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Establishing a best practice model of supplier relationship management (SRM) for multinational manufacturing companies in the European transportation industry

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Author´s declaration

I declare that the work in this thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of the thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas. Any views expressed in the thesis are those of the author and in no way represent those of the University.

Signed …….…….. Date …….…….

for 貴子, 歩美 & 愛美

be not afraid of growing slowly,
be afraid only of standing still

(Japanese proverb)

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First of all, I would like to express my sincere gratitude to all people, who supported me during the preparation of the doctoral thesis. In this context, I would like to name my superiors in Bombardier Transportation, my colleagues, my subordinates and the participants in this research, who were of great support in making valuable contributions to this research in SRM.

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List of abbreviations and acronyms

AL	Action learning
ALS	Action learning set
ALSTOM	Alstom Rolling Stock
APQP	Advanced planning and quality process
AR	Action research
BIC	Best-in-class
BCL	Business critical
BME	Bundesverband für Materialwirtschaft, Einkauf und Logistik
BMW	Bayerische Motorenwerke
BOS	Bombardier Operating System
CAS	Complex adaptive systems
CBC	Clause by clause
CET	Central European Time
CPO	Chief Procurement Officer
DBA	Doctorate in Business Administration
DR	Doctor
EBIT	Earnings before income tax
EUR	Euro
FAI	First article inspection
FOM	Hochschule für Oekonomie und Management
GTC	Global terms of condition
HS	Hochschule
ILD	Insitut für Logistik und Dienstleistungen
IPM	Institut für Produktionsmanagement
IPM	Institute for Purchasing and Marketing
IPO	International Procurement Office (China)
IRIS	International Railway Industry Standard
ISM	Inside Supply Management
ISO	International Organization for Standardization
KPI	Key performance indicators
LCCS	Low-cost country sourcing
LPSM	Low performance supplier management
LTSA	Long-term service agreement

MBA	Master of Business Administration
MELCO	Mitsubishi Electric Corporation
MEP	Material enhancement plan
MRS	Market Research Society
NAFTA	North American Free Trade Area
NCC	Non-conformity costs
NCG	Non-conforming goods
NPR	Non product related procurement
OEM	Original equipment manufacturer
OTD	On-time-delivery
P	Page
PAP	Production approval process
PASE	Panasonic Automotive Systems Europe
P2E	Procurement to excellence
PHD	Doctor of Philosophy
PPM	Parts per million
QBR	Quarterly Business Review
QCDSF	Quality, cost, delivery and supplier financial health
RCA	Root cause analysis
SBB	Schweizerische Bundesbahn
SCIP	Site continuous improvement plan
SCM	Supply chain management
SEAP	Supplier evaluation and approval process
SRM	Supplier relationship management
SVME	Schweizer Verband für Materialwirtschaft und Einkauf (Procure.ch)
THM	Technische Hochschule Mittelhessen
UK	United Kingdom
USCM	Upstream supply chain management
VP	Vice President
ZF	ZF Friedrichshafen
8D	8D report

Abstract

Purpose/objectives: The research deals with establishing a best practice model in SRM for manufacturing companies in the European transportation industry. The objective of the thesis is to identify schools of thought in SRM, to highlight the causal factors for supply disruptions and to outline how supply disruptions can be anticipated, managed and prevented. The identified best practices shall be categorized and utilized to establish a best practice model for the respective sector. The purpose is to show how supply chain resilience can be accomplished in global and complex supply chains by means of proactive SRM.

Design/methodology/approach: The empirical part of the research has been conducted with a qualitative and multiple approach over a period of more than two years. The paper examines best practice elements through a systematic literature review combined with semi-structured interviews involving senior managers in SRM in the European transportation industry. Two case studies have been included for confirming or disconfirming the best practice elements. The empirical part has been divided into four phases: (1) verifying or falsifying the appropriateness of the research questions, (2) best practice identification and categorization, (3) confirmation or disconfirmation of best practices in SRM, and (4) refining best practice elements.

Findings: The findings represent a significant contribution on how to deal with complex and global supply networks. They will help researchers and practitioners faced with the task of setting up supplier relationships. Furthermore, the findings can be applied when establishing an overall best practice framework and SRM model.

Research limitations/implications: The research focuses on establishing a best practice SRM model for multinational manufacturing companies in the European transportation industry. The model has not yet been implemented. Therefore, implementation and application to other industries will have to be the subject of further research.

Synopsis

The European transportation industry is currently faced by fierce competition inside and outside Europe, mainly Asia. This is forcing manufacturing companies to concentrate on core competencies and to transfer the production of components, goods and services to external suppliers (Hamm, 1998; Aberdeen group, 2006; Harland et al. 2003). The number of value-adding activities has decreased constantly and now lies between 20 and 30 per cent in this industry (Dyer, 1996; 2000). Such a development has had a great influence on the structure of supply chains and supplier relationships. Supply chains (the terms "supply chains" and "supply networks" are used synonymously in the literature) have become more complex and international, as pointed out by several authors (Harland et al., 2003; Aberdeen group, 2006; Bozhard et al., 2009). Christopher and Peck see the level of complexity increasing in the upstream supply chain management of manufacturing companies in the European transportation industry, a trend which is characterized by the growing transfer of activities to suppliers, high numbers of supply chain layers (tiers), and the ongoing globalization of supply chains (Christopher & Peck, 2004). As a consequence, vulnerability and risk exposure have risen significantly. The rapid increase in supplier activities directly affects supplier relationship management (SRM), as emphasized by Emmett and Crocker (2009). In recent years, many companies have reduced their value-adding activities and implemented efficiency-oriented cost reductions, e.g. outsourcing, single sourcing, low-cost country sourcing, platform concepts, lean management, design-to-cost approaches (Aberdeen group, 2006; Gürtler & Spinler, 2010). SRM has become more important in core and peripheral business areas (Trkman & McCormack, 2009) and is aimed at building resilient supply chains (Christopher & Peck, 2004). Resilience is based on being able to anticipate, manage and prevent supply chain disruptions at an early stage (Christopher & Peck, 2004). On the other hand, supply risks have risen due to increased dependency on supplier networks (Kersten et al., 2008). In their research "An Empirical Analysis of the Effect of Supply Chain Disruptions on Long-Run Stock Price", Hendricks and Singhal (2005) found out that enterprises without operational slack and redundancies in their supply chains experience negative stock effects. The authors revealed the tremendous impact of supply chain disruptions on stock price performance and shareholder value. Supply disruptions can easily lead to high recovery cost, waste and sharp decreases in sales, as pointed out in the present study. External customers become dissatisfied and internal core functions (e.g. assembly) are disturbed. In most cases, supply disruptions have negative impacts on brand image, sales figures and the company's own financial situation (Haslett, 2011; Jing, 2011; Grant, 2010; Connor, 2010; Trkman & McCormack, 2009; Blackhurst, 2008; Kumar, 2001; Tomlin, 2006). Although literature is already available on the topic, both top management and academia underline the need for a more holistic approach towards SRM

(Narasimhan & Talluri, 2009). Several authors point out that there is a discrepancy between the proactive role of SRM in complex and global supply networks and the traditional view of how to deal with suppliers (Aberdeen group, 2006). Christopher and Peck stress that supply chain resilience and SRM is a relatively new and still largely unexplored area of management (Christopher & Peck, 2004). Supply chain risks have mainly been investigated on the direct level of tier-one relationships, but consideration has not been fully extended to subsuppliers, i.e. tiers one, two, three and beyond (Harland et al., 2003). This study therefore seeks to address these concerns by identifying the schools of thought in SRM and supply networks, by outlining risk factors for supply chain disruptions, by investigating how disruptions can be anticipated, prevented and managed, and by showing best practices in SRM in manufacturing companies in the European transportation industry. Finally, a best practice model has been developed which can be applied to other manufacturing companies in their respective industry. The doctoral thesis is subject to certain limitations. The research area covers multinational manufacturing companies in the European transportation industry, with a focus on the railway, automotive and truck sectors. The study is restricted to supply chains with tier one, tier two and tier three companies and focuses on module, systems and components suppliers. The supply of these modules, systems and components is linked to certain phases and processes of the value stream of the buying company, including supplier selection, launch, production and after-market stages. The typical challenges and issues dealt with in the existing literature are in themselves very similar and raise the following questions (Bennett & O´Kane, 2006; Aberdeen group, 2006):

I. What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint or others?
II. What are risks and causal factors for supply disruptions?
III. How can supply disturbances and disruptions be anticipated, managed and prevented?
IV. What are the best practice elements, milestones and development steps of SRM in manufacturing companies in the European transportation industry? Can you give examples?

The empirical part of the research took place in the transportation sector, since the author himself is employed in a manufacturing company in the European transportation industry (Bombardier Transportation). He therefore has extensive access to data and experts. The interviews with the practitioners raised the following issues:

1. How can supply disturbances and disruptions by avoided by means of SRM?
2. How to recognize supply disruptions at an early stage?

3. How is SRM linked to the corporate strategy and integrated in corporate management?
4. What are the company's policies on SRM?
5. How is SRM organized?
6. Who is responsible for SRM?
7. How are information systems used in SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. What are the values and policies on SRM, and how does SRM add value to the organization?

