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Master Thesis

A Conceptual Model of Risk Assessment in Collaborative Transportation Management: A Perspective through Transport Services

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Graz, 08.02.2010 Yasanur Kayikci

ABSTRACT

Collaboration as a concept has gained a lot of momentum since outsourcing trend was being deployed that utilizes the competitive power by enabling a strong relationship both vertically with supply chain partners and horizontally with other transport services in a supply chain. The former literatures in supply chain collaboration mostly focused on the vertical collaboration whereas only a few studies have been paid to the impact of transportation management on capabilities and competitive advantages through transport services in supply chain. A relatively new business initiative in supply chain collaboration is Collaborative Transportation Management (CTM), which is a business process model in transport. CTM can only be accomplished by integrating the business processes, the transportation activities and the supporting information flow between trading partners; the increasing existence of information and communication technology enables better collaborative interactions between all parties, moreover IT based automated online-negotiations decrease complexity, reduce risks and ease shipper-carrier relationships.

However, CTM proves a better supply chain collaboration and visibility, including the ability to gain control over transportation processes and experience long-term savings, companies often face with the question of which risk factors should be taken into consideration before implement to CTM business system as CTM is inherently fraught with risk and uncertainty. Project managers in the companies need to develop an aggregated risk profile for CTM system. Identification of risks is very crucial before adoption of any kind of CTM solution into an enterprise. As complexities that arise from the number of trading partners along the transport chain make it hard to determine risk factors for CTM. Overlooking of risks associated with CTM application could cause disruptions and process delays and massive financial ramifications could propagate throughout the entire supply chain system.

The purpose of this thesis is to outline the concept of CTM and analyze the importance in the strategy of the enterprise. Then it gives the sight of CTM implementation in achieving supply chain excellence while emphasizing the risk associated with its working environment. In addition, a conceptual model of risk assessment on multi-criteria decision making (MCDM) is given to identify and prioritize risk factors in CTM business system under uncertain conditions with the perspective of transport services. In the model, Delphi methodology for identifying potential CTM risk factors and Analytic Hierarchy Process for analyzing and prioritizing the CTM risk factors are employed. The result shows which risk factors are crucial to take into consideration in a CTM business system.

Keywords: Collaborative Transportation Management, Risk Assessment, Risk Identification, E-Collaboration, Analytic Hierarchy Process, CTM, AHP.

PREFACE

This master thesis has been written at the Institute for Production Science and Management (PSM) at the Graz University of Technology.

First, I would like to express my deepest gratitude to my advisors Prof. Dr. Josef W. Wohinz and Dr. Hannes Fuchs, for their patience and guidance during this study. It has been a great pleasure and incredible experience to work under their supervision. Speaking about my gratitude in this journey, I have been fortunate to have benefited from the academic support and professional guidance of some very thoughtful people. The encouragement and direction were all delivered at just the right time to complete this thesis in-time. I thank everyone for having supported me to finish my work. I would also like to thank to the members of the Turkish Union of International Freight Association and Turkish Union of Chambers of Commerce for their cooperation with extensive interviews and questionnaires, and also very special thanks goes to my dearest friend DI Sameeruddeen Kammar for his tremendous help in editing my thesis and to my colleague DI Markus Zoier for his valuable comments and suggestions on early draft of the thesis.

Last but not the least; I thank to my family for their eternal support and love at every stage of my education. During this journey they always encourage me with a saying “If it doesn’t kill you, it will make you stronger”.

Thank you!

Danke schön!

Teşekkür ederim!

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CHAPTER 1

1 INTRODUCTION

This thesis examines the subject of the risk assessment for Collaborative Transportation Management (CTM) business model within the freight transport triads. As an e-business model CTM covers opportunities as well as risks. This thesis addresses the potential risk factors in CTM perspective and subsequently it suggests a conceptual risk assessment model to reveal the aggregated risk profile for CTM applications.

The concept of CTM is used with different names in academia like *Collaborative Logistics Management*, *Logistics Collaboration*, *Lean Logistics*, *E-logistics* or *Collaborative Transportation Network*[1]. In this thesis CTM is chosen as the by far the most widespread name in industry.

Chapter 1 gives a short background and introduces the research questions, the scope and the delimitations of the study.

1.1 Background and Motivation

Over the last decade, innovation in supply chain management has evolved into a more collaborative direction in response to achieving the key performance goals like lower inventory carrying costs, better customer service, supply chain velocity and efficiency. Moreover companies move to leaner operating models for logistics services and increasingly leverage collaborative partnerships. Adoption of such practices increase business revenue through new business innovations and deliver the right product to their customers at the right place at the right time while optimizing operations and controlling costs.

The rapid development of information technology (IT) and especially internet-based information transfer between companies, suppliers, customers and various service providers has accelerated race to create new e-business models in the freight transport and logistics arena[2]. Additionally, companies are increasingly dependent on collaborative business solutions where effective information sharing is an important success criterion[3]. It is thus clear that IT and the emerging e-business applications

[1] Stefansson (2006), pp. 76; Sandberg (2007), pp. 274 and Stefansson and Russell (2008), pp. 347.
[2] Cf: Johnson and Whang (2002), p. 414.and Pompeo and Goulmy (2001), p. 64.
[3] Cf: McLaren et al. (2002), pp. 349.

and related new business models has created opportunity to revolutionize old business models and in particular to implement new supply chain strategies[4]. New electronic business models allow companies to minimize costs, maximize asset utilization and customer service, moreover to facilitate coordination of various decision and activities beyond transaction among the trading partners[5] by establishing collaboration over the Internet technologies.

Supply chain activities	**Collaboration benefits**
Procurement	✓ Less time searching for new suppliers and tendering ✓ Easier management of a reduced supply base ✓ More stable prices
Sales	✓ Rapid access to markets ✓ Increased market share ✓ Improved promotional events
Transportation	✓ Faster delivery ✓ Flexible delivery
Manufacturing	✓ Increased product quality ✓ Minimize supply disruptions
Customer service	✓ Improved product availability ✓ Improvements in lead times
Inventory management	✓ Lower stock holdings ✓ Increased asset utilization
Order processing	✓ Increased responsiveness

Tab.1-1 Linking supply chain activities to specific collaboration benefits

Collaboration is not only the process of *working together* towards achieving a common objective for *win-win outcomes* but also integration of *behavioral, communicational* and *interactive flows*[6]. Clearly, collaboration cannot be achieved only by individual efforts of participants alone but have to be supported by a common understanding of all parties, in which the participants are committed and interdependent, with individual and collective accountability for the results of the collaboration, and each of the participants share a common benefit. The level of

[4] Simchi-Levi et al. (2004), p.69.
[5] The term "trading partners" refers to triadic relationship between shipper (supply chain), receiver (demand chain) and carriers (logistics service intermediaries, third-party service providers, logistics service providers etc).
[6]Cf. Esper and Williams(2003), p.56

collaboration in a supply chain ranges from information sharing between partners in the supply chain to strategic alliances between competitors. Some of the benefits arising from collaboration in supply chain as in Tab. 1-1 depicted[7].

Collaboration in supply chain is categorized with two levels: horizontal and vertical collaboration. On the one hand in *horizontal collaboration*, companies with similar characteristics collaborate to achieve greater benefits. Capacity sharing and code sharing among passenger airlines would be some examples for horizontal collaboration. On the other hand, in *vertical collaboration*, supply chain partners collaborate with each other across different level of supply chain. Information sharing and coordination of operations are the most typical examples in this category. The former literatures in supply chain collaboration mostly focus on the vertical collaboration whereas only a few studies have been paid to the impact of transportation management on capabilities and competitive advantages through transport services in supply chain.

Transport is so important for the economy, as the replenishment process cannot be carried out without transportation concerns. Transportation extends far beyond the movement of products between companies. As defined traditionally, it is process of getting the right product to the right place at the right time in the right condition for the right price[8]. Transportation is the exact physical contact point between companies and their customers and it constitutes the last ring of supply chain.

Transportation capacity and cost management is one of the most pressing issues in operating logistics functions. Transportation also adds value to the product by providing time and place utility for the firm's goods. Gaurav (2004)[9] highlights that there are two factors why transportation is becoming a more strategic business function than in the past:

1. Transportation costs account for a larger percentage of the cost of goods sold; and

2. There is a growing realization of the strong correlation between customer service levels and transportation performance.

Transportation is usually the largest single cost expenditure in most supply chain operations for almost all companies[10]. Western Europe is the most transport-intensive region, as transportation consumes 7 percent of the EU's gross domestic

[7] Cf: Matopoulos et al. (2007), p. 179.; BALLOU (1998), p.142
[8] Langley (2000), p.7.
[9] Gaurav (2004), http://www.inboundlogistics.com/articles/itmatters/itmatters0804.shtml (last access:15.12.2009)
[10] Cf: Bowersox et al. (2003), p. 378.

product, 5 percent of all jobs in EU Member States[11] and approximately the same proportion of a company's sales revenue. Fig. 1-1 shows the cost ratio of logistics items[12], where transportation is seen as an highest cost, which makes up roughly 29,4% of logistics cost. These percentages has been declined, as transportation has been due for changes since transportation regulation in 1980 occurred and new practices in that area are evolving. This may especially be the case when companies face higher limitations in profitability, as well as a major change in business priorities and management approach. That is, in majority of the cases, transportation management operations tend to require more sophisticated and problem specific approaches rather than their forward counterparts with higher transportation costs. These often urge companies to rethink their transportation strategies and to find innovative solutions to reduce cost and improve efficiency.

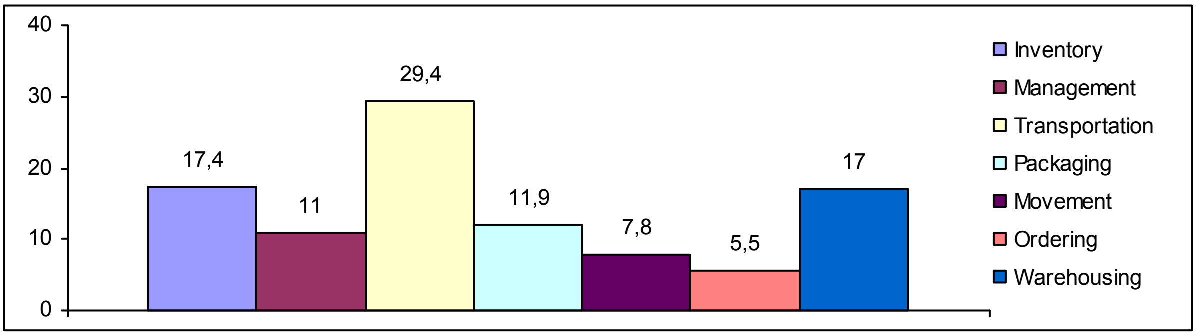

Fig. 1-1 Cost ratio of logistics items

The current trends in transportation management such as increased competition, need for improved customer responsiveness, outsourcing, and globalization drive companies towards collaboration that means being able to source supplies from wherever in the world there is the best combination of quality, price, service, communications, administrative capabilities and total cost. These from the viewpoint of the transportation management are being codified as CTM. CTM is a business model that changes ways of working and enables collaboration and efficiency as well as flexibility and resilience through of the presence of transportation management networks. The growing interest in CTM is fuelled by the ever increasing pressure on companies to operate more efficiently[13]. CTM has become an important differentiator for companies gaining competitive advantage through lower associated costs

[11]Cf: N.N: http://www.eu2009.cz/en/eu-policies/transport-telecommunications-and-energy/transport/transport-703/
[12] Cf: Tseng at al. (2005), p. 1661.
[13] Ergun, et al. (2007), p. 1552.

(transportation, warehousing and inventory) and more effective transportation management.

CTM requires a tight collaboration between three parties; shipper, carrier and receiver. To work effectively and efficiency, CTM partners must first have "*a common understanding of collaboration and information sharing*". CTM business model can establish the common business sense to avoid logistics bottlenecks and to overcome transportation inefficiencies within supply chain, CTM should be adopted and implemented to the business in accordance with enhancing closer collaboration among the shipper and the carrier as well as the transport provider.

Uncertainty and risks are part of doing business. Many risk issues are associated with managing transportation. As the companies that sharpen their competitive advantages tend to adopt increasingly collaborative business operating models with global sourcing, uncertainty in both supply and demand grows along with supply chain complexity[14]. Although the change of business environment due to exploding IT has created opportunities for companies, many of the new business models have begun to flounder or at best, not reach their full promise. Investing in business models is becoming an important and non-trivial strategic issue for companies in terms of gaining competitive advantages. Therefore, the need for a logical and rational risk assessment procedure rather than tested rules of thumb has increased. CTM business model is also inherently fraught with risk and uncertainty. From the point of view, this thesis attempts to propose a conceptual risk assessment model in CTM business environment to give insight practitioners and efficiently assist them in making decision with respect to the considered risk criteria.

1.2 Purpose and Scope

The ultimate purpose of the thesis is **to enlighten CTM business system and to establish a risk assessment model to identify, analyze and prioritize risk factors from CTM perspective**. Therefore, the key objectives of the thesis are:

- Examine the CTM business system within and across boundaries of information technologies
- Support the development of a risk assessment model

[14] Hillman and Keltz (2007), p. 2.

Furthermore, this research is indented to combine theories from CTM, IT and risk assessment model. The theoretical framework is strengthened with interviews and statistics.

In this thesis Boehm's (2001) proposed a risk driven management model[15] is taken as a base to structure the risk assessment model which is illustrated in Fig. 1-2. This model is deployed into three sub-categories; risk identification, risk analysis and risk prioritization. In methodological framework of the thesis, a conceptual version of risk assessment model is given and examined in depth.

Fig. 1-2 Risk Assessment Model

1.2.1 Research Questions

The overall aim for CTM is to provide the right product to their customers at the right place and time, under the right conditions, in the right quantities, and at the lowest possible costs while improving a given performance measure (e.g. minimizing total operating costs) and satisfying a given set of boundary conditions (e.g. budget constraints). CTM provides complete visibility internally and throughout the supply chain with trading partners, as well as the ability to create efficiencies as they established and modify their rules of engagement with alliance partners (other shippers)[16]. Using IT application is crucial for CTM success, therefore CTM and Information Systems (IS) are strictly parallel and simultaneous occurrence. IS are the central component of IT infrastructures. In this sense, IS investments add value to the firms' (IT) infrastructure capability and can be viewed as an important strategic infrastructure decision[17].Therefore, the risk assessment models are based theoretically on the interrelation between CTM, information technologies and whereby the importance of transport services emphasized. In this thesis, the research questions are addressed which are as follows:

[15] Cf: Boehm (2001), pp. 31.
[16] Langley (2000), p.7.
[17] Bernroider and Stix (2006), p. 107.

RQ 1.What are the actual risks in CTM business environment?

RQ 2.Which of these risks do practitioners perceive to be more deserving of their attention?

RQ 3.How are risks and rewards shared in CTM?

RQ 4.What role does information technology play for creating transparency in transport chains?

RQ 5.How is information systems and technology integrated between partners?

RQ 6.What challenges effect today's transportation management?

RQ 7.What are the role of transport services in CTM business model?

1.3 Delimitations

This research is based on a system-theoretical approach which emphases a holistic view to describe the risk assessment model. In a holistic view, the environment of CTM and related IT and transport services are emphasized. System-theoretical outline of the thesis is illustrated in Fig. 1-3. As there has been not much literature available to further support and to determine risk factors in collaborative transport chain environment, that's why theoretical framework of the thesis plays a connective role to give feedback to make up the methodological system to develop risk assessment model.

A methodological system is formed based on the literature study, statistics, existing surveys and having feedback from professionals by interviews.

The delimitation of the thesis' scope has been on improving the extended collaboration including business-to-business (B2B) collaboration, leaving the business-to-consumer (B2C) and consumer-to-consumer (C2C) collaborations outside the scope of the thesis. Shipper-carrier collaboration as B2B transaction is examined carefully to narrow the scope of the thesis as well as to denote the understanding from the perspective of transport services. This thesis does not address to risk factors from customers' point of view.

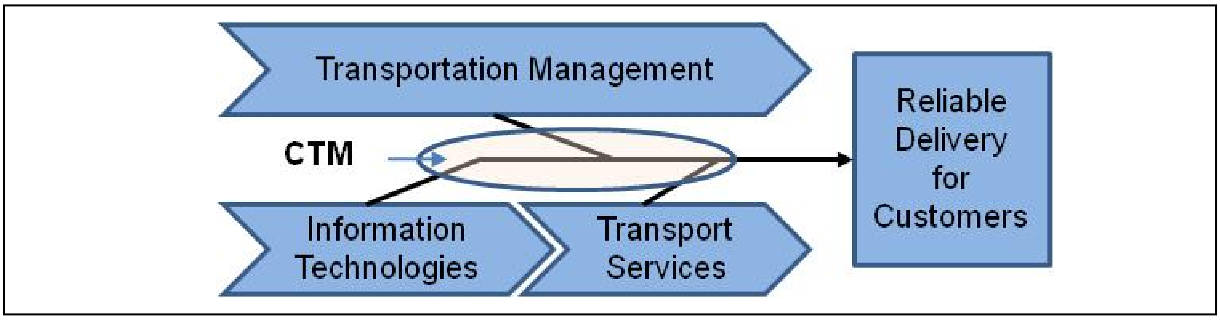

Fig. 1-3 System theoretical outline of the thesis

1.4 The structure of the thesis

This thesis consists of six chapters: Fig. 1-4 depicted the structure of the thesis.

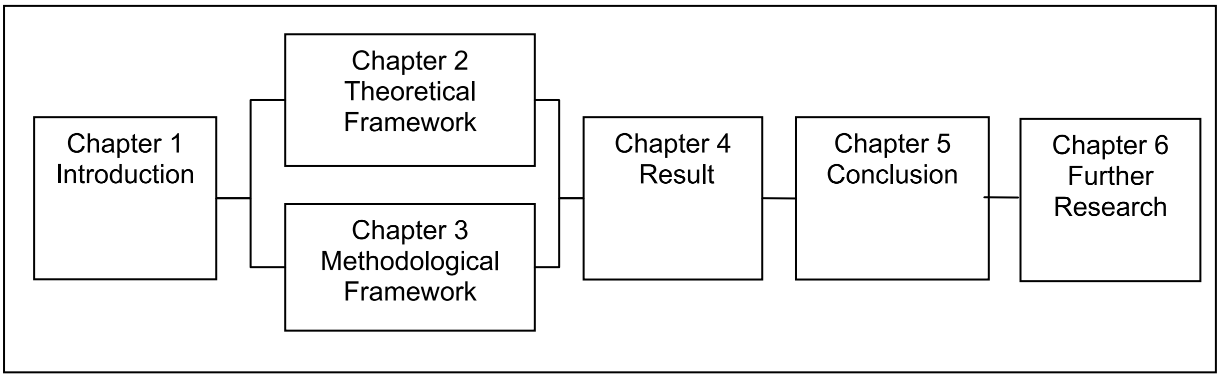

Fig. 1-4 The structure of the thesis

The outline of this thesis is presented as follows:

Chapter 1 provides a reflection of background and emphasizes the aim and practical relevance of this thesis. This is achieved with the presentation of research questions and delimitations based on the scope and purpose of the thesis.

Chapter 2 provides the theoretical framework of the thesis. Theoretical framework is divided into three interrelated parts to figure out the interrelation between transportation management and information technologies thereby to reveal the potential risks factors for CTM business system via enlighten risk assessment approach.

Chapter 3 introduces the scientific approach and its application in the research. It illustrates a conceptual risk assessment framework, gives an in depth view of risk identification, risk analysis and risk prioritization and it is followed by a numerical example given at the end of the chapter to verify and validate the result.

Chapter 4 presents the result of the thesis and summarizes the findings.

Chapter 5 gives the final conclusion and remarks

Chapter 6 gives sights on further research subjects in the field.

CHAPTER 2

2 THEORETICAL FRAMEWORK

Chapter 2 introduces the theoretical framework that is the backbone of this thesis. Fig. 2-1 illustrates the theoretical background of this thesis. The framework aims to combine the two distinctive fields of IT and collaborative transportation management in order to determine risk assessment in the transportation management network.

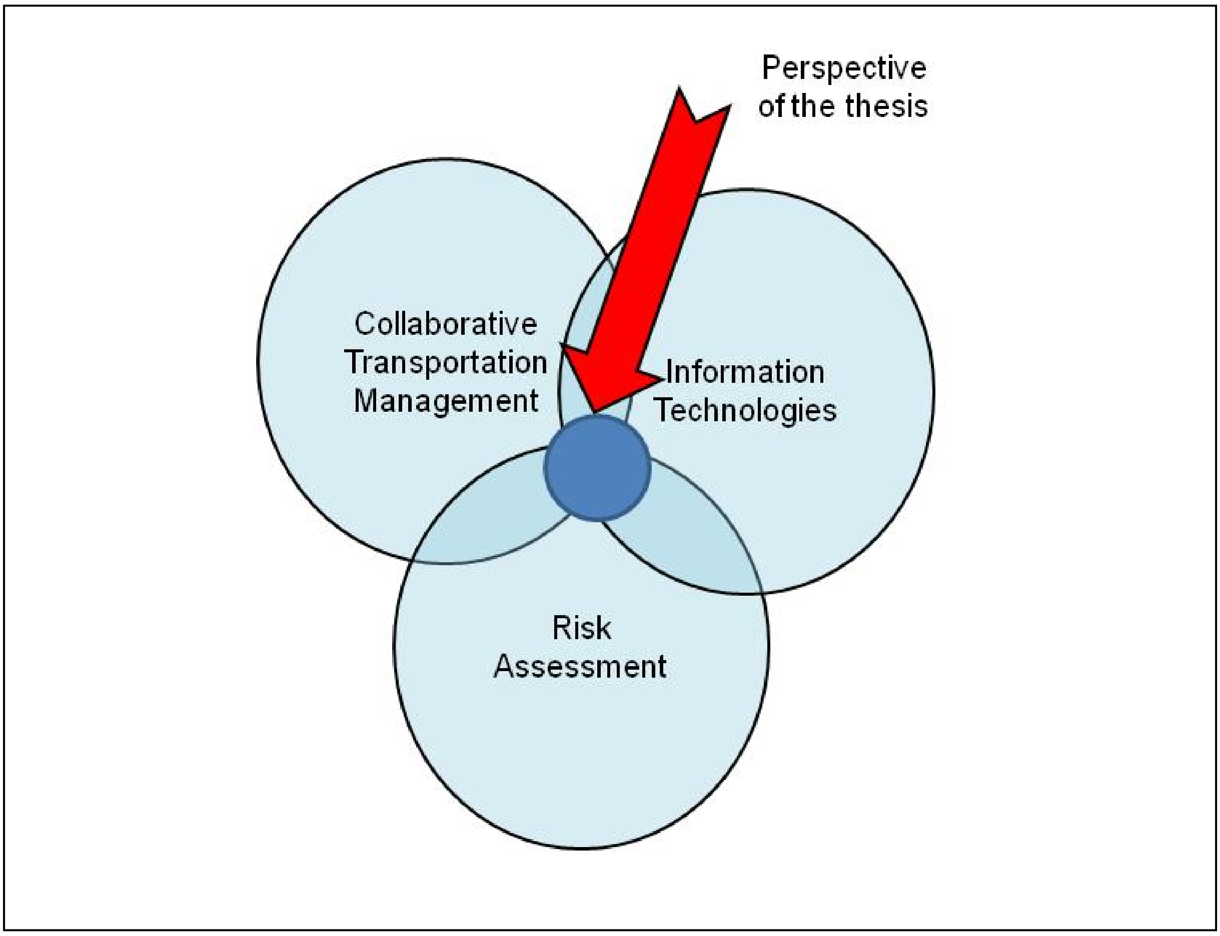

Fig. 2-1 Theoretical background of the thesis

2.1 Collaborative Transportation Management Concept

Collaboration as a concept has gained a lot of momentum since outsourcing[18] trend was being deployed that utilizes the competitive power by enabling a strong relationship vertically with supply chain partners and horizontally with other *transport services* in a supply chain. Collaboration creates considerable value in the relationship between trading partners at every level of value chain. Many organizations have already realized that competition is no longer between companies, but between supply chain networks. This is to say that, how well a particular network is managed, might just be the factor that separates a successful chain from an unsuccessful one. Therefore today's successful companies are acting more as a network to collaborate with transport services effectively in order to create a flexible system for their operations. A more precise definition for collaboration is[19]: "the process of working together towards a common purpose or goal in which the participants are committed and interdependent, with individual and collective accountability for the results of the collaboration, and each of the participants share a common benefit".

