture. Concerning the current position where Western organisations seem to lag behind their Eastern counterparts with regard to knowledge sharing, this is encouraging. Cultural differences are not seen as an insurmountable obstacle, but something to be embraced and used to your advantage. Organisations just need to understand what changes are required in knowledge programmes and adapt their approaches accordingly.

3.4.3.2 Infrastructure

The infrastructure of an organisation allows knowledge to flow. What is meant by infrastructure, are all the physical aspects of a firm that are needed to enable

knowledge flows. It is obvious that it will not be possible for knowledge to flow if there are no channels in which it can do so.

Pan and Scarborough (1999) identify knowledge architecture as a major requirement for effective knowledge management and transfer. The authors argue that this type of architecture needs to be designed according to the hierarchical level of an organisation, and they identify humans, organisational entities, documents and books as comprising such architecture. All other knowledge repositories and operating entities for managing and disseminating knowledge within and between firms are, however, also needed for the flow of knowledge.

The specificity of investment that two organisations engage in, complexity with regard to the number of interdependent routines, individuals, protectiveness of firms concerning their knowledge and technologies, are elements identified by Simonin (1999) as infrastructure factors influencing the transfer of knowledge (see also Parise and Henderson 2001).

Information technology (IT) is cardinal for knowledge to flow. It will be difficult to distribute and share information and knowledge without such facilitating infrastructure. Although IT is not well suited to enable the flow of tacit knowledge, explicit knowledge is mostly disseminated through the use of IT tools. People and their personal relationships are part of the knowledge infrastructure that allows for the flow of tacit knowledge.

3.4.3.3 Organisational Learning

For knowledge flows to exist between organisations, repositories are needed in which knowledge resources are stored and thus can flow from when needed. Like that of any other resource, the competitive value of knowledge will reduce over time as competitors gain their own knowledge on a subject. A method by which to replenish knowledge repositories is that organisations should continuously learn.

To understand why some firms learn faster than others do, it must be recognised that companies do not learn in a vacuum (Dyer 1999). The author argues that much of the knowledge relevant to a firm's continuous success has likely been developed outside the firm. Therefore it is important, after identifying specific knowledge flows, to establish the direction in which knowledge is flowing. This will enable organisations to

guide knowledge flows so that they are bi-directional and beneficial to both parties involved.

Learning in organisational units affects outflows of knowledge to other units (Schultz 2001). The same in my opinion can be said for learning in organisations within a collaboration agreement. Schultz explored three learning processes and their effects on knowledge flows in firms. He argues that the collection of new knowledge intensifies the vertical flow of knowledge. Codification of gathered knowledge facilitates horizontal and vertical flows, while the combination of old knowledge mainly affects horizontal knowledge flows. In the study Schultz suggests that uncertainties surrounding the relevance of new knowledge are resolved via vertical flows. Such flows expose new knowledge faster and to a wider range of business areas, facilitating faster and more comprehensive discovery of its relevance. The same principles are in my opinion applicable in a knowledge collaboration programme where organisations form "units" of learning from where knowledge is shared.

Schultz (2001) found that exposure to internal and external sources of newness and the uniqueness of experiences intensify vertical outflows of knowledge, but they do not affect horizontal outflows. Interestingly enough it was found that within corporations, the reception of knowledge from the top level is paralysing to learning and knowledge exchange between sub-units horizontally. This emphasises the fact that within a buyer-supplier relationship, it is the experts involved that need to exchange knowledge and learn from each other in order to make sufficient knowledge gains.

Many of the basic concepts of organisational learning within organisations are applicable to learning between organisations. The theories need to be amended, however, in order to accommodate the special features and requirements of a supplier network (Lane in Dierkes et al 2001). According to the author an amended theory has to take into consideration the co-ordination of learning between organisations and must also create awareness of the problems entailed in this process.

Lane (Dierkes et al 2001) identifies specific parameters that have not received adequate attention in theories pertaining to learning in networks. Firstly, it is widely recognised that inter-organisational relationships may be a more important source of

competitiveness than internal relationships, and that dense flows of information are associated with superior performance. Secondly, he states that the biggest problem for learning in networks is the transfer of knowledge between legally and economically independent organisations. Therefore network construction goes beyond building good channels of communication to the co-ordination of goals and methods with which to achieve these goals. He thirdly emphasises the importance of conceptual knowledge for innovation in network relations. Network relations should be organised in such a way as to encourage learning. Fourthly, firms need to build experience in network management before committing themselves to the transfer of valuable strategic capabilities. Lastly, research is needed to establish the impact of organisational diversity on the synchronisation of mental models for mutual organisational learning.

3.4.3.4 Barriers

In the global business environment many barriers hinder the flow of knowledge, and some of these may be circumstantial. Barriers to the flow of knowledge are factors that influence or prohibit the flow of knowledge.

Information politics are one of the main factors influencing communication and therefore the transfer of knowledge (March, Davenport and Prusak 1998). This is very relevant in a supply chain context. The authors compare the information-political situation with forms of government and argue that not all forms will be equally effective for a knowledge sharing culture. Knowledge sharing will in my opinion most certainly prove to be a political issue for management. If the situation is not managed correctly this will be a major constraint to the flow of knowledge.

Dyer (1999) identifies two major barriers to intra-plant knowledge transfers. Firstly, there are external system constraints like customer policies or constraints imposed by customers, and secondly there are internal process rigidities. The second barrier has to do with practical difficulties in the layout and physical distribution of plants and logistics, which make it difficult to access plants. For example, it was found that in some cases large machines and equipment were bolted down or cemented into the floor, there was trenching in the floor or the utilities were hardwired to the machines. These factors caused internal process rigidities that increased the cost of making transfers. In the relationship between an OEM and its suppliers the same problems

will occur. It is essentially different plants operating under a shared agreement and the physical circumstances of the organisations might not support the wide sharing of knowledge.

The elements of knowledge and especially tacit knowledge, cause some difficulties to arise regarding knowledge flows between entities. If tacit knowledge is viewed as highly individual and achievable only through personal experience, the diffusion and flow thereof seem impossible (Augier and Vendelo 1999). However, a more positive attitude towards the sharing of knowledge is emerging within the global business environment (Bennett and Gabriel 1999). Such an attitude change will increase the efficiency with which organisations can overcome barriers to knowledge flows.

People sometimes are unaware of their own knowledge, or unable to communicate it properly if a language barrier makes it very complicated for two persons of different backgrounds to share what they know. Also, in the light of the ever-increasing speed of activities in the current business environment, time for reflection is scarce (Haldin-Herrgard 2000). Therefore new employees or outside agents may not have enough time to properly understand or grasp particular knowledge, which in turn will lead to less efficient or no knowledge flows at all.

Different time zones in the global business environment further complicate knowledge flows. People living in different time zones will rarely have the chance to communicate and share knowledge on the same level as people in the same time zone.

Business-related values of rationality and logic do not always leave room for attributes such as intuition and anticipation, and these concepts are difficult to value. Value is associated with some form of measurement, and not being able to always value tacit knowledge makes it difficult to initiate flows thereof (Haldin-Herrgard 2001; see also Zack 1999).

Distance also has an influence on the flow of especially tacit knowledge. Although much can be done with modern information technology, tacit knowledge is difficult to diffuse through technology. These difficulties are however also an advantage to organisations in the sense that crucial knowledge cannot be easily copied by competitors (see Leonard and Sensiper 1998, Brown and Duguid 1998, and Haldin-Herrgard 2001).

Dixon (2000) identified specific criteria that may create barriers to the transfer of knowledge between entities. Especially three criteria are mentioned. Firstly the intended receiver and the similarities between the tasks of the sender and receiver play a role. If the tasks performed are more or less similar the need to transfer knowledge is diminished. Secondly, if the nature of the task is routine, Dixon argues, knowledge transfer is again not paramount. Lastly the type of knowledge that is being transferred is important in order to establish whether personal or less personal methods of transferring the knowledge are needed. Knowledge that is more personal in nature will require a different approach to enable knowledge diffusion between entities.

Gibbert and Krause (Davenport and Probst 2000) identify four main parameters within which barriers occur. Firstly, personal barriers influence the way in which employees conduct themselves. Secondly, collective barriers relate to the organisation and support of knowledge transfer efforts. Thirdly, structural barriers refer to the physical shortcomings of a knowledge sharing system, and the belief among employees that, given a certain structure, it is better to retain knowledge. Fourthly, political barriers refer to inhibitions such as language problems, internal competition and culture. Lane (Dierkes et al 2001) identifies trust as the basic condition for organisational learning. The lack thereof will in my opinion present a near insurmountable obstacle.

Knowledge and understanding regarding the barriers that exist will help organisations to better equip themselves to utilise specific opportunities or minimise threats that arise from knowledge flows. People and political issues will however in my opinion be a major constraint to knowledge flows and collaboration programmes.

3.4.4 Opportunities and Threats resulting from Knowledge Flows

In circumstances of imperfect information and knowledge, unexpected events should be expected, and these might have different effects on different organisations. The ability of organisations to cope with these uncertainties will to a large extent determine whether they benefit from opportunities or suffer from threats, respectively.

3.4.4.1 Opportunities

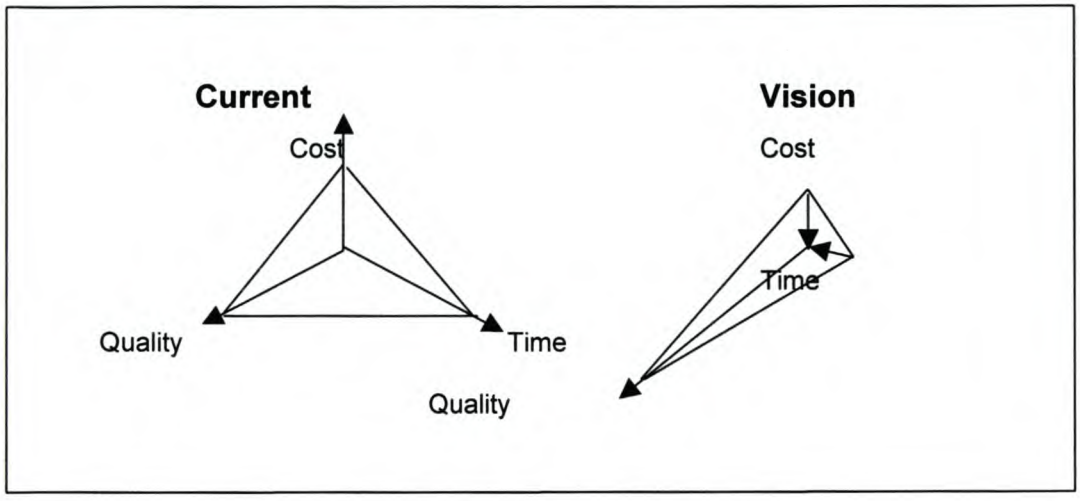
Clark et al (1987) found in an analysis of development times for Japanese, European and US firms in the auto industry, that Japanese firms had a clear advantage over their counterparts. Echeverri-Carroll (1999) states that Japanese high-technology firms tend to develop new products and processes faster than their competitors because of the superior knowledge flows between them and their suppliers.

Organisations must maximise utilisation of available information in order to minimise the effect of errors (May et al 1999). Knowledge is central to such an effort. The authors argue that early communication, rapid agreement and joint decision making are critical attributes of the supply chain. Innovative activities within the automobile supply industry are at a very high level (May et al 1999). For OEM's this poses an opportunity not only to learn from suppliers, but also to enhance the performance of all organisations involved in collaboration and the sharing of knowledge.

According to Gibbert and Krause (see Davenport and Probst 2000) the rationale for knowledge transfer becomes clear when the basic economies behind research and development expenditure are considered. In short, it means that the more a given resource is utilised the more the leverage of the knowledge asset increases (Gibbert and Krause). In some supply chains trust and mutual dependence have developed to the point where collaborative planning means that goods are being cross-manufactured on a cue from an electronic order (Lang 2001).

One example is "BOC Gasses", a New Jersey-based international supplier, which gives its suppliers full access to its inventory data (Lang 2001). The relevance that this has for OEM's and especially MTC, is that by sharing mutually beneficial knowledge with suppliers, development effectiveness can be enhanced. The difference in developing times that exists between Western and Japanese OEM's may thus be reduced and even obliterated. Figure 3.5 contains the vision of reducing time and cost while increasing the quality of new product development.