In accordance with pragmatic interpretivist epistemology, the intention was to apply a pragmatic and qualitative research regimen, including interviews and a case study approach coupled with an ongoing literature review. Interpretivisim assumes that scientific investigation on SRM has real, manipulable, internal mechanisms that can be actualized to produce a particular result (Burrell & Morgan, 1979). In this context, SRM needs to be interoperable, dynamic and situative. Scientific or interpretivismis therefore to be considered as a suitable basis and appropriate perspective for deriving a SRM best practice model, as proposed by Pawson (2006). In contrast to the positivistic or interpretivist´s viewpoint, interpretivismfocuses on meaning and tries to understand SRM. The doctoral study has spanned a period of more than three years and the empirical component of the research has been conducted over four phases in a time period lasting more than 24 months. The four phases comprise the following aspects:

Phase I: verifying appropriateness of the research questions and making necessary adjustments,
Phase II: identifying and categorizing best practices through systematic literature review and semi-structured interviews,
Phase III: case study approach, confirming or disconfirming best practices in SRM through pattern matching, and comparing case study results with Phase II results,
Phase IV: refining best practice elements in SRM in manufacturing companies in the European transportation industry and establishing a best practice SRM model.

The complete doctorate, including research on SRM, had been scheduled prior to enrolment for the duration of three to four years. Enrolment into the doctoral programme of the University of Gloucestershire started at the end of 2009, followed by residential weekends concerning four modules ("systematic literature review", "methodology and methods", "action research", and "professional reflective practice") which took place in Munich (Germany) and Cheltenham (Great Britain). After passing all of them, the research degree form (RD1) was submitted in 2011/2012 to

obtain official approval to proceed with the research and to enter the research phase in summer 2012. Any ethical issues and aspects of data handling or storage which arose during the research have been considered and addressed. The research has been conducted according to the guidelines of "The University of Gloucestershire's Handbook of Research Ethics (2008)". A copy of these guidelines was offered to all participants on request. Full compliance with the rules of ethics ensures that the thesis reports data, information and results honestly, while avoiding bias in the interpretation of the data analysis. All data arising from the empirical part of the interviews as well as any other data are stored safely on the researcher's personal computer. Interview data will be destroyed after approval of the thesis by the University of Gloucestershire. It was pointed out to all interviewees that the author expected this research to contribute both to general theory and to managerial practice within the industry. Phase I lasted three to four months. With the help of interviews with management experts in the European transportation industry, it was possible during this time to confirm the appropriateness of the research questions and to determine the contribution the thesis would make to managerial practice within the industry. The interviews also served as a pilot phase for later interviews in Phase II. Five experts from SRM-related areas with experience inside and outside Bombardier Transportation were interviewed in semi-structured interviews. Rich data were generated with which to address the research questions. The interview results enabled the author to prioritize research objectives, support potential adjustment or revision of the research questions, and incorporate additional aspects. The appropriateness of the research questions and their importance for science and managerial practice have been mostly confirmed. On three occasions, appropriateness or contribution to managerial practice could not be fully confirmed, so that it was necessary to adjust the research questions in these cases. After adjustment of the questions, the question list, sequence of questions and research prioritization were confirmed. Phase II took ten to twelve months and was the longest of all the phases. This stage deals with responding to the research questions in Phase I and thus makes up an essential part of the thesis. In Phase II the author addresses the research questions by identifying schools of thought in SRM, by outlining risk factors for supply chain disruptions, by investigating how disruptions can be anticipated, prevented and managed, and by showing best practice elements in SRM. A qualitative and multiple approach, including an ongoing systematic literature review and semi-structured interviews, was considered to be the most appropriate research methodology in this phase. With the help of the literature review and the ten interviews with senior managers in the respective industry, it was possible to disclose different schools of thought and a number of risk factors for supply chain disruptions. All in all, Phase II provided the basis for inductively identifying, clustering and categorizing best practice elements of SRM in manufacturing companies in the European transportation industry. Phase III lasted three to four months. Two in-depth case studies in the respective industry were used to confirm or disconfirm best practice

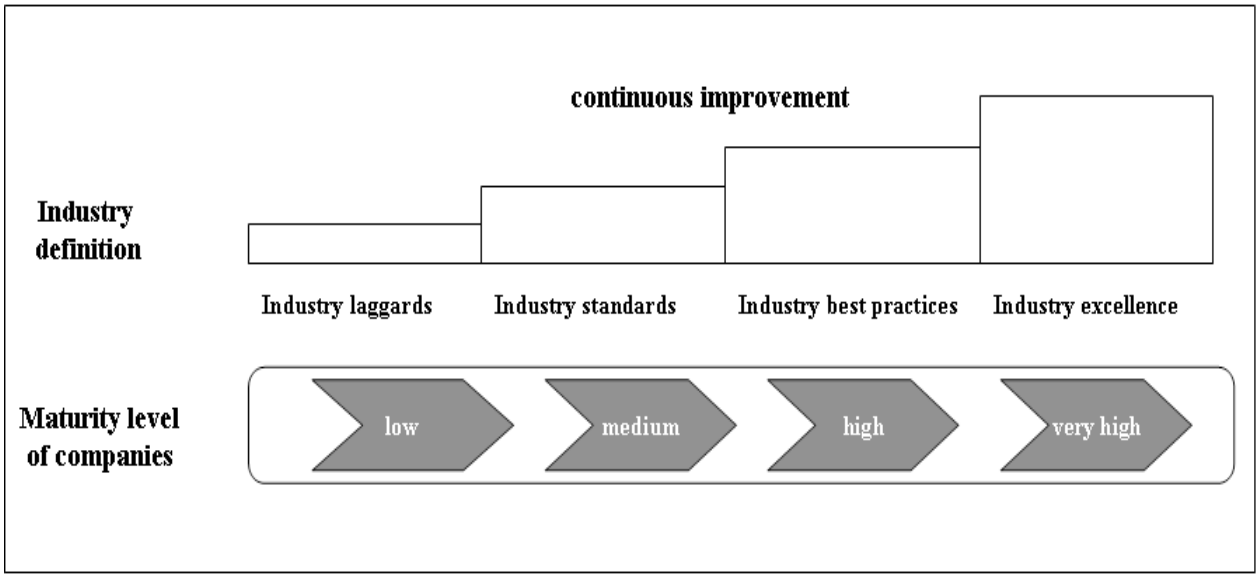
elements in SRM. The pattern-matching technique was applied in the case studies as an analysis tool (Yin, 2009; p. 38). Best practice elements from Phase II served as a template with which to compare, confirm or disconfirm the empirical results of the case studies in Phase III. Two SRM-related projects involving supply chain disruptions and mitigation activities were chosen for the purpose of confirmation or disconfirmation. The two case studies were taken from two separate and independent locations within Bombardier Transportation in Europe, whereby the second case study served as replication. Yin stresses that cross-case analysis is more effective than using only a single case study (Yin, 2009; p. 140). Each case study involved five semi-structured interviews with the senior management of relevant SRM functions and, additionally, five interviews with the operational project members in order to underline the respective validity. A matrix of categories similar to those identified and defined in Phase II was used for comparing, confirming and disconfirming the elements in Phase III. Interview protocols were transcribed for data analysis and confirmation. In order to reduce data and cluster the collected data, the findings were allocated to the generated categories of best practices. Phase IV lasted three to four months. It was the last of the four stages of empirical research and served to refine the best practice elements and establish the best practice model. Data were transcribed from the interview protocols and reduced by applying category-related best practices. The majority of the elements were confirmed, only a few had to be adjusted. No element had to be disconfirmed. The research helped to identify various schools of thought, define and classify causal factors for supply chain disruptions, examine how supply chain disruptions can be anticipated, managed and prevented, and showed best practice elements of SRM. The systematic literature review identified three schools in SRM: (1) collaborative supply networks; (2) keiretsu supply networks; (3) complex adaptive supply networks. Whereas traditional paradigms consider the SRM function only as a peripheral function to ensure timely deliveries at the lowest possible cost (Bennet & O´Kane, 2006), the three identified schools focus on partnership and fairness (Hamm, 1998). Even though the literature review identified three schools of thought in SRM, the majority of companies involved in the research strive for a collaborative approach (Christopher & Peck, 2004); just a few companies have a keiretsu-focused approach within their supply network (Liker, 2005). The classification of risk factors and causes for supply disruptions, e.g. external (macro-risks like natural disasters) or internal (micro-risks like internal supply chain vulnerability), raises the question of how to anticipate such incidents (Aberdeen group, 2006). One possibility would be to identify best practice elements. Most elements emphasize proactive measures, tools and processes. They could be linked to certain patterns and behaviours in the respective company. The best practice elements comprise in total 15 elements:

1. Corporate strategy

2. Organization
3. Supplier selection
4. Supplier co-operation
5. Supply chain visibility
6. B2B collaboration
7. Cost transparency
8. Risk management
9. Demand scheduling and production system
10. Supplier quality performance
11. Supplier academy
12. Global sourcing
13. Claims management
14. Dual source paradox
15. Qualitative investigation of supply chain discrepancies