Although many studies have exposed the potential benefits of strategic alliances[20] which are pointed out by the horizontal collaboration, there are only limited references in the literature for vertical collaboration to conduct on the concept of CTM with analytical experiments, simulations and practical case studies in some industries[21]. CTM is widespread used especially in food and consumer goods[22] (Wall-Mart, P&G) industry. Most of the researches were done on the direct collaboration between carrier and the other trading partners, where it is discovered that, by implementing CTM could bring about better outcomes and profits for all trading partners.

[18]Here the outsourcing is defined as the transfer of a business activity or function to a third party, usually along with people and/or knowhow.

[19] Light et al. (2001). http://www.tarrani.net/kate/docs/CollaborationSuccessFactors.pdf (last access: 12.12.2009)

[20] Bowersox (1990), p.36.

[21] Browning and White (2000), Russell (2002), Dutton, G. (2003), Esper and Williams (2003), Tyan et al. (2003), VICS CTM (2004), Field, 2004; Sutherland (2006) and Feng and Yuan (2007).

[22] Karolefsky (2002)

2.1.1 Definition of CTM

CTM is a business process model recently developed by the Voluntary Inter-industry Commerce Standards Association's (VICS)[23] as an extension of Collaborative Planning, Forecasting and Replenishment (CPFR[24]) process.

CTM is defined as mutually beneficial cooperative problem solving and opportunity exploitation- beyond traditional, predefined trading partners, to foster new different and innovative ways to solve business problems and capture new business. Properly executed, collaborative transportation can significantly reduce costs, increase supply chain efficiency, and make trading partners more flexible in addressing shifts in consumer demand.-Increase the opportunities for continuous moves by collaborating.

According to Tyan et al., (2003) CTM is defined as a new business model for integrating transportation management with Supply Chain Management (SCM)[25]. Additionally, Sutherland (2006) emphases that CTM is a holistic process which brings together supply chain trading partners and service providers to drive inefficiencies out of the transport planning and execution process[26]. Karolefsky (2002) adds that CTM constitutes "the missing link" of supply chain collaboration[27].

A unique characteristic of the CTM is that it often involves three principle parties (trading partners): shipper, carrier and receiver, as well as secondary participants such as third-party logistics (3PL) service providers. This can be named as a triadic relationship[28]. Here shipper represents buyers of freight, companies, manufacturers, distributors or sellers; similarly receiver represents buyers, retailers or end-customers. Carrier and 3PL service providers represent transport service intermediaries (transport service providers) with a wide range of names including LSPs, 3PLs, 4PLs, shipping lines, freight forwarders, etc (in Appendix A you can see the other names of transport services). As can be seen in Fig.2-2, a triadic relationship[29] among the involved parties is depicted in CTM system. It is useful to review the role and perspective of each party in order to understand the complexity of the transportation environment. Triad benefits include greater flexibility, higher inventory availability, more on-time pickup and delivery, and lower (transportation,

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[23]VICS, http://www.vics.org/ (last access: 05.12.2009)
[24]CPFR is a nine-step business process model for value chain partners to coordinate planning, forecasting and replenishment in order to reduce variance between supply and demand http://www.vics.org/committees/cpfr/ (last access: 05.12.2009)
[25]Tyan et al. (2003), p.286.
[26] Sutherland (2006), p.1.
[27] Karolefsky (2002), www.accessmylibrary.com (last access: 28.11.2009)
[28] Larson (2002), p. 21.
[29] Cf: Bask (2001), p.473.

warehousing and inventory) costs[30]. Triad consists of three sub-collaborations; between shipper and carrier (Collaboration A); shipper and receiver (Collaboration B); and receiver and carrier (Collaboration C). Collaboration A aims to establish an arm's length relationship between carrier and shipper to provide market power. Collaboration B is important to enhance process transparency between shipper and receiver and finally Collaboration C enables the information availability in shipping by haulage carrier shipping time.

As above mentioned that the basic structure of CTM is composed of three parties, but there are also many users which are connected with CTM. A comprehensive perspective of CTM users is listed in Appendix B.

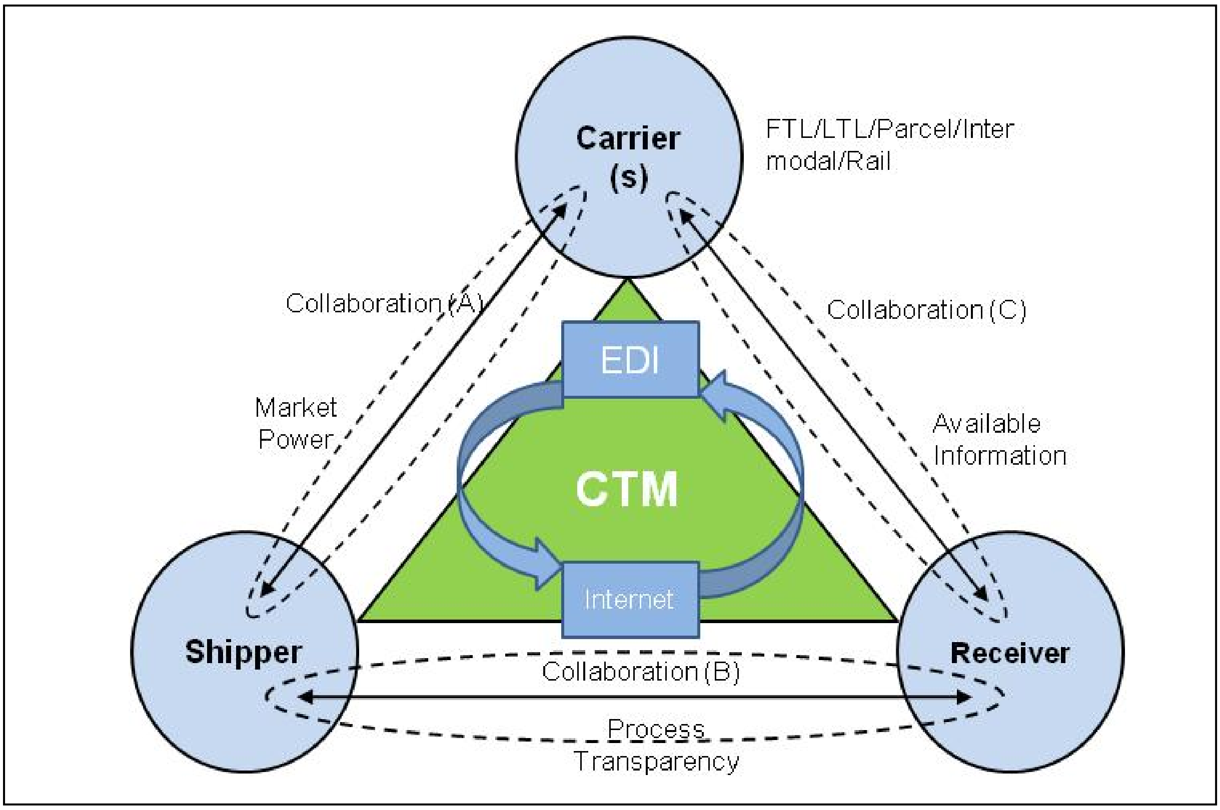

Fig. 2-2 Triadic collaboration among shipper, receiver and carrier

* Carrier includes logistics service intermediaries, third-party service providers, logistics service providers etc.

[30] Larson and Gammelgaard (2001), www.entrepreneur.com/tradejournals/article/91140458.html. (last access: 11.12.2009)

However, collaboration is not easy task, and it involves much more than simple cooperation. It requires that all companies engaged in a collaborative initiative work actively together[31]. To implement CTM, the process must involve all three partners--receiver, shipper and carrier (transportation provider)--working together to make all three more efficient as one toward common objectives, sharing information, knowledge, risks, and profit/benefits in an agreed-to, consistent fashion for all participants. CTM affects more than just the cost of transportation. Its promise is a longer window of "visibility" so that carriers can plan further ahead, maximize their assets and share the benefits with shipper and receiver[32]. CTM business process makes hidden costs visible, so all trading partners can work together to reduce them. To effectively manage the process, a basic level of information integration must exist. Information sharing requires standardized data formats for transport documents. IT has become the key facilitator of triadic collaborative transportation. Either EDI or internet based online exchanges/B2B hubs can enable to coordinate the flow of goods and information within trading partners.

2.1.1.1 Forms of collaborative transportation management

Collaborative transportation is achieved when two or more companies form partnerships, or work with existing trading partners to optimize transportation operations by sharing truck capacity to cut the high costs of LTL shipments and empty back hauls.

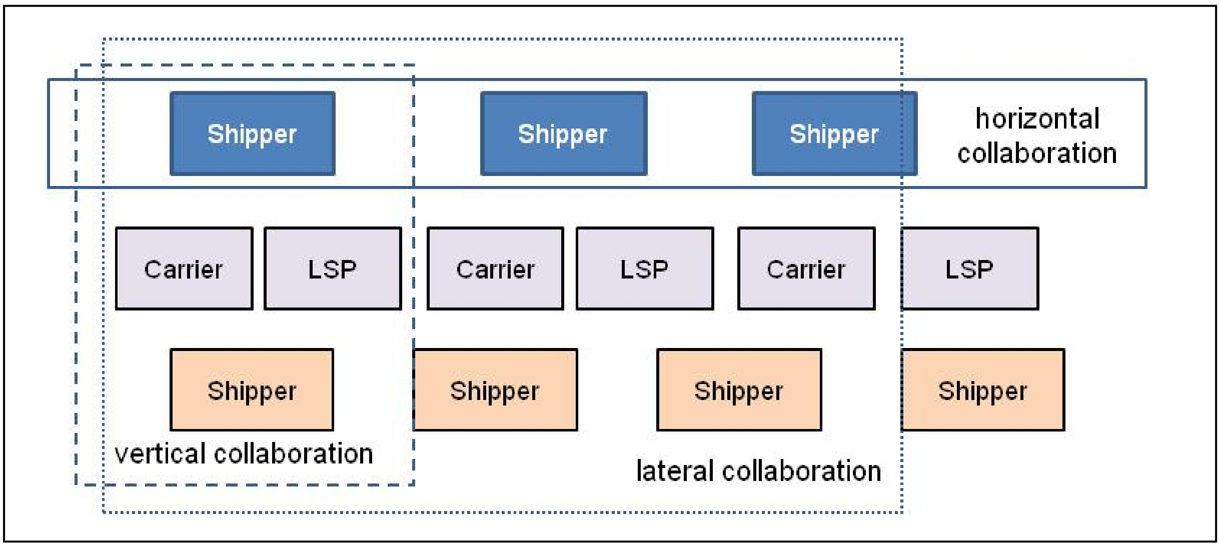

Fig. 2-3 Three forms of transportation collaboration

[31] Sutherland et al. (2004), p.193.
[32] Ergun, et al. (2007), p. 1552.

The industry focus is normally regarded from either a vertical or a horizontal perspective[33].As mentioned earlier that according to Barratt (2004) there are two forms of supply chain collaboration possible: vertical collaboration; shippers, receivers and transport service providers on the vertical axis and horizontal collaboration; complementors and/or competitors on the horizontal plain. Additionally Soosay et al (2008) proposed a combined relationship as a third form of collaboration which links the benefits of vertical and horizontal collaboration has been identified, known as lateral collaboration. All these forms of transportation collaboration are summarized in Fig. 2-3.

- *Vertical Collaborative Transportation Management*: the collaboration is based on internal collaboration[34] within the company departments or along the supply chain more closely within the trading partners (transport services) to improve efficiency for collective objectives. e.g. to share the order information with carrier to enable effective transportation planning.
- *Horizontal Collaborative Transportation Management*: the collaboration is based on external collaboration[35] and it requires the cooperation between competing (competitors) or non-competing companies (other organizations) that can be called as a strategic alliance. In such collaboration, companies share their facilities or operations to reduce cost and improve operational efficiency. e.g. code sharing within the flight companies to sell as much as possible seat or to share a warehouse space into shippers to enable their shipment by FTL instead of paying much for LTL.
- *Lateral Collaborative Transportation Management*: Lateral collaboration aims to gain more flexibility by combining benefits and sharing capabilities in both vertical and horizontal integration. Integrated logistics and inter-modal transport are examples of an application of lateral integration that aims at synchronizing carriers and shippers of multi-firms in a seamless effective freight transport network[36]

[33] Rudberg, et al. (2002), p. 598.
[34] Barratt (2004), p. 32.
[35] Barratt (2004), p. 32.
[36] Cf: Soosay et al. (2008), p.162

2.1.2 The Objective of CTM

The objective of CTM is to improve the operating performance of all parties involved in the relationship by eliminating inefficiencies in the transportation component of the supply chain through collaboration[37]. The CTM process is designed for application to both inbound and outbound transportation flows. As such, both the shipper and the receiver can perform some of the steps in the CTM business process, while other steps are performed individually by either the shipper or receiver. Closer collaboration and extensive information sharing with transport service providers in overall supply chain is crucial to improve supply chain performance which creates flexible operating systems characterized by coordinated operations that can drastically cut order lead times and inventory levels as goods flow seamlessly from raw material supplier to end consumer[38]. Transport services represent a major component of order lead time that elapses between the time at which order is placed and the time at which goods or service are ultimately delivered to the receiver. Much of the variability in order lead time is attributed to variation in transit times. With more and more companies operating on a just-in-time basis, there is less room for error in the delivery process[39].

The benefits of CTM can be achieved through two primary avenues: 1) direct communication between carriers and the trading partners, or 2) third party facilitation of the communication and execution process.

The fact that trading partners in supply chain are strongly striving to work together to eliminate inefficiencies, reduce cost, and ensure excellence in the flow of goods and information. In most instance there is only so much that a single member of the supply chain can do to resolve the problems noted above. Therefore, that collaboration among trading partners in supply chain has become a topic of great interest for many and an essential element of company strategy for others[40]. In order to achieve positive results of CTM, the business processes between trading partners should be real-time, versatile extendible, automated and cost-effective[41].

[37]VICS CTM (2004), p.3.
[38] Stank (2000), p.72.
[39]VICS CTM (2004), p.3.
[40] Sutherland et al. (2004), p.193.
[41]Cf: Feng and Yuan (2007), p. 627.

Metrics	Major Benefits
Reduced transportation cost	Shippers and receivers have realized freight cost reduction in excess of 20 percent and administrative cost reductions of 20 percent through CTM initiatives.
Improved service levels	CTM initiative has resulted in on-time service (customer response) improvements of 35 percent and lead time reductions more than 75 percent for participating shippers and receivers. Furthermore, inventory reductions of roughly 50 percent have also been realized. Lead times is drastically reduced to 1,5 days from a week.
Increased asset utilization	Carriers have indicated that fleet utilization (vehicle fill) has improved 33 percent. Improved fully load miles, better on shelf performance. In addition, dead-haul (empty truck) miles, dwell time, hidden costs and driver turnover have all decreased by 15 percent as a result of CTM adoption.
Reduced inventory levels	Inventory level has been reduced by 12 days of supply and increased on-time deliveries to above 98% within a predefined time frame.
Increased revenue and end-customer satisfaction	Sales improvements of about 23 percent have been gained through the improved customer service that results from CTM initiatives.
Increased visibility	Shipper, carrier and receiver alike have indicated that CTM initiatives have resulted in an enhanced ability to identify the location of freight in the supply chain, giving them the ability to manage their supply chain more effectively. This benefit particularly due to inter-organizational systems that are utilized to integrate firm involved in CTM.
Optimized transport-mode utilization	The back-haul utilization has increased approx. 25 percent by optimized work-load.

Tab. 2-1 Major benefits of CTM

Developing CTM as a process code is to provide a framework of how to structure such collaborations to maximize effectiveness and manage expectations. CTM can cost and boost efficiency for all trading partners. The benefits of CTM can be achieved through two primary avenues: direct communication between carriers and the trading partners, or 3PL facilitation of the communication and execution process[42]. The major benefits of CTM are emphasized in Tab. 2-1[43].

In summary that CTM can deliver more transparency (visibility) of data and costs; accountability of services and processes; both internal and external optimization of assets; flexibility to meet new and changing requirements; control of own and partner processes and additional value to gain and retain business.

2.1.3 CTM Business Model

The CTM business model (see Appendix C) was proposed by VICS and consists of 14 steps. These steps are further divided into three main phases: namely, planning, forecasting and execution.

1. Strategic Planning and Transportation Procurement Phase (Steps 1-2)

This phase includes steps 1 and 2. Initially in this phase, trading partners establish a collaborative agreement plan (front-end agreement) to define consideration factors for the relationship in terms of freight shipment, exception handling, and key performance indicator (KPI). Afterwards, an aggregative planning is constructed to determine resource and equipment requirements by matching with the planned shipment.

2. Transport Forecasting Phase (Steps 3-5)

This phase makes up steps 3 to 5. By sharing order and shipment forecast in step 3, the carrier gains insight into the changes of planned volume and adjusts the equipment requirement accordingly. Exceptions due to the shipper or the carrier are generated in step 4 and resolved collaboratively in step 5. Unlike with the traditional one to two days' advanced notice of potential shipments; the carrier has ample time (one to four weeks depending on the forecasting horizon) to handle the resolved volume.

[42] Sutherland (2003), p.1.
[43] Cf: Sutherland et al. (2004), p.196. and VICS CTM (2004), p.4-5

3. Transport Execution Phase (Steps 6-14)

This phase consists of four stages: shipment tenders, distribution, payment, and a review in order to manage the whole distribution cycle. The shipment tenders stage starts from steps 6 to 8 of CTM. Step 6 is the creation of order/shipment tenders based on the resolved order forecast. Any exceptions based on latest equipment availability, pickup and delivery requirements are identified in step 7 and resolved collaboratively in step 8. The distribution stage—steps 9 through 11—involves the physical distribution and the visibility of the shipment status. Step 9 is the creation of the final shipment contracts, outlined as the results of collaborative tender acceptance and shipment terms. Shipment status is continually updated throughout the distribution cycle and any exception is identified during step 10. Step 11 is the resolution of delivery exceptions. The payment stage involves steps 12 and 13. Invoicing discrepancies are greatly reduced with the communication of shipment attributes, such as weight, freight class, and destination between carriers and shippers, in step 10. Any payment exceptions identified in step 12 are collaboratively resolved in step 13. Finally, the review phase involves measuring the distribution performance against the KPI in step 14 and seeking opportunities for continuous improvement[44].

Fig. 2-4 illustrates the CTM business model with three discrete phases; strategic, tactical and operational:

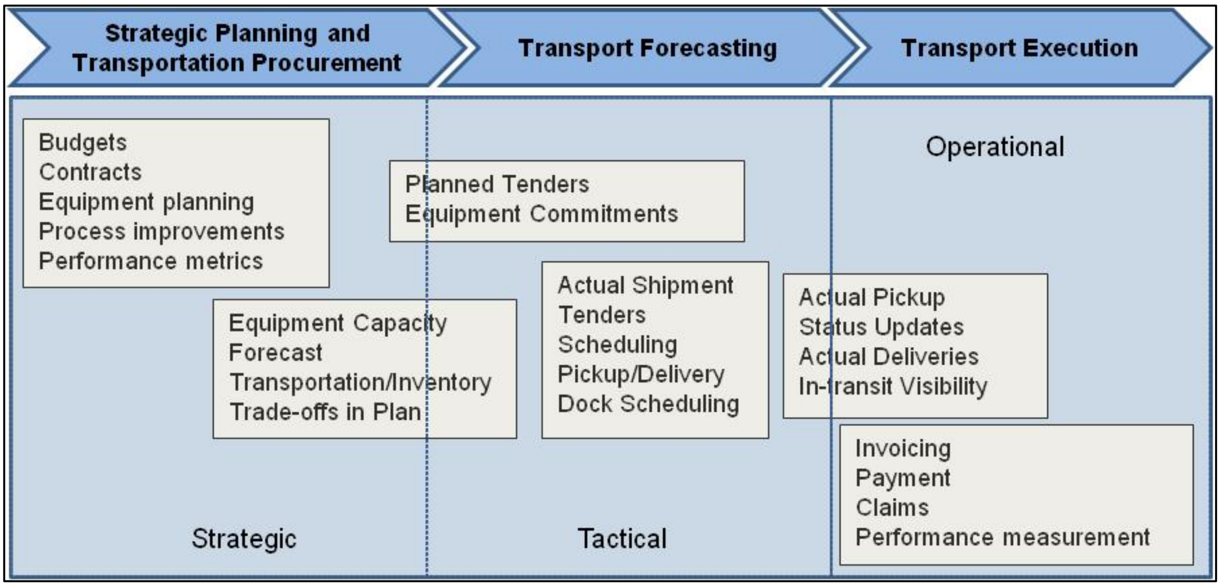

Fig. 2-4 CTM business model

[44] Tyan et al. (2003), p.286.

2.1.4 Transportation Challenges

Transportation industry has been in a change since the regulation in 1980. A deregulated environment has dramatically intensified the competition among shippers and carriers such that they must either run an efficient operation or shut out of the market[45]. While efficiency improvements are abundant over the past two decades, there still remain significant opportunities for further improvement.

Shippers and carriers face enormous challenges in transportation management inherent to a complex business environment including increased globalization, outsourcing and growing customer demand for rapid order fulfillment. As a result, efficient supply chain execution and transportation management have become more important than ever for sustained profitability and customer retention. Now, herewith one research question about *what challenges effect today's transportation management*? is answered where challenges are summed up all with those headlines, namely: macro-economic challenges, increasing customer demands, regulation issues, capacity challenges, infrastructure challenges and finally heightened IS needs.

- *Macro-economic challenges:* expanding globalization and outsourcing including company merger and acquisition drive more complex transport requirements; counterproductive to supply chain velocity; increasing lead-time, variability and inventory; many more parties involved.
- *Increasing customer demands:* customers are becoming more demanding than ever. They require shorter lead times, lower inventory levels, smaller and more frequent shipments to different destinations and greater visibility which force more complex distribution channel requirements to maintain customer loyalty.
- *Regulation issues:* government policies and regulations affecting transportation have an important impact on capacity[46]. Increased oil/fuel costs rates, increased expedition, supply/demand imbalances, regulatory compliances, increased security and global regulatory environment, regional conflicts, driver shortages, embargos, taxation, tariffs.
- *Capacity challenges*: companies face many capacity constraints such as driver shortage, hours of service rules, trade lane imbalance.