Figure 3.4 Benefits of Knowledge Collaboration



Knowledge sharing therefore offers the opportunity of enhanced development effectiveness. Other benefits and opportunities also arise from knowledge flows.

McDermott and O'Dell (2001) emphasise that all the best practice companies they studied see knowledge sharing as a practical way to solve business problems. They argue that if a manufacturing company should give its suppliers insight and the opportunity for input into the process of quality refinement, a lot of bad products might be eliminated. This is also applicable to MTC.

Within MTC a quality gate is a control point within the product development process, at which previously agreed on exit criteria are measured and assessed in terms of quality and completeness. If a product or part of a product is rejected, time and resources are lost. Communications flow back and forth between the OEM and the supplier until the problem is solved. This one-way information flow creates a "bull whip" effect that increases cost (Brulz 2001). If suppliers had direct access to quality gate information, it might be beneficial for problem solving. Faster information and knowledge flows should enable early action and therefore save both time and cost.

At present MTC are collaborating with suppliers to some extent in the sense that mutual agreement is reached with regard to exit criteria for product standards. In close co-operation with suppliers, however, this process may be integrated even more extensively, and could possibly be delegated to the supplier altogether. MTC would then need to fulfil only a supervisory role. This would eliminate a lot of time-consuming communication, while not affecting quality or input from the manufacturer.

The industry is in need of a suitable solution that can embrace the requirements of the supplier network and be adaptable to different approaches of OEM's (Brulz 2001). The innovative power of suppliers will provide the basis for defining a standard of collaboration between an OEM and its suppliers. In my opinion development times at MTC would be reduced if proper collaboration plans were in operation.

Knowledge flows in supply chains have the further benefit that they may be used to reduce waste. Storey (1994) identifies seven types of waste that may be reduced: overproduction, waiting time, transport, process, inventory, motion and defective goods. Thomas and Griffin (1996) also suggest that improving co-ordination and integration of process and product decisions across the value chain may reduce costs and improve service levels.

The financial benefit of knowledge flows and sharing will serve any organisation well. Davenport and Prusak (1997) confirmed the financial benefits of knowledge sharing. Ford managed to save $34 million in one year while Chevron reduced its costs on capital projects alone by $816 million (Dixon 2000). Being six months late in bringing a new product to the market can result in a 30% loss of profit on a product life span of 5 years. However, increasing the development budget by 50% to be on time will cause only a 4% loss of profit (Reinertsen 1983, Crawford 1992, see also Anumba et al 2000). According to Holberton (1991), an automotive manufacturer in Europe lost US$ 1.8 billion in profit alone by being one year behind competitors in introducing a new model into the market. Anumba et al (2000: 567) state that an automotive manufacturer in Europe will experience a loss of US $150 thousand in sales revenue for a replacement vehicle and over US$ 1,5 million for a vehicle penetrating a new market due to one day's delay in design (based on figures for 1993). The authors also state that because 'Japanese automotive companies have faster development times with lower costs', they may run up to five times more exploratory vehicle programmes than a European manufacturer. Manufacturing and construction industries are moving to adopt the philosophy of concurrent engineering to, better utilise the expertise of other companies in the supply chain (Anumba et al 2000). This will allow them to be more efficient and innovative.

Properly managed knowledge flows in the supply chain will also help to circumvent and improve a non-efficient supply chain. During the early 90's, for example, organisations within the Argentine automobile sector experienced problems in

several areas. According to Luchi and Paladino (2000) weak links in the supply chain, the uncompleted regulatory framework for the achievement of synergy in a regional context, and different operation strategies followed by assemblers caused some of the problems. The speedy and efficient flow of knowledge would have enabled organisations to solve such problems much more efficiently.

DaimlerChrysler (2002) expect to reap many benefits from the integration of a global supplier portal. The purpose of such a portal would be the circumvention of cumbersome and expensive web applications and therefore enhancing information and knowledge flows. These expected benefits include:

- Improvements in OEM-to-supplier and supplier-to-supplier communication
- A uniform solution for web-based applications, providing a common interface for navigating and conducting business across all systems of parties involved
- The simplification of user experience
- Increased efficiency, enabling organisations to focus on core competencies

By implementing electronically enabled quality planning tools that offer real-time tracking of specific quality measurements that are visible to suppliers, DaimlerChrysler have increased efficiency levels in quality assurance by 50% (DaimlerChrysler 2002).

If organisations wish to benefit from collaboration and knowledge sharing, they need to enhance their ability to share relevant knowledge. The end goal should be for organisations to become linked by the common goal of creating a benefit for all. Engineers should be able to freely discuss and share experiences in certain areas. This will allow manufacturers to improve standards and, importantly, also the time in which tasks are performed, which would lead to substantial opportunities for competitive advantage.

3.4.4.2 Threats

As with opportunities, threats in the business realm with regard to the flow and sharing of knowledge are numerous and may be circumstantial. A few specific threats are discussed in the literature. Threats refer to factors that may endanger the

strategic position of a firm, and should not be confused with barriers. Barriers prohibit and influence the flow of knowledge, while threats are endangering circumstances and factors that result from knowledge flows.

Efforts to increase the replication of current knowledge give rise to the fundamental paradox that the codification and simplification of knowledge also induce and enhance the likelihood of imitation (Prusak 1997). Especially within the parameters of knowledge flows between two organisations, the potential for imitation and therefore loss of competitive advantage may be huge. The emphasis again needs to be on basic knowledge that does not necessarily have independent value for innovation in individual organisations, but shared will enhance effectiveness and performance. This will reduce the risk of losing competitive advantage. Organisations should not be over-protective of their knowledge resources. Particular areas of knowledge that will enhance the supply chain and development phases for both firms need to be identified, and co-operation at those levels should be established.

Davenport and Prusak (1997) warn that while suppliers often have a vested interest in talking with you, they also have information that they wish to hide. The authors argue that suppliers would want to build good relationships but will not wish to relinquish all their power. The same argument applies to manufacturers, and again the importance of trust in and mutual benefit from knowledge sharing programmes emerges.

A possible disadvantage of sharing knowledge with suppliers is that if an organisation puts too much effort into improving supplier performance, it is indirectly helping its competitors who also buy from that supplier (Dyer 1999). Therefore in the relationship between two organisations it is very important to ensure that they have a mutually beneficial relationship, neither organisation being at a disadvantage. Toyota handled this problem by investing heavily in networks of communication among its suppliers, at first between Toyota and the suppliers only and later among the respective suppliers (Dyer 1999). According to the author these networks promote the spread of successful practices, involving both explicit and tacit knowledge, while creating relevance and trust for the parties involved.

It seems that the major concern for organisations is that they will lose critical knowledge and competitive advantage to suppliers or other organisations, who may exploit knowledge collaboration. OEM's should therefore be knowledgeable about the

situation concerning different collaboration programmes. Knowledge of the direction in which the relevant supply chain with which they collaborate is developing should also prepare an OEM for contingencies.

3.5 Future Trends in Original Equipment Supply Chains

Already in 1994 Dominguez and Zinn found that a trend towards long-term relationships with suppliers and buyers was emerging. The commercial focus in global business has been shifting from the competitive advantage of a single firm to the competitive advantage of an entire supply chain (Christiaanse and Kumar 2000). With regard to the US and European environments, the situation seems to be that an assembler's initiatives with regard to certifications and audit plans, have defined an initial foundation for a new approach to the relationship between organisations (Luchi and Paladino 2000). The authors state that an evolution towards less vertical integration and a reduction of first supplier base by assemblers are happening in parallel. They emphasise that it is necessary to reinforce the operative links with regard to the sharing of benefits between the parts, and to define a real framework to establish continuous improvement goals (see also Helper 1991 and Lamming 1990).

These developments shift our focus to the direction in which suppliers can be expected to develop.

In order to determine the direction of trends in the automobile industry supply chain, a study by Roland Berger and Partner gmbh (2000) will be used extensively, although other sources have also been used to analyse trends within this paradigm. The study outlined below was performed by means structured personal interviews with key decision makers, and supplemented by further research done by the company. Very relevant to the current study is the fact that the majority of the suppliers interviewed in the Roland Berger study are tier-1 suppliers. This group of suppliers, in my opinion have a cardinal role in innovation through the flow and sharing of knowledge.

3.5.1 Identification of trends

In their predictions for the period up to 2010 Roland Berger and Partner GmbH (2000) identified nine major trends in the automobile industry supply chain.

Value added per vehicle replaces volume growth

The "supply environment" today is revealed to be the most critical area in the creation of added value (Toni et al 1994). The Roland Berger study found that the "traditional" triad markets are expected to stagnate and long-term growth will come from Asia. OEM's have already started to access new methods to enhance profit and they face four options for growth: Outsourcing, innovation, growth in existing markets and diversification. However, technological innovations and more value per unit are the major growth areas.

OEM concentration will result in eight global purchasing hubs and trigger supplier globalisation

The number of OEM's is suspected to decrease to eight, therefore leaving eight major centres where supplies will be bought. The supplier industry will be dominated by global players, but Japanese suppliers will still be more focused on their home region than other suppliers.

Increasing platforms and model varieties require advanced deal and project management capabilities

Model variety and the share of platform-based cars are expected to grow. Because of this growth, platform vehicle deals will be polarised into a few large-scale platform deals and a huge amount of model-related deals. While the number of models launched per year will double, the number of platform launches will shrink to only eight per annum. System suppliers will have to develop specific competencies for specific production areas.

Tier one suppliers will take an increasing share of the risk from OEM's

Risk sharing will increasingly complement cost pressure on suppliers. The amount of risk shared is shifting due to the transfer of responsibility for R&D, production and purchasing to suppliers. Suppliers will also be increasingly responsible for quality defects. Suppliers will further increase finance, invest in and operate plants within the value chain on behalf of OEM's.

We are already seeing this phenomenon, incidentally, in that leading automobile manufacturers like DaimlerChrysler, BMW, Saab and Porsche are outsourcing the total production of vehicles.

Suppliers will take over responsibility for systems integration and management of the supply chain

OEM's will reduce their value added by shifting system/module integration to their tier-one suppliers. Importantly, it is predicted that OEM's will follow various innovative approaches to strengthen the partnership with their suppliers. These suppliers will continuously be integrated into the development process and extension of system contents. They will be used along the complete processing chain, and not be selected for individual parts in the supply process. Tier-one suppliers will be forced to delegate responsibility, and as a result professional sub-supplier management will have to be implemented.

Electronic business-to-business commerce will revolutionise the supply chain and trigger industry shakeout

Skjoett-Larsen (2000) argues that supply chains will become more virtual. In virtual logistics, the author argues the physical flow of materials and information are treated independently of each other and ownership and control of resources are handled electronically. The author singles out the Internet as the main method of communication between organisations. Homs (2000) also points to the emergence of a network supply chain. This author defines such a network supply chain as "A network of inter-enterprise supply chain events connected through a private or public e-Marketplace".

Direct material buyers plan to move online, but confidentiality seems to be a concern (Garretson 2000). The author differentiates between four types of collaboration personas:

- Isolationist

  These personas will not wait for industry-wide marketplaces to take hold, and with limited reason to share standards or infrastructure will focus on their own supply chains. Companies

mentioned by Garretson are Boeing and Volkswagen. These organisations are predicted to streamline information sharing with their own suppliers and stamp out their personal inefficiencies.

- Associators

According to the author tier-one suppliers (like Eaton and Denso International) do not have enough market leverage to push their suppliers into private groups. Instead they are predicted to endorse standards and develop their own optimisation routines.

- Co-operators

These organisations will build inter-enterprise solidarity and will look to leverage their shared supplier base and standardised product inputs. These organisations are predicted to proactively share data and to establish future beneficial collaboration groups.

- Duellists

Firms like Lucent and Ford are predicted to see substantial benefits from reining in their own supply chains, as well as for supporting industry-wide collaboration. They can do this by building out proprietary venues through the creation of private groups and secondly by leveraging some low-risk collaboration with peers.

The electronics revolution will change the " rules of the game"

Hammant (1995) identifies some trends within the information technology parameters.