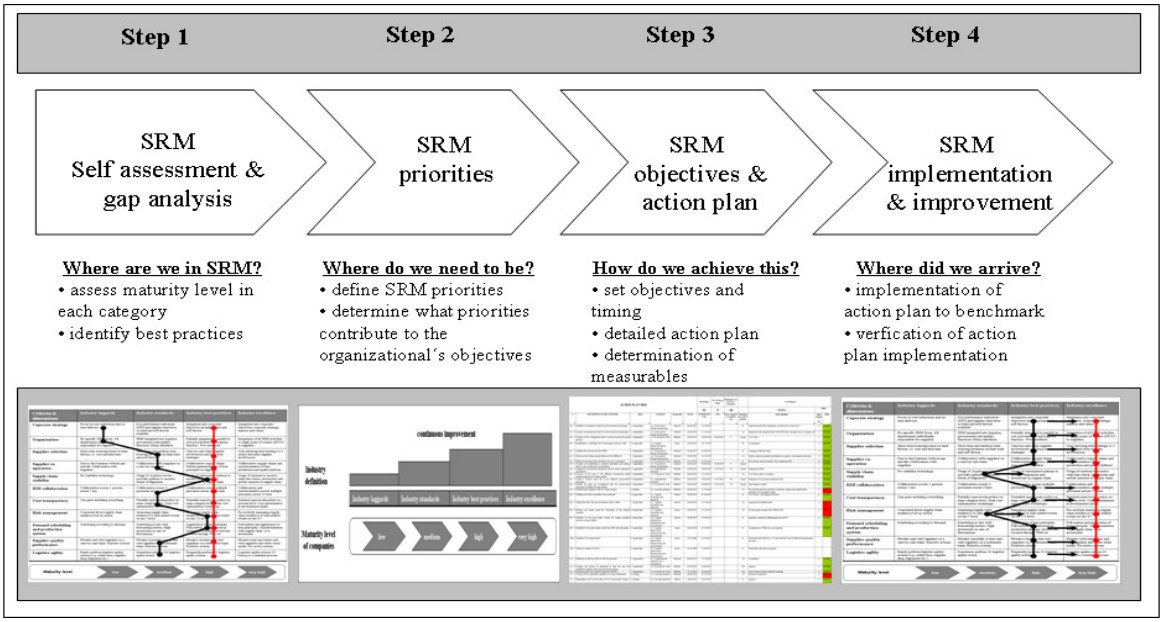
The research helped to establish a best practice model (see figure next page), including the development phases from baseline to industry excellence for the identified elements and categories. The best practice categories in Appendix 18 were clustered in levels: low maturity (industry laggard), medium maturity (industry standard), high maturity (industry best practice), highest maturity (industry excellence) –-see figure below.

Maturity levels of SRM best practices



This model will explicitly help manufacturing companies to determine where their own organization stands and what measures they should take to achieve the best practice or industry excellence level, as shown below. The research and the developed best practice model have certain limitations. The doctoral study is limited to the transportation industry. In addition, interviews have been undertaken in multinational manufacturing companies in the European transportation industry. Therefore, results are applicable to the transportation industry and multinational companies. The best practice elements and the established model have not yet been implemented in managerial practice, so they still have to be proved via separate research. The proposed framework is meant to be a guideline in SRM with a focus on proactive measures. Action research was not considered, but it could also be a suitable qualitative and interventionist approach (Gummesson, 1990). Areas for further research have been discussed in the doctoral thesis. The best practice model needs empirical confirmation. Therefore one logical plan would be to apply the best practice elements and the model to a manufacturing company of the respective industry for testing purposes. The following questions would have to be answered: "Where are we now in terms of SRM?", "Where do we need to be?", "How do we achieve this?", and "Where will we be after implementation?". First of all, a manufacturing site, e.g. Crespin (France) or Derby (UK), has to be chosen for carrying out the assessment. Step 1 would involve determining the extent to which best practice elements are installed. For this purpose, a gap analysis of SRM best practices can be carried out by means of self-assessment or assessment by auditors. This would last for a period of three to four months. Based on the result of the assessment, a plan would be made, including actions and implementation timing. Implementation could be realized with an interventionist approach, which would probably take six to twelve months.

Steps for SRM best practice model implementation



A crucial part of the assessment (step 1) would be to evaluate each best practice element in terms of maturity level (from industry laggards to industry excellence) with a view to achieving the optimum result. After the assessment stage, priorities (step 2) and a clear and logical plan (step 3) should be made to implement the best practices into the respective company. Whereas some practices might take longer to implement and even trigger resistance within corporate management, other principles could be introduced within a shorter time frame. An examination after implementation (step 4) is necessary to verify that actions have been implemented. Resistance could arise insofar as both the collaborative and the keiretsu model require considering suppliers as equal partners with the same rights (Behrendt, 1996; Ellram & Cooper, 1990). Traditionalists are not yet treating suppliers as equal partners at this stage (Glickmann & White, 2006). Moreover, establishing SRM functions requires certain resources, which might be rejected due to budgetary constraints (Helmold, 2011). The interviews in Phase II revealed that best practice companies assign former line functions to the responsibility of SRM managers, since they have experience in dealing with supply networks on a tier-one, tier-two and tier-three basis. After a final review, the results of the action research could be used for further refinement of the best practice model in SRM. Another area of research might be to evaluate the application of the best practice model in other industries (e.g. manufacturers of electronics or machinery), and even the service sector. Especially companies which have outsourced a large part of their products to global supply networks would benefit from such research. All in all, it is evident that proactive SRM requires a set of principles: 1) SRM best practices are dependent on a multilayer approach, involving not only tier one, but also tiers two and three; 2) SRM has to be integrated into corporate management and corporate strategy. Objectives have to be communicated and cascaded throughout the organization to make the introduction and execution of proactive SRM possible; 3) advanced and innovative SRM management needs standardized tools and processes; 4) best practice companies have sophisticated B2B platforms in terms of quality, cost and delivery; 5) SRM activities have to be sustainable and long-term; 6) there must be a collaborative approach, including strategic alliances with suppliers. These activities have to be organized centrally; 7) there has to be a single point of contact to the supplier; 8) performance indicators have to be mutually agreed upon and may comprise hard and soft factors. Assessment criteria should include quality, cost, delivery and technological aspects; 9) there must be supplier academy or training center, which also includes coaching suppliers. All these principles should be combined with a philosophy of continual improvement (10), thus creating the tenth principle in achieving a best practice model in SRM. Companies that want to gain competitive advantage over their rivals through best-in-class SRM must implement the ten principles and adopt a collaborative approach in dealing with their supply base. Thus, it is possible to gain a competitive advantage by managing the supply base appropriately. The

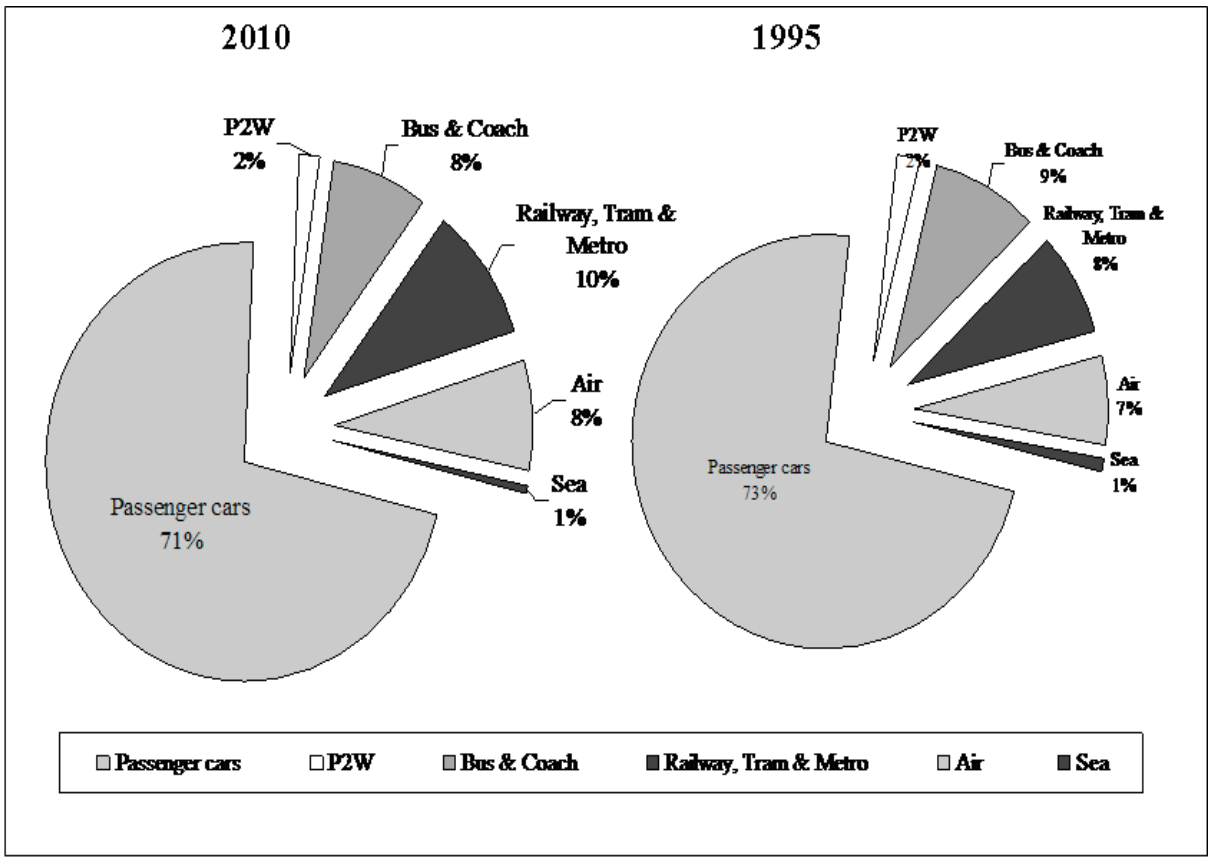
research journey is not yet over, the present and future will show when and where the research journey will continue.