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[45] Cf: Sutherland et al. (2004), p.192.

[46] Stank et al. (2007), www.industryweek.com., (last access: 02.12.2009).

- *Infrastructure challenges:* global infrastructure, road systems, rail systems.
- *Heightened information system needs:* real time connectivity for tighter control and monitoring, sharing logistics impact across organization and network, data quality and sharing reliability across shipping community.

2.1.5 Inefficiencies in Shipper-Carrier Relationship

CTM is not simply about putting together continuous moves to improve carriers' efficiency or not only bringing carries into the relationship just for the sake of shipper's advances. It is based on win-win outcomes among all parties to weed out inefficiencies in transport chain[47]. Relationships can be fostered to facilitate CTM in which both shippers and carriers realize measurable benefits[48].

In transport, both shippers and carriers are facing inefficiencies[49] which are for shippers such as high transportation costs, long cycle times, poor on-time performance and high inventory carrying costs; for carriers empty dead head miles, unproductive (idle) waiting time, dead-head (empty) miles[50]. Therefore they are continuously looking for ways to operate more efficiently and more productively, as they face inefficiencies like unproductive waiting time and lack of critical network mass.

In response to the increase in supply chain velocity and agility, shippers are under continuous pressure to reduce transportation costs while improving logistics performance and customer service. Shippers have to provide the delivery of smaller product quantities (e.g. less than truckload rather than full truck load shipments) at more frequent intervals for the market place. Furthermore, they have to ensure stable supply chains replete with reliable transportation services where the supply chain buffers that once protected against production delays or out-of-stocks have shrunk, as inventory volumes grow smaller. Mistakes that were once covered by excess inventory now emerge as expedited transportation costs.

Carriers are facing also new challenges to profitability; that experience earnings slide on large cost fluctuations, limited cash flow and unsatisfied margins – an anecdotal account from a recent panel on "Multimodal Carrier Executives: Viewpoints from all angles" shows that operating margins for truckload carriers were average 1.75

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[47] Cf: Murphy (2003), p.2
[48] Cf. Esper and Williams(2003), p.58.
[49] N.N.: Majority of 3PLs are using cost cutting strategies (2009), www.industryweek.com (last access: 05.12.2009).
[50] Cf: Sutherland (2003), p.1.

percent in 2008[51]. Shippers are seeking mainly rate stability, a competitive cost structure and capacity whereas carriers are seeking the maximum yield for its transportation services. Given this situation, shipper-carrier collaboration is the best long-term strategy to get through an unwanted downturn in the economy that has been occurring.

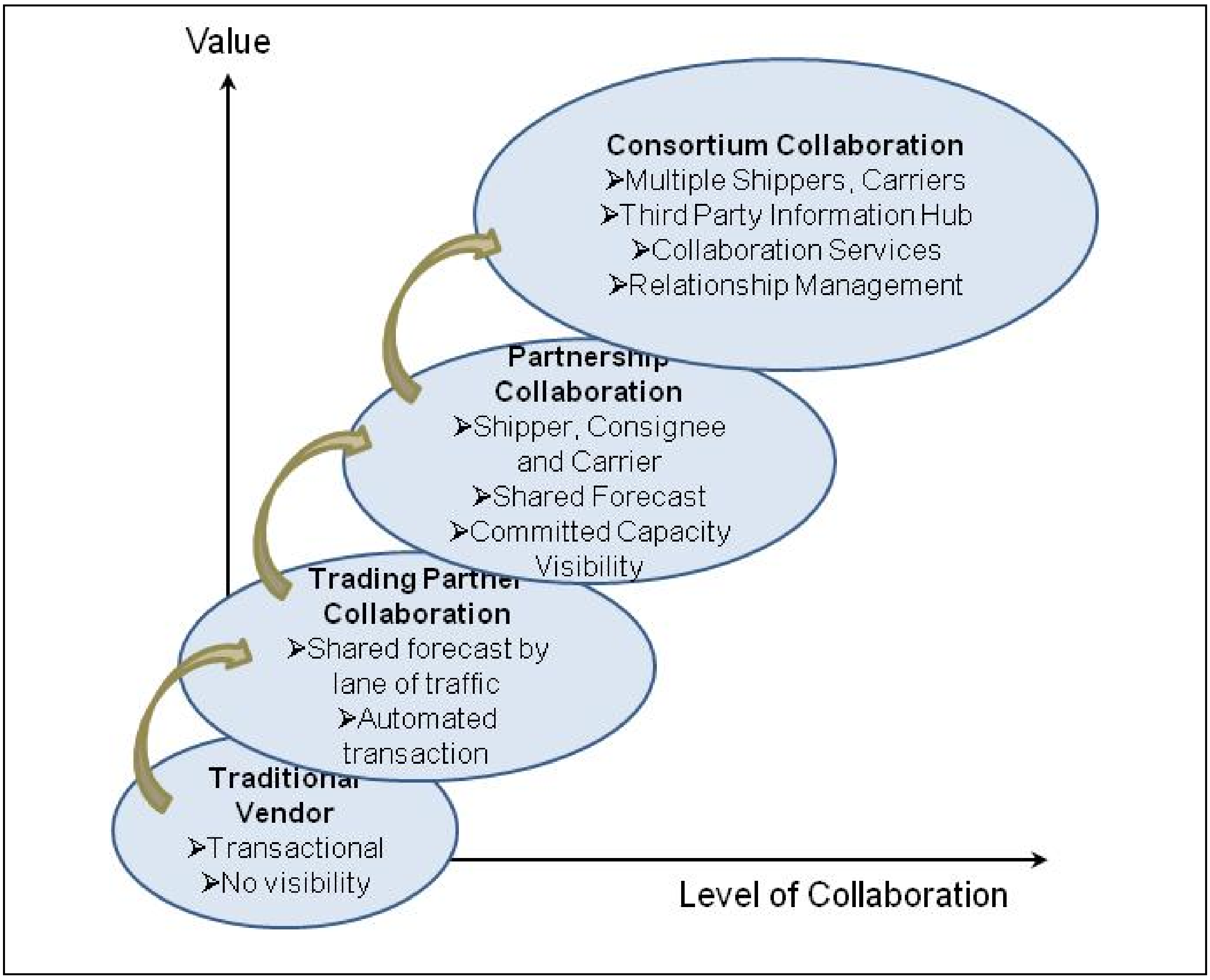

Fig. 2-5 Collaboration Level in CTM Business Model

Shippers need to share as much data as possible with their carriers concerning freight characteristics, volumes, lanes, delivery requirements, freight rates and so on while carriers need to share their strengths on terms of head haul and back haul requirements, capacity, service levels etc. Sharing such information within trading partners is crucial to enhance open communication, trust and flexibility. Utilizing

[51] Cf: Berman (2009), www.logisticsmgmt.com/article/CA6656219.html , (last access: 19.11.2009).

transportation providers increase the level of collaboration and promises greater CTM value than a 'go-it-alone' strategy, as illustrated in Fig. 2-5[52].

As a result, the common objectives from the sight of shipper and carrier in CTM are summarized:

➢ Shipper's benefits are: Lower transportation cost Improve on-time performance Inventory reduction Sales enhancement Guaranteed capacity	➢ Carrier's benefits are: Reduce empty (dead) miles Minimize idle time Improve asset utilization

2.2 Information Technology

The role of IT has received a great deal of attention as a potential enabler of competitive advantages for companies. IT provides various interfaces to enable seamless communication not only within the company and also with other trading partners and customers. The rapid adoption of Internet for communication between companies and their partners seems to reflect potential of this communication mean. In parallel, the Internet enables companies to implement new e-business models that strengthen their competitive advantages[53]. Electronic business (E-Business) is any commercial transaction carried out, facilitated or enabled by the electronic exchange of information. Electronic exchange can be via the Internet (Web), EDI, intranets, dedicated telecommunications or email.

IT has become a commodity in transportation as well as availability of IT has increased and transportation cost has decreased. Having IT capabilities is to support new collaborative business models that provide companies with a distinct competitive advantage, moreover they allocate cost risk and management responsibility within trading partners.

[52] Cf: Sutherland (2003), p.2
[53] Cf: Dussart (2000), p. 386 and Simchi-Levi et al. (2004), p.69.

2.2.1 Evolution of CTM with IT

As mentioned in Section 2.1.4 enabling rigorous cost reduction, impetus and flexibility would be the today's key success parameters for companies to overcome above mentioned challenges to achieve competitive advantages. Here especially the integration of IS of each party in a supply chain has become an unavoidable necessity. Certainly there are apparent benefits of IT: the significant expansion of information availability and visibility, efficient communication, improved supply chain management tools, such as enterprise resource management (ERP), customer relationship management (CRM) and SCM[54].

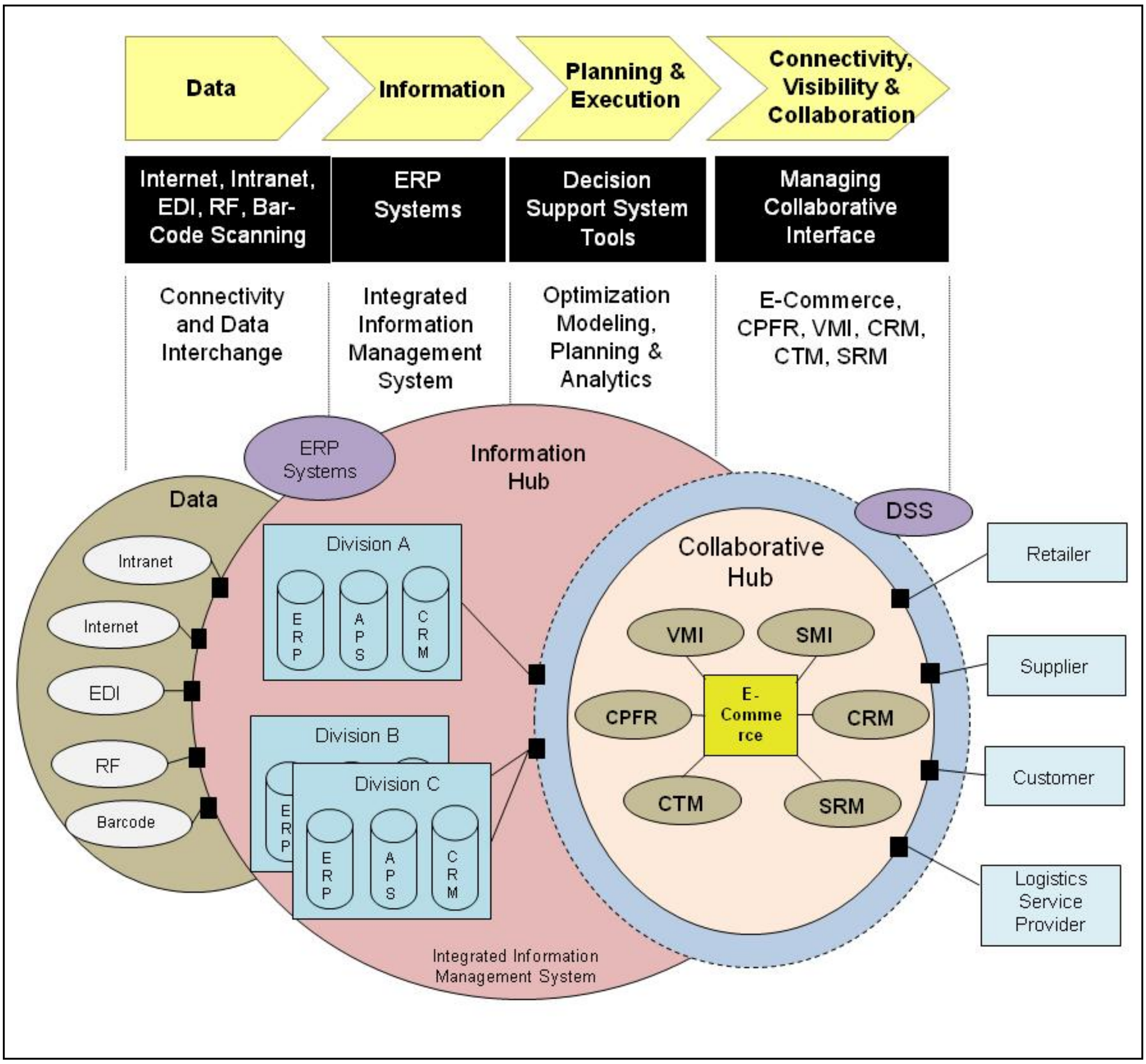

Fig. 2-6 Integrated information management system in supply chain

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54 Cf: Auramo et al. (2005), p.83 and Fawcett et al. (2007), p. 37.

Fig. 2-6 illustrates an integrated information management system in supply chain, where the collaborative infrastructure can be seen. This Figure also reflects the complexity of the IS as well as the complexity of the organization it serves. As seen in the Figure, all parts of supply chain is connected each other by IS so that all systems can cooperate mutually, sufficiently share and use the information resources to enhance supply chain excellence. Here, CTM is illustrated as a part of collaborative tools of supply chain in this collaborative infrastructure in order to enable smooth interaction and control between other trading partners along the transport chain.– mostly referred as 'the missing link' of collaborative supply chain execution. It plays a role to enhance coordination and collaboration between company and its other trading partners. CTM systems are focusing on internal information sharing as well as external data sharing from other channel partners, therefore it should be able to interface with company's ERP system as well as other partner's operating systems seamlessly to facilitate decision making adequately. Here, IS includes modelling and management of decision making and more important issues are tracking and tracing. It provides essential data and consultation in each step of the interaction among transport services and the target stations in supply chain[55].

IT is important "must" for CTM. CTM creates the need for new information and technologies to foster collaboration ahead. It is very clear that communication possibilities and information access are important elements in this system. CTM should be viewed as provider- and platform independent, such that any trading partner entering into a collaborative relationship will not be hindered by any technical limitations. Existing technologies such as EDI, eXtensible Markup Language (XML), internet-enabled host and client/server applications, as well as traditional paper and phone communications technologies will prove to be inadequate, but still useful as foundations for scalable CTM[56].

Business models in logistics and transportation chain have been developed and changed within the years since the IS are around. In general, the development of transportation management can be illustrated by the following Fig. 2-7[57]. The blue area is presently the last expansion of current business models since the middle of 90's which denotes CTM, e-logistics and other transport providers.

[55] Cf: Tseng at al. (2005), p. 1659
[56] Cf: Dutton (2003), p.42.
[57] Cf: Frazelle (2002). p. 6.

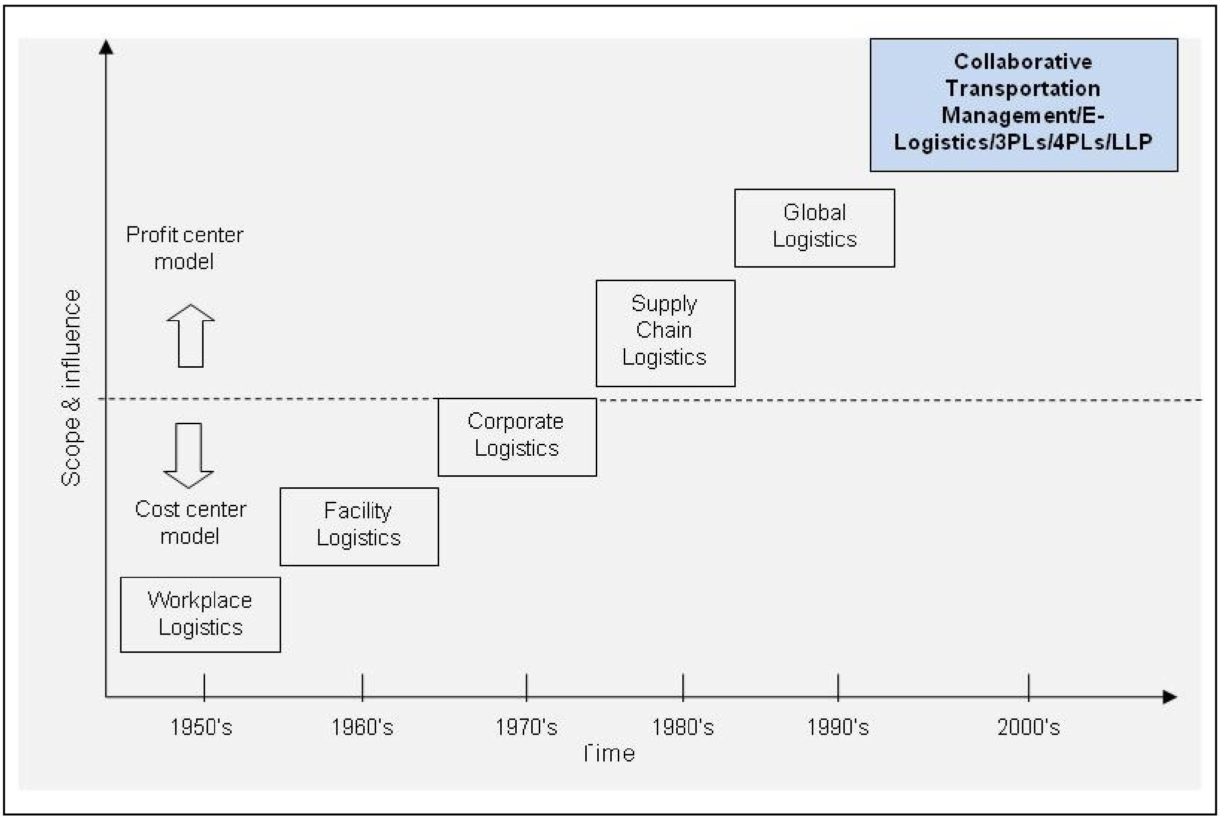

Fig. 2-7 The Evolution of transportation business model

As in Chapter 1 mentioned, CTM provides a complete visibility to entire transportation process flow, from beginning to end, to all participants. Partners with CTM gain forward visibility internally and throughout the supply chain, as well as the ability to create efficiencies and they establish and modify their rules of engagement with alliance partners. To equip partner organizations for optimal performance, a collaborative logistics network must support meaningful collaboration between participants: Information, products, assets, documents and capital[58] are the areas to collaborate to enhance transportation process flow.

In short, CTM enables companies to increase the efficiency and end-to-end visibility of their supply and distribution networks through Internet-based technology and exact data management system within carriers and transport intermediaries across transportation modes (road, rail, air, sea, inland waters).

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[58] Langley (2000), p.7.

2.2.2 E-Collaboration and CTM System Strategy

E-collaboration is a part of e-business, and today a very influential aspect of collaboration between companies. E-collaboration is defined as business-to-business (B2B) interaction facilitated by the internet[59]. According to Grocery Manufacturers of America Association[60], e-collaboration is the use of Internet based technologies to facilitate continuous automated exchange of information between supply chain partners. E-Collaboration is about companies working together to integrate their operations and eliminate barriers that impact their ability to satisfy consumers and drive out unnecessary cost. It is being used to integrate previously separate aspects of the supply chain and to enhance the value delivered to the consumer by providing a series of practical improvement concepts to unlock this value. The performance of transportation chain is becoming more and more dependent on technological innovations which can enable new opportunities in transport chain. The use of appropriate IT is essential to the achievement of CTM objectives. *CTM occurs only when a community of shippers and carriers coordinate business activities using IT and the emerging e-business applications to improve profitability and performance*[61]. Internet-based IT is explicitly a cornerstone in enabling the evolution of today's collaborative transportation business models.

VICS basically defined four general categories of Internet use; publication, interaction, transaction and collaboration[62] respectively. *Publication* refers to sharing specification, advertising and other static information with trading partners. *Interaction* provides trading partners interactive access to product catalogs, shipment tracking and other relevant business information. *Transaction* implies to conduct business over the internet by taking orders, collecting payment, and so on. *Collaboration* extends business processes beyond the scope of transactional business which covers a range of business processes including product design and development, joint marketing, program development, forecasting and replenishment which can be connected and collaborated via the Internet. These four categories are combined with scenarios which describe the ways that companies deploy electronic commerce between themselves and their trading partners. Fig. 2-8 shows those scenarios[63]: interaction between shipper and its trading partners can be as a shared solution by extranet, application service provider (ASP) or portal as well as a peer-to-peer solution by company to company, company-to-portal or portal-to-portal.

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[59] Johnson and Whang (2002), p. 420.
[60] NN: GMA (2010), http://www.gmabrands.com/industryaffairs/ecollaboration.cfm
[61] Cf: Lynch (2001), p. 2.
[62] N.N.: Internet Commerce Model, Recommended Technologies for Internet Commerce (2001). p.7.
[63] N.N.: Internet Commerce Model, Recommended Technologies for Internet Commerce (2001). p.9.

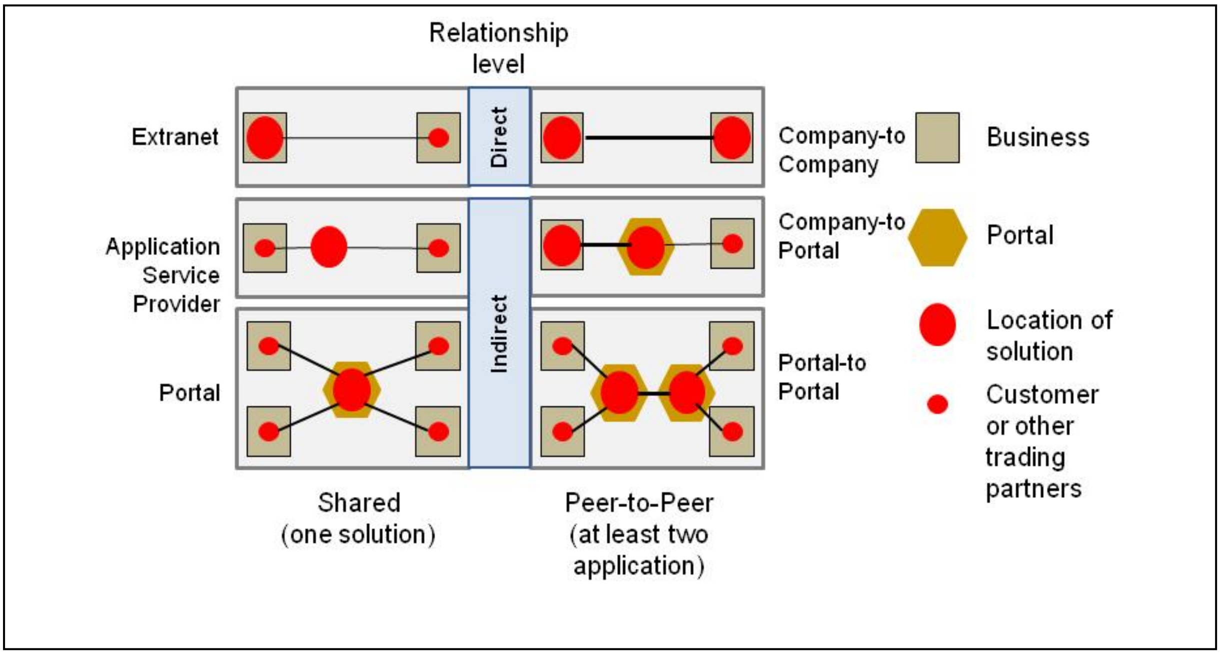

Fig. 2-8 Electronic collaboration scenarios for deployment

CTM business model is promising, especially for e-commerce initiative. It is the only process model that exclusively focuses on the communication in B2B relationships. The great majority of so-called collaborative efforts focus predominantly on the physical exchange of data or only the simple Internet-enablement of information to provide visibility. In CTM system communication between shipper and carrier could occurs in three different ways: 1) direct communication within trading partners by using phone, email/fax or a shared collaborative system via extranet/EDI/EAI to manage it in-house; 2) hosted communication by using a ASP or portal (e-hub) 3) outsourced communication by using a 3PL/4PL provider's electronic market places.