- Integration and flexibility

Advanced transaction-processing systems, which address the needs of an entire organisation, are now commonplace. According to the author supply chain systems must be able to adapt to changing demands quickly and cost-effectively.

- Electronic Data Interchange

This refers to the "computer-to-computer exchange of inter-and intra-company business and technical data, based upon the use of agreed standards" (Hammant 1995). He states that the key point here is to notice that the information passing between computers is structured so as to conform to an agreed standard.

- Hardware

The author emphasises two trends. Firstly hardware will get even smaller, faster and cheaper. This will enable computing power not possible before to be implemented in parts of the supply chain. The second trend is the growth in open systems. These open systems together with hardware that supports open systems which many users might utilise, also increase the potential to share knowledge.

- Communications Technology

This refers to the advances in communications that make the flow of information easier and faster. Secure and resilient communication networks are also a prerequisite for achieving supply chain integration.

The proposed electronic revolution will take place in the automobile industry at four levels (Roland Berger and Partner Gmbh 2000): A surge in innovations in the automobile, networking and integration of electronics, networking of vehicle environment and automotive embedded mobile computing. Roland Berger found that 90% of all future innovation in the industry would be driven by electronics. Suppliers are expected to provide most of the electronics know-how in the future. Electronic subsystems will become increasingly integrated. Importantly the automobile is predicted to become part of information, messaging and transaction services. This trend is supported by the world's biggest e-business venture formed jointly between DaimlerChrysler, Ford and General Motors (Anonymous B 2000).

Suppliers establish closer links to consumers

Buyer-supplier relationships will become closer (Toni et al 1994). Component branding is one way of establishing closer links with

consumers in the automotive supplier industry. "Intel inside" that became synonymous with the whole product while being only a part of the whole is a good example. This trend might prove dangerous to OEM's if they lose the innovative edge to suppliers, whose products might become sought after by consumers. The study conducted by Roland Berger found that component branding might even be extended to interior and safety aspects of automobiles. The study does not however identify this as a problem but rather an opportunity for OEM's to differentiate from competitors and to add value for customers.

30-50 Suppliers will lead the supplier industry and set performance standards

Toni et al (1994) also foresee a reduction in the number of suppliers. They argue that the requirements for design, production and logistic interaction imposed by modern management and production systems are such that the relational resources of the customer (and supplier) are conveyed into a restricted number of channels. These authors therefore attribute the reduction in suppliers to the inability of organisations to have more than a limited number of close relationships that are beneficial to both parties.

The Roland Berger study argues that a continuous reshuffling may be expected where current tier-one suppliers will reach out to complementary capabilities. This prediction entails a major change from the current situation, where there are literally thousands of suppliers in the international automotive industry, with many of the smaller ones being experts in specific fields. This reduction may however also make the collaboration process between OEM's and suppliers easier, for the plain reason that the number of suppliers needed to produce top quality products will reduce. Collaboration should be easier between a smaller number of organisations than between many.

This view is supported by Skjoett-Larsen (2000) who argues that suppliers will become increasingly global and the role of domestic and local suppliers will become less important. The author also states that within European industry in general there is a trend towards a reduction in supplier base and that co-operation with suppliers will become more important. The author

envisions mainly four generic supplier strategies: Strategic partnerships (or system suppliers), outsourcing of non-critical purchase, leveraging purchasing and bottleneck purchasing.

A trend not identified in the Roland Berger study but that will influence all OEM's, however, is the move toward environmentally friendly supply chains. The environment will receive increasing attention (Skjoett-Larsen 2000, Kachadourian 2000) and logistic managers in the supply chain will have to deal increasingly with relationship management.

3.5.2 Influence and Management of Trends

The emerging global marketplace and the need for innovation through knowledge are making it imperative that OEM's and their suppliers collaborate. Indications are that co-operation between OEM's and suppliers will increase. Within this parameter of increased co-operation the co-ordination and support of increasing knowledge flows will be cardinal to ensure sustainable competitive advantage.

All the trends identified indicate that knowledge flows will not only be of the utmost necessity, but will also increase in depth and frequency. The different parameters of intra- and inter-organisational knowledge flows are important, with inter-organisational knowledge flows becoming a primary source of capacity and innovation.

Part of the long-term growth in the industry is expected to come from Asia. Therefore the influence of culture and tradition on knowledge flows needs to be taken into consideration by organisations. Efforts should be made to allow beneficial knowledge flows and opportunities in order to learn from each other, instead of letting the cultural differences inhibit knowledge flows. The expected purchasing hubs formed by OEM's might have the effect of creating knowledge flows on a regional basis. Again culture needs to be taken into consideration. I was aid earlier in this study that trust is the main cultural issue in knowledge collaboration agreements. Therefore organisations must ensure that methods are in place to enhance trust and support knowledge flows. Knowledge flows on a regional basis might create the situation where collaboration between groups of organisations can become more important than single relationships between organisations. This will result in a concentration of knowledge flows. OEM and supplier concentration will create huge knowledge

repositories and knowledge flows should become more concentrated to create effectiveness. Increased knowledge flows will create the need among organisations to identify their respective knowledge needs and the knowledge flows that would create benefits for both entities. Identifying these elements will help ensure that neither too much nor too little knowledge occurs as far as flows are concerned.

The predicted move to platforms of production will increase the need for engineers to collectively discuss and solve problems. Collaboration with system suppliers and the engineers at OEM's will enable them to do this. The prediction that risk will be transferred from OEM's to suppliers, makes it necessary that suppliers have insight into the workings and procedures of OEM's. It will allow them to bear the burden of increased risk in a much more efficient way if they are able to analyse the movements of OEM's, thus enabling a faster and more efficient response.

The predicted increase in the role played by suppliers with regard to the integration and management of the supply chain may lead to a decreasing role for OEM's. That knowledge flows and the sharing of knowledge will be tremendously important to suppliers cannot be doubted. However, OEM's must be careful not to lose their innovative and creative abilities. Therefore the sharing of basic and mutually beneficial knowledge must be emphasised again.

Information flows will increasingly occur through electronic resources, and in my opinion this fact underlines the importance of human interaction. Such interaction will ensure that all relevant knowledge and know-how, both tacit and explicit, can be shared between organisations. In this respect there is a definite gap between the conduct of Western and Eastern OEM's. While their Eastern counterparts have close ties with their suppliers, Western OEM's tend to have arm's length relationships with their suppliers. This might lead to a serious disadvantage in innovation, quality and cost for western OEM's as it is very difficult to diffuse tacit knowledge through electronic sources.

In light of the expectation that suppliers and consumers will move closer to one another, it will be essential for an OEM to have access to the knowledge that suppliers gain concerning their ultimate market. Suppliers will however be reluctant to volunteer any information. Therefore formal collaboration and knowledge sharing programmes will benefit both entities, by allowing them access to applicable knowledge resources. Suppliers are also expected to become bigger, and the

emergence of 30-50 large suppliers is predicted. OEM's therefore must implement stringent guidelines to ensure that they do not become obsolete while suppliers take a primary role in the industry, as happened within the computer industry with Intel-inside as example.

A specific trend that will also influence the need for collaboration is the focus on environmentally friendly products. Co-operation between specific suppliers and OEM's can ensure that products not only meet legal regulations but also the demanding standards of public acceptability.

It should be emphasised that the technology revolution and knowledge economy that, characterise the global business environment make it essential for organisations to recognise and utilise the benefits of knowledge sharing.

3.6 Summary

This chapter has attempted to shed light on the extent and parameters of the automobile industry supply chain. For this purpose an overview of the applicable supply chain was given, and it was narrowed down to the links between MTC and suppliers. The role of KM in supply chains was described in order to form a frame of reference for analysis and also to create the proper background for the identification of knowledge flows.

Knowledge flows were analysed systematically to ensure proper understanding of the issues at hand. Within this section a wider look was taken at the flow of knowledge in supply chains, and some literature studies on supply chains outside the automotive industry were also included. Issues regarding the identification of knowledge flows were raised, and possible directions and speeds of flows were discussed. Important to this section, were the factors that are recognised as having an influence on the flow of knowledge and also the opportunities and threats arising from these flows. The identification of opportunities and threats served to outline the importance of enhancing knowledge flows, while the influencing factors intended to give an impression of the steps that need to be taken to ensure the speedy and beneficial flow of knowledge between entities.

In order to identify future trends in the automobile industry supply chain, the study by Roland Berger was used as basis for analysis. This study was not used in isolation,

but was supported and extended by views expressed in other studies and by opinion leaders.

Knowledge flows between organisations are seen to be on the increase. Some strategic issues for international business underscore the need for knowledge sharing. Organisations therefore need models to guide management. Good guidelines should ensure that all organisations share equally in the benefits of their co-operation.

Chapter 4: Strategic Management Issues, and the Management of Knowledge Flows in Original Equipment Manufacturer Supply Chains

4.1 Introduction

It is necessary to give a short overview of two specific factors that may emphasise the need for, and the effectiveness of knowledge sharing. Although many factors may influence the implementation of knowledge sharing programmes, globalisation and the effect of alliances are specifically noted due to their relevance to global OEM's. Globalisation has a direct influence on the way in which OEM's operate in their respective environments. Knowledge collaboration programmes are also similar to alliances between organisations, but not all alliances will involve the sharing of knowledge. A short discussion of both these topics provides an overview concerning the necessitating influence thereof on knowledge sharing.

Human knowledge activity is driven by the need to make sense (Shariq 1998). The expanding complexity of knowledge, increases dependence on cognitive artefacts to help people perform. The artefacts and tools used for the management of knowledge are useful, because they provide a framework for individuals to make sense of the enormous amount of information and knowledge that have to be dealt with on a daily basis (Shariq 1998). Therefore closely related to and underpinning the flow of knowledge in supply chains are the methods and tools used by organisations to regulate and make sense of such knowledge flows.

Tools refer to the physical technologies that assist managers and organisations to co-ordinate and regulate knowledge and flows thereof between organisations. Rudy and Ruggles (1997) define knowledge tools as " technologies which enhance and enable knowledge generation, codification, and transfer". Models, on the other hand, refer to the more abstract mental guidelines according to which management and organisational thought can be structured. Models enable managers to comprehend and make sense of the parameters and abstract nature of a topic such as knowledge and flows thereof. The Karboul Board Report (2000) emphasises that a good KM model helps managers to analyse and act on knowledge opportunities related to globalisation and e-business.

This chapter focus firstly, on two strategic issues for international OEM's and the need, created by these issues, for a knowledge collaboration process between organisations in a supply chain. Thereafter the chapter outline the models and tools used within different OEM's and their supply chains. MTC is specifically referred to and used as a unit of analysis to establish the effectiveness of management tools for knowledge flows between an OEM and its suppliers.

4.2 Globalisation

"During the past decade, significant changes have affected the world economy and international business, forcing companies to adapt to the new world of the global economy" (Jeannet 2000; see also Kelleher and Seekings 2000, and Banks 1999). The foundation of the world economy is shifting away from traditional tangible assets such as capital, labour and land, toward the identification and leverage of intellectual assets (Kelleher and Seekings 2000). Globalisation is transforming the international economy, from comprising bounded national economies interacting on the basis of differing national comparative advantages, into a system where a variety of competitive advantages exist (Lang 2001). It can be argued that globalisation is one of the main challenges to top management (Louis Harris and Associates 1998, Lang 2001).

Imminent change and pressure on resources resulting from globalisation emphasises the need to maximise utility of all resources. Knowledge is shown to be a cardinal resource for global organisations. OEM supply chains are a potential source for considerable innovation enabling knowledge. A logical model to guide the implementation of a mutually beneficial knowledge collaboration process between organisations in a supply chain is therefore pertinent.

The parameters and boundaries of a knowledge collaboration process may, however, be susceptible to change. Management teams of organisations must be able to comprehend the global environment and be able to adapt. A guideline or methodology to guide their thinking will prove a valuable asset. Organisations need to share both tacit and explicit knowledge, and the role people play is getting increasingly important in this respect (Lang 2001, Kelleher and Seekings 2000). Lang emphasises the role of suppliers in the knowledge domain of organisations. Culture plays an increasing role in efforts to enhance organisational performance through

knowledge sharing between organisations (Kidd 2001). Knowledge sharing between organisations is not, however, necessarily spontaneous and always beneficial. Many aspects of a knowledge-sharing programme need to be understood and managed systematically.