1. SRM in the European transportation industry

1.1 Introduction

The European transportation industry is a growing industry and exceeds five percent of the gross value adding activities of the gross domestic product (GDP) of the European Union (EU). With a total amount of EUR 533 billion of gross value adding activities, the transportation sector is one of the largest in the European Union as outlined by the European Commission (2012). Figure 1-1 shows the percentage of mode of transport in the 27 countries of the EU for the European transportation industry from 1995 and 2010. The car, bus and railway sectors amount to approximately 90 percent of the transportation sector. Even though the form of passenger cars slightly decreased to 71 percent in 2010, it is still the dominating form of transportation in the EU, followed by the railway, tram, metro and bus sector. The air, personal two wheel (P2W) and sea transportation forms amount to 10 percent. Employment in the transportation sector in 2009 and 2010 amounted to approximately 11 million people, which is the equivalent of more than five percent of the total workforce in the European Union and its 27 members.

Figure 1-1: European transportation industry figures

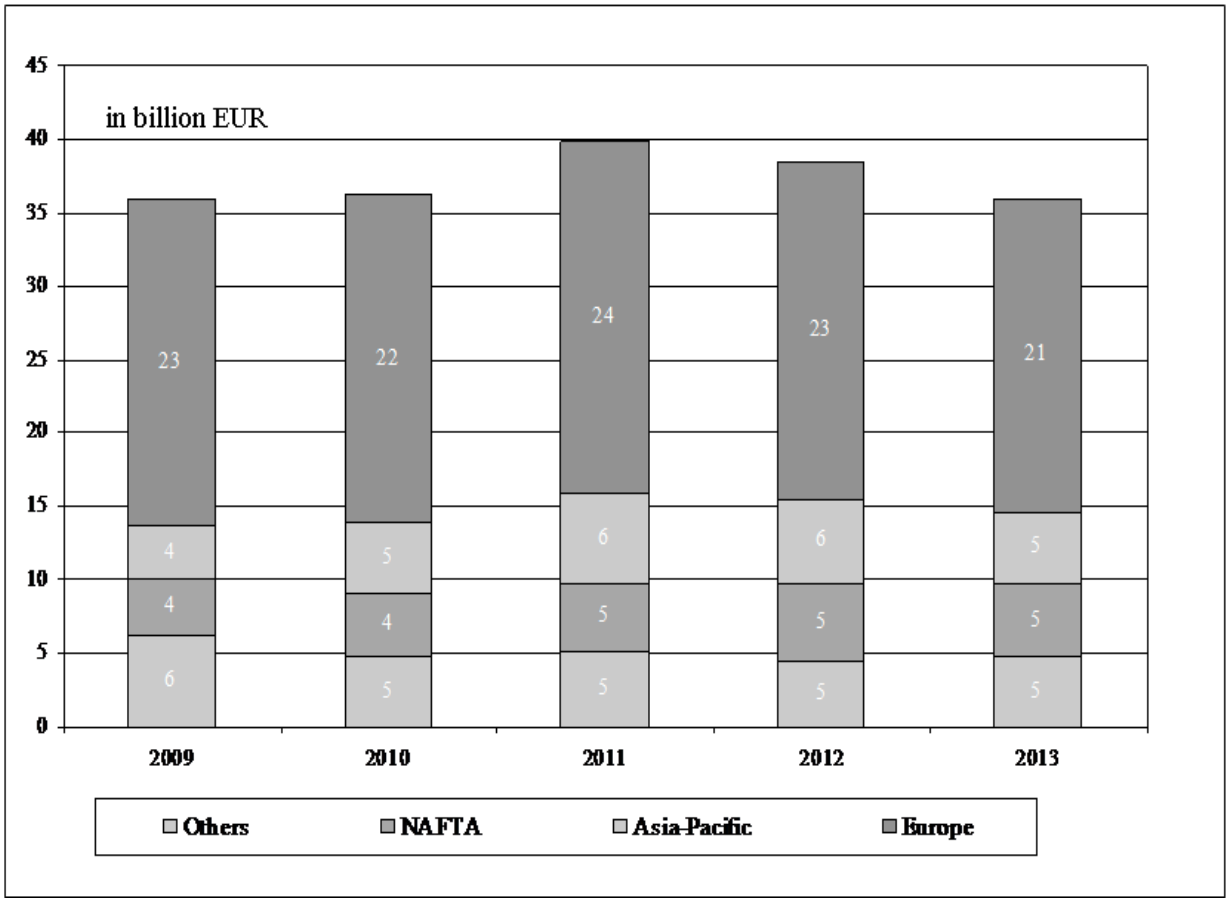


Source: European Commission (2012). EU transport in figures. Statistical pocket book 2012.

More than 65 percent of them worked in areas related to transportation and 22 percent in warehousing, supporting and other transport activities, such as cargo handling, storage and warehousing. The remaining 17 percent work in other related areas to the European transportation industry such as postal and courier activities. The report of the European Commission (2012) points out that European transportation industry will be growing in the next years. The commission also stresses also that the transportation sector is facing new and emerging challenges that will dramatically reshape the transportation priorities and needs. The report highlights that the challenges derive from the impacts of major trends like the ongoing globalization, the climate change, the changes in the cost of fuels, new technologies, and from domestic trends, such as changing demographics and lifestyle expectations. These challenges will result in a drastic change from fuel consuming passenger transportation to energy efficient mass transportation forms like railway, tram or metro (European Commission, 2012). These trends have influences on the future needs and shapes for transportation forms, thus sustainably affecting manufacturing companies in the relevant industry (European Commission, 2010). Organizations like the Commission or the Roland Berger Strategy Consultants show in their studies an ongoing trend towards globalization, specialization and the concentration on core companies in manufacturing companies in the respective environment (Roland Berger Strategy Consultants, 2012; European Commission, 2010). Authors also point out, that there is a potential for new research, which incorporates the mentioned aspects and which explores these trends and changes more in detail in the European transportation industry. (Rondinelli & Berry, 2000; European Commission, 2012; Roland Berger Strategy Consultants, 2012). Research will sustainably help to ensure that practitioners and academics in the transportation industry are equipped with the tools to deal with future challenges facing the industry over the next 30 to 40 years (European Commission, 2012). The globalization of economic activities and the gradual liberalization of the transport market throughout the European Union have led to changes in the business dynamics and structure of the sector of the European transportation industry. The European Commission outlines, that the environmental aspects of transport have become a priority in the development of policies and regulations for the transportation industry. The movement into the direction of more environmentally sustainable solutions is seen in promoting rail transport as a substitute for road transportation and passenger cars as manifested by the Roland Berger Strategy Consultants (2012). The same report also shows a steady growth in this industry in Europe. The accessible market volume in Europe will grow by more than two percent each year and with incoming orders worth EUR 45 billion in Europe, showing the largest growth in the European railway industry. Existing literature and case studies give a strong case in supporting the predicted future scenario (Cantos & Maudos, 2001). The European railway industry is with an outlook of more than 60 percent or EUR 21 billion in 2013 the largest industry compared to regions in the North

American Free Trade Area (NAFTA), Asia-Pacific and other areas as shown in the Figure 1-2. (Bombardier Transportation, 2010)

Figure 1-2: European railway industry (in billion EUR)