McLaren et al (2002)[64] explained an inter-organizational system for supply chain collaboration into three major steps. This is adopted for CTM system strategies. Inter-organizational system refers that actors from different companies are involved in each step of process including planning, forecasting, execution and so on. There are many inter-organizational relationships like: joint ventures, networks, consortia, alliances, trade associations, interlock directories[65]. These major types are message-based systems, electronic procurement hubs, portals or marketplaces and shared collaborative systems (one-to-one inter organizational information system). The

[64] McLaren et al(2002), p. 352.
[65] Barringer and Harrison (200), p.368.

future deployment of this system should be concentrate on the red labeled area in the Fig. 2-9 and also our concentration in this thesis is dedicated in this area.

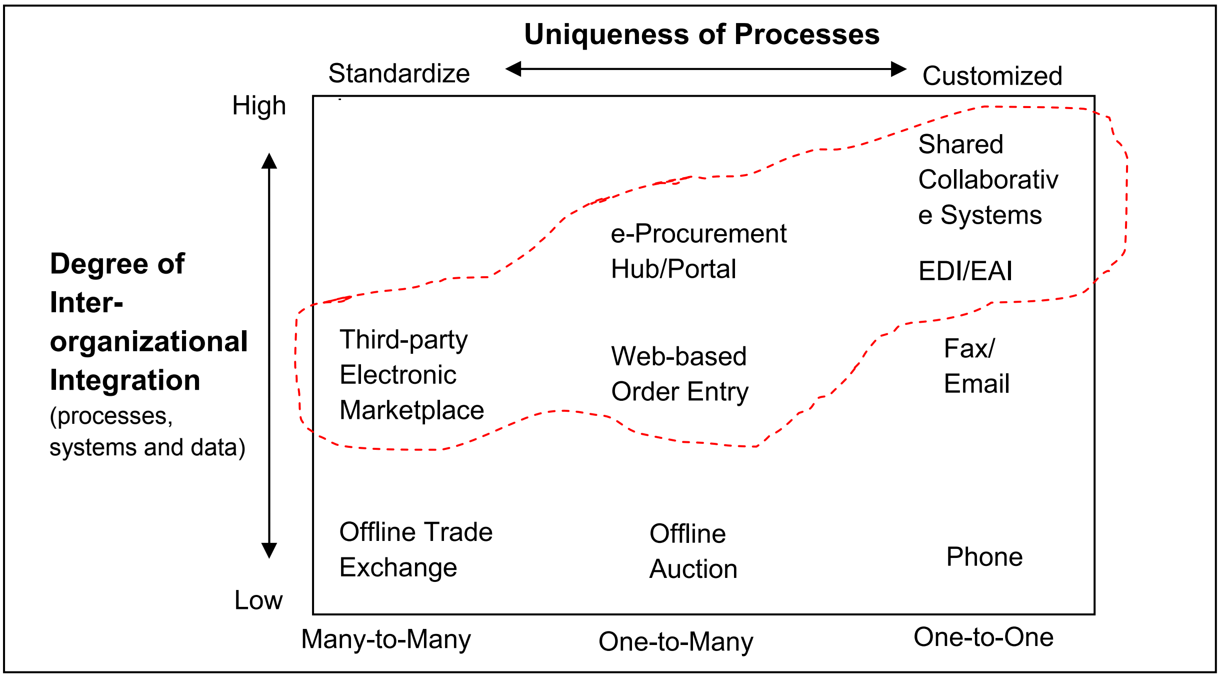

Fig. 2-9 Inter-organizational systems for CTM strategies

Seen in Fig. 2-9 that the usage of IT is categorized with the degree of inter organizational integration. Normally, shippers foremost prefer phone, fax or email for the communication for one-to-one relationship, but because of the higher inter-organizational integration, the IT usage is inevitable, moreover today many companies find IT enabled CTM automation solutions more viable. The more participants are used CTM, the more IT dependent CTM system should be structured.

2.2.3 Trends of electronic business models

E-business has emerged as a key enabler to realize the vertical chain integration; through e-business the supply chain can gain global visibility across their extended network of trading partners and help them to respond quickly to market changes. By adopting e-business approaches companies can gain the benefits of integration – reduced costs, increased flexibility, and faster response times – more rapidly and effectively[66]. There is no doubt that electronic commerce and Internet technology have a significant potential to impact ways of business for transportation

[66] Cucchiella and Gastaldi (2006), p. 701.

management. In an effort to address the need for increased performance, both shippers and carriers are turning toward e-business solutions. Collaborative networking is the current trend of growing integration across trading partners to gain efficiencies by simplifying the transport processes. Online tendering and internet-based transportation management act as a cultural catalysers and technical enablers. Collaborative networking enables an effective communication between multiple carriers and shippers by a user-friendly business platform. This kind of electronic business market platform is named as “transport exchange”, “logistics exchange” or “freight exchange” in the business which has emerged as key information and transaction nodes in the transport chain. The Internet and the emergence of electronic business market platform have a great impact on execution performance in supply chain by enabling visibility and integration of corresponding trading partners.

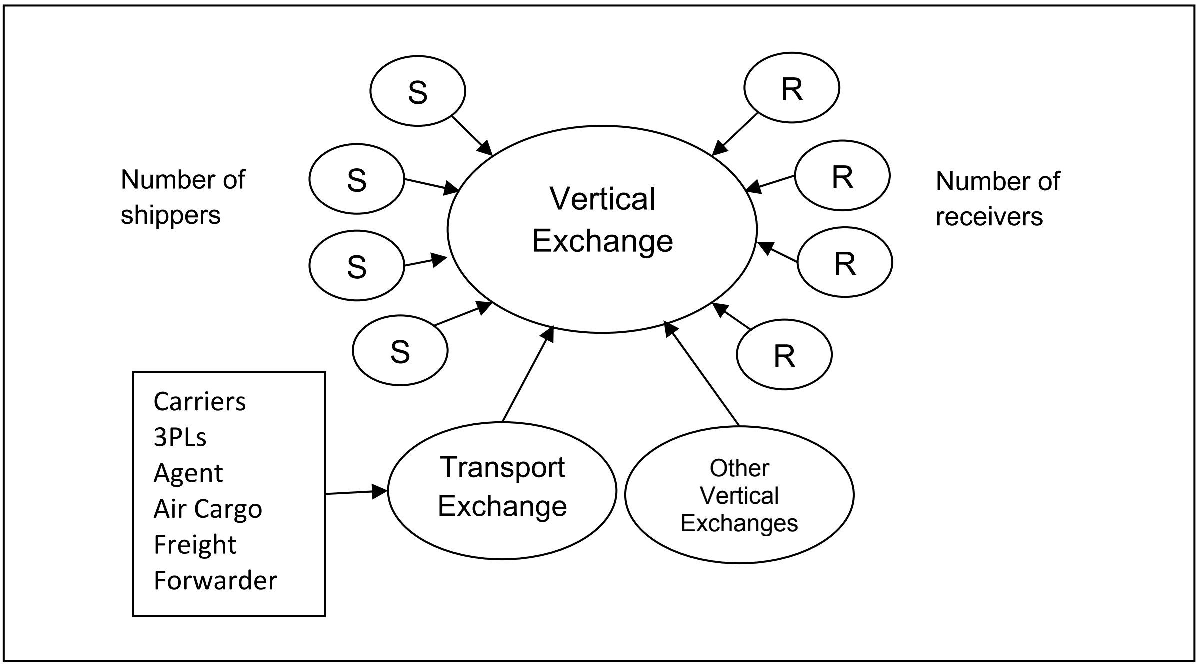

Fig. 2- 10 Electronic business platform in transportation management

Transportation services play a central role in seamless transportation management operations. They offer software solutions such as Warehouse Management System (WMS) or Transportation Management System (TMS) to manage warehouse, transportation and other activities. Added to this, they offer also today quick and easy transfer of information between those solutions by using Internet technologies. As mentioned in Chapter 1, the scope of the thesis focuses on those B2B interactions within shippers and carriers.

Pompeo and Goulmy (2001) categorized current e-business models for collaborative transportation management as follows;

- *Freight exchanges (FXs):* are Internet services that bring together buyers (shippers) and sellers (carriers) of transportation services in order to increase the efficiency of both shipper and carrier operations[67]. Freight exchanges is a neutral system, a provider dependent, allows each shipper and carrier to quickly find a load or a truck for any destination, moreover allows using their choice of communication format, such as EDI/EAI messages, XML, Web forms, or fax, to send and receive information. This aim at to manage activities from the shippers point of view.

- *Proprietary customer interface web-sites*: a carrier or logistics service provider (transportation provider) provides information. The aim is to provide better customer service at a lower cost[68]. Practically every carrier or LSP has its own customer electronic platform, although functionalities from carrier to carrier differ. Using Internet to address need to avoid empty mileage through visibility of available loads. Teleroute, Transpobank, Timo.com are the most commonly used platforms in Europe.

- *Multi enterprise collaborative platform,* is defined as an inter-organizational information system that provide common electronic market platforms (neutral portal) bringing together shippers and carriers of transportation services to conduct business and to explore collaborative opportunities in order to manage the entire lifecycle of the shipments efficiently. Thus a collaborative platform is a form of intermediary that establishes electronic links between buyers (shippers) and sellers (carriers) interested in conducting transactions

Today, more and more companies have begun using internet-based collaborative network for online tendering, executing and managing all of their inbound and outbound truckload (TL) and less-than-truckload (LTL) transportation. In general, these networks blend all traditional and collaborative functionality for maximum exchange benefits to a group of shippers and carriers and promote intense information sharing in terms of capacity and streamline in order to increase asset utilization and customer service and reduce logistics costs[69]. Internet based transportation exchanges allows building upon existing carrier relationship while achieving efficiencies inherent in a seamless, highly visible replenishment system. The partners can be either a group of carriers and LSPs or include shippers. Internet

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[67] Kale et al. (2007), p. 22.; Rudberg et al. (2002), p. 596.
[68] Pompeo and Moira (2001), p.66.
[69] Cf: Blanchard (2005), p.114

marketplaces in existence include Covisint in the automobile industry, Travelocity in the airline industry, and The Seam in the cotton industry. Several electronic markets operate in the logistics field, bringing together buyers and sellers in such areas as transportation, warehousing, and manufacturing (e.g., Descartes Systems Group, Manhattan Associates, National Transportation Exchange, Nistevo, Transplace, Logility, One Network or Sterling Commerce)[70]. These providers are called as fourth party logistics provider (4PLs) which could act as a consultants and even substitute for shippers in the design and management of supply chains[71] from end to end; often they are hiring subcontractors. Another term for a 4PL is a Lead Logistics Provider (LLP).

- *Electronic transportation management system (e-TMS):* This provides shippers and 3PLs with hosted transportation management, including transport order management, load tendering, multi-modal carrier assignment, multi-modal rating engine and integrated accounting capabilities like invoicing. e-TMS works in conjunction with B2B connectivity and visibility solution to provide users with end-to-end control of their transportation network. e-TMS allows the open system, vendor-neutral nature of e-Frame translation engines which ensure that each shipper and carrier receives accurate, real-time information in the format of their choice. These capabilities enable 3PLs to efficiently set up and manage their trade partnerships with shippers, carriers and customers in an online logistics marketplace. A e-TMS is a must for a multi-channel distributor. In this model, shippers do not own the software or the accompanying hardware; users pay transactional or monthly fees in addition to implementation and support changes. This model calls as Software as a Service (SaaS), is generally less costly and easier to implement. Individual shippers can use e-TMS and e-Frame to connect with, monitor and optimize their activities with suppliers, carriers and customers in a secure, real-time environment. I2, Manugistics, Oracle, JDA, SAP, Aspen Tech are the outstanding providers.

- *Niche products:* which facilitate international trade through e-payment, landed-cost calculation, electronic bills and documents and other service necessary to allow automated transport execution at a reduced cost. Examples of such services are Vastera, Nextlinx and Bolero.net[72].

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[70] Kale et al. (2007), p. 22.
[71] Fabbe-Costes (2009), p. 72
[72] Pompeo and Moira (2001), p.66.

Pompeo and Moira suggested that the future collaborative electronic business models can be evolved into meta-market places, end-to-end e-enabling and optimization, suite of standard application provider, e-risk manager and virtual LSP[73].

- *Meta-market places:* could evolve out of exchanges backed by existing transport service providers. As the transport value chain continues to unbundle, highly liquid market places would mainly trade capacity between transport service providers. The value proposition of these meta-marketplaces would be to provide a neutral, standard transaction and interaction platform for the industry, including short-term contracting and long-term agency relationships as well as spot contract and day-to-day management capacities.

- *End-to-end e-enabling and optimization* would entail the creation of a platform where transport orders and contracts are aggregated and routed through a network optimization model. It would select the optimal quantity, routing and timing of mode of transport and other assets to carry out the required transport services at the required quality and automatically notify associated partners.

- *Suite of standard application provider:* This refers standard application for a single product like payment, insurance and e-documentation etc. Current niche application providers are probably best placed to implement such suites.

- *E-risk manager:* these types of players would take some of the risk of the operation by taking position in the market. They create derivatives and offer risk management tool to shipper and transport service providers.

- *Virtual logistics service provider:* this would be a more or less asset free one-stop for shop for transport services, covering all geographies and modes as well as providing supply chain optimization services. The value of this model would show the abilities to manage and coordinate transport service provider's network to establish customized solutions for shippers.

Fig. 2-11 shows the segmentation of electronic business models for CTM[74].

CTM business models should be able to provide user friendly interface, measurable return on investment (ROI), integrated B2B EDI/EAI/XML/Web-Services capabilities (electronic carrier communications), avoided empty mileage through real-time visibility, precise and regulated point-in-time reporting capabilities, immediate productivity upon implementation, customizable carrier selection criteria, real-time tracking/tracing of shipments, general ledger (GL) allocations, accurate carrier

[73] Pompeo and Moira (2001), p.68.
[74] Pompeo and Moira (2001), p.70.

invoice auditing, Flexible and unique shipment consolidations capability, detention/demurrage processes, claims, multi-location shipment management, multi-carrier management (rates, service, destination and origin), reverse logistics, automation of processes, and rigid and restricted security.

CTM delivers robust transportation planning, transportation procurement and execution capabilities to shippers and third party logistics providers. It integrates and streamlines transportation planning, execution, freight payment, and business process automation on a single application across all modes of transportation, from FTL to complex multi-modal air, ocean, road, and rail shipments.

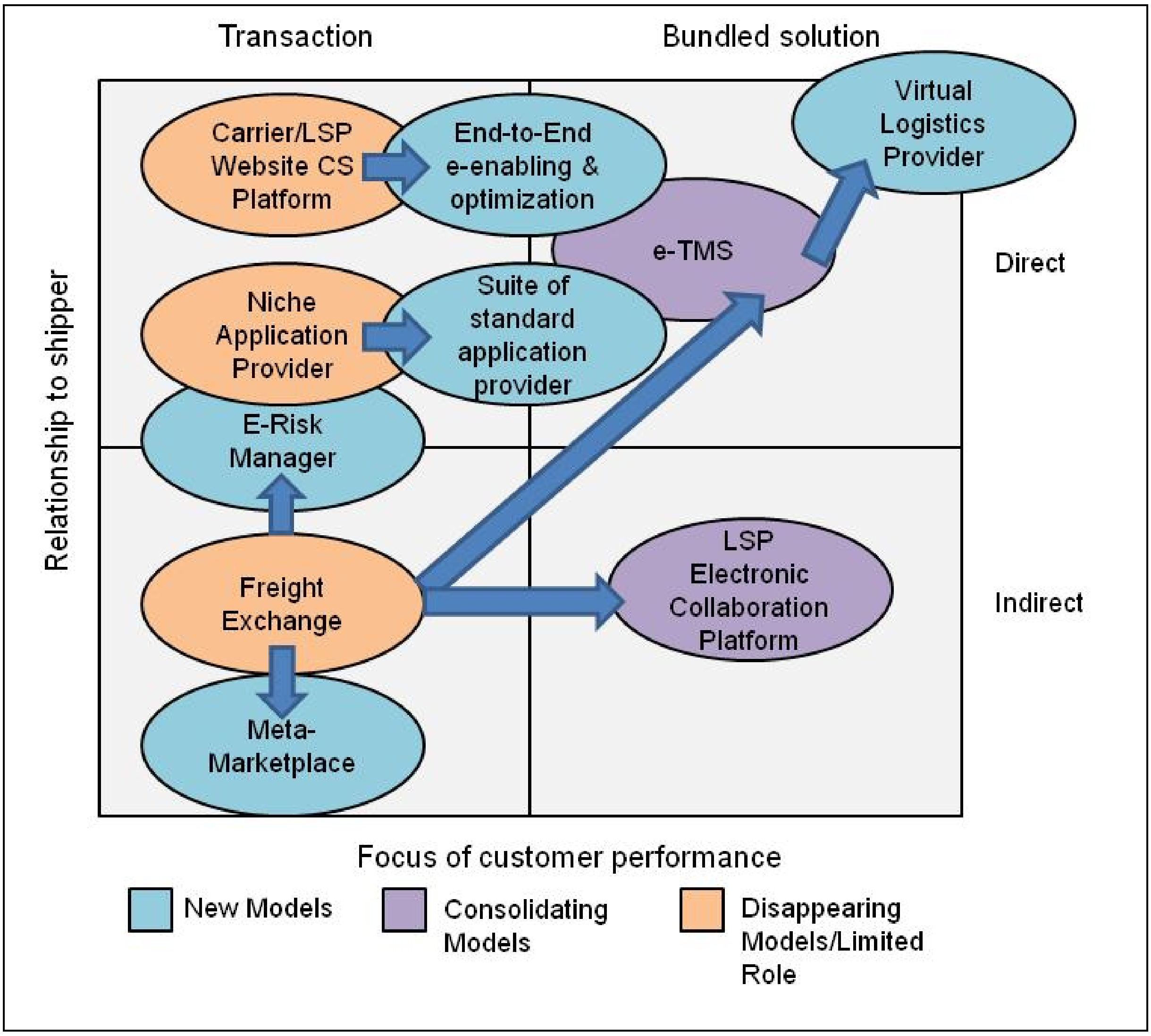

Fig. 2-11 Different e-business models within freight transport and logistics

Participating e-business market platform creates benefits for shipper as well as carrier. These benefits for both carriers and shippers are summarized in Tab. 2-2.

The Internet has influenced the usage of CTM business system in three ways. First, the internet has facilitated increased use of TMS. Second, the ability to obtain real-time information and the access to large computer system is enabling companies to develop detailed CTM system that can be utilized to make real-time decisions. Last, the internet has created opportunities to integrate information and decision making across different functional units, thereby creating a need for CTM system that go beyond a business unit to study the extended enterprise.

Shipper Benefits	Carrier Benefits
Increased price transparency	Increased price transparency
Automatic procurement processing	Increased asset utilization
Greater access to service providers	Greater exposure to large shipping base
Lower procurement costs	Confidentiality
Greater visibility	Reduced sales and marketing overhead
Confidentiality	Greater breadth of payment services
Automated payment processing	Data mining capabilities
Data mining capabilities	Asset optimization services
Supply chain optimization	

Tab. 2-2 Benefits of e-business market platform

2.3 Risk Assessment in CTM

The purpose of a transportation system is to physically move the goods within a certain supply chain in order to fulfil the scope of logistics. This means that the transportation network only physically integrates the supply chain with the fulfilment of the supply chains' transport demand[75]. In general, transport demand is moving toward longer and more customized transport linkages with higher levels of sensitivity to the timing of connections, arrivals, and departures and heavier reliance on communications networks and information systems[76]. On the other hand, certain risks and uncertainties in transport chain affecting operations and performance are growing along with supply chain complexity. Some issues such as lack of visibility,

[75] Cf. Bowersox et al. (2003), p. 6-7.
[76] Vaidya (2006), p. 303.

delivery delays, empty running, and complex transportation networks are major obstacles to the delivery of superior customer value in transportation management[77]. Collaborative action is important to overcome those difficulties and risks along the whole lifecycle of the transportation. Transportation with today's required challenges is growing continuously complex, interconnected and global. In contrast with operations become increasingly dispersed within supply chain. Many companies realize that transportation is not their forte and they take on the approach of applying collaborative business solution for their transport operation to gain competitive advantage. With the expanding technology in size and complexity, companies are focusing on managing risk in collaborative business.

However, technology alone is not enough to manage successful collaboration and bring true CTM system to an organization, all partners in CTM system must know, how to use IT to reap benefit of collaborative processes. Therefore, the enabling and supporting role of IT to CTM processes can only be realized if the technology is employed properly.

It is obvious that there are many obstacles in a collaborative transport business, including technical, commercial and organizational aspects. Those obstacles should overcome in the joint process of combining several transport services to an effective and efficient transport chain; therefore CTM needs to be viewed holistically for possible drawbacks. It is about identifying, analysing and prioritizing all risk factors (uncertainties) from transportation processes among all the parties involved.

In this thesis Boehm (1991)[78] proposed the risk assessment model is used which has three main steps as risk identification, risk analysis and risk prioritization respectively. Risk identification produces lists of system-specific items that are likely to compromise a system's success. Risk analysis assesses the loss in probability and magnitude for each identified risk item. Risk prioritization produces a ranked ordering of risk items that are identified and analysed.

The theoretical framework of the thesis comprises the detailed view of this risk assessment model. In this section, the possible risk factors are going to be extracted from literature review including interviews, online resources, surveys, white papers, technical papers and discussing with experts.

Firstly, it is started with to explain what exactly risk and risk assessment are; subsequently a comprehensive view of risk factors of CTM is given.

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[77]Cf. Rodrigues, et. al. (2008) ,p. 401 and Viau et. al. (2009), pp. 250.
[78]Cf. Boehm (1991), p. 33-34.

2.3.1 What is Risk?

According to the Merriam Webster Online dictionary[79], the term risk is defined as "the possibility of loss or injury". There are variations on these definitions of risk, but what they all have in common is the possibility of a negative realization among a set of *uncertain outcomes*.

The term risk is associated with many human endeavours such as exploration, nuclear reactor construction, company acquisition, security evaluations of IS and software development[80]. As such, people in a variety of domains have studied the notion of risk. Basically anything that can affect a program, project or process implies a certain level of risk. Siropolis[81] subdivided risk into three types: pure, fundamental and speculative. The pure risk results in either a loss or no possibility of gain. The fundamental risk differs from pure risk in that risk events typically come from the environment. The speculative risk involves a gain by improving the current situation relative to the status quo or a loss which makes situation worse off than at present[82]. An example of speculative risk would be the development of a new software product or adoption of new IS that has the potential to reap great reward if the software reinforces productivity. Alternatively, it could cause a loss, i.e. loss of investment.

Many of the literature emphasise two components of the risk[83]:

1. Potential loses (if the risk is realized, what losses will result and what is the significance of the consequences of the losses); and
2. Likelihood of those losses (the probability of the occurrence of an event that leads to realization of the risk).