Globalisation and the emphasis it puts on knowledge resources, therefore, enhance the importance of a knowledge collaboration process. A model to guide the implementation of a knowledge collaboration programme will thus be of immense value.

4.3 Alliances

With knowledge collaboration, organisations seem to be developing alliances within specific parameters. Alliances in this respect refer to the collaboration between two organisations on pre-determined grounds within an identified parameter to the benefit of both entities. A formal definition of a strategic alliance is given by Wheelen and Hungar (2000) who state that “a strategic alliance is an agreement between firms to do business together in ways that go beyond normal company-to-company dealings, but fall short of a merger or full partnership”.

Three trends have been conducive to strategic alliances in the automotive industry (Chan and Wong 1994), and these are technological evolution, automobile demand and government involvement. The authors argue that these trends make it necessary for organisations to form strategic alliances to increase their competitive advantage (see also Holmqvist 1999, Love and Gunasekaran 1999), and that only organisational learning can compensate for weaknesses in corporate culture that might inhibit learning ability. Without a co-operative learning environment the success of strategic alliances will be limited in the long term (Morrison and Mezentseff 1997). Love and Gunasekaran (1999) define learning alliances as a "strategic partnership that is based on creating an environment that encourages mutual and reflective learning between supply chain partners”.

Learning in alliances is based on single loop learning (Crossan and Inkpen 1995). Single loop learning occurs when members of an organisation respond to changes in their environment by detecting errors and correcting them, but still adhere to existing organisational norms. Learning opportunities are not typically exploited in consistence with initial learning objectives, and the primary barrier to learning occurs

at an individual level (Crossan and Inkpen 1995). Double loop learning can help overcome such problems. Double loop learning incorporates a high level of evaluation and analysis of information into knowledge, and that enables changes to be made to the organisation's knowledge base, competencies and routines (Crossan and Inkpen 1995).

Vertical alliances succeed when firms develop idiosyncratic inter-firm relationships through investments in specific capital assets, shared know-how, complementary assets and effective governance mechanisms (see Gulati 1995, and Dyer and Singh 1998). The proposed methodology (chapter 5) suggests more. First it does not envision a vertical relationship, but a horizontal relationship of equal input. Also it does not envision that knowledge flows will be initiated by cross holdings of assets and economical power. A proper guideline should ensure equality within a horizontal relationship. Such a horizontal relationship will enable engineers or experts to share knowledge on relevant problems without the constraints of vertical relationships.

In order for both organisations to benefit they must invest in the "particular" knowledge that they wish to share under the collaboration agreement. Such investments will create competence, enable the flow of knowledge and provide mutual benefit.

Within the parameters of international strategic alliances Simonin (1999) identifies tacitness of knowledge as the most significant determinant of knowledge transferability. Cultural distance, asset specificity, and prior experience, the author argues, are other important influencing factors. Elmuti and Kathawala (2001) list commitment by senior management, effective management, similar management philosophies, frequent feedback and clearly defined goals as important factors in the success of an alliance. The proposed methodology (chapter 5) will enable organisations to overcome barriers by following a clear and logical process. Through the use of mutual CoP's organisations should be enabled to share all relevant tacit knowledge within the predetermined boundaries. Inkpen (1998) argues that not all alliances are set on knowledge acquisition, however, and that partners differ at the level in which they protect their knowledge. This argument supports the need for the proposed methodology, since knowledge boundaries are set up beforehand to ensure all parties involved know the extent of the boundaries within which they can

operate. The proposed methodology will protect both entities from losing skills or direction in the collaboration process.

Alliances with suppliers achieve tight integration resulting in reduced costs, improved efficiencies, and improved quality for the focal firm (Parise and Henderson 2001). In a strategic alliance, shared risk occurs in a joint venture where firms provide a final product, or when they establish a research consortium. In knowledge collaboration programmes organisations will share risk with partners in order to prohibit the lost of specific expertise (Tucci et al 2000). They might incur high costs initially, or the benefit might entail the realisation that developing a specific project is not viable. Where benefits are not clear or only long term, a logical guideline will ensure continuance and reduce pressure to produce immediate benefit.

Within the business scope of OEM's the development of new products is essential. This is also the direct role of MTC. Therefore development partners might be important. Instead of undertaking numerous customer visits in the process of developing products, time must be spent on identifying successful customers who are leaders in some way (McElroy 1995). This also holds true for suppliers. Such an identification and collaboration process should enable an organisation to work closely with another competent firm to develop certain products cheaper and faster. This is directly relevant to the proposed model of knowledge collaboration. Both organisations have to identify and then adhere to all steps to ensure workable implementation of the programme with a collaboration partner. A strategic balance should be achievable between two knowledge-sharing entities. Although this approach might seem obvious it is in the detailed implementation of the process that success or failure might be found.

There has been a recent surge of enthusiasm within the automotive industry for the idea to build closer supplier relationships in the area of product development (Evans and Jukes 2000). These authors suggest that synchronisation can be achieved through four key steps: process standardisation, knowledge sharing, alignment of existing practices and continuous elimination of waste within the joint development cycles. For the proposed methodology the aspect of knowledge sharing is particularly important. The authors argue that the emerging model in the automobile industry supply chain is one of collaborative partnerships between vehicle assemblers and component manufacturers. These partnerships are characterised by longer supply

contracts, more frequent communication, a drive on quality standards, and increased supplier responsibility. This emerging relational agreement emphasises knowledge collaboration between OEM's and their suppliers. The proposed methodology is an attempt to provide a guideline for the implementation of knowledge collaboration.

From the international business environment considerable pressure is put on global organisations to enhance and create sustainable competitiveness. Knowledge collaboration within the supply chain parameters of international firms is a valuable potential source of innovation and increased competitiveness. Within the boundaries of these forces global OEM's are forced to utilise all their resources to the full extent possible.

Although only a guideline for management thinking, the use of a model such as the proposed methodology and other tools that facilitate knowledge collaboration seems to be of immense strategic importance. It can therefore be concluded that the adoption of a knowledge collaboration programme and a model to base it on should be a priority for OEM's.

4.4 Knowledge Management in Supply Chains

In his analysis of 431 European and US companies, Ruggles (1998) found that there are eight major categories of knowledge-focused activities. Although one of these activities is the sharing of knowledge, the focus falls mostly on internal knowledge sharing. Little mention is made of knowledge sharing with external entities (see Lane 1997). In a study of the literature, many KM models emerge (see McAdam and McCreedy 1999). However, barely any models are provided for the management of knowledge flows between organisations. Therefore this section will focus on both the academic literature and on the methods and tools implemented by organisations in an attempt to generate a framework for the establishment of a model for the management of inter-organisational knowledge flows.

Most KM projects in organisations fall into a few categories, each with a key objective (Davenport and Völpel 2001; see also McAdam and McCreedy 1999). It seems that information technologies are the most widely used tools for the management of knowledge sharing and dissemination.

The most common technologies are those that allow firms to build knowledge repositories, provide broad access and allow people to find knowledge objects (Davenport and Völpel 2001; see also Shariq 1998 and Marwick 2001). Lotus Notes, Web-based Intranets, and Microsoft Exchange are identified as the three basic pillars of repository and access environments. However, tools that are technology and software based, in my opinion, lack human involvement thus making the flow and transfer of tacit knowledge very difficult.

Software tools identified for KM are rated very low in user satisfaction (Bartlett 2000). Organisations specialising in KM tools, such as Microsoft and Ernst and Young, are currently working on a variety of new models and tools (Hibbard 1997 and Schwartz 1999). All the tools mentioned are software based, however, and therefore again insufficient in managing knowledge flows where human interaction is needed.

A useful tool for the management of knowledge flows within organisational parameters, however, is electronic mail (e-mail). Advances in e-mail use occur mainly through trial and error (Stevens and McElhill 2000). The authors emphasise the usefulness of e-mail as a tool to manage knowledge flows, but recognise that e-mail lacks the attributes to make it an independent tool for knowledge flow management. Therefore it needs to be used together with alternative tools and models. Managing tacit knowledge with electronic tools such as electronic communications is especially difficult. Both Royal Mail and Texas Instruments Europe use documentation and easy access to documentation to ensure that knowledge on best practices is readily diffused (Zairi and Whymark 2000).

Manufacturing organisations are starting to compete as a supply chain rather than as individual organisations, and therefore (Anonymous D 2001) see e-commerce as the basis for future supply chain collaboration and knowledge sharing. Inter-organisational systems will reduce uncertainty by extending the reach of managerial control (Warkentin et al 2001). The authors argue that with the use of greater volumes of timely and accurate information, decision makers may operate with lower levels of ambiguity and uncertainty, enabling more effective decisions. The Internet is providing a widely accepted platform for continuous and unattended exchange of information and knowledge. Especially relevant is the significant attention that is currently directed to business-to-business e-commerce (Warkentin et al 2001). Such networks are adding value to the supply chain and especially OEM supply chains,

because organisations spend a huge proportion of their budgets on the procurement of different knowledge resources, which in turn will lead to increased innovation.

In the realm of aerospace OEMs a variety of methods are used to facilitate the incorporation of supplier input into design (Fan et al 2000). These authors argue that subcontracting will in concept be the simplest way to integrate a supplier into a co-operation process. They also argue that an important aspect of working with suppliers is the ability to achieve improvement together.

Among all the major automobile manufacturers the emphasis is on the use of technological tools, and specifically the Internet, for transferring and sharing knowledge (Karboul Board Report 2000). Most of the knowledge sharing activities identified in OEM's, focus on the diffusion and sharing of internal knowledge. Very little attention is currently being given to the aspect of and opportunities offered by knowledge sharing with suppliers. The Karboul Report indicates, however, that Eastern automobile manufacturers like Toyota and Honda place a much smaller emphasis on technology tools and are much more focused on personal knowledge sharing, and on sharing knowledge with their suppliers. On this basis Toyota has been able to reduce part defects by 84% and the ratio of inventory to sales by 35%. Even in the US market where Toyota deals with the same suppliers as its competitors these achievements were possible (Karboul Board Report 2000). Accordingly, the methods and tools used by Toyota can prove insightful.

Toyota has two major divisions that take the lead in co-ordinating supplier development activities. These are the purchasing and the operations management consulting divisions (Dyer 1999). When the need arises these divisions will also involve other divisions in solving problems with suppliers. Approximately 15-20 consultants are permanent members of the operations consulting division, while younger individuals are expected to extend their knowledge of the Toyota production system. This is done through an internal rotation between departments that usually lasts 3 years. A group of consultants is sent to suppliers, for periods ranging from a few days to many months, to assist in problem solving and in such a way transfer knowledge.

Toyota facilitates knowledge sharing across suppliers by organising voluntary study groups with their key suppliers (Dyer 1999). Suppliers are grouped according to their production processes or activities, and geographic proximity. Close competitors will

not be grouped together. In order to maintain creativity, stimulus and diversity, these groups are reorganised every three years. The groups meet once a year with the goal of increasing productivity in areas of common interest.

After a theme for discussion has been decided on, the group establish a rotation schedule between the different plants of suppliers (Dyer 1999). Each plant is focused on for approximately four months. The group evaluate the process and other suppliers will visit the plant as needed to evaluate and offer suggestions. Thereafter the same is done at the other plants. A member of the Toyota operations management consulting division visits suppliers every week or two to give advice and monitor progress. This allows Toyota to bring its expertise to bear on and help solve supplier problems (Dyer 1999). It also allows Toyota to ascertain what its suppliers have learnt.

This method also worked well in the US, but due to problems with the skills level of different suppliers, the groups were divided up to ensure that all suppliers in a group would be on the same level. If a supplier wants to join such a group Toyota has specific requirements to ensure that the process is beneficial for all concerned. Sometimes Toyota might decide that a supplier could benefit from accessing the knowledge that resides within a competitor (Dyer 1999). Normally these firms would not be in the same group, but in such a case Toyota may attempt to orchestrate a supplier-to-supplier knowledge transfer. This is done on the basis of a negotiated agreement with both suppliers, who both can derive benefits. This method is however not used in the US as often as in Japan itself, and Toyota would rather organise trips to Japan for US suppliers. For example, Toyota asked a US supplier to reduce its changeover time from two hours to thirty minutes. When the US firm replied that this would be impossible, Toyota organised a trip to a competitor in Japan who was doing it in 15 minutes. Therefore, through the use of its personal and technological tools, Toyota is maximising utility of its knowledge resources, while Toyota's suppliers receive equal benefits.