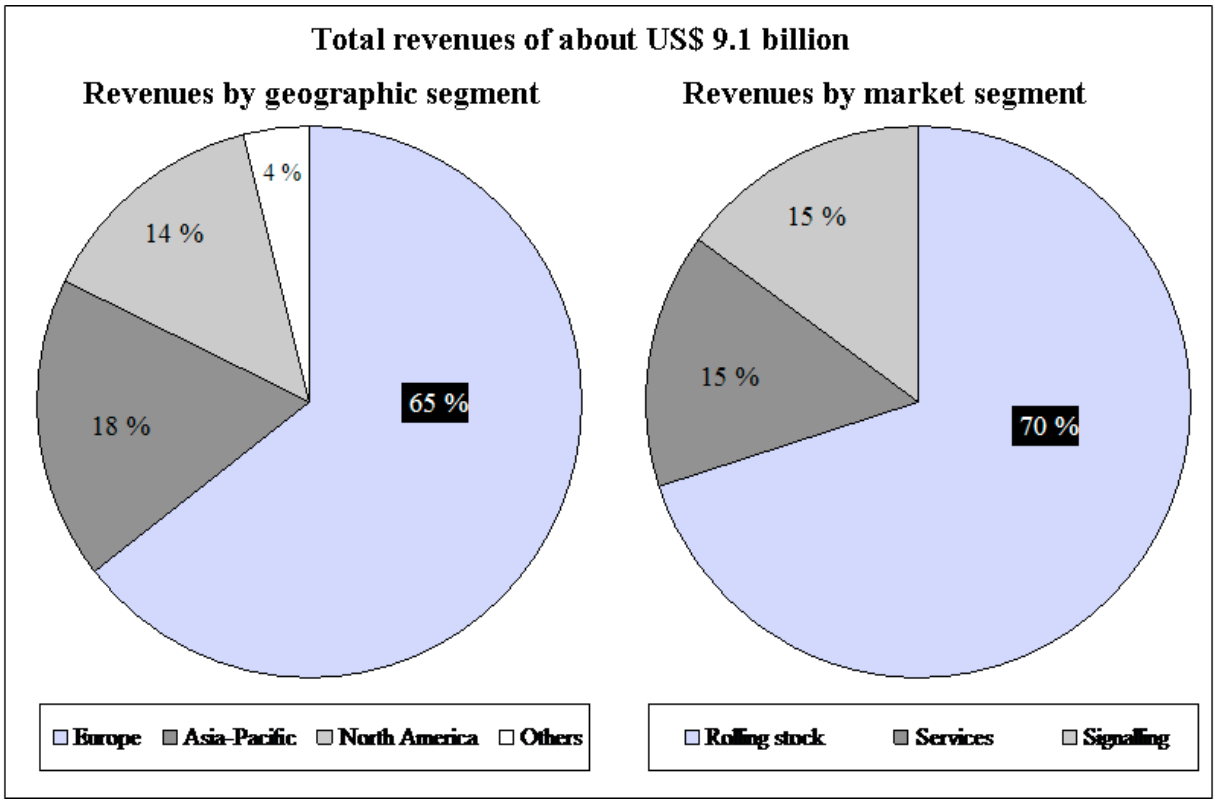
Source: Bombardier Transportation, 2010

1.2 Bombardier and the European transportation industry

Bombardier Transportation (Bombardier), in which a large part of the empirical research has been conducted, is a global transportation company with 69 production and engineering sites in 23 countries, and has a worldwide network of service centres (Bombardier Transportation, 2010). It operates two industry-leading businesses, i.e. aerospace and rail transportation systems. The number of employees working in design and manufacturing sites exceeds 65,000 in these two sectors. The transportation sector is the largest with approximately 53 percent. Bombardier is regarded as the global market leader in modern rail transportation technologies and has its headquarters in Berlin (Germany) since 2002. Bombardier is one of the key players of the internationally leading German rail industry. With a market share of around 20 percent and a turnover of US$ 9.1 billion and 65

percent of this turnover from activities in Europe (see Figure 1-3), Bombardier is the global leader in rail technology (Bombardier, 2010). The company has a global and European presence with a network of world wide operations. Even though Bombardier has several European manufacturing sites in Great Britain (Derby), the Czech Republic (Ceska Lipa), France (Crespin), Belgium (Bruges) or Austria (Vienna), there is a concentration of assembly locations for trains, trams and metros in Germany.

Figure 1-3: Bombardier revenues by geographic and market segment



Source: Bombardier Transportation, 2010.

Specialized on mass transit, regional and mainline trains are the sites in Hennigsdorf near Berlin, Aachen and Görlitz. The site in Bautzen is a centre of expertise for trams while Kassel is specialized in locomotives. Bogies development and production takes place in Siegen. Propulsion and control systems in Mannheim and the development of rail control solutions in Brunswick round off the broad portfolio of rail transport technology of Bombardier Transportation in Germany. More than 50 percent of the engineering and production work is exported to customers around the world, increasingly to emerging markets like China and Asia. Even though the railway sector is growing, many authors highlight that the railway industry has overcapacities in manufacturing resources and

sites (Bombardier Transportation, 2010). This is visible through the closure of certain factories and downsizing activities in Europe like the sites Aachen, Salzgitter and Görlitz. Figure 1-4 shows an overview of railway manufacturers in the transportation industry (Bombardier Transportation, 2010) including Bombardier, Alstom, Siemens, Hyundai Rotem, the Japanese conglomerate of Hitachi, Kawasaki and Mitsubishi, the Chinese companies CNR and CSR, the Spanish CAF and Stadler (Bombardier Transportation, 2010).

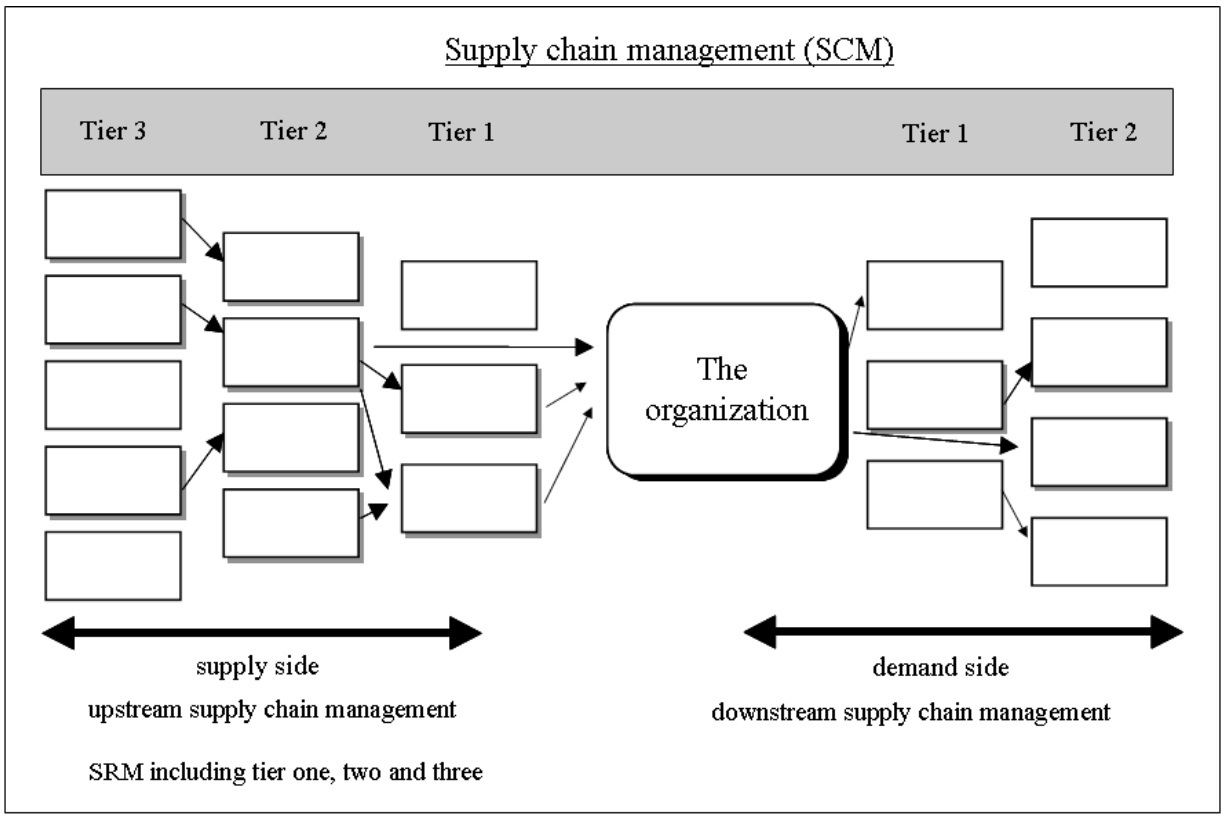
Figure 1-4: Overview of railway companies in European transportation industry

Source: Bombardier Transportation, 2010.

1.3 SRM in the context of global and complex supply networks

Fierce competition in the transportation industry forces manufacturing companies to follow the global trend to become more efficient, by specializing in core competencies, radically re-shaping the environment of the upstream supply chain management (Aberdeen group, 2006). Figure 1-5 depicts the supply chain management (SCM) in relation to the supply and demand sides (Slack, 1995; p. 512). Several authors point out that supply networks or supply chains, the terms supply chains and networks are used synonymously in literature, have become more complex and international (Aberdeen group, 2006; Bozhard et al., 2009). Bozhard et al. (2009) describe complexity as being a general trend in the upstream supply chain management, i.e. growing transfer of products, services and activities to suppliers, increase in number of supply chain layers (tiers), and the internationalization of supply chains.

Figure 1-5: SRM in the context of the upstream supply chain management



Source: adapted from Slack et al., 1995; p. 512.