Therefore, risk is the expected outcome of an uncertain event, i.e. uncertain events lead to the existence of risks.

Often, risk is equated with "uncertainty". For the sake of precision, however, it's more accurate to think of uncertainty as a lack of certainty, whereas risk refers to uncertainty where at least one potential outcome is unfavourable. In this thesis uncertainty is taken into consideration as equal to risk. Identifying potential risk factors in CTM business is crucial as those factors could cause vulnerabilities and inefficiencies in transport chain.

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[79] http://www.merriam-webster.com/dictionary/risk (last access: 02.12.2009)
[80] Cf. Barki et al. (1993), p. 204.
[81] Cf. Siropolis, (1997), p,112.
[82] Cf. Albert (2006), http://www.sei.cmu.edu/reports/06tn014.pdf. , (last access: 12.12.2009)
[83] Manuj and Manuj (2008), p. 196.

2.3.2 What is Risk Assessment?

Risk assessment is a step in a risk management process which is the determination of risk related quantitative or qualitative factors for a certain situation and a recognized threat. Risk assessment focuses on quantifying and analysing problems by having ability to measure impact and likelihood of potential threats and associated consequences, rather than solving them.

Risk assessment with risk management is increasingly becoming a well-known research area in supply chain; Boehm (1991) proposed a three step approach for risk assessment for software development[84]. Finnman (2002) used preliminary hazard analysis and proposed a risk assessment model for supplier selection process using AHP technique[85]. Zsidisin and Ellram (1999) set up a ten step methodology for risk assessment by giving equal importance with eight identified risk factors and using a five-point nominal risk scale[86] where the maximum of the factorial risk is assigned as the overall risk of a project. Hallikas et al. (2004) analysed risk sources of supplier network in detail and semi-quantified supply chain risk upon probability[87]. Wu et al. (2006) proposed an AHP methodology with enhanced consistency to rank risk factors for suppliers[88]. Karningsih, et al (2007) proposed a risk identification model, in global manufacturing supply chain[89].

In summary, all of the models are developed for either inbound supply chain or supplier side of supply chain. Secondly, most of existing research relies on a product-oriented approach. There are not exactly well-done researches focusing on collaborative system in transport chain with IT consideration. However, a research gap still exists in the supply chain management literature on providing guidelines for practitioners of collaborative transportation management that may affect decision making.

Therefore, this master thesis is an attempt to develop a risk assessment model to expose the potential risk factors to view in the field of collaborative transportation with respect of usage of information technology. Once an assessment of risks has been undertaken, an integrated collaborative transportation strategy can be established between trading partners. Further info regarding model is founded in the theoretical part of thesis.

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[84] Boehm (1991), p. 33-34.
[85] Finnman (2002), p.62.
[86] Zsidisin and Ellram (2003), p. 10.
[87] Hallikas et al. (2002), p. 45.
[88] Wu et al. (2006), p. 355.
[89] Karningsih et al. (2007), p. 11.

2.3.3 Risks and Uncertainties in CTM

The rapid development of IT and the emerging e-business applications are increasing and facilitating communication on a technical level for transportation management, but there are a number of additional issues that have to be addressed if the communication along the transport chain is to be efficient. One is the need for common definitions, common system architecture and administration; another is the more complex issue of rules for collaboration among trading partners in supply chain and additionally, from the view of use of information technologies; integrated transport systems and innovative solutions with increased speed of change. CTM as a new e-business system faces with several key challenges:

- Support multiple technologies
- Support of multiple collaborative business models
- Scalability of collaborative solutions.

CTM should support many technologies for message based data transactions that transmit information to trading partner's applications using technologies such as e-mail, EDI, XML messages;

CTM supports multiple collaborative business models like electronic procurement hubs, portals or marketplaces that facilitate the coordination and collaboration within trading partners; but at the same time these business models introduce a higher level of complexity in the network connected to the substantial difficulty in realizing integrated processes and systems and providing rich information over distance.

Scalability of collaborative solutions means that using adequate system architecture in conjunction with the dynamic nature of the internet; all parties can response quickly to changes in demand and covert the uncertainty into opportunity.

Before structuring risk factors for CTM, it is important to disclose the risk sources in supply chain which could help to categorize risk factors.

2.3.3.1 Source of Risks

In today's global working environment no company can work alone without any connection to other companies. Furthermore the increasing complexity which is the result of collaborative linkages with other companies that characterizes the actual supply chains determines an always increasing number of sources of uncertainty inside a network[90]. As a result of environmental changes like concentration and globalization, centralized distribution, technological innovations, dependency on IT and e-commerce, increased volatility demand and so on[91], supply chains are becoming more complex and more vulnerable, hence contributing to potential supply chain disruptions

As seen in Fig. 2-12: each trading partner in supply chain is linked to each other. This denotes also that partners can suffer from supply chain disruptions as for instance, a delay aroused from a partner may affect whole chain performance.

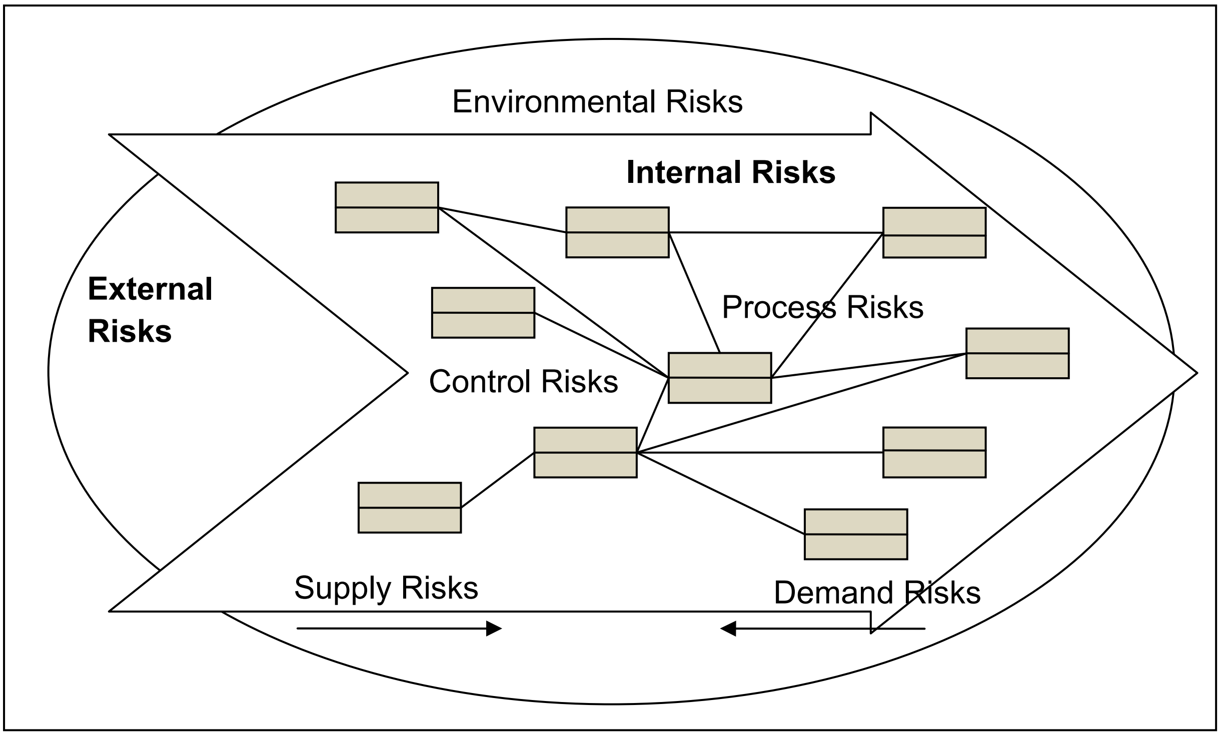

Fig. 2-12 Risk sources in supply chain

To understand and succeed possible disruptions first it is important to identify and undertake the main sources of risks across the supply chain. Both shipper and carrier side many risk sources may occur. Shippers and carriers have different expectation in transport chain to fulfill. While shippers are looking to obtain favorable rates to make more profit; carriers are looking to strengthen relationships and secure volumes. This round of sourcing, however, looks and feels different. Moreover, recent declines in demand and economic pressure on shippers and carriers have led to

[90] Cucchiella and Gastaldi (2006), p. 702.
[91] Cf: NN: Supply Chain Risk Management, (2004)

significant disruption on the supply and demand side. Service levels and operating costs are becoming more volatile as cutting costs aggressively and reducing capacity, and consolidation is increasing across all modes.

Risk sources in transportation and supply chain are any variables which cannot be predicted with certainty and from that disruptions can emerge. Generally, two important risk sources are talked about: internal and external risks. They often create disconnections across the supply chain. Mason-Jones and Towill (1998) proposed five overlapping categories for supply chain risk sources: environmental risk sources, demand and supply risk sources, process and control risk sources[92]. Cavinato (2004) suggested five sub-chain categories[93] for identifying risks and uncertainties as follows: physical, financial, informational, relational, and innovational. Rodrigues et al. (2008) suggested a transport and supply chain uncertainty model within the triadic collaboration where risk sources were classified into four sub-categories: uncertainty related to suppliers, customers, carriers, control systems and external uncertainties. However, in this thesis, risk sources are summed with two titles, like Cucchiella and Gastaldi (2006) suggested: internal risks and external risks: environmental risk is taken as external risks whereas supply risk, demand risk, process and control risk are distinguished as internal risks – supply chain intern risk.

Internal risk can arise within the trading partners from both supply and demand side because of many factors like sudden changes in the demand patterns or customer requirements. Furthermore internal risks source includes both the uncertainties inherent in the operational aspects of supply chain activities, such as uncertain supply and demand, as well as disruptions to its operations resulting from human or technology related insufficiencies[94]. Processes can either amplify or absorb the effect of risks in the supply chain and refer to the design and implementation of processes within and between the entities in the supply chain[95]. Those risk sources would be common system architecture, administration, supply chain bottlenecks or dependencies on IT systems. Similarly, control risk sources refer to like rules or policies for collaboration among trading partners, human or technology related issues which can either amplify or absorb risk effects.

External risk sources may result from unexpected change of conditions out of the value chain; economical change, fuel crisis, governmental regulations and so on.

[92] Mason-Jones and Towill (1998), p. 17.
[93] Cavinato (2004), p. 384.
[94] Cheng and Kam (2008), p. 347.
[95] Juttner (2005), p. 123.

2.3.3.2 Structuring CTM risks

The wealth of literature on risk management of collaborative transportation is scarce. To some extent, this reflects the immaturity of this business system. However by enabled rapid development in IT, the use of CTM has grown and exerted significant influence over the way transport is managed and the supply chain is structured. Thus there is a need for academics and practitioners to understand which kind of risk factors such models can have. However most of the researches and results reported here were done in the information based supply chain context, which are applied also to CTM.

Collaboration is the most underutilized aspect of B2B commerce[96]. Closer collaboration with transport users and transport service providers can help moreover to manage operating system more effectively. Working more closely with trading partners naturally requires mutual trust and potential investment in technology, but the benefits can have a real impact on bottom line of system. Despite the benefits that have been identified in collaboration, collaborative practices may not be appropriate for every business relationship. The questions related coordination and commercial integration in transport business are inherently difficult because of its competitive nature. As one of supply chain studies explained that a good relationship between partners should rely on trust, commitment and collaboration[97] (which can be also applied to CTM). and also according to recent published 2009 third-party logistics study[98] that shippers and carriers agree the success of relationships include: openness, transparency and communication; the ability to create personal relationships on an operational level; the flexibility of carriers to accommodate customer's needs; and the ability to achieve cost and service objects. The need for better integration is often recognized among transport chain partners, but the practical solutions are not easy to implement like defining the appropriate degree of openness or elements of risk sharing etc. In fact, apart from the benefits, risks and uncertainties are also involved in collaborative business. CTM as a collaborative business model is subject to certain risks and uncertainties. The lack of common definitions of data structure, content and architecture is well known, but there are also wider problems related to the applicability, scope, and commercial acceptance of standardization efforts. Moreover lack of IT infrastructure, security, privacy and trust, channel conflicts, poorly developed telecommunications infrastructure, insufficient number of specialists, lack of knowledge, complex regulations and so on

[96] Aichlymayr (2000), p. 66.
[97] Humphries and Wilding (2004), p. 260.
[98] NN: 2009 Third-Party Logistics survey (2009), p.4.

would be the important barriers to overcome for success of CTM. The information sharing and visibility are cornerstones of CTM, but these are a contentious issue for many companies because of above mentioned reasons.

As mentioned earlier that CTM creates need for new information and technologies to foster collaboration. Anthony (2000) suggested that collaboration occurs only when two or more companies share the responsibility of exchanging common planning, management, execution and performance measurement information and he added further that collaborative relationships transform how information is shared between trading partners and drive change to the underlying business processes[99].

According to Dutton (2003), the following technology considerations must be explored further to accommodate the goals of vendor- and platform-independence[100], namely:

- ✓ Standards
- ✓ Scalability
- ✓ Security
- ✓ Openness of Design
- ✓ Manageability
- ✓ Resiliency
- ✓ Vehicle(s) for Collaboration
- ✓ Data Formats
- ✓ Transport Protocols

Though the existing technologies show that they are still insufficient to form an effective and efficient CTM system, they are used widely to enhance useful communication among partners. Those technologies are like EDI, EAI, Internet-enabled host and client/server applications, as well as traditional paper and phone communications technologies. Helo and Szekely (2008) executed the current entirely IS for transportation and logistics and concluded that the integration of the different legacy and other IS becomes the core issue in terms of facilitating the functioning of the e-enabled business models[101.]

CTM benefits are not easy for shippers and carriers to achieve on their own. As with many other dot-com businesses, transportation exchanges have not been universally successful. Among the reasons most often cited for their failure are that shippers and carriers use the exchanges to transact only a small percentage of shipments that

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[99] Anthony (2000), p. 41.
[100] Dutton (2003), p. 42.
[101] Helo and Szekely (2008), p. 15.

shippers prefer to send loads via their trusted contract carriers rather than rely on Internet-facilitated spot market exchanges. As well, carriers are reluctant to participate in transportation exchanges in order to avoid reducing their businesses to ‘‘commodity’’ status, thereby eroding profit margins[102].

Developing the necessary dense network of shipper freight requires multiple shippers to combine networks under one system and then execute collaborative transportation solutions. Sharing vital information, trusting CTM partners, and making the necessary cultural shift internally is proving to be a daunting task and demonstrates certain risks in CTM system,

Using common platform (internet base interfaces and service oriented architecture) simplifies the execution of centralization strategies and ensures the necessary critical mass of freight and carrier capacity, utilizes Internet-based tools to connect all trading partners and supplies in transit visibility, and it applies industry-leading optimization technology to deliver CTM value. To realize CTM benefits, it is important to implement/set common data standards for information exchange.

As cost associated risk factors in shipper-carrier collaboration become increasingly critical. Through collaboration, participants can identify hidden costs in transport chain and then implement a business process specifically designed to reduce or eliminate them[103].

Getting transport service providers more actively involved earlier on in the transaction process can ensure that front-end agreements, acquired transportation forecasts, operational planning and transportation execution including continuous moves are all in line with consumer demand. Especially a technology foundation already is in place, than the collaboration requires only a little capital investment; the primarily investment would be people and time. The success of CTM business system depends highly on the collaborative culture between trading partners that must have the resources and the commitment to create it. The possible outcomes would be better rates, greater stability and relationship with transport service provider and optimized asset utilization.

Mason et al. (2007) summarized inefficiencies in transportation with three heading: efficiency, asset utilization and customer response (service)[104]. Milgate (2001)[105] divided the risk factors in transportation into three primary dimensions: technological

[102] Kale et al. (2007), p. 22.
[103] Lynch (2001), p. 4.
[104] Mason et al. (2007), p. 196.
[105] Mitiate (2001), p. 107.

intricacy, organizational systems and flow of supply chain It is discoursed that risk exists at every echelon in the transport chain. Looking at upstream, risks can be manifested through late or inadequate deliveries by transport service providers, or in downstream in turn problems can occur because of the unforeseen transport demand variability which effect delivery performance in terms of transport planning, analysis and execution.

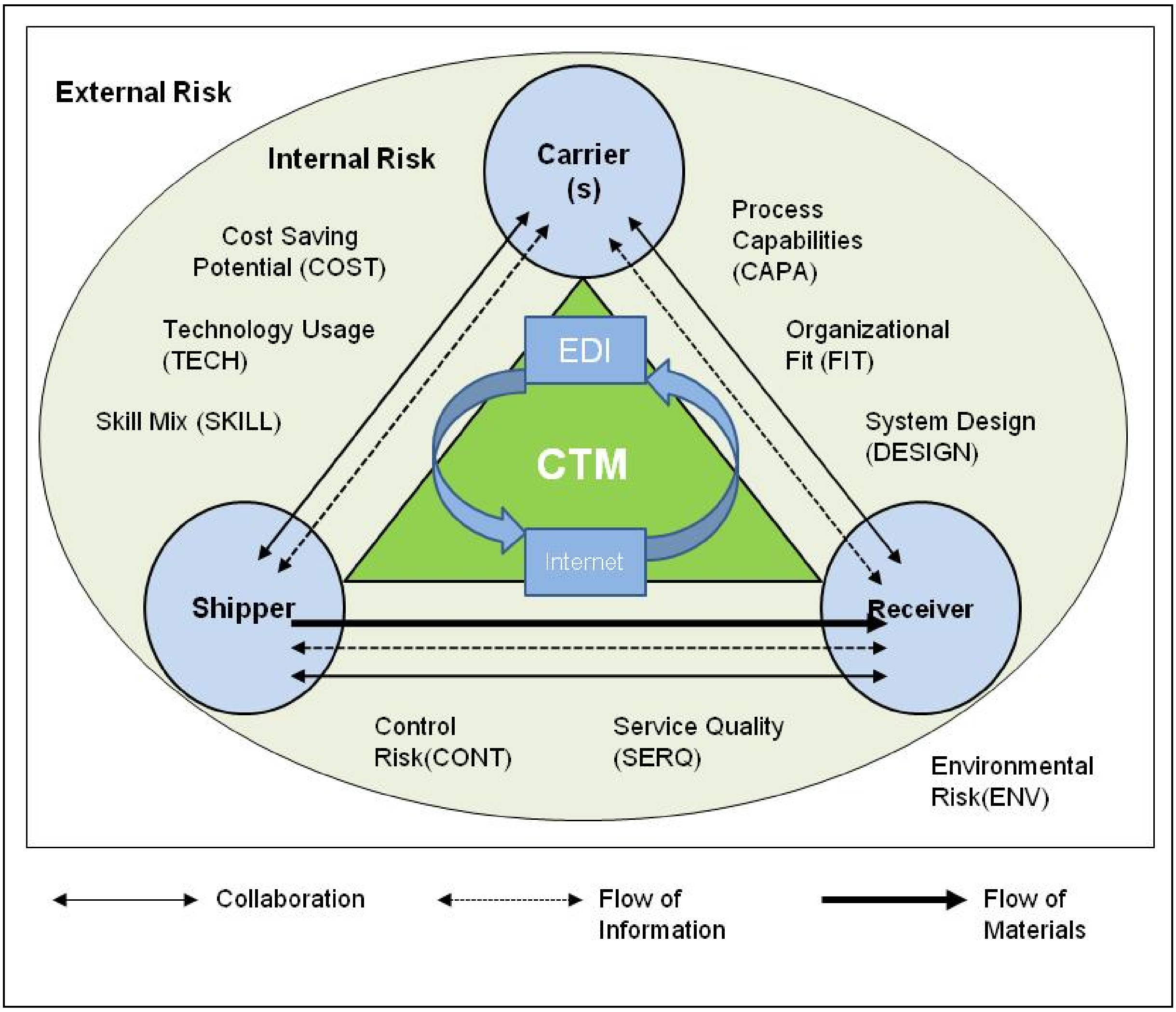

Fig. 2-13 Risk Categories in Triadic Collaboration

It is suggested that many of the problems related to collaboration are due to a lack of understanding of what collaboration actually implies. For instance, Barratt (2004) pointed out that a major barrier to the development of CPFR initiatives was a lack of attention to developing front end agreements as to specifically what organizations were going to collaborate over. This poor understanding is further increased due to the association of collaboration with the hype surrounding e-business whereby technology has been promoted as the key to enabling wide-scale inter-organizational collaboration[106].

Based on literature review, technical papers, white papers, surveys, interviews, electronic resources and previous researches, the CTM risk factors are summarized in nine risk categories with the aspects of IT and CTM (Tab. 2-3). These nine categories are namely; process capabilities, technology usage, organizational fit, and cost saving potential, system design, skill mix, control risk, environmental risk and service quality. Environmental risk factors are summed up under external risk, whereas the other mentioned risk factors are categorized as internal risk factors. Although this classification does not cover all risk factors that restrain the collaborative approach, but most of the important reasons fall in those categories. In Fig. 2-13 these risk categories in a triadic collaboration are illustrated.

Category	**Risk factors in IT**	**Risk factors in CTM**
Process Capabilities (CAPA)	Incapable technical infrastructure, insufficient adaptability to changes in processes, technical limitations, lack of real time shipment tracking and tracing, lack of reporting functions; supply chain level reporting [107]	Process mapping, Information sharing about inventory levels, agreements on delivery frequency, metrics to asses benefits, gap between strategy and execution, commitment, bad reporting, documentation[108]
Technology Usage (TECH)	High level of integrity, availability and accessibility, efficiency, flexibility, standardization, compatibility, performance, reliability and security of IT, inadequate B2B integration interfaces for data transfer, quick adaptability to evolving technologies[109]	Lack of IT infrastructure, collaborative technology, lack of adaptability to Internet based solutions[110]

Tab. 2-3 continues on following page.

[106] Barratt (2004), p.39.
[107] Ergun, et al. (2007), p. 1553.; House and Stank (2001), p. 18.; Helo and Szekely (2005), p.14.
[108] Vereecke and Muylle (2006), p.1183; Min et al. (2005), p. 245; Wang et al. (2007), p. 1179.; Sutherland et al. (2004), p.195.; House and Stank (2001), p. 18.
[109] Cripps et al. (2009), p. 189.; Mentzer et al. (2000), p. 53.; Stefansson and Russell (2008), p. 349; Rodrigues, et. al. (2008), p. 402.
[110] Min et al. (2005), p. 245.; Langley (2000), p.4.; Kampstra et. al. (2006), p. 313.

Category	Risk factors in IT	Risk factors in CTM
Organizational Fit (FIT)	Ineffective communication within trading partners, resource insufficiencies, degree of computerization, data exchange difficulties[111]	The inability of management to successfully integrate any acquisition, conflict between users departments, lack of trust between trading partners, lack of CTM strategy, Inability to define short-term and long-term goals, cultural incompatibility, common interest[112]
Cost Saving Potential (COST)	Expensive investment of technology, Ineffective ROI analysis[113]	Unsuccessful asset utilization, Increased supply chain costs position, lack of agreement on cost goals, unproductive waiting time, high transport cost, high inventory carrying costs[114]
System Design (DESIGN)	Lack of effective system methodology, lack of common system architecture, poor estimation of shipment, insufficient data visibility; Internet-base real time transaction system, management control, decision analysis[115]	Lack of integration between shipper and carrier, insufficient KPI definition, lack of common definition/systematic description; data compatibility and common formats, lack of critical network mass[116]
Skill Mix (SKILL)	Lack of IT resources and skills, Lack of open system application[117]	Lack of staffs with business and technology knowledge, insufficient training of users, scarcity of IT specialist[118]

Tab. 2-3 continues on following page.