It has to be emphasised that such groups are not intended to undermine competition but to gain knowledge and insight in areas of common interest. This enables different suppliers and the OEM involved to find innovative of improving of knowledge flows, and to reap the benefits underlying such flows. In addition to technological tools

personal knowledge tools are also needed to ensure that organisations can reap all the benefits offered by inter-organisational knowledge flows.

Clearly illustrated by Ford UK is that the blind implementation of Japanese methods will not necessarily work in Western organisations. Ford UK suffered major setbacks with an 'After Japan' campaign in 1979 in which they tried to implement the same methods (Storey 1994). Not all Western manufacturers have a totally independent view on supplier relationships. In their Mlada Boleslav plant near Prague, teams of Skoda (part of Volkswagen) employees interact closely with suppliers (Kochan 1998). This allows relevant knowledge to flow freely between the entities that need it, creating enormous possibilities for value added through innovation. Even within the Mercedes-Benz plant at Rastatt there are some suppliers that are located in the supplier park (Kochan 1998). Although selected for logistical reasons to be situated nearby, this arrangement also allows people to interact, solving problems faster, and generally allowing more efficient knowledge sharing.

Cisco Systems is an excellent example of a tightly disciplined business that resembles a Japanese "Keiretsu", which is a block of interdependent organisations operating within a given industry (Häcki and Lighton 2001). Unlike a "Keiretsu" a network is held together not by cross-holdings of debt and equity, but rather by an information standard, enabling network participants to exchange information (Häcki and Lighton 2001). The authors emphasise, however, that a network only thrives if the organisation or person orchestrating this network labours to create benefits for all entities involved.

Setting up a collaborative environment with supply chain partners requires an investment of time and money from both entities (Eisenhart 2001). Therefore it is necessary to make sure that the organisation that you wish to establish closer links with, is suited and committed to a long-term relationship. At Ford, for example, management works with individual supply teams in order to establish what type of information needs to be shared and how it wants that information to be presented (Eisenhart 2001). According to a spokesperson at Ford the goal is to improve productivity on the supplier's side in order for Ford itself to benefit from that.

One of the most difficult aspects of an information management plan is how to determine what information people require to do their various tasks, as well as how to help them expand and update their existing knowledge (Foo and Hepworth 2000).

The authors propose the use of extensive surveys to identify what knowledge is required and to expand and update such knowledge. This can be done either electronically or manually depending on the circumstances. KM solutions should display the following characteristics (Koulopoulos and Frappaolo 2000).

- Context sensitive

  The solution must be able to take the context of a specific situation into account.

- User sensitive

  The tool or solution should be able to organise the knowledge in such a way that it is most useful to the person that specifically seeks and needs such knowledge.

- Flexible

  Knowledge of any form should be within the capability of the system to handle, including for example different subjects, structures and media.

- Heuristic

  It must be possible to adapt and learn the solution, thus improving its ability to provide its users with tailored knowledge.

- Suggestive

  The solution or tool should be able to deduce what a person's knowledge needs is.

Very few, if any, technologies are able to provide all of these features. Therefore the aspect of human support and interaction is again brought to the forefront in this discussion. Many of the characteristics mentioned by the authors refer to the need for human understanding and anticipation. Not all knowledge can be shared through the use of technology. Tacit knowledge cannot be electronically communicated and organisations must know what type of knowledge they want to share to enable them to invest in the correct balance of technology and human interaction.

Although some of the models and tools are based on the principle of interaction between employees, these models and tools are mostly focused on internal knowledge diffusion. The importance of knowledge sharing between organisations now and in the future, due to specific trends, has been shown. Before putting forward

a model for knowledge sharing between organisations in the supply chain, MTC at DaimlerChrysler will be presented as a good benchmark for an analysis of current tools and models.

4.5 Processes, Tools and Methods between Mercedes-Benz Technology Centre and Suppliers

At MTC the supply chain vision entails an increase in the visibility and agility of information. In order to reach its goal the organisation is making use of specific models and tools. One such tool is the internet-based "Covisint", system and in a continuing effort to implement its e-business strategy the organisation announced that its new global supplier portal would be developed with Covisint (Internal documents). Covisint is a tool, which allows the process of knowledge sharing to be managed according to a defined method.

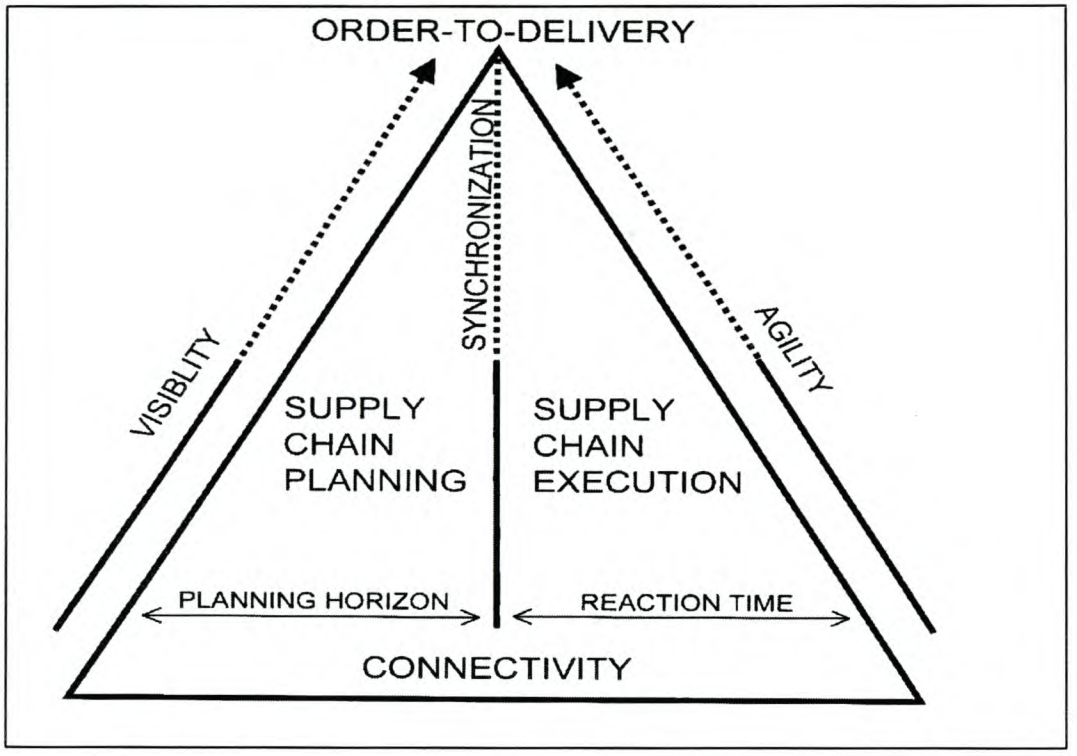
This system or internet-based product can be placed into two categories: planning and execution. "Covisint" provides the foundation for visibility, collaboration and optimisation (Internal documents). In regard to the connectivity between trading partners, this allows for the exchange of key supply chain data and connects all trading partners with varying levels of technical sophistication. Regarding execution, this tool allows users to manage tactical events in real time. These events refer to supply chain events like transportation management, trade management and other hosted applications.

To summarise, the Covisint system connects all trading partners through a single integration point. The ability is generated to access, view and download documents and information through the Covisint portal, with the ability to send and receive documents in multiple formats, while customers are electronically notified of customer document delivery (Internal documents). The system and its scope are summarised in Figure 4.1. It has been argued, however, by (anonymous C 2001) that the creation of this online marketplace caused tremendous high expectations, but that it is yet to deliver benefit to OEM's, their suppliers and consumers respectively.

At MTC tools for transferring knowledge are intended to be used for active transfer of knowledge within and into the company, as well as to procure human knowledge carriers (Internal documents). While the organisation uses tools such as mentoring, training seminars, circular letters, virtual teaming, debriefing, networks, knowledge

brokers, learning modules, etcetera for internal knowledge transfer and sharing, no formal tools are being used to actively share knowledge with suppliers.

Figure 4.1 The Covisint System



Source: Internal documents

MTC is part of the bigger DaimlerChrysler operation, and according to Karlenzig (1999) a lot of DaimlerChrysler's knowledge experts are situated in the supply base. It is therefore essential for the organisation to be able to access the knowledge of these experts and to give these experts access to relevant knowledge and know-how that might be useful for mutual application. However, with E-BoK supplier participation, issues of security, liability and culture come to the front (Karlenzig 1999). At present participation is limited to suppliers presenting computer discs to employees for their review. If the Tech Club involved gives its approval the information can be entered into the E-BoK. This is a lengthy process and reduced entry times may be beneficial.

This does not mean, however, that there is no knowledge collaboration with suppliers. On an informal basis employees still meet and discuss certain problems

while the organisations will also share information and knowledge in the normal course of doing business with each other. However, by formally implementing knowledge sharing and collaboration both entities can benefit tremendously with regard to gained innovation, competitiveness and reduced cost.

At present the process of KM and sharing between MTC and its suppliers are not formally co-ordinated and knowledge is only being transferred through existing methods, which mostly includes technological tools. Based on this analysis a methodology and guidelines for management were proposed. The importance of the steps involved in the process as a whole was emphasised, while it was also argued that management should be aware that a process such as the above is only a guideline and that ample room must be left for innovation and adaptation to specific circumstances.

4.6 Summary

This chapter outlined the necessitating presence of certain strategic issues in the international business environment for knowledge collaboration and knowledge flows between organisations. The benefits and importance of knowledge collaboration between organisations have been shown. Current tools for knowledge sharing between organisations were analysed using the existing approaches of MTC as representative of OEM's as benchmark. It was shown that most of the current methodologies and tools for the sharing of knowledge are focused on internal knowledge dissemination, and with the exception of a few organisations there is hardly any suggestion of formal knowledge sharing programmes with suppliers.

The focus on mostly internal knowledge flows demonstrates a lack of models and tools for inter-organisational knowledge flows. The vast potential for knowledge flows between organisations has been shown. Therefore a model to guide the implementation of a mutually beneficial knowledge sharing process between organisations in a supply chain is important.

Chapter 5: Proposed Model for Managing Knowledge Flows in a Collaboration Programme

5.1 Introduction

In the previous chapters all relevant aspects of the stated problem were discussed. Definitions of knowledge and knowledge management have been presented. The evolution of knowledge management at MTC as representative of OEM's has also been described. Relevant topics regarding the applicable supply chain and the methods organisations use to manage the flow of knowledge were identified and discussed. Based on this analysis and against these benchmarks a methodology for the management of knowledge collaboration in an OEM supply chain can be proposed.