As a result, the vulnerability and exposure to external disturbances arising from supply risks have grown significantly (Trkman McCormack, 2009; Zsidisin, 2003). Dyer (1996; 2000) and the Aberdeen group (2006) observed that companies are specializing in their key processes and products, thus concentrating on core competencies. In many cases, the activities carried out by the organization

itself account for only 20 to 30 percent of its total performance (Bozhard et al., 2009). The growth of supplier activities directly affects the supplier relationship management (SRM), as emphasized by Emmett and Crocker (2009). In recent years, many companies have reduced their value-adding activities and implemented efficiency-oriented cost reductions, i.e. outsourcing, single sourcing, low-cost country sourcing, platform concepts, lean management or design-to-cost approaches (Aberdeen group, 2006). As a consequence, SRM has become more important in core and peripheral business areas (Trkman & McCormack, 2009) and is aimed at building resilient supply chains (Christopher & Peck, 2004). Resilient supply chain is referred to as the anticipation, management, prevention of supply chain disruptions and mitigations at an early stage (Christopher & Peck, 2004) as with the increased dependency on supplier networks (Tang, 2006; Kersten et al., 2008; Tomlin, 2006) supply risks have increased, too. Examples in literature of supply disruptions led to high recovery cost, waste and sharp decreases in sales, as shown in the following Table 1-6 (see also Appendix 1).

Table 1-6: Examples of supply disruptions

Year	Description	Source
2011	Deficient electrical parts caused passengers to stay in Eurostar train overnight.	Haslett, 2011
2011	China's new high-speed rail plagued by power outages caused by malfunctioning electrical appliances and overvoltage.	Jing, 2011
2010	Honda recalls 437,000 cars due to potential faults in airbags. Airbag supplier faced quality problems.	Grant, 2010
2009/2010	World-wide recalls for major car lines by Toyota due to defective component and systems supplier (floor mats).	Connor, 2010
2008	Module and component supplier Plastech went into receivership (Chrysler). This led to temporary shutdown of Chrysler factories.	Trkman & McCormack, 2009
2007	Toyota Motor Corporation halted production in all Japanese factories due to an earthquake that severely damaged Riken as the major parts supplier.	Blackhurst, 2008
2001	Ford Motor Company spent 2.1 million USD to replace defective tires from Firestone. 14.4 million tires were recalled.	Kumar, 2001
2000	Lightning caused a fire that shut down the Philips semiconductor factory in Albuquerque, thus causing shortages of components for several industries.	Tomlin, 2006

Source: Haslett, 2011; Jing, 2011; Grant, 2010; Connor, 2010; Trkman & McCormack, 2009; Blackhurst, 2008; Kumar, 2001; Tomlin, 2006.

Customers were dissatisfied, which had negative impacts on brand image and sales, as shown by supply disruptions and incidents (Haslett, 2011; Jing, 2011; Grant, 2010; Connor, 2010; Trkman &

McCormack, 2009; Blackhurst, 2008; Kumar, 2001; Tomlin, 2006). Hendricks and Singhal (2005) identified that enterprises without operational slack and redundancies in their supply chains experience negative stock effects. They revealed the tremendous impacts of supply chain disruptions on stock price performance, shareholder value and profitability (Hendricks & Singhal, 2005). In addition, disruptions caused by suppliers can also impact the image of a company as shown by the worldwide recall actions of cars to the dealers due to faulty parts by Toyota in 2010 (Connor, 2010). Although literature is already available on the research topic, several authors point out the need for a more holistic approach (Narasimhan & Talluri, 2009; Nishat & Ravi, 2006; Choy et al., 2003). There is a discrepancy between the proactive role of SRM in complex and global supply networks and the traditional view of how to deal with suppliers (Christopher & Peck, 2004; Aberdeen group, 2006; Gürtler & Spinler, 2010). SRM and Supply chain resilience is a rather new and still a largely unexplored area of management (Christopher & Peck, 2004). Supply chain risks have been predominantly investigated on the direct level of tier one relationships, but consideration has not extended to that of the sub-suppliers, i.e. tiers one, two, three and beyond (Harland et al., 2003). Moreover, best practice suggestions in SRM in the relevant industry are not available in literature (Harland et al., 2003; Gürtler & Spinler, 2010). This research seeks to address these concerns by examining risk factors of supply chain disruptions, by investigating how disruptions can be anticipated, prevented and managed and by identifying the best practice elements of SRM in manufacturing companies in the European transportation industry. All this leads practitioners and academics in manufacturing companies to avoid these negative incidents throughout the supply chains by developing preventive actions and by identifying best practice elements for SRM (Gürtler & Spinler, 2010). The typical challenges and issues described in the existing literature raise the following questions as outlined by several authors (Tang, 2006; Cohen & Kunreuther, 2007; Seuring & Müller, 2008; Bozhard et al., 2009; Dust et al., 2010; Gürtler & Spinler, 2010):

I. What are the schools of thought in SRM?
II. What are the causal factors for supply disruptions?
III. How can supply disruptions be anticipated, managed and prevented?
IV. What are the best practice elements in SRM?

This thesis seeks to address these issues and to find answers to the questions in the respective field. The research will therefore represent a major contribution to science and managerial practice, as existing research in SRM does not suggest best practices in SRM and as it is limited to a more narrow view on how to create a resilient supply chain in global and complex supply networks. The

following chapter two will highlight certain limitations, the objectives, the sequence, the research plan and additional aspects of importance for this thesis.

2. Scope of research and definition of terms

2.1 Definition of terms and limitations

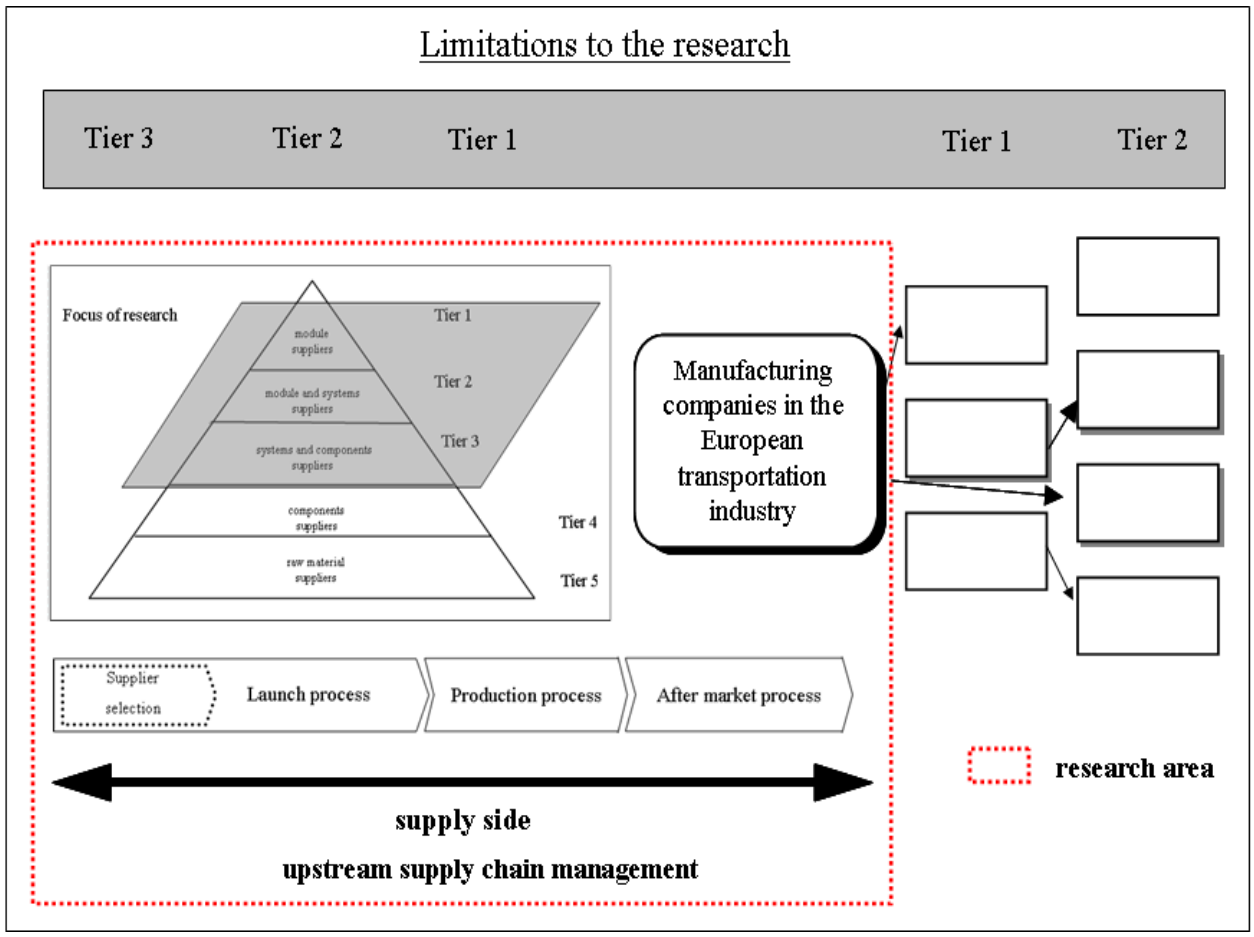
This doctoral thesis on creating a best practice model for SRM in manufacturing companies of the European transportation industry has certain limitations. SRM deals with the relationships to suppliers and the respective supply chains or supply networks as defined by various authors (Emmett & Crocker, 2009; Johnson et al., 2006). Supply chains and supply networks are used in literature synonymously and incorporate in this thesis the supply of raw materials, components, systems and modules to manufacturing companies and original equipment manufacturers (OEM) in the European transportation industry (Dyer, 2000). The different supplier layers are called "tiers" in literature and managerial practice as shown in Figure 2-1 (Blokdijk & Von Emero; 2008; Christopher, 2005). The doctoral thesis is restricted to supply chains on tiers one, two and three and focuses on modules, systems and component suppliers. The supply of these modules, systems and components is linked to certain phases and processes of the value stream of the buying company, the OEM, as displayed in the same figure (Emmett & Crocker, 2009). These processes are:

- supplier selection process
- launch and pre-production process
- production process
- after market process

These four phases include SRM activities during the supplier selection process, the supplier launch activities, also called pre-production in managerial practice, supplies during the own production and the after market activities of suppliers (Tan, 2001). It is the responsibility of the procurement or SRM function to shape supply networks designs with on time deliveries at the highest quality and the lowest total cost and the optimal structure given in order to secure supply chain resilience (Emmett & Crocker, 2009). Practical applications for network optimization include the manufacturing site selection, capacity utilization, and product allocations to suppliers as recommended by Behrendt (1996). Moreover, the supplier selection and the shaping of global supply chains include the logistics centres and warehouse site selection, number and size of locations. The dotted line shows the limitations of the thesis including manufacturing companies within the European transportation industry, the tiers one, two, three, and the relevant phases from supplier selection to the after market. This research aims at addressing these aspects by defining best practice elements of SRM in manufacturing companies in the European transportation industry, by identifying macro and micro

root causes for non resilient supply chains or delivery disruptions and by giving recommendations how disruptions can be anticipated, avoided or mitigated (Bennett & O´Kane, 2006; Rao & Goldsby, 2009; Narasimhan & Talluri, 2009). Authors point out that the layout and shape of supply chains or supply network within the last decade have been subject to significant changes in terms of total numbers of involved chains and nodes (Aberdeen group, 2006). Also, the distances and the cross border movements have been increased due to liberalization of global markets (Christopher & Peck, 2004; Roland Berger Strategy Consultants, 2012).

Figure 2-1: Scope and limitations of doctoral thesis



Source: Limitations on research in SRM - adapted from Slack et al., 1995.

This thesis is limited to supply networks and its supplier relationships with manufacturing companies in the European transportation industry. The study is executed within manufacturing companies of this sector and limited to the automotive, truck and railway areas. Interview candidates and senior managers in the field of SRM participating in this research are mostly employed in multinational companies, so that the application to small-medium size enterprises (SME) needs further investigation in a future and separate thesis. For validation and adjustment of research questions in

Phase I, senior managers from Bombardier with experience inside and outside the company have been interviewed. The systematic literature review in Phase II is based on limitations in terms of population, date and other criteria. These limitations have been displayed in the inclusion and exclusion criteria as recommended by Fink (2010). Additionally, Phase II comprises interviews from senior managers in SRM related areas of manufacturing companies in the relevant industry. These interviewees have been selected by their experience and work area. Phase III targets to confirm or disconfirm the results from the previous stage by two case studies. As final stage, Phase IV confirms, disconfirms and refines the theory and best practice elements, which have been identified in the previous phase.

2.2 Research sequence of this thesis

Chapter one starts with the introductory part of the research topic and field, including the outline of the research purpose and objectives within the European transportation industry. In this context, the railway industry and the company Bombardier, in which a large part of the field research of this thesis takes place, are described (Roland Berger Strategy Consultants, 2012). The same section outlines the challenges in globalized and compound supply networks, followed by the scope of the thesis, the definition of terms and limitations of the research in chapter two (Zsidisin, 2003) . Chapter two outlines the need for a broader view on SRM and its management of suppliers, including proactive and preventive measures (Cavinato, 2004; Bozhard et al., 2009). Chapter three describes the ontological viewpoint and the reflective professional practice of the author. This section highlights important aspects and people of influence for the research activity and study. It also highlights the reflectional practice of the past, the present and the future. Chapter three explains in detail, why there has been a change from a positivist to a pragmatic interpretivist. The next chapter four outlines the research methodology and research methods. A qualitative and multiple methods approach has been applied, involving an ongoing systematic literature review, semi-structured interviews and two case studies. Even though, qualitative methods show weaknesses according to critics, there are many researchers who recommend the usage of qualitative methods rather than quantitative ones (Yin, 2009). The same chapter is giving the reasons why qualitative and multiple methods approach has been chosen. Chapter five starts with Phase I and the confirmation, disconfirmation and refinement of research questions (Remenyi et al., 2003). For this purpose, five semi-structured interviews with senior management in SRM have been conducted. The generic and specific research issues addressed in literature and managerial practice have been confirmed or disconfirmed through this step. Where necessary, adjustments to the research questions have been made. Chapter six covers field research including an ongoing systematic literature review and the

interviews (Phase II) with some ten senior managers in manufacturing companies in the transportation industry in Europe. In this chapter, it has been intended to identify answers on the generic and specific questions. It has been targeted to show schools of thought in SRM, causal factors for supply disruptions, measures how to anticipate, manage and prevent supply disruptions and to identify best practices. Categories of best practices in SRM in the respective industry have been defined in this chapter. The next chapter seven has confirmed and disconfirmed the findings of best practices by a case study approach within Bombardier (Phase III). Two in depth cases have been applied to validate or adjust the aspects which were identified in Phase II. The pattern matching technique has been chosen as suitable method to compare the findings of literature review and interviews with the findings in the case study review. After confirmation or disconfirmation, chapter eight (Phase IV) has refined the findings, how companies in the European transportation industry can apply best practices in SRM in that way to create a resilient supply chain. The conclusion in chapter nine has given logical implications to the research as well as limitations by establishing a best practice model of SRM for manufacturing companies in the relevant industry. This section has provided clear recommendations how manufacturing companies in the analyzed industry must implement strategies, processes or tools in order to have a best-in-class SRM. Finally, recommendations of future research areas in the scrutinized industry have been outlined in the same section.

2.3 Proactive measures versus reactive measures in SRM

In today's uncertain and turbulent markets, supply chain vulnerability has become an issue of significance for many companies (Christopher & Peck, 2004; Gürtler & Spinler, 2010). As supply networks and supplier relationships become manifold due to global sourcing and the continued trend to become leaner, supply chain risks increase (Harland et al., 2003). The challenge to business today is to manage and mitigate that risk through creating more resilient supply chains (Nishat & Ravi, 2006). Supply chain managers strive to achieve the ideals of fully integrated efficient and effective supply chains, capable of creating and sustaining competitive advantage (Christopher & Mangan, 2005). To this end they must balance downward cost pressures and the need for efficiency, with effective means to manage the demands of market-driven service requirements and the known risks of routine supply chain failures. Better management and control of internal processes together with more open information flows within and between organizations can do much to help (Hittle & Leonard, 2011). However, in an age of lengthening supply chains serving globe-spanning operations, recent events around the world have provided frequent reminders that we live in an unpredictable and changing world (Gürtler & Spinler, 2010). Natural disasters, industrial disputes, terrorism, not to

mention the spectre of war in the Middle East, have all resulted in serious disruptions to supply chain activities. In these situations reactive business practices as usual are not an option as outlined by Hittle and Leonard (2011). Modern commercial supply chains are in fact dynamic networks of interconnected firms and industries. No organization is an island and even the most carefully controlled processes are still only as good as the links and nodes that support them. Effective business continuity plans enable users to assess the vulnerability of the company to supplier and manufacturing operations failures, logistics failures, workforce unavailability, and information and technology disruptions (Rao & Goldsby, 2009; Gürtler & Spinler, 2010). They also help create accurate what-if scenarios and assess the capability to respond to disruption (Dust et al., 2010). When creating a business continuity plan, it is necessary to engineer a clear, actionable contingency plan for failures of any supply chain pillars (Nishat & Ravi, 2006; Wieland & Wallenburg, 2012). Also it is of the utmost importance to identify key thresholds for executing risk mitigating decisions, such as sourcing from alternate partners, channels, and manufacturing and distribution systems as recommended by Rao and Goldsby (2009). Disasters like military conflicts or natural catastrophies that ultimately lead to supply disruptions often result from misaligned company departments, functions, strategies or contingency plans as outlined by several authors (Gürtler & Spinler, 2010; Rao & Goldsby, 2009). In such situations, centralized decisions based on real-time information from all sources are crucial. It is essential to institutionalize a contingency management team that will direct all actions during times of disruption. This team must be comprised of senior people who can exercise influence over the various decision makers of the company as recommended by Christopher and Peck (2004). It is vital to keep an eye on each country or region for threats and trends that will affect the supply chain: weather, port and transportation worker strikes, fuel prices, currency exchange, inflation, labour rates, pending legislation, political elections, natural disasters, and more. Finally, it is necessary to employ historical data for operations planning, and avoidance of sourcing in certain regions must be addressed in the context of securing supply chain resilience (Christopher & Peck, 2004). As can be seen from disruptions in the past, SRM activities have been classified by Harland et al. (2003) and other authors (Christopher & Peck, 2004) in three categories. These categories are: (1) proactive or preventive SRM measures, (2) reactive measures or mitigations, and (3) post recovery actions (Harland et al., 2003; Gürtler & Spinler, 2010). Preventive actions are all activities in SRM before the disruption occurs. The aim is to create a resilient supply chain by anticipating potential supply chain disruptions and by addressing all identified impacts through an early warning or alert systems (Christopher & Peck, 2004). Reactive steps are undertaken when the disruption already occurred. The objective for reactive actions is to quickly mitigate with special activities in SRM in order to reach full recovery. Post-recovery steps comprise risk assessments, performance reporting on potential risks, supply chain evaluation, and recovering losses through

insurance or supplier claims. While the strategic vision must take a top-down direction, operational activities need to be implemented from the bottom up perspective. Based on the efforts required before, during, and after a disruption, the research will present a comprehensive framework to build a resilient supply chain for manufacturing companies in the European transportation industry by implementing best practice elements (Harland et al., 2003; Kersten et al., 2008). The next section outlines the aspects of ontology and epistemology, which contributed to the research.