[111] Mentzer et al. (2000), p. 53; Lynch (2001), p. 2.
[112] Vereecke and Muylle (2006), p.1183; Emmett and Crocker (2000), p. 53; Kampstra et. al. (2006), p. 313.
[113] Sutherland et al. (2004), p.195.
[114] Langley (2000), p.7.; Aichlymayr (2000), p. 66.; Emmett and Crocker (2000), p. 53.; Mason et al. (2007), p. 196.
[115] Rodrigues, et. al. (2008), p. 402.; Bowersox et al. (2003), p. 193-194.; Helo and Szekely (2005), p.14.; Mason et al. (2007), p. 196.
[116] Rodrigues, et. al. (2008), p. 399.; Mentzer et al. (2000), p. 53.; Bowersox et al. (2003), p. 195.; Helo and Szekely (2005), p.14.; Lynch (2001), p. 2.
[117] Cripps et al. (2009), p.189.; Mentzer et al. (2000), p. 53.
[118] Emmett and Crocker (2000), p. 53.; House and Stank (2001), p. 18.; Simchi-Levi, et. al (2008), p. 247; Murphy (2003), p. 3.

Category	Risk factors in IT	Risk factors in CTM
Control Risk(CONT)	Lack of effective control methodology to measure system performance, insufficient performance control system[119]	wrong performance control definition, insufficient evaluation and selection of trading partners, lack of financial settlements, lack of coordination, benefit sharing, inadequate definition of KPI[120].
Environmental Risk(ENV)	Insufficient technological infrastructure, degree of customization, security, quality of internet-base services[121]	Government regulations and control, industrial actions, market fluctuations, road conditions, tariff barriers, cross-border customs requirements, tax harmonization[122]
Service Quality (SERQ)	Ineffective communication with users, insufficient user support, Immature standards[123]	Lack of greater accuracy and visibility, Lack of transport and other additional services, poor on time performance, long cycle times, empty running miles[124]

Tab. 2-3 Risk Factors of CTM business system

Above mentioned categories are depicted from the literature review, where considered or mentioned those category names, even not literally.

With the perspective of these risk factors, shippers may able to rethink their overall supply chain strategies actively, their relationships with carriers as well as all other transport service providers to make decision whether they are a part of right collaborative system or be enough fit to join into this system. Once risks can be identified, they can be monitored and controlled, to the advantage of the enterprise.

In methodological part of the thesis, these risk factors with above mentioned nine categories are used to structure the final risk factor list during the Delphi study.

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119 House and Stank (2001), p. 18.; Bowersox et al. (2003), p. 195.
120 Wang et al. (2007), p. 1180.; Mentzer et al. (2000), p. 53; Bowersox et al. (2003), p. 195.
121 Rodrigues, et. al. (2008), p. 403.; Simchi-Levi, et. al (2008), p. 247.; Meixell and Norbis (2008), p. 185.
122 Emmett and Crocker (2000), p. 53.; Rodrigues, et. al. (2008), p. 393 and 403.: Rushton, et. al. (2006), p.86.
123 Emmett and Crocker (2000), p. 53.
124 Aichlymayr (2000), p. 66.; Simchi-Levi, et. al (2008), p. 179., Mason et al. (2007), p. 196.

CHAPTER 3

3 METHODOLOGICAL FRAMEWORK

Chapter 3 introduces the scientific approach and its application in the research.

3.1 Research Procedure

The proposed model for risk assessment as shown in Fig. 3-1, consist of three main phases: (1) risk identification, here Delphi method is used to identify risk factors; (2) and to analysis; (3) and to prioritize the risk factors, AHP method is adapted.

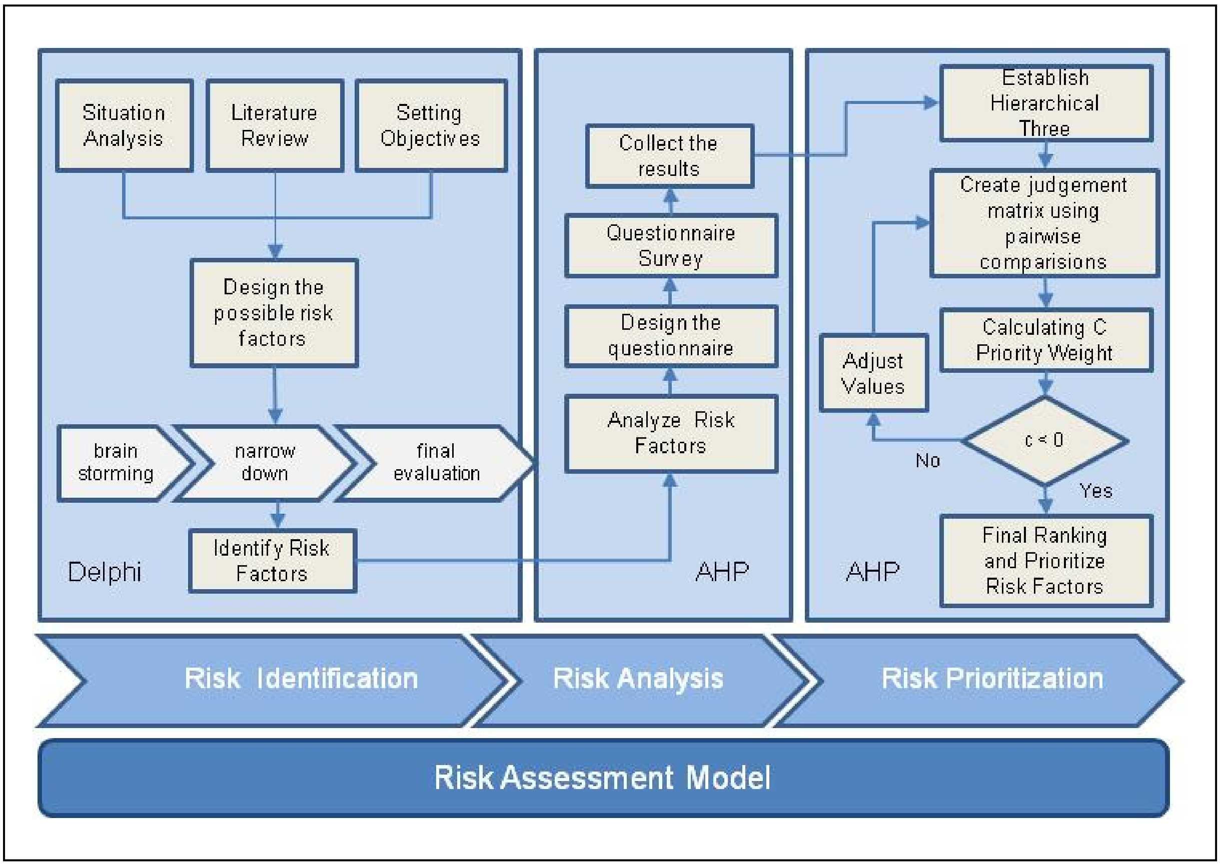

Fig. 3-1 The Structural Design of the Proposed Methodology for Risk Assessment

3.2 System Approach

3.2.1 Risk Identification

In this phase, the Delphi method is used to identify risk factors. On the strength of experienced practitioners and professional consultants who have practiced for CTM business system before additionally main findings from literature reviews including company expertises, white papers and existing surveys on the internet and so on are used to design in a form of the all possible risk factors then the appropriate CTM risk factors are extracted from this form during Delphi session.

3.2.1.1 Delphi Method

In general, the Delphi study is a systematic and interactive method for structuring a group process so that the process is effective in allowing a group of disjoint individuals as a whole to deal with complex problems[125]. The name Delphi derives from the Oracle of Delphi and this method is based on the assumption that group judgments are more valid than individual judgments. Delphi provides primarily a means that is applied to obtain, refine and communicate the informed consensus of experts on an uncertain issue is desired. The method consists principally of knowledgeable and expert contributors (comprising of practitioners, consultants, researchers and so on) individually completing a form and submitting the results to a central coordinator. The coordinator processes the contributions, looking for central and extreme tendencies, and the rationales therefore. Then the results are then feedback to the respondent group, who are asked to resubmit their views, assisted by the “new” input provided by the coordinator. The Delphi method was successfully used in technical and business related evaluation system and has a methodical advantage compared to other group discussion methods due to anonymity of experts and avoidance of the dominance of singular opinions[126]. This research is invited five experts to participate in this study who come from research centre, university, consulting company, software providing company and logistics provider company; they are all experienced and well performed in CTM system adoption. In Tab. 3-1, the demographic structure of participants is given.

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[125] Cf: Schmidt et al. (2001), p. .
[126] Cf: Buyukozkan (2004), p.147.

Characteristics	1	2	3	4	5
Title	Consultant	Senior Consultant	Assoc. Professor	Consultant	Senior Researcher
Work experience (year)	8	5	4	3	6
Number of managed projects	7	8	2	5	12

Tab. 3-1 Demographic structure of Delphi study participants

The Delphi method consists of three steps:

- Brain storming
- Narrow down
- Final evaluation

The first step focuses on the exploration of the subject and participants, contributes additional information by making *brain storming*. Some consensus occurs in the middle step in which is attempted to *narrow down*. In the last step a *final evaluation* of occurs when all previous information has been analysed and results have been provided for participants evaluation. A telephone-conference session was organized by the participation of above mentioned experts to identify risk factors. All findings from theoretical part of the research were sent to the experts in advance and during the brain storming session the possible risk factors are entirely discussed. After obtaining consensus from Delphi method, 41 proper risk factors are extracted, and then these are categorized into 9 relevant categories based on their attributes. These categories are process capabilities, technology usage, organizational fit, cost saving potential, system design, skill mix, control risk, environmental risk and service quality. These factors, what in previous Chapter extracted with literature review, are used to construct the framework of risk assessment model.

As a first step of risk assessment model by using Delphi method, risk factors has been identified initially the decision problem formulated in the form of hierarchical framework. Fig. 3-2 illustrates the synthesis of CTM risk factors. Then the next step is started.

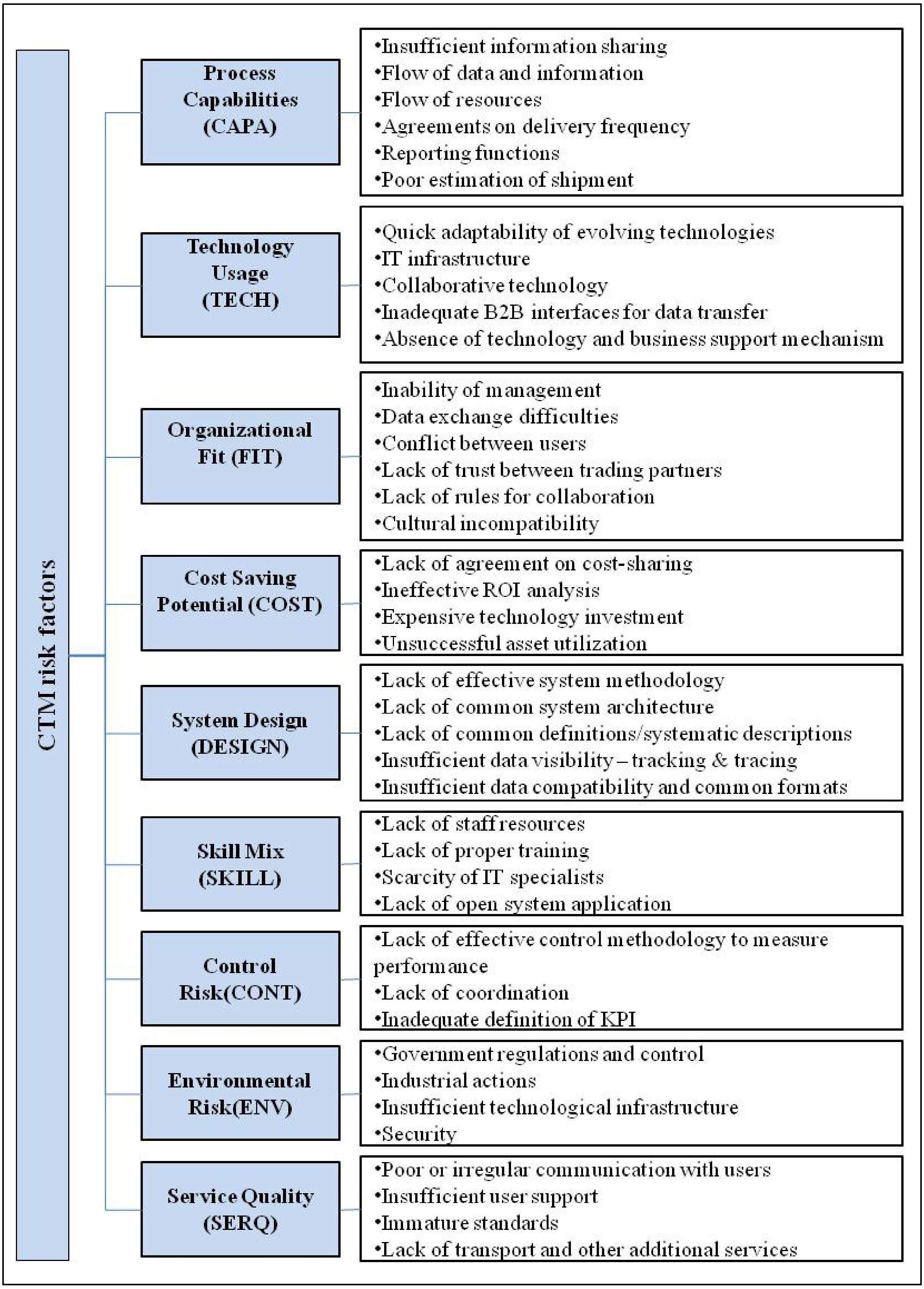

Fig. 3-2 Synthesis of CTM risk factors

3.2.2 Risk Analysis

In this phase, the AHP method is used to analyse risk factors. The AHP provides a flexible and easily understandable way of analysing of risk factors and has successfully been applied to many practical problems.

Now, the AHP Method is explained at the first hand.

3.2.2.1 AHP Method

A decision is the choice for a decision alternative in order to attain an objective. The Analytic Hierarchy Process (AHP), first suggested by Saaty (1980) more than two decades ago, is one of the widely used multi-criteria (or attribute)-decision-making methods ((MCDM)[127]. This technique aims to support the analysis of complex decisions. AHP can effectively handle both qualitative and quantitative data to decompose the problem hierarchically where the problem is broken down thoroughly and its related sub-elements with regards to the hierarchical level are listed in relation from the overall objective (e.g. selecting the appropriate distribution methodology) to the sub-objectives (e.g. minimize cost, maximize process capability). In a typical AHP model, the top level reflects the overall goal or the focus of the decision problem. The elements affecting the decision are called criteria, and the criteria can be further subdivided into sub-criteria for additional refinement, if required. The criteria can be subjective or objective depending on the means of evaluating the contribution of the elements below them in the hierarchy. The lowest level comprises the decision options or alternatives.

The AHP method divides the decision problem into the following main steps[128]:

Step 1: Identifying the decision problem and general goal/objective.

Step 2: Structuring the hierarchy at different levels, from the top through the intermediate to the lower-level, which usually contains a finite number of decision elements. The upper level of the hierarchy represents the overall goal, whereas the lower level consists of a list of alternatives. One or more intermediate levels embody the decision criteria and sub-criteria (Fig. 3-3).

[127] Saaty (1980)
[128] Cf: Saaty (1980, 1990, 1994)

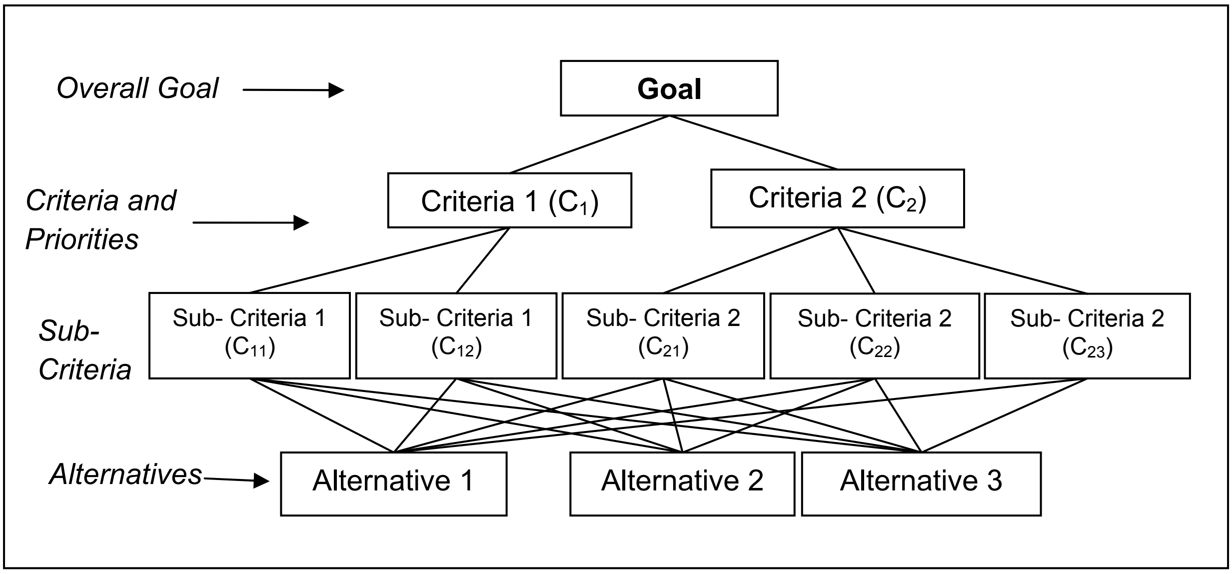

Fig. 3-3 The AHP hierarchy structure

Step 3: Construction of the weight of the criteria and the scores of the alternatives are considered as decision elements in the third step of the decision process. The decision-maker has the option of expressing his or her intensity of preferences on a nine–point scale[129]. If two criteria have the same importance, a value of 1 is given in the comparison, while a 9 indicates an absolute importance of one criterion over the other. Tab.2 shows the measurement scale of pair-wise comparisons (size n x n).

Step 4: Pair-wise comparisons among n elements in each level lead to an approximation of each $a_{ij}=w_i/w_j$, which is the ratio of the weight of element i to element j (i,j=1,2,….n).

$$A = (a_{ij}) = \begin{pmatrix} 1 & w_1/w_2 & w_1/w_n \\ w_2/w_1 & 1 & w_2/w_n \\ \ldots & \ldots & \ldots \\ w_n/w_1 & w_n/w_2 \; \ldots & 1 \end{pmatrix} \quad \text{, \textit{reciprocal matrix}} \qquad (1)$$

Step 5: Consistency and consequence weights analysis. Check the consistency after the pair-wise comparison. Saaty (1980) has shown that the largest eigenvalue, λ_{max},

[129] Cf: Saaty (1980; 1994)

of a reciprocal matrix *A* is always *greater than or equal to n.* If the pair wise comparisons do not include any inconsistencies, λ_{max} = n. The more consistent the maximum comparisons are, the closer the value of computed λ_{max} to n. A *Consistency Index* (CI), which measures the inconsistencies of pair-wise comparisons, is given as:

$$CI = \frac{(\lambda_{max} - n)}{(n - 1)} \quad \text{, consistency index} \qquad (2)$$

,where λ_{max} is an eigenvalue of matrix *A*.

A *Consistency Ratio* (CR) is given by:

$$CR = 100\left(\frac{CI}{RI}\right) \quad \text{, consistency ratio} \qquad (3)$$

Where CI is consistency index; RI is random index and *n* is number of columns which is taken from the *random consistency index table* in Appendix D. The RI is the average of the CI of a large number of randomly generated matrices. Where *n* is the matrix size. Judgment consistency can be checked by taking the CR of CI with the appropriate value.

Saaty's rule of thumb is that 10 per cent of the inconsistency of the random matrix is allowed. If CI is sufficiently small, the decision-makers comparisons are probably consistent enough to give useful estimates of the weights for the objective function. If CI/RI < 10%, the degree of consistency is satisfactory, but if CI/RI > 10%, serious inconsistencies may exist, and the AHP may not yield meaningful results[130].

Step 6: If the CI and CR are satisfactory, then the decision is taken based on the normalized values; else the procedure is repeated till these values lie in the desired range.

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[130] Saaty (1980);

3.2.2.2 Analysis of the selected criterion

In this step, after identification of the main risk factors, all these main risk factors are put to hierarchical model and to analyse them. In Tab. 3-2, the selected risk-factors are analysed. Conventionally, risk analysis is performed at the overall hierarchical level three. But in this case, only the analysis of the main risk factors was taken into consideration.

Main Risk Factors	**Description**
Process Capabilities (CAPA)	Refers the ability of a process to perform to the target and specifications set out for collaborative business.
Technology Usage (TECH)	Shows the capability of current technical infrastructure of the enterprise and also the adaptability and flexibility of technological newness.
Organizational Fit (FIT)	Indicates the organizational readiness and compatibility for adoption of collaborative business
Cost Saving Potential (COST)	Represents the potential cost effectiveness by using the system.
System Design (DESIGN)	Depicts the capability of the system structure in terms of system architecture, definitions etc.
Skill Mix (SKILL)	Shows the efficiency of organizational architecture in terms of human resources and system.
Control Risk (CONT)	Indicates coordination mechanism, performance measurement mechanism in business model
Environmental Risk (ENV)	Indicates the potential risks which is generated or comes from out of the system in acquiring environmentally such as government, society or surrounding environment.
Service Quality (SERQ)	Refers the major influence on customer satisfaction which affects the system competitiveness in terms of performance.

Tab. 3-2 Analysis of the selected criteria (risk-factors)

The main criteria (risk factors) for the objective are assumed to be: process capabilities (F_1), technology usage (F_2), organizational fit (F_3), cost saving potential (F_4), system design (F_5), skill mix (F_6), control risk (F_7), environmental risk (F_8) and service quality (F_9).

3.2.2.3 Defining the sub-criteria (sub-risk factors)

After the analyzing main risk factors, the level of the hierarchy of the AHP risk assessment three is constructed. Fig. 3-4 illustrates the hierarchical structure of CTM risk factors which is depicted with all corresponding 41 sub-risk factors. This hierarchical structure is composed of three levels where top level shows the aim of the hierarchy; aim is to “assessing the riskiness of CTM business system, at the second level, all main risk factors for CTM business model are placed and on the lowest level alternatives/sub-risk factors are located. Here no alternative is proposed, as only major and sub-risk factors in AHP are used for computation. As mentioned before that these 41 proper sub risk factors were extracted during Delphi session in this case.