5.2 Proposed Model

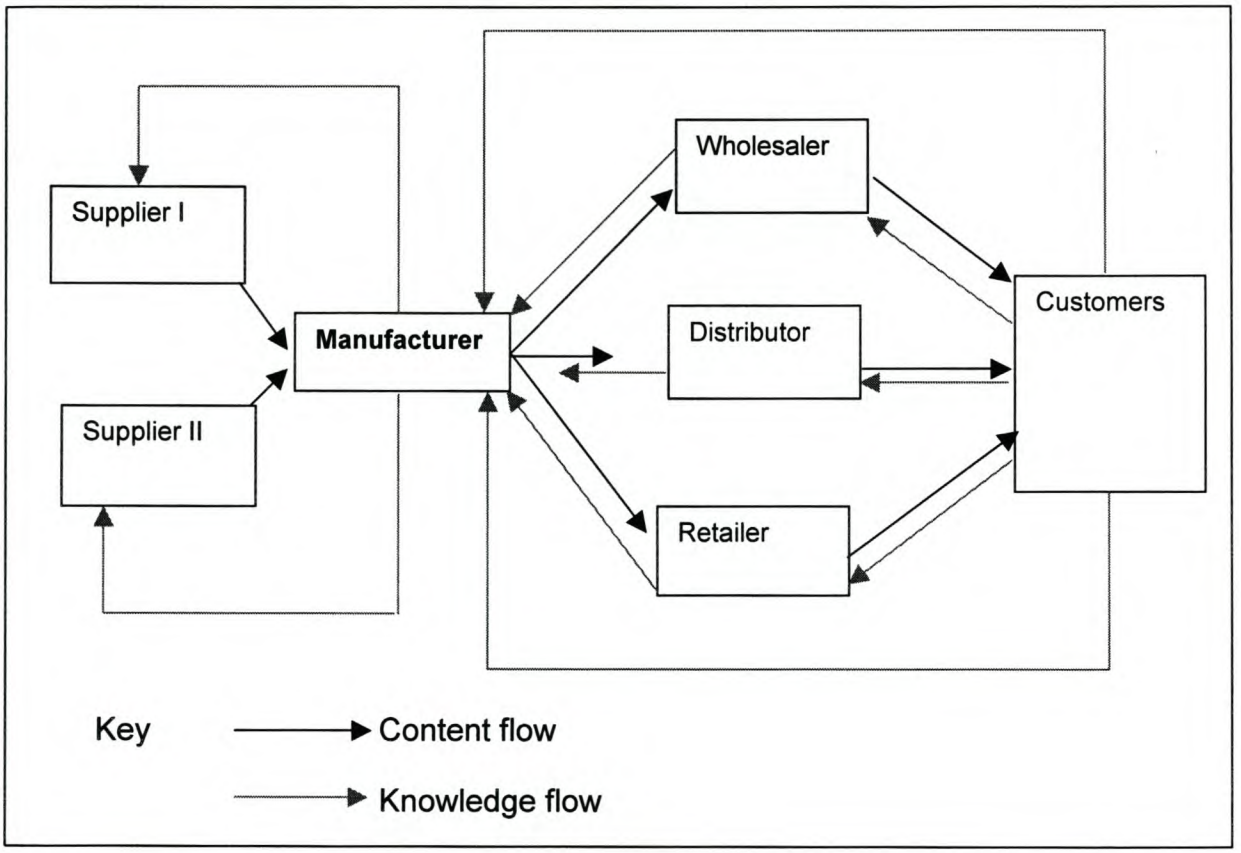
The type of relationship that Japanese manufacturers have with their suppliers elevates them to the first position of knowledge sharing within the supply chain. It is not suggested that MTC copy such a system, but rather that the methodology used be analysed, adapted and improved to maintain high levels of development, while reducing time and costs.

The current and undesirable state of knowledge flows in supply chains is shown in Figure 5.1. The need exists to move away from a one-sided knowledge sharing approach. A collaborative and integrated model of knowledge sharing is needed to ensure sustainable competitive advantage. In Figure 5.1 the flow of knowledge is mostly in one direction. The supplier will be the end receiver of all the information, but not before it has been filtered through the manufacturer.

Much of the knowledge transferred between organisations in alliances occurs by means of interaction between personnel (Inken and Dinur 1998). The authors argue that the transfer and rotation of personnel help members of an organisation to understand the business from a multiplicity of perspectives. Such understanding makes knowledge more fluid and easier to transfer. Personnel rotation might be effective, but knowledge needs to be subjected to different processes, methods and tools to be shared fully (see Inken and Dinur 1998). Organisations will have to take a strategic decision concerning the goal of collaboration. Setting goals will provide

guidelines for the sharing of basic and mutually beneficial knowledge between OEM's and their suppliers.

Figure 5.1 Supply Chain Knowledge Flows



Source: Warkentin et al 2001

Bal and Gundry (1999) recognise the need to introduce networks of collaboration. They argue however that such networks should not be IT based. An IT focus will result in too little attention being paid to human and process factors. They argue in favour of using technology and the Internet to form a knowledge-sharing base through what they call virtual teaming. They define virtual teams as groups of people who are geographically dispersed, who work together to reach a specified goal in a collaboration process of an indefinite duration.

The effectiveness of computer-based tools is already limited in the information management domain (Lueg 2001). To circumvent similar limitations in KM the role of humans must be emphasised and supported. Lueg argues that tools should be

applied in such a way that human cognitive and social capabilities are supported. Most inter-organisational systems for the sharing of knowledge are designed to share narrowly defined data and information (Warkentin et al 2001). Already in 1994 Storey argued that contrary to what one might think, the impressive electronic corporate communication tools widely implemented do not necessarily facilitate strong links between affiliates who supply each other.

It is not necessarily beneficial to openly share all knowledge with a supplier, however, and the ability to access and share knowledge when needed is very valuable. Therefore it is imperative that an organisation builds a personal relationship with a supplier. At present most of the contact between MTC and suppliers is on the level of technological tools. These tools have the physical disadvantage of not being able to transfer tacit know-how. The personal relationships used by Toyota to ensure beneficial knowledge flows to and from suppliers are a more effective way of sharing tacit knowledge and creating innovation.

When one considers the different types and levels of knowledge that exist in organisations, it may safely be said that probably no one model will be able to encompass all types of knowledge. Davenport and Prusak (1997) argue that the best distribution system for information is often a combination of hybrid systems of people, documents and computers. At present most tools and models within the paradigm of knowledge sharing in supply chains are focused on explicit knowledge. Hedlund and Nonaka (1993) assume that there are four different levels of carriers or agents of knowledge in organisations: individuals, small groups, the organisation and the inter-organisational domain. The inter-organisational domain includes important customers, suppliers, and competitors. McAdam and McCreedy (1999) criticise this model, however, on the grounds that it assumes the carriers, like the knowledge can simply be segregated.

The authoritative model of Nonaka and Takeuchi (1995) for transferring knowledge forms a suitable background from which to derive a knowledge collaboration model in supply chains.

Figure 5.2 Nonaka's Knowledge Management Model

TO → / From ↓	**Tacit**	**Explicit**
Tacit	Socialisation	Externalisation
Explicit	Internalisation	Combination

Source: Nonaka and Takeuchi (1995)

On the basis of the work done by Nonaka and Takeuchi (1995), we can argue that the way to transfer tacit knowledge between organisations in a supply chain is through socialisation. Tacit knowledge can be converted to explicit knowledge through a process the authors call externalisation. To achieve the goal of tacit and explicit knowledge flows between organisations the use of specialised CoP's is suggested. Such CoP's should be used together with the necessary supporting technological tools.

CoP's are widely used within MTC and also other OEM's to transfer and share knowledge. The use of the same principle, but across organisational boundaries, will enable an organisation to identify knowledge needs, to transfer and gain tacit knowledge, and also to internalise the knowledge gained from the other organisation. Specialised CoP's will ensure that both organisations share relevant knowledge and that both entities benefit from this collaboration. The use of technological tools will ensure that information and explicit knowledge can be shared without too much effort.

Knowledge sharing between organisations might be a sensitive and political issue. As indicated, trust is crucial in order to enable knowledge sharing. Therefore clear and unambiguous steps for the establishment of a knowledge-sharing programme are important. An established set of guidelines that organisations can follow, that is logical and systematic, should reduce ambiguity and enhance trust. This will form a base from where collaboration can be developed further.

Close relationships do lead to faster development times (Luchi and Paladino 2000; see also Stuart 1997). These findings emphasise the importance of a sound methodology as a guideline for the implementation of a knowledge collaboration programme.

The challenge is now to establish a model, on which a knowledge-sharing agreement can be based. In Figure 5.3 a model to guide management's thoughts for the sharing of knowledge between entities in a supply chain is suggested. The purpose of this model is not to lay down rigid parameters. Its goal is to serve as a guide for management on which thoughts their with regard to the total process can be based.

1. The first step in any collaboration process is the conscious decision by management to initiate a knowledge-sharing programme. Collaboration entails that a programme be put in place to share specific pre-determined know-how, which will benefit both organisations. At this stage the benefits of and need for collaboration are recognised and both management teams make the decision to work together with regard to knowledge resources. A common vision shared by both management teams is necessary to drive the decision-making process and to prevent unnecessary delays. Political considerations might prove to be a considerable barrier, because without management support a knowledge collaboration programme will only be implemented with difficulty.

2. The next step is one of the most crucial steps in the whole collaboration process. While later steps concern the methods by which to facilitate knowledge flows, this step involves the total process of moulding the parameters and rules for collaboration. This step needs to remove any ambiguity between the entities and in such a way enhance the trust factor between organisations (see McGrath 2001). Structured negotiations are needed to ensure that all aspects of collaboration are clearly understood. A guideline should allow ambiguity to be reduced and enhance a clear understanding of common goals.

   The rules and specific areas of collaboration must be identified. The specific areas relate to the exact type of knowledge and parameters in which knowledge sharing is needed. The rules, which will govern this process must be assessed, while the goals of the programme need to be clearly articulated. All influencing factors must

be identified and discussed. These steps will help to create uniform expectations even though people might be from differing cultures or backgrounds. Business relationships in Western cultures are more distant and individual (Hofstede 1993). Specific rules will help to identify and provide guidelines for individual conduct. These guidelines govern the sharing process and in such a manner ambiguity is removed.

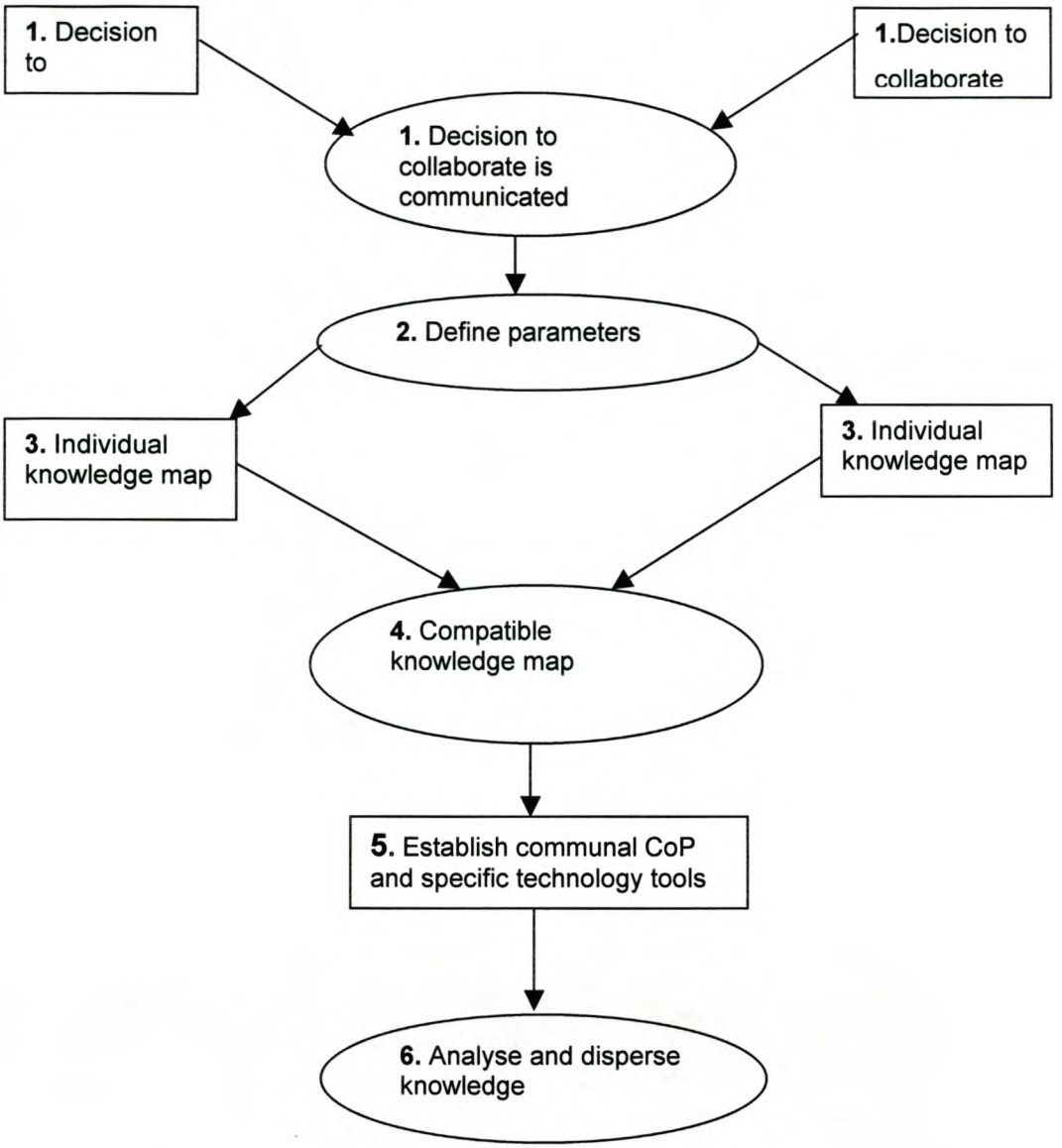
By identifying mutual goals, rules and guidelines to reach these goals, a background is created against which the organisations can deal with unforeseen problems. From this basis possible barriers and problems that might occur can be handled.