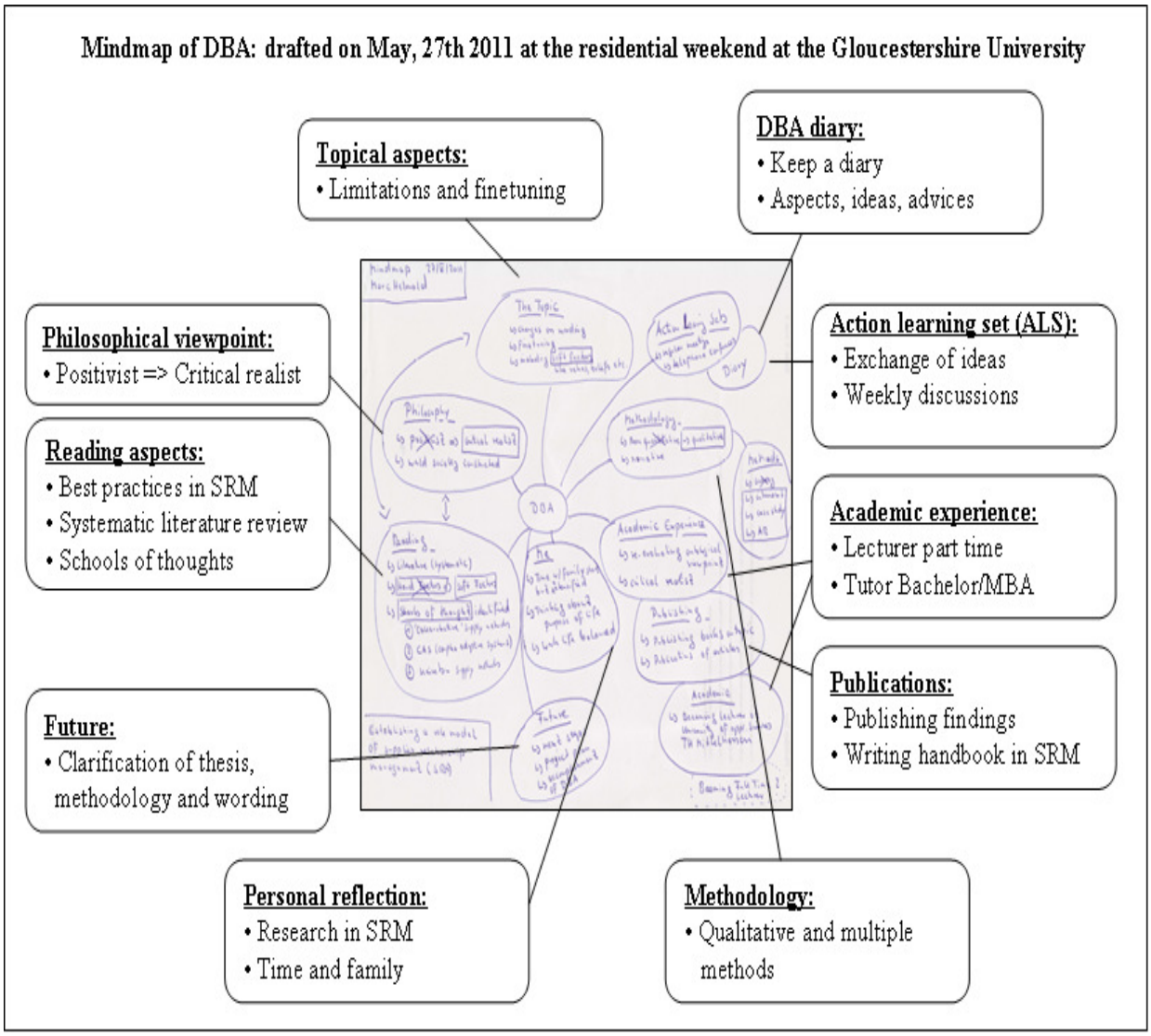
3. Ontological viewpoint and reflective professional practice

3.1 Ontological viewpoint

Ontology and epistemology have been important aspects of the following research on SRM. Ontology describes the philosophical viewpoint, and the particular theory about the nature of being or the kinds of things that have existence (Remenyi et al., 2003). Epistemology deals with the study or a theory of the nature and grounds of knowledge especially with reference to its limits and validity (Remenyi et al., 2003). This section outlines the ontological and epistemological viewpoint as well as reflective professional development of the past, the present and future of the research journey as recommended by several authors (Dewey, 1933; Hulfish & Smith, 1961; Schön, 1983; Moon, 2004). It will also give an outlook to the future, particularly showing changes in terms of beliefs, viewpoints and personal aspects from enrolment up to now as proposed by Moon (2004). She summarizes three major and common principles for reflection (Moon, 2004): First, "reflection lies somewhere around the process of learning and the representation of that learning". Secondly, "reflection implies a certain purpose". This fact is also emphasized by Dewey (1933) and Hulfish and Smith (1961). The third aspect is, that "reflection involves complicated mental processing of issues for which is no obvious solution" (King and Kitchner, 1994). The paper also means to outline the reflective process in terms of other perspectives developed by van Manen or Schön (Moon, 2004). Van Manen (1977) describes certain "levels of reflection" whereas Schön (1983) interprets reflection as "reflection by action" and "reflection in action". A very significant statement comes from Bolten (2004). Bolton (2004; p. 4) constitutes that "reflective practice is only effectively undertaken and understood by becoming immersed in doing it rather than reading about it or following instructions". He mentions, too, that "reflective practice is a process of learning and developing". Moon (2004) emphasizes that "a metacognitive stance" is extremely important to have a critical awareness of one's own processes of mental thinking. After the description of theories of reflection, the paper highlights the personal experiences during the research journey and how ideas, beliefs and paradigms changed (Beckhard, 1969). Beckhard developed a model including aspects, strategies and tactics of organizational change, in which the main principles also apply to personal development. Furthermore, this section will highlight other changes and areas affected during the journey, such as family, friends and work related environments. Finally, as part of the reflection process, resistance to change will be shown, as resistance to change, including personal and organizational life, is an inescapable part of life as manifested by K. Lewin (1946) and other authors (Beckhard, 1969; Lewin, 1946). Other influential factors on the personal development and the progress of the research have been tackled, such as contact with advisors, discussion with SRM experts and advices by mentors and experts in the field

of supply networks and SRM (Moon, 2004). Authors like Moon propose to draft the key influential aspects of the research journey. The mindmap in Figure 3-1 from summer 2011 summarizes the major aspects during the research. It was drawn and presented to the module advisors during the residential weekend in Cheltenham in May 2011 and tackles areas like the research questions itself, the action learning set (ALS), the philosophical viewpoint, the methodology, the academic experience acquired, the personal change, family matters and other issues. As recommended by the same author, additional aspects of reflective development have been added to the figure during the writing and completion of the thesis (Moon, 2004). If the research was ongoing, further aspect could be implemented into such mindmap as a never ending process of reflection (Moon, 2004). The thesis will later on explain the individual categories in more detail.

Figure 3-1: Mindmap: doctorate and research (May, 27th 2011)



Own source, mindmap drafted in 2011in Cheltenham and amended until completion of thesis.

3.2 Why research on SRM and supply networks

During the professional career of the author in procurement and supplier performance management, he passed through certain steps from buyer via purchasing specialist, group leader to manager and director, predominantly in the transportation industry (Ford Motor Company, Mazda Corporation, Porsche AG, Panasonic Automotive Systems Europe (PASE), but also in the railway sector (Bombardier). The author himself experienced that as the value-adding activities of one's own organization decrease, the importance of supply networks and supplier management has become more and more important, as several authors have highlighted (Hamm, 1998; Ellram & Liu, 2002; Bozhard et al., 2009). As the share of procurement activities gets bigger and more goods and services are purchased from suppliers, the risk of supply chain and supply network disruptions increases (Chopra & Sodhi, 2004). This has led the author to the question of what a resilient supply chain and best practice SRM model should look like. After the transfer from the Ford Motor Company in Cologne (Germany) to Mazda in Hiroshima (Japan), he experienced a different way of dealing with suppliers