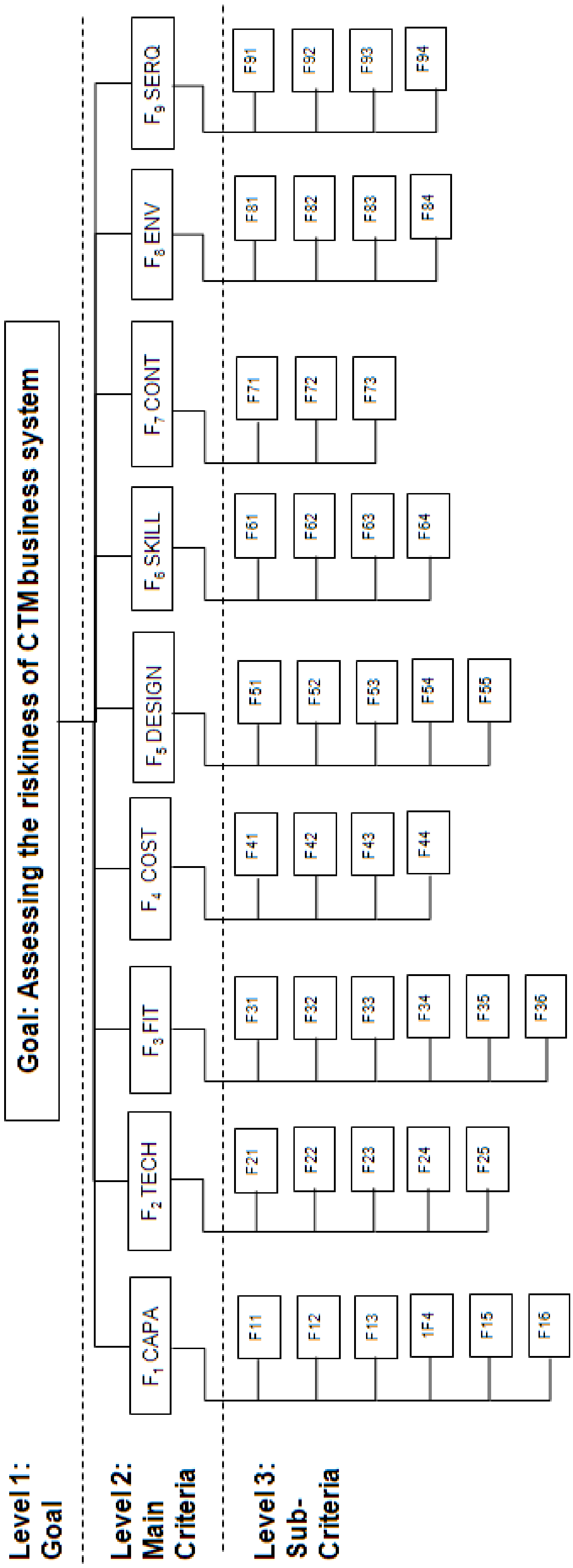

Fig. 3-4 The AHP Risk Assessment Three

3.2.3 Risk Prioritization

After constructing the hierarchy, the prioritization procedures are started to determine relative importance of the element in each level of the hierarchy. The elements in each level are compared pair-wise with respect to their importance in making the decision.

3.2.3.1 Data Collection

The aim of AHP method in this study is to get opinion of decision makers (CEO, logistics managers, inventory managers etc.) who have experience using CTM business model. A Questionnaire survey is constructed and invited 60 experts who were chosen from Turkish Union of International Freight Association and Turkish Union of Chambers of Commerce, to participate to this research and 60 initial surveys were mailed. All the respondents were assured that their individual responses would be kept confidential. 36 useable responses from this survey were received which shows about 60% responses rate, this is rather limited in size. The participant list of questionnaire is shown in Tab. 3-3.

Respondent	Number of respondents	Percentage (%)
Others	12	33
DIY	6	17
Automotive	4	11
Computer and communication	4	11
Chemical	3	8
Consumer products	2	6
Electronic equipments	2	6
Medical equipments	2	6
Industrial machinery	1	3
Total respondent	36	100

Tab. 3-3 Survey respondent list

A copy of the questionnaire survey for this kind of study is presented in Appendix E.

3.2.3.2 Data Analysis

After collecting the survey data, the next step is arranged to analyze the collected data. First of all, a pair-wise comparison matrix in an Excel spreadsheet is prepared to find out the corresponding priority weights of selected criteria and sub-criteria.

3.2.3.2.1 Pair-wise comparison matrix

AHP uses a fundamental pair-wise comparison scale. This comparison especially can be performed during brainstorming sessions[131]. The scale extended from 1 to 9 to measure the different weights as shown in Tab. 3-4[132]. This comparison scale enables company's decision-maker to incorporate experience and knowledge intuitively[133]. Expert can express his preference between every two elements verbally as equally important, slightly important, highly important, very highly important, and extremely important. These descriptive preferences would then be translated into numerical values 1,3,5,7 and 9 respectively, with 2, 4, 6 and 8 as intermediate values for comparisons between two successive qualitative judgments[134].

Degree of preference	Definition	Degree of preference
1	Equally important	Two activities contribute equally to the objective
3	Slightly important	Experience and judgment slightly favor one over another
5	Highly important	Experience and judgment strongly favor one over another
7	Very highly important	Activity is strongly favored and its dominance is demonstrated in practice
9	Extremely important	Importance of one over another affirmed on the highest possible order
*Intermediate levels are 2,4,6,8 which are used to represent compromise between the priorities listed above. *Reciprocal of above non-zero numbers: if activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.		

Tab. 3-4 The fundamental scale: measurement scale for preferences associated with pair-wise comparisons

[131] Banuelas and Antony (2003); p. 335.
[132] Saaty (1990);
[133] Mustafa and Al-Bahar (1991), p.47
[134] Saaty (1990)

The importance of each criterion (risk factor) with respect to others was given on the Tab. 3-5 where shows the pair-wise comparison matrix and indicates how important the i-th criterion is compared with the j-th criterion which is previously calculated via using Tab.1. In this case, for example: the criterion of *"Process Capabilities - CAPA"* is equally important than "*Technology Usage - TECH*". Hence, the number 2 was assigned. Therefore, reciprocally the criterion *"TECH"* is 0,50 (1/2) times less important than the criterion "*CAPA*". After completing pair-wise matrix, the next step is to divide each entry in column i by the sum of entries in column i which shows with normalized matrix on the Tab.3-6.

Risk Factors	CAPA	TECH	FIT	COST	DESIGN	SKILL	CONT	ENV	SERQ
CAPA	1	2	1	2	2	1	1	1	1/2
TECH	1/2	1	1	1	2	2	1	1/2	2
FIT	1	1	1	2	2	1	2	1	1/2
COST	1/2	1	1/2	1	2	2	2	3	1
DESIGN	1/2	1/2	1/2	1/2	1	1/2	1	2	1/2
SKILL	1	1/2	1	1/2	2	1	2	2	1/2
CONT	1	1	1/2	1/2	1	1/2	1	1	1
ENV	1	2	1	1/3	1/2	1/2	1	1	2
SERQ	2	1/2	2	1	2	2	1	1/2	1

Tab. 3-5 Pair-wise comparison matrix

Risk Factors	CAPA	TECH	FIT	COST	DESIGN	SKILL	CONT	ENV	SERQ	Total
CAPA	0,12	0,21	0,12	0,23	0,14	0,10	0,08	0,08	0,06	1,127
TECH	0,06	0,11	0,12	0,11	0,14	0,19	0,08	0,04	0,22	1,070
FIT	0,12	0,11	0,12	0,23	0,14	0,10	0,17	0,08	0,06	1,105
COST	0,06	0,11	0,06	0,11	0,14	0,19	0,17	0,25	0,11	1,192
DESIGN	0,06	0,05	0,06	0,06	0,07	0,05	0,08	0,17	0,06	0,649
SKILL	0,12	0,05	0,12	0,06	0,14	0,10	0,17	0,17	0,06	0,966
CONT	0,12	0,11	0,06	0,06	0,07	0,05	0,08	0,08	0,11	0,732
ENV	0,12	0,21	0,12	0,04	0,03	0,05	0,08	0,08	0,22	0,954
SERQ	0,24	0,05	0,24	0,11	0,14	0,19	0,08	0,04	0,11	1,201

Tab. 3-6 Normalized matrix

Normalized matrix was shown with vector *C* which is used to calculate *priority vector* which is shown with w_i. Formulization of priority vector is as follow[135];

$$w_i = \frac{\sum_{j=1}^{n} C_{ij}}{n} \quad \text{, \textit{priority vector}} \qquad (4)$$

Risk Factors	Total Normalized Matrix (A)	n (B)	Priority Weights (A/B)
CAPA	1,127	9	0,125
TECH	1,070	9	0,119
FIT	1,105	9	0,123
COST	1,192	9	0,132
DESIGN	0,649	9	0,072
SKILL	0,966	9	0,107
CONT	0,732	9	0,081
ENV	0,954	9	0,106
SERQ	1,201	9	0,133
Total	9		1

Tab. 3-7 Priority weights for risk factors

Finally *W* vector was created by computing w_i, which shows the resultant of priority weights according to comparison carried out. Tab. 3-7 shows the calculation of priority weights for risk factors. As a graphic, Fig.3-5 illustrates the priority weights as to each criterion. Here "*SERQ*" has most priority weights with 13,34 percent, where indicates that participants perceive *service quality* to be the most important risk factor to make a decision on a collaborative business process. Result shows that service quality, cost saving potential (13,25%), process capabilities (12,53%) and organizational fit (12,29%) respectively are the facts concerning of the study. These four factors occupy almost 50 (51,40%) percent of the total factor.

[135] Saaty (1980);

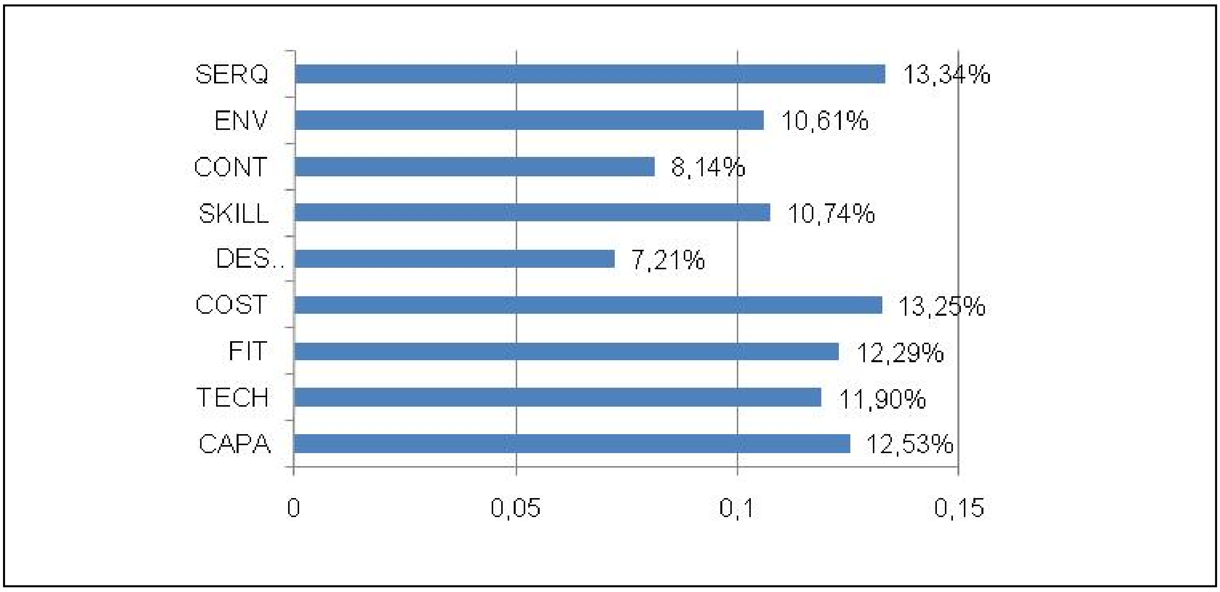

Fig. 3- 5 Priority weights for criterion (risk factors)

3.2.3.2.2 Check the consistency of pair-wise comparison

If the pair-wise comparison matrix is consistent, a value of the *consistency ratio* (*CR*) should show a value almost 0,1. A value less than or equal to 0,1 is acceptable. For that we need to find first *consistency index* (*CI*) values for each parameter to use below formulas:

$$\lambda = \frac{\sum_{i=1}^{n} E_i}{n} \quad \text{, main value} \tag{5}$$

$$E_i = \frac{d_i}{w_i} \quad \text{, consistency elements} \tag{6}$$

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad \text{, consistency index} \tag{7}$$

First *D* column vector is calculated, for this it is needed to calculate *A* column vector (*pair-wise*) times *W* (*priority weights*) then the *main factor of consistency elements* (*E*) afterwards *main value* (*λ*) are computed which were found 90,38 and 10,04 respectively. By using these values, *CI* will be computed. The *CI* value is found to be 0,13 and the *RI* (*random index*) value for n= 9 is 1,45 which was taken from the *random consistency index table.* The *consistency ratio* (*CR*) (*CR=CI/RI*) was found in this case to be 0,09, which is less than 10%. It proofs that the degree of consistency of collected data is satisfactory.

3.2.3.2.3 Calculating the overall rating for each sub-criterion

Followed the step, according to survey results normalised comparison for every sub-criterion (sub-risk factor) is calculated, then main factor priority weight pro main factor is multiplied with this normalised comparison value to calculate the priority weight value for corresponding sub-factors. The normalised comparison value and priority weight for every sub-factor are shown on last two columns in Tab. 3-8. Within main risk factors, Service Quality (SERQ) is selected as the first major risk factor. The other major risk factors are Cost Saving Potential (COST) and Process Capabilities (CAPA) respectively.

Main Factors	Weights	Sub Factors	Normalised Comparison	Priority Weights
F_1: Process Capabilities (CAPA)	0,125	**F_{11}: Insufficient information sharing**	**0,23**	**0,029**
		F_{12}: Flow of data and information	0,17	0,021
		F_{13}: Flow of resources	0,13	0,016
		F_{14}: Agreements on delivery frequency	0,18	0,023
		F_{15}: Reporting functions	0,09	0,011
		F_{16}: Poor estimation of shipment	0,20	0,025
F_2:Technology Usage (TECH)	0,119	**F_{21}: Quick adaptability of evolving technologies**	**0,33**	**0,039**
		F_{22}: IT infrastructure	0,16	0,019
		F_{23}: Collaborative technology	0,21	0,025
		F_{24}: Inadequate B2B interfaces for data transfer	0,12	0,014
		F_{25}: Absence of technology and business support mechanism	0,18	0,021

F_3:Organizational Fit (FIT)	0,123	F_{31}: Inability of management	0,09	0,011
		F_{32}: Data exchange difficulties	0,08	0,010
		F_{33}: Conflict between users	0,15	0,018
		F_{34}: Lack of trust between trading partners	**0,35**	**0,043**
		F_{35}: Lack of rules for collaboration	0,22	0,027
		F_{36}: Cultural incompatibility	0,11	0,014
F_4:Cost Saving Potential (COST)	0,132	**F_{41}: Lack of agreement on cost-sharing**	**0,32**	**0,042**
		F_{42}: Ineffective ROI analysis	0,17	0,023
		F_{43}: Expensive technology investment	0,14	0,019
		F_{44}: Unsuccessful asset utilization	**0,37**	**0,049**
F_5:System Design (DESIGN)	0,072	F_{51}: Lack of effective system methodology	0,27	0,019
		F_{52}: Lack of common system architecture	0,25	0,018
		F_{53}: Lack of common definitions/systematic descriptions	0,12	0,009
		F_{54}: Insufficient data visibility – tracking & tracing	0,17	0,012
		F_{55}: Insufficient data compatibility and common formats	0,19	0,014
F_6:Skill Mix (SKILL)	0,107	F_{61}: Lack of staff resources	0,11	0,012
		F_{62}: Lack of proper training	**0,35**	**0,038**
		F_{63}: Scarcity of IT specialists	**0,32**	**0,034**
		F_{64}: Lack of open system application	0,22	0,024
F_7:Control Risk(CONT)	0,081	**F_{71}: Lack of effective control methodology to measure performance**	**0,41**	**0,031**
		F_{72}:Lack of coordination	0,34	0,028
		F_{73}:Inadequate definition of KPI	0,25	0,023
F_8:Environmental Risk(ENV)	0,106	F_{81}:Government regulations and control	0,32	0,029
		F_{82}:Industrial actions	0,20	0,027
		F_{83}:Insufficient technological infrastructure	0,27	0,029

		F_{84}:Security	0,21	0,022
F_9:Service Quality (SERQ)	0,133	**F_{91}:Poor or irregular communication with users**	**0,28**	**0,037**
		F_{92}:Insufficient user support	0,19	0,025
		F_{93}:Immature standards	**0,35**	**0,047**
		F_{94}:Lack of transport and other additional services	0,18	0,024

Tab. 3-8 Priority weights of risk factors and sub-factors

Among the selected 41 risk factors, As Tab. 3-9 shows that the top ten risk factors are summarized in a ranking list, which affects the success of CTM business system more than others. This ranking list is associated almost 40% (38,9%) of the total sub-risk factors. In this table, unsuccessful asset utilization, immature standards and lack of trust between trading partners are extracted as the major causes of unsuccessful collaboration in this category.

Ranking	Name	Priority Weights
1	F_{44}: Unsuccessful asset utilization	0,049
2	F_{93}: Immature standards	0,047
3	F_{34}: Lack of trust between trading partners	0,043
4	F_{41}: Lack of agreement on cost-sharing	0,042
5	F_{21}: Quick adaptability of evolving technologies	0,039
6	F_{62}: Lack of proper training	0,038
7	F_{91}: Poor or irregular communication with users	0,037
8	F_{63}: Scarcity of IT specialists	0,034
9	F_{71}: Lack of effective control methodology to measure performance	0,031
10	F_{11}: Insufficient information sharing	0,029

Tab. 3-9 Ranking list of top-ten risk factors of CTM business system

3.2.3.3 Data Evaluation

By the definition of ranking list, the last step of risk assessment model is concluded. The results of AHP study show that the unsuccessful asset utilization/turnover is the most important cause/drawback that hinders the success of electronic collaboration system. It can be interpreted that such a system should achieve better asset utilization, and better asset utilization means savings in terms of asset efficiencies, investment capital and capital assets, additionally maximize vehicle and driver utilization, eliminate empty backhauls.

Trading partners exchange information along the transport chain by means of information packages (as XML files). A software tool allows partners to send/receive them. Generalization of real processes it is crucial to achieve common standards and common system architecture to design and implement CTM systems. Therefore immature standard is prioritized as a second important risk factor; all users require common definitions which are incorporated into the standard approaches supported by every organization. Standardisation enables interoperability between IT systems and allows trading partners to exchange data efficiently.

To implement a CTM system needs business process reengineering (BPR) and may change for sure the environment of organization. That means, for instance, BPR enables companies to change the flow of transportation process and re-identify roles and rules within partners, improve process and functions, create a new structure of data model and so on. But BPR needs a lot of effort to ease to fear of transport users and to eliminate the resistance. As previous researches have pointed out that trust between trading partners is a key ingredient for participation in an e-commerce platform, therefore the trust factor is even major barrier to B2B e-commerce. In our findings it shows that the lack of trust between trading partners is chosen as a third important risk factors for e-collaboration system in transportation management.

To sum up from the point of data evaluation, above mentioned risk factors are very important to take them into consideration for an electronic collaborative business system. The success of such system depends on involvement and participation of all trading partners. Under the guidance of above-mentioned risk factors an implementation of CTM system could be established successfully which would help all partners to achieve and maintain a competitive edge in today’s global transportation market.

CHAPTER 4

4 RESULT

Chapter 4 gives a short presentation of the findings and the results from the analysis which are summarized, as well as research problems are answered.

The results from theoretical and methodological frameworks conducted in relationship with this thesis are related to the seven research question as follows:

RQ 1.What are the actual risks in CTM business environment?

Transportation Management is presently at a state where e-business and collaboration within the supply chain is greatly valued. Potentials for e-collaboration are great allowing for easy decision sharing, information sharing and integration, and resource sharing within trading partners[136]. Like other collaborative processes, CTM is a long-term approach that isn't solved once and then forgotten. "It is not a one-time deal; it's about continuous improvement. To integrate such a system to an enterprise would be not an easy decision, moreover risks could arouse inherently in any intervention.

In the theoretical part of the thesis, a literature review was performed to gather relevant information on potential risk factors in CTM business environment. These factors were summed up with two main categories: internal and external risks and then initially findings on risk factors from literature review were categorized under these two categories with nine associated titles. As discussed in the methodological part of the thesis these factors during Delphi-session were categorized into nine different classes based on their connection and contents These nine main factors are namely: process capabilities, technology usage, organizational fit, cost saving potential, system design, skill mix, control risk, environmental risk and service quality. Afterwards these nine categories were decomposed into sub-components which were used to determine which risk factors are more relevant that could undermine the success of CTM system.

[136] Johnson and Whang (2002), p. 420.

RQ 2.Which of these risks do practitioners perceive to be more deserving of their attention?

From the findings, it is found out and prioritized that there are 41 major risk factors that should be taken into account to implement and maintain a successful collaborative business system. As trading partners have to meet strategic commercial objectives to adapt this system into their organizations like cost reduction, revenue and profit growth and market share increase as well as improved end-customer satisfaction and improved service levels, To achieve these all partners consider those risk factors. As denoted that the most important ten factors are, respectively: unsuccessful asset utilization, immature standards, lack of trust between trading partners, lack of agreement on cost-sharing, quick adaptability of evolving technologies, lack of proper training, poor or irregular communication with users, scarcity of IT specialist, lack of effective control methodology to measure performance and insufficient information sharing.

RQ 3.How are risks and rewards shared in CTM?

As mentioned in theoretical part that since transportation technology is changing so quickly moreover transport chain has become more and more complex and complicated, most shippers recognize they cannot keep up all activities alone. Most shippers also recognize that no matter how big they are, they cannot generate the critical mass of freight necessary to drive out inefficiencies; therefore they have to collaborate with transport services to carry out transportation processes while achieving cost reduction, high asset utilization and improved service level. All parties should be vested in the result. Successful use of CTM system depends on the ability to be responsive and flexible for all parties moreover that have to be able to make the changes.

Companies collaborate in CTM system with carriers by developing shared goals and shared processes which also result in sharing risks and rewards with partners. By deploying standardized platforms and applications, CTM enables transportation user and transportation service providers to employ consistent, shared data and to operate as a “single company” across business units, regions and sectors. Data access and superior decision support enable all partners to improve their processes for strategic planning and procurement, forecasting and replenishment and physical execution, to accelerate the deployment and to deliver more reliable and cost-effective end-to-end transportation services. All those processes have certain risks; every partner in collaboration has responsibility to share risk and reward.

RQ.4.What role does information technology play for creating transparency in transport chains?

CTM is not simply about putting together continuous moves to improve carrier efficiency. Nor is CTM intended to be the driving force in reducing inventory. CTM is a holistic business procedure that identifies and focuses on all forms of inefficiencies throughout the transport planning and execution process. IT capabilities in CTM support new collaborative business models that provide companies with a distinct competitive advantage; therefore companies have to have constant transparency as to how the transport chain is acting and how it is performing. That is very important to a successful collaboration. In the theoretical part of the thesis the importance of IT is explained explicitly. As shippers and carriers would like to pursue more collaborative relationship between trading partners to realize their processes real-time, extendible, automated and cost-effective, therefore using the power of IT is very crucial in every step of this collaboration to enhance exact transparency in transport chain. Transparency has been one of important contribution of IT. It is clear every party in transport chain want to have a powerful visibility to manage system with sufficient and reliable information. Hence, the adoption of CTM requires systems that enable inter-organizational collaboration in a cost-effective and technologically compatible manner. Without having such systems, all endeavors to apply CTM would be ineffective and complicated to manage.

As pointed out before that technology alone is not enough to manage successful collaboration and bring true CTM system to an organization, all partners in CTM system must know, how to use IT to reap benefit of collaborative processes. Therefore, the enabling and supporting role of IT to CTM processes can only be realized if the technology is employed properly.

RQ 5.How are information systems and technology integrated between partners?

Collaborative transportation refers to the sharing of services across district boundaries in search of cost savings and service quality improvements. CTM can be viewed as provider- and platform-independent, such that any trading partner entering into a collaborative relationship will not be hindered by technical limitations. Internet and associated technologies such as XML, EDI, web-enabled host and client/server applications is useful as foundations for scalable CTM[137] and have revolutionised inter-enterprise business processes by enabling seamless information exchange between business trading partners. Any long-term expansion of CTM system must be supported by consistent IT development. Having developed a CTM friendly environment and set about driving both step and incremental changes for the implementation of a CTM system, the natural trend is to gain critical mass and embrace different segments of the business. Evolving transportation network architectures require flexible IT systems that are easily inter-connectable, but also fast to change whenever required[138]. The CTM process can only then truly enable the whole chain integration.

As mentioned in the theoretical part of the thesis, there are some electronic business model for CTM system which are classified as freight exchanges, Carrier/LSP website customer service platform, multi enterprise collaborative platforms (Carrier/LSP collaborative platforms), electronic transportation management system (e-TMS) and also niche application providers. As future e-business models, meta-market places, end-to-end electronic enabling and optimization, suite of standard application provider, e-risk manager and virtual logistics service providers. As an extension of e-TMS, virtual LP would have more potential to be successful in the future, although there are still not exact developed model in this direction to encompass all system requirements.

RQ 6.What challenges effect today's transportation management?

In the theoretical part of thesis the important challenges in transportation management were discussed and summed up with six headings, namely: macro-economic challenges, increasing customer demands, regulation issues, capacity challenges, infrastructure challenges and heightened information system needs.

Transportation is a key part of the holistic supply chain and logistics strategy. Transportation management at a global level must support adaptable business processes that are easy to manage. Adaptable processes can also connect with the information chain for improved, automated collaboration with shippers, carriers and receivers. This would enable multi-modal planning of activities for road, rail, air, sea transportation modes.

[137] Cf: Field (2004), p. 19.
[138] Helo and Szekely (2005), p. 16.

Transportation became a very complex process and above mentioned challenges in the market are driving the need for strong transportation solutions and also including system integration, partner collaboration, supply chain velocity, increased risk, cost and profitability awareness and greater globalization.

RQ 7.What are the role of transport services in CTM business model?

As every company proclaims that today's customers are more demanding than ever, wanting the best product at the best price with the best quality and in the shortest time. Therefore it is need integrating acquired new collaborative business system into a streamlined transportation process while incorporating synergies to improve service and cost levels with transport services. There are inefficiencies both in carrier and shipper sides; for carriers, CTM addresses inefficiencies such as empty dead-head miles, unproductive waiting time (dwell time) and a lack of critical network mass. On the shipper side, inefficiencies such as high transportation costs, long cycle times, high inventory carrying costs, and poor on-time performance are addressed. By reengineering transportation processes, dramatic CTM benefits can be achieved. In the CTM business system, companies can collaboratively plan both inbound and outbound transportation of shipments with transport services by joining an Internet-hosted transportation network of shippers and carriers. This business system has ability to send transport orders / transport data to carriers in real time to accelerate shipment planning to meet customer service objectives. Transport services can involve intensively into transportation process to be responsive to fulfil customer demand with achieving high service level. The key to CTM lies in identifying and reducing hidden costs in transportation chain that all participants in a logistics system pay for, but no one control individually. This problem may be relieved through use of collaborative system, where transport services are especially important to manage these hidden costs. They must optimize asset utilisation to respond shipper requirements. As seen in findings of methodological parts, achievement high asset utilization is crucial for collaborative system. With CTM system carriers can manage the transportation of shipments, eliminate empty backhauls, and maximize the load miles. Transportation services are also important to improve quality and service level as well.

CHAPTER 5

5 CONCLUSION

Chapter 5 contains the main conclusion of the thesis.

5.1 Theoretical conclusions

The drastically change of today's business environment due to exploding collaborative business models force companies to rethink the view of their transportation management's role and responsibilities in an integrated supply chain[139]. Consolidation, globalization, transport cost pressure, environmental needs, increasing market polarization, continuing logistics chain integration, agile and flexible transport systems and increasing pressures from outside of the value chain are creating greater demand for collaborative transportation infrastructure and platforms.

Many companies are realizing that Internet enabled collaborative activities for their transportation operations are critical to their growth and success in e-commerce. They are also realizing the unique complexities and challenges of these activities versus those of traditional transportation management. As collaboration among trading partners increases, proportionately large increases in trade and development are sure to follow.

Close collaboration and information sharing with external transport service providers have become an indispensable strategy for companies to achieve sustainability and risk limitation. Today's successful companies will be the winners who are willing to expose their weaknesses, have a close relationship with carriers and can quickly rally and speak candidly to create solution for themselves and productivity for carriers. They are acting more as a network with the transport services in order to create a flexible transportation operating system which is characterized by coordinated operations that can drastically cut channel cycle times and inventory levels as goods flow seamlessly from shipper to receiver.

In order to increase transport productivity and competitiveness, the collaborative transportation system infrastructure must promote:

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[139] Cf: Stank and Goldsby (2000), p. 72

- Integrated transport systems
- Common standards, common system architecture and administration
- Innovative solutions with increased speed of change

Additionally, it is also required to set rules for collaboration among trading partners in supply chain.

CTM is a transportation management strategy which is becoming increasingly popular. It is a technique that is of special interest for multi-location supply chains, because it allows multiple plants to manage their logistics operations centrally[140]. CTM is a holistic process focused on managing distribution operations – mode/carrier selection; load tendering, tracking, scheduling, and payment – in a manner which ensures shared risk and benefits for all parties involved. The primary goal of CTM is to drive inefficiencies out of the transport planning and execution process by improving the operating performance of the shippers, carriers, receivers and 3PLs participating in the CTM exchange. Moreover CTM includes;

- Sharing key information (i.e. forecasts, capacity plans),
- Exchanging ideas on how to improve the planning and execution of transportation processes
- Co-investing in assets that provide all parties involved with operational benefits

CTM essentially involves including transportation management in the strategic planning process, and folding it into collaborative supply chain management exchange processes

As a collaborative business model, CTM creates opportunities as well as risks along the application. However, the main advantage of CTM is to drive inefficiencies out of the transport planning and execution process by collaboration between trading partners and transport service providers, the main purpose of such business models cannot be perceived by companies most of the time. They either involve into the system without having any perspective or stay resisted that means they postulate to understand which kind of risks such collaborative systems contain and on which risk

[140] Viau et al (200), p. 251.

factors they especially focus their attention. After having a broad view of the potential risk factors of CTM, they can make a decision whether their system and organization are enough suitable to take steps. Insufficient collaboration could result reaction in transport chain – domino effect- which could cause financial and productivity losses, moreover reputation damage.

The purpose of this thesis is to build a risk assessment model to show which risk factors could affect the success of CTM business system. As previous researches stated that the proper risk assessment requires distinguishing and understanding of:

1. What the typical risk factors are in collaborative business system and;
2. Which of them enterprises perceive to be more deserving of their attention?

In this thesis, to address of these two points properly have been taken some steps further. Firstly the risk assessment model was constructed with three sub-steps namely; risk identification, risk analysis and risk prioritization. Secondly, A Delphi method was employed to acquire the risk factors associated with CTM business system and 41 sub-risk factors were extracted during the Delphi session. These risk factors have potential to affect performance and success of collaborative business system and thirdly, an AHP based framework was established to assess and prioritize these factors. The result of study demonstrated also that there are noticeable differences for the identification and perceived importance of certain risk factors. At the end of thesis, the important ten risk factors were summarized in a table then tried to find out the all associated research questions in term of the result of theoretical and methodological parts of thesis. The result of this thesis can assist practitioners on assessing the risk if they want to practice CTM application and be the part of CTM business system and also results can be used as a reference for further researches in academia.

CHAPTER 6

6 FURTHER RESEARCH

IT changes, leading to more effective collaborative capabilities are providing increased possibilities for transport users as well as transport service providers to work more closely together to reduce transportation cost eliminate inefficiencies and deliver service excellence, within a more robust business model framework. This kind of framework should be based on win-win outcome for all parties[141]. Therefore, there has been aroused a need to identify and manage risks along transport chain to eliminate possible drawbacks or inefficiencies for the success of collaborative business system in order to achieve mentioned mutual results for all parties.

There has been a steady increase in the number of papers published addressing the subject of risk management in supply chain in recent years[142]. In contrary there are only a few researches that focus on risk management content separately in transport chain and electronic business system. Actually this is a niche research area to make research questions related with risk and collaborative transportation management.

This thesis has identified mentioned significant risk factors of CTM business system. However, it is yet unclear how these factors inter-relate with one to another. Many of these risk factors, such as cultural incompatibility, lack of trust between trading partners, conflict between users, data exchange difficulties and lack of effective control methodology to measure performance have been to a large extent ignored due to their complexity, and deserve significant attention individually in terms of further research. Further research is also required to develop a deeper understanding of the relationships between these risk factors of collaboration. Moreover the study can be extended to measure the risk level of collaboration among low risk, middle risk and high risk. This would help practitioners to make a decision whether they are ready to be part of such collaborative business system in terms of their technological and organizational capabilities or what they are lacking to invest in developing their resources.

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[141] Sahay (2003), p. 83.
[142] Zsidisin and Ritchie (2009), p. 48; Chopra and Meindl (2008), p. 231.; Dey (2001), p. 634.

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List of Abbreviations

3PL	Third Party Logistics
4PL	Fourth Party Logistics
AHP	Analytic Hierarchy Process
ASP	Application Service Provider
B2B	Business-to-Business
B2C	Business-to-Consumer
BPR	Business Process Reengineering
C2C	Consumer-to-Consumer
CPFR	Collaborative Planning, Forecasting, and Replenishment
CRM	Customer Relationship Management
CTM	Collaborative Transportation Management
EAI	Enterprise Application Integration
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
e-TMS	Electronic Transportation Management System
IS	Information Systems
IT	Information Technology
KPI	Key Performance Indicator
LSP	Logistics Service Provider
LTL	Less-than-truckload
MCDM	Multi-criteria decision making
SaaS	Software-as-a-service
SCM	Supply Chain Management
TL	Truckload
TMS	Transportation Management System
VICS	Voluntary Inter-industry Commerce Standards Association
WMS	Warehouse Management System
XML	Extensible Mark-up Language

APPENDIX

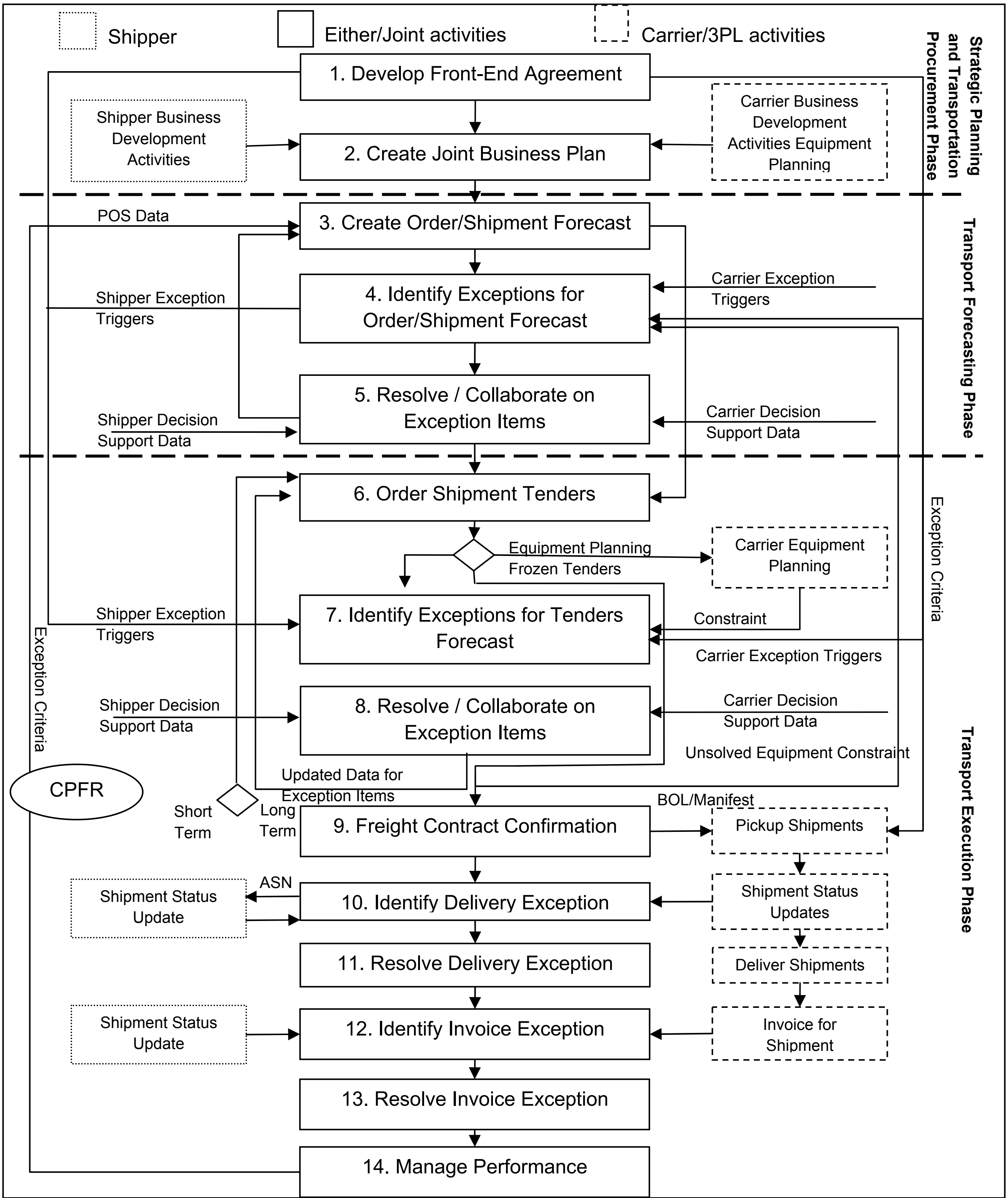
APPENDIX A: The different name of transport service providers[143]:

- Carriers
- Freight Forwarders
- Forwarding Companies;
- Transporters;
- Transport(ation) Firms;
- Transport Companies;
- Transport(ation) Providers;
- Transportation Partners;
- Transportation and Warehousing Providers;
- Third-Party Transport Services;
- Logistics Service Companies;
- Logistics Service Providers;
- Logistics Service Suppliers;
- Subcontracted Logistics Service Partners;
- Logistics Partners;
- Logistics Operators;
- Third-Party Logistics;
- Third-Party Logistical Services;
- Third-Party Logistics Service Providers;
- Third-Party Logistics Partners;
- Third-Party Logistics Providers (3pls);
- Fourth Party Logistics (4pls);
- Supply Chain Service Providers;
- Global Logistics Providers; and
- Logistics Integrators.

[143] Fabbe-Costes et al. (2009), p.76.

APPENDIX B: Collaborative Transportation Management System Users

APPENDIX C: CTM Business Model



CTM Business Model[144]

[144] Cf. Tyan et al.(2003), p 287

APPENDIX D: Random consistency index (RI)

Random consistency index table represents a composite of two different experiments performed by Saaty and his colleagues. 500 random reciprocal n x n matrices were generated for n=3 to n=15 using the 1 to 9 scale. The maximum eigenvalue was determined by racing each random matrix to increasing powers and normalizing the result until the process converged.

n	3	4	5	6	7	8	9	10
RI	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

APPENDIX E: Questionnaire Survey

01/12/2009

Dear M'aam/Sir,

This is Yasanur Kayikci, I am a graduate student at Technology University of Graz, Austria. I am writing to you because I would like your assistance with my Production Science and Management Master's thesis, which is a focused investigation on collaborative transportation management (CTM) systems. My survey is the core of risk assessment for CTM business system and I want to prioritize selected risk factors by the result of this study, and I am asking Transport User and Transport Service Provider professionals to help me by answering the survey questions.

Detailed you will find the enclosed chapters. It would be highly appreciated, if you could send me the completed questionnaire form directly at yasanur.kayikci@gmail.com.

As a "thank you" for filling out the survey, I will share the results with all respondents who would like to receive them. Of course all names and information of participating companies will be kept strictly confidential.

Thank you in advance for your contribution.

Sincerely,

Yasanur Kayikci

yasanur.kayikci@gmail.com.

1. Default Section

I am writing to ask for your assistance with my Production Science and Management Master's Thesis at Technology University of Graz in Austria, which aims to promote a conceptual model of risk assessment in collaborative transportation management business system.

Thesis focuses on finding out primary risk factors for collaborative transport chain which will be taken into account to enhance successful collaborative business relationship between Transport Users and Transport Service Providers.

This short survey is based on Analytic Hierarchy Process (AHP) technique and it requires comparison between given pair criterion according to your personal opinion. For this a measurement scale is used with ranking 1-9. Once data is collected, it will be used to prioritize the in-advance identified risk-factors which were determined during a Delphi study session. Survey takes no more than 15 minutes.

It is suitable for Transport Users and Transport Service Providers. If you do not use or provide transport services then this survey is not for you and I thank you for your time.

Your contribution to my surveys will help to ensure that the results of my Master's Thesis, and the future CTM applications, fully reflect the needs of the CTM users.

2. Data Protection

Your response will be treated in strict confidence, and names of individual respondents or organizations will not be used in published material or given to third parties. The general findings of the survey will be published.

3. Initial Information

3.1 Are you a Transport User or a Transport Service Provider?

- o Transport User
- o Transport Service Provider
- o Not a provider or user of transport services.

3.2. If you are Transport User, please indicate what the business area of focus of your company is:

- o Automotive
- o Computer and communication
- o DIY

- Chemical
- Consumer products
- Electronic Equipment
- Medical Equipment
- Industrial Machinery
- Others:__________________

4. Pair-wise Comparisons

Here we would like you to make comparisons for all question with given categories of risk factors. Please use below illustrated scale for comparison.

Numerical Values	Definition
1	EQUAL: Equally important of preferred
3	MODERATE: Moderately more important or preferred
5	STRONG: Strongly more important or preferred
7	VERY STRONG: Very strongly more important or preferred
9	EXTREME: Extremely more important or preferred
2,4,6,8	Intermediate values

We have identified below mentioned main risk factors for CTM business system during Delphi study session.

F_1: Process Capabilities (CAPA)
F_2: Technology Usage (TECH)
F_3: Organizational Fit (FIT)
F_4: Cost Saving Potential (COST)
F_5: System Design (DESIGN)
F_6: Skill Mix (SKILL)
F_7: Control Risk(CONT)
F_8: Environmental Risk(ENV)
F_9: Service Quality (SERQ)

4.1 Which main-criteria (risk factor) would you find more relevant for evaluation of a CTM business system? Compare each of the following pair of the criteria with respect to overall goal, and circle one number per row:

CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TECH
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FIT
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	COST
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DESIGN
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SKILL
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CONT
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
CAPA	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FIT
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	COST
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DESIGN
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SKILL
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CONT
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
TECH	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
FIT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	COST
FIT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DESIGN
FIT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SKILL
FIT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CONT
FIT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
FIT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
COST	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DESIGN
COST	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SKILL
COST	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CONT
COST	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
COST	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
DESIGN	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SKILL
DESIGN	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CONT
DESIGN	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
DESIGN	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
SKILL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	CONT
SKILL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
SKILL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
CONT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ENV
CONT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ
ENV	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SERQ

4.2. How relevant would process capabilities (CAPA) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to process capabilities, and circle one number per row:

F11: Insufficient information sharing
F12: Flow of data and information
F13: Flow of resources

F14: Agreements on delivery frequency
F15: Reporting functions
F16: Poor estimation of shipment

F11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F12
F11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F13
F11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F14
F11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F15
F11	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F16
F12	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F13
F12	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F14
F12	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F15
F12	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F16
F13	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F14
F13	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F15
F13	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F16
F14	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F15
F14	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F16
F15	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F16

4.3. How relevant would technology usage (TECH) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to technology usage, and circle one number per row:

F21: Quick adaptability of evolving technologies
F22: IT infrastructure
F23: Collaborative technology
F24: Inadequate B2B interfaces for data transfer
F25: Absence of technology and business support mechanism

F21	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F22
F21	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F23
F21	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F24
F21	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F25
F22	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F23
F22	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F24
F22	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F25
F23	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F24
F23	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F25
F24	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F25

4.4 How relevant would Organizational Fit (FIT) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to Organizational Fit, and circle one number per row:

F31: Inability of management
F32: Data exchange difficulties
F33: Conflict between users
F34: Lack of trust between trading partners
F35: Lack of rules for collaboration
F36: Cultural incompatibility

F31	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F32
F31	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F33
F31	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F34
F31	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F35
F31	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F36
F32	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F33
F32	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F34
F32	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F35
F32	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F36
F33	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F34
F33	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F35
F33	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F36
F34	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F35
F34	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F36
F35	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F36

4.5 How relevant would Cost Saving Potential (COST) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to Cost Saving Potential, and circle one number per row:

F41: Lack of agreement on cost-sharing
F42: Ineffective ROI analysis
F43: Expensive technology investment
F44: Unsuccessful asset utilization

F41	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F42
F41	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F43
F41	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F44
F42	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F43
F42	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F44
F43	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F44

4.6 How relevant would System Design (DESIGN) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to System Design, and circle one number per row:

F51: Lack of effective system methodology
F52: Lack of common system architecture
F53: Lack of common definitions/systematic descriptions
F54: Insufficient data visibility – tracking & tracing
F55: Insufficient data compatibility and common formats

F51	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F52
F51	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F53
F51	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F54
F51	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F55
F52	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F53
F52	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F54
F52	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F55
F53	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F54
F53	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F55
F54	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F55

4.7 How relevant would Skill Mix (SKILL) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to Skill Mix, and circle one number per row:

F61: Lack of staff resources
F62: Lack of proper training
F63: Scarcity of IT specialists
F64: Lack of open system application

F61	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F62
F61	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F63
F61	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F64
F62	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F63
F62	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F64
F63	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F64

4.8 How relevant would Control Risk (CONT) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to Control Risk, and circle one number per row:

F71: Lack of effective control methodology to measure performance
F72: Lack of coordination
F73: Inadequate definition of KPI

F71	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F72
F71	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F73
F72	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F73

4.9 How relevant would Environmental Risk (ENV) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to Environmental Risk, and circle one number per row:

F81: Government regulations and control
F82: Industrial actions
F83: Insufficient technological infrastructure
F84: Security

F81	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F82
F81	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F83
F81	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F84
F82	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F83
F82	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F84
F83	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F84

4.10 How relevant would Service Quality (SERQ) of collaborative business system be for your organizations, if you had the following features? Compare each of the following pair of the sub-criteria with respect to Service Quality, and circle one number per row:

F91: Poor or irregular communication with users
F92: Insufficient user support
F93: Immature standards
F94: Lack of transport and other additional services

F91	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F92
F91	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F93
F91	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F94
F92	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F93
F92	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F94
F93	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	F94

It was the last question, but you feel free to make here any other remark about CTM risk factors.