3. This step is highly subjective and will differ from one organisation to the next. Its purpose is to give organisations the opportunity to establish their own level of knowledge and expertise concerning the area of collaboration. This will provide them with the necessary background to ensure that their core competencies are not eroded while enhancing the applicable knowledge area.

To identify the specific and relevant knowledge that organisations wish to share, a tool like a knowledge map is very important. Such a knowledge map can bridge the gap between different areas of the organisation (Vail and Edmond 1999). These authors refer to: "the visual display of captured information and relationships, which enables the communication and learning of knowledge by observers with differing backgrounds at multiple levels of detail" (see also Davenport and Prusak 1997).

Across supply chains knowledge maps will aid organisations to identify knowledge and specifically knowledge that is of interest to all parties involved. Knowledge mapping requires management support and must evolve through utilisation to ensure sustainable value (Vail and Edmond 1999). They propose the following methodology for establishing a knowledge map.

Figure 5.3 Model for Managing Knowledge Flows in the International OEM Supply Chain



- Determine the initiator or sponsor of the knowledge map (top management, strategy managers or knowledge manager etc.).
- Establish the goals, scope and user requirements for the map.
- Initiate an ongoing education process on benefits and requirements, making sure the initial sponsors are informed and educated.
- Identify the key stakeholders (in this case the supply chain collaborators).

- Create a steering committee with direct representatives of the key stakeholders and members of relevant technical committees.
- Develop an evaluation process.
- Identify and establish a person responsible for the maintenance process. (Maps must evolve through utilisation, and therefore be adapted and maintained constantly.)
- Create the initial map.

Within the parameters of knowledge sharing in supply chains, knowledge mapping will provide the relevant starting point from where both organisations can monitor the types of knowledge involved and the continuous process of collaboration.

4. A compatible knowledge map refers to a mental model, which will allow two or more organisations to compare a specific class or area of intellectual capital that exists within the parameters of both organisations. This will allow organisations to compare the state of each organisation individually concerning the area that they wish to collaborate on. It will enable them to identify strong points on which they can build and also negative points which can be improved and in such a way enhance the benefits for both entities.
5. This step involves the actual tools with which to facilitate the process of knowledge sharing and collaboration. Within the realm of knowledge sharing in supply chains, organisations have to deal with both tacit and explicit knowledge. With regard to explicit knowledge organisations can to a great extent use current technological tools to transfer this knowledge between them. The Internet, e-mail, data transferring and telephone services are some of the tools that can be utilised.

   It becomes problematic, however, when organisations want to share more intrinsic knowledge. Knowledge that is embedded within persons or in the processes of different firms cannot be transferred using the normal channels. It is simply not possible to transfer experience or specific process know-how by means of electronic tools. To solve this problem it is suggested that organisations in a supply chain, under the leadership of an OEM establish a “communal” CoP.

Organisations thus set up a group of persons or a learning team, consisting of professional people from both the organisations involved. This group or CoP should then be able to discuss specific areas and problems as defined previously in the collaboration process. Such a team should also be able to visit the different production plants and be allowed to study the specific process, if relevant. In such a case the team should be able to acquire the tacit know-how of individuals in the other organisation. The goal of such a CoP must be to identify and establish best practice, which will allow a mutually beneficial process to enfold. This will allow these organisations to streamline certain processes and will eliminate waste.

To build and sustain competitive advantage the knowledge and expertise of global organisations' staff need to be seen as a critical strategic resource (Bender and Fish 2000). The authors argue for the importance of global assignments in transferring knowledge. They support the idea of establishing global knowledge sharing teams between organisations to ensure sustainable competitive advantage.

OEM's compete in product markets through price, quality and delivery times. To be successful managers must define the firm's core capabilities. Core capabilities may often be embedded in the know-how and procedures that employees follow (Tucci et al 2000). The tacit knowledge described here is accumulated in a learning process and therefore firms compete in an evolutionary way, where successes and failures enhance team "know-how" if properly managed. Tucci et al (2000) further argue that if activities are outside the firm's core capabilities managers must consider the most economical way to produce or purchase the non-strategic parts.

Williamson (1985) maintains that when an OEM demands specific investments and specifications from a supplier they enter into a relationship of mutual dependence. Tucci et al (2000) argue that this mutual dependence develops from both the specific knowledge that each party has and from specialised capital investments. It was also shown in section 2 that teams, which manage cross-functional issues and the transfer of knowledge, improve the quality of products. Although knowledge does flow between collaborative partners, inter-firm teams enhance the effect of these exchanges (Tucci et al 2000). This emphasises the

need to create a well-balanced learning team that will be able to benefit both organisations.

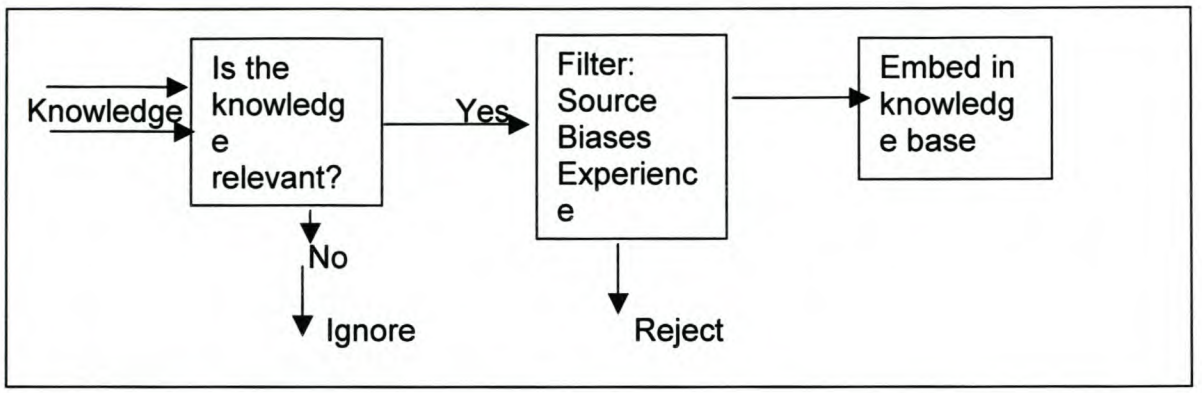
Kletter (2001) highlights five characteristics of successful knowledge-sharing communities:

- **Interactive**: Members play dual roles, both contributing and receiving knowledge
- **Distributed**: Knowledge is distributed among members and shared through a central platform
- **Segmented**: Communities can be broadly focussed or narrowly targeted, but must be organised around a central mission
- **Regulated**: Member activity is measurable and is sensitive to incentives
- **Self-reinforcing**: Community value begets more value

6. The knowledge and know-how acquired in the above process should at this stage be analysed by each specific organisation. Where it is relevant it must be made available to other parts of the organisations where such knowledge may be needed. It is logical that not all knowledge will be relevant to every department in the organisation. Therefore knowledge acquired in such a fashion, should be analysed and made available to all areas that are necessary. This will also prohibit an information or knowledge overflow.

   Organisations need to have a system in place to ensure that they do not waste precious resources on capturing or sharing irrelevant knowledge. Godbout (1999) therefore correctly argues that all types of knowledge have one thing in common: It is acquired through a selection or filtering process.

Figure 4.5 Knowledge Filtering Process



Source: Adapted from Godbout (1999)

The filter in the figure refers to the principles on which knowledge is classified as relevant or not. Management need to decide if knowledge is relevant based on the source of the knowledge, their experience, intellect, and personal viewpoints.

O'Dell and Grayson (1999) support the argument that although every organisation will have a different set of reasons for wanting to transfer knowledge, it is the role of strategists to help guide the selection of the knowledge that will lead to the greatest gains. For the internal dissemination of knowledge, organisations should use their own internal knowledge management and sharing programmes as applicable in subjective circumstances.

5.3 Summary

From the background of the previous chapters a model for the implementation of a knowledge collaboration programme between organisations is proposed. The model intends to simplify the implementation of a knowledge sharing process by dividing the process into logical steps. Specifically with reference to MTC it is believed that such a logical and systematic approach to the implementation of a knowledge sharing process will enhance the probability of success and mutual benefit for organisations.

Chapter 6: Summary, Conclusions and Recommendations

6.1 Summary

The objective of this study is to create an enhanced understanding of knowledge flows in the international automobile industry supply chain, and to propose a model for the implementation of a knowledge-sharing process between organisations in the supply chain.

The background to this study is the emergence of a knowledge economy, in which knowledge is indispensable for competitive advantage. Knowledge is shown to be a crucial resource for innovation and continued competitive advantage. With specific reference to DaimlerChrysler and MTC all relevant concepts relating to knowledge flows between organisations are defined. Knowledge is defined and its difference from data and information illustrated. The concept of knowledge management is discussed in general terms, and applicable concepts regarding knowledge management at Chrysler Corporation, Daimler-Benz, DaimlerChrysler, and MTC respectively are then discussed. Because of the importance of CoP's for the knowledge management programme at MTC this topic is discussed in some detail.

In order to narrow down the parameters in which the flow of knowledge was analysed the supply chain of MTC is used as a basis for analysis. The broader discussion of supply chains is meant to provide a theoretical background for the discussion that follows. Differences in the supply chain parameters of Eastern and Western organisations are shown. These different parameters influence the way in which knowledge-sharing programmes are implemented, thus making this matter a relevant issue to consider. After a discussion of the role of knowledge management in the supply chain, knowledge flows are analysed. Knowledge sharing between organisations leads to both opportunities and threats, and these are identified and discussed. Future trends within the automobile industry supply chain are of immense importance for the sharing of knowledge between organisations in the supply chain. Using predictions by consultant firms these trends are identified and their possible influence discussed.

Within the global business environment are strategic management issues that underscore the importance of collaboration between organisations. The issues of globalisation and alliances are discussed in more detail. Both these issues indicate the importance of a logical and well-structured model to assist management in the

implementation of a knowledge-sharing process between organisations. To create an understanding of knowledge management within supply chains, the models and tools used by OEM's in their supply chains are analysed. The models and tools used by MTC are analysed to create a background to and also a benchmark for the creation of a proposed model for the management of a knowledge-sharing process between organisations in a supply chain. The proposed model is meant to form a logical framework to guide the establishment of a mutually beneficial knowledge-sharing process between OEM's, especially MTC, and suppliers.

6.2 Conclusions

External sources of knowledge are becoming increasingly important for innovation and sustainable competitive advantage. The supply chain parameters of OEM's are an area where considerable knowledge to enable innovation is believed to exist.

There seems to be relative consensus on concepts involved in the flow of knowledge. Knowledge is defined and clearly differentiated from information and data. A distinction is also made between tacit and explicit knowledge. Tacit knowledge is not conveyed in the same way as explicit knowledge. Knowledge has been shown to be of tremendous importance for innovation. Tacit knowledge is a much more abstract form of knowledge than explicit knowledge. The abstract nature of tacit knowledge makes it more difficult to disseminate than explicit knowledge.

There also seems to be relative consensus about the importance and properties of KM in organisations. Many organisations have already implemented formal KM programmes or are in the process of doing so. These programmes are however mostly focused on internal KM and little mention is made of external parameters. Within MTC at DaimlerChrysler, CoP's are central to the KM effort. CoP's have therefore been defined and the way they differ from project teams and international teams has been shown. Within these organisations KM enjoys a high amount of support and seems to be very beneficial. People are recognised to be at the centre of any KM programme and through the establishment of CoP's these organisations have succeeded in getting all relevant people involved.

The parameters of supply chains can be very vague. Supply chains can also be very complex and abstract, and without clear boundaries knowledge flows may be difficult to analyse and understand. Therefore this parameter was defined and narrowed

down to the supply chain parameter of MTC. The supply chain of MTC is enormous and Tier 1 suppliers were used for a basis of discussion. The difference between supply chain structures in Western and Eastern organisations is considerable. This is very relevant to KM programmes engaged in with suppliers. In the East relationships between supplier and OEM tend to be closer than in the West. Closer relationships make the initiation of knowledge flows between entities easier. Human involvement to enhance relationships in a supply chain is important.

The importance of knowledge for innovation is tremendous. Sustainable competitive advantage is dependent on innovation. Therefore new sources of knowledge from which innovation can be derived are essential. The need for OEM's to start competing in supply chain format also emerges from the research. The role of KM in a supply chain is thus to identify and locate innovation-enabling knowledge. KM programmes in supply chains also need to capture the knowledge available and disseminate it throughout the organisation. The role of KM in the supply chain should not be to secure as much knowledge as possible for one firm only. The emphasis should be on interactive two-directional knowledge sharing that may be beneficial to all entities involved. A successful KM programme should also enable the sustainable improvement of core suppliers to the OEM. It is well recognised that for an OEM 70% of value added occurs within the supply chain. Therefore the sustainable improvement of a supplier will benefit an OEM tremendously. A balance needs to be found, however. The purpose of KM in a supply chain programme is not to ensure the development of suppliers only. A KM programme should be beneficial to both entities.

Knowledge flows are more than information flows and are cardinal for innovation. A substantial number of definitions of knowledge flows have emerged. Although an abstract concept, it is possible to form a good idea of what knowledge flows comprise. Knowledge flows need to be managed properly to ensure benefit. If not managed properly they may become a hazard to an organisation's competitive advantage. Different organisational contexts will consist of different knowledge flows and therefore it is difficult to classify and categorise knowledge flows. With the use of guidelines it is possible to establish the existence of knowledge flows. In analysing factors that indicate knowledge flows, management should look at the context situation to establish specific knowledge flows.

It is very difficult to identify or categorise the speed at which knowledge may flow between entities. Therefore, the amount of knowledge that flows within a specific time interval can be used as an indication of the speed at which knowledge flows. Analysing and evaluating knowledge flows are often left to the intuition of strategic managers. The level of the relationship between entities will give an indication as to the frequency and amount of knowledge flows that can be expected. The direction of knowledge flows is easier articulated. It is argued that knowledge will flow either from one organisation to the other or alternatively back and forth between organisations. Therefore knowledge flows can be one-directional or two-directional.

Numerous factors influence the flow of knowledge. KM and the value of knowledge are intrinsically linked to human involvement. Therefore it may be expected that culture will have a big influence on knowledge flows. Of all cultural factors, trust has been shown to be the most prominent factor influencing the flow of knowledge. Knowledge flows between organisations will be very difficult to initiate if trust does not exist between the organisations. The creation of trust in a collaboration programme should therefore be a priority. To enhance trust, organisations should focus on the process of knowledge collaboration. A well-structured and logical process should enhance trust by eliminating ambiguity. Organisations do not need to adapt their culture to fit their KM programmes. Organisations should rather adapt their KM programmes to fit their organisational culture. Although it seems that Eastern cultures are better suited to knowledge collaboration, culture need not be an insurmountable barrier. Beneficial KM and knowledge flows between organisations are a realisable goal for organisations. An adapted strategy and well-planned process should enable Western organisations to implement knowledge collaboration programmes as efficiently as any Eastern organisation.

Knowledge infrastructure is important for enabling knowledge flows. A distinction must be made between infrastructure that allows the flow of different types of knowledge. Information technology and communication infrastructure can to a great extent accommodate the flow of explicit knowledge. Tacit knowledge is not so easily communicated. Tacit knowledge is passed on through human interaction. Therefore the human element in the organisation should also be seen as an integral part of the knowledge infrastructure of an organisation.

Organisational learning is of critical importance to the flow of knowledge between entities. Without organisational learning, no new knowledge will be generated. If no new knowledge is generated, only existing knowledge will flow between organisations. This is problematic, because such a flow may deplete an organisation's knowledge resources. Organisational learning and knowledge flows have a reciprocal influence on each other. Organisational learning is however not only dependent on knowledge flows. Learning from other sources should be used to enrich knowledge resources and thus to sustain mutually beneficial knowledge flows between organisations.

There are many barriers to knowledge flows between organisations. Establishing a knowledge collaboration programme between separate organisations in a supply chain is a relatively new line of thought. This is evident from the lack of guidelines and academic literature on this topic. Probably the biggest barrier to knowledge flows is the human element. Knowledge flows between organisations is a highly political topic. Without management support, knowledge collaboration programmes have little chance to succeed. Organisations need to realise the benefit of sharing knowledge with key identified supply chain partners. It should be emphasised that the idea is not to share core competencies or intrinsic know-how. Organisations will benefit greatly if mutually beneficial knowledge is shared. Mutually beneficial knowledge refers to knowledge that will help both organisations in a collaboration programme to enhance their performance, reduce costs and add more value for the customer. Due to the political factor in knowledge collaboration programmes the total process of implementation is important. Barriers to the flow of knowledge are furthermore also dependent on circumstances. Therefore barriers can hardly be listed according to a checklist. Every situation needs to be judged by management to ensure that all barriers relevant to the situation are identified.

From the flow of knowledge both opportunities and threats will emerge. Subjective circumstances may prove to have a huge influence on opportunities and threats respectively. Therefore management need to be well informed on the respective environments in which they plan to have knowledge collaboration. In the context of international OEM's and especially at MTC, the improvement of development times is one of the biggest opportunities. Proper knowledge collaboration programmes with suppliers should enable MTC to reduce development times and cost while enhancing or at least maintaining quality. By achieving a reduction in developing times and cost

while keeping quality constant, the organisation can enhance its competitive advantage.

Threats that coincide with the flow of knowledge are also circumstantial and it will be difficult to compile a definite list of possible threats. One of the major threats to organisations is the possibility of losing competitive advantage. Such a loss may occur in a variety of ways. An OEM may lose innovation capabilities to the supplier resulting in a loss of competitive advantage. An OEM may also unwittingly help a competitor by developing a mutual supplier. The relationship between the OEM and supplier involved in knowledge collaboration is therefore critical. Good judgement is important in the identification and circumvention of threats that emerge from knowledge flows. The emphasis therefore needs to be on intuition and human involvement in the process of knowledge collaboration.

Trends in the automobile industry supply chain indicate that closer relationships between OEMs and suppliers can be expected. The amount of knowledge that flows between entities should therefore also increase. Knowledge is pertinent to innovation and increased knowledge flows in supply chains will therefore make suppliers important for innovation at OEMs. To enable organisations to manage an increase in knowledge flows a proper methodology should be used. OEM's that disregard the emerging necessity of enabling knowledge flows with suppliers might find their competitive advantage being eroded over time.

Knowledge and innovation are important for OEM's. Organisations need proper tools and models to guide a collaboration plan. Most tools and models for the management of knowledge flows seem to be focused on internal knowledge flows. Little attention has yet been given to knowledge collaboration between organisations. The lack of clearly defined principles for knowledge collaboration indicates a lack of official acknowledgement regarding knowledge flows in supply chains. Much of the knowledge flow that does exist between organisations is believed to be explicit knowledge. Explicit knowledge is disseminated through the use of information technology tools. The focus on technology tools neglects the issue of tacit knowledge transfer between organisations. There is a definite lack of human involvement in the flow of knowledge between organisations. Human involvement facilitates the transfer of tacit knowledge.

Toyota is at present one of the only organisations that are making an effort officially to share knowledge with their respective suppliers. It is generally acknowledged that Toyota's development times are faster than those of MTC. Human involvement especially in the process used by Toyota is believed to make their knowledge collaboration programmes so successful. Their knowledge collaboration programme with suppliers is shown to contribute to a large extent to their faster development times. It should however not be the aim of MTC to copy the methods used by Toyota, but Toyota does seem to have set the standard. The implementation of Japanese methods will not necessarily benefit Western organisations. Blindly implementing a Japanese approach has been shown not to work in a Western organisation. Organisations should analyse their own situation and make educated decisions as to what tools or models would be best suited to enable knowledge flows. It is unlikely that one tool will be able to transfer all types of knowledge, and a combination of models and tools is more likely to succeed.

MTC is beginning to recognise the benefit of knowledge collaboration involving supply chain partners. The benefit that knowledge flows in the supply chain can have for innovation is not yet formally acknowledged, however. At present most of the knowledge flows between MTC and its suppliers are effected by means of IT tools. A lot of the knowledge that flows in the supply chain may therefore consist of information, or explicit knowledge at the most. To enable the reduction of development times and create more benefits, tacit know-how is critical. As the tacit knowledge of individuals and experts is difficult to transfer via technological tools, human involvement is very important. MTC will be well advised to enable their own knowledge experts to share relevant knowledge with the knowledge experts of key suppliers. The goal is to enrich the total business process through applying available knowledge resources to the utmost.

In the global business environment certain strategic issues emphasise the need for a knowledge collaboration programme between entities. Both globalisation and alliances are issues that seem to be promoting the flow of knowledge between organisations. Such an increase in knowledge flows is a vast potential for innovation. An increase in knowledge flows further emphasises the need to manage such flows.

A logical model for the guidance of management thinking should prove helpful. No one model or guideline should however be seen as the sole answer. Neither IT tools

nor human involvement on its own will be optimal for the management of knowledge flows between organisations. Organisations need to combine both these aspects in order to find an optimal solution for the management of knowledge flows in their respective environments. Much of the success of a knowledge collaboration programme will come from the ability to adapt. The emphasis should be on the total implementation process of a knowledge-flow and collaboration programme. Attention should be given to the development of two-directional knowledge flows between organisations. One-directional flows will benefit only one organisation and therefore will reduce the probability of mutually beneficial collaboration.

Technological tools are very useful. To maximise knowledge flows and their benefit, however, the human element is cardinal. To enable people to become involved in the knowledge collaboration process the use of CoP's is suggested. Such CoP's will provide the background for a knowledge-sharing paradigm. CoP's will enable knowledge experts to interact and for tacit knowledge to be shared also. The close co-operation of knowledge experts should furthermore enable them to solve problems more easily and to find more effective working methods. Faster problem solving and more effective working methods should enable MTC to reduce development times.

The ability to utilise a supply chain as a possible source of innovation may become an important factor in competitive advantage in the future. Organisations should not, however, overcomplicate KM. The use of a proper model will assist organisations in reducing ambiguity, setting clear goals and creating benefits for all organisations involved.

6.3 Recommendations for Further Research

From the study and conclusions reached, certain issues emerge that deserve further research and analysis.

Communities of practice within organisations seem to be researched and understood fairly well in the literature reviewed. Further research is, however, needed regarding communities of practice between organisations in a supply chain. Understanding relating to the structure, parameters of conduct and duration of such communities should be analysed. It should further be established if the proposed use of communal communities of practice is indeed the optimal method for enabling a knowledge-

sharing programme between organisations in a supply chain. The optimal level at which both communal communities of practice, and technological tools are used within a knowledge-sharing programme should be established. Research is also needed into specific technological tools for the enhancement of a knowledge-sharing programme between organisations in the supply chain of organisations.

The proposed model is a theoretical model aimed at guiding the practical implementation of a knowledge-sharing process between organisations. The effectiveness of a knowledge-sharing programme between organisations in the supply chain of an OEM, implemented on the basis of this model, should however be tested further. Further research is also needed to establish all the barriers in the physical implementation phase of a knowledge-sharing programme. By identifying such barriers solutions will be found and the process refined for the mutual benefit of the organisations involved.

The proposed model is developed with reference to the international automobile industry supply chain, and more specifically Mercedes-Benz Technology Centre. Research is therefore needed to establish whether this model can be applied to other organisations in the international automobile industry, and to establish the relevance of knowledge sharing between organisations in the supply chains of other global industries.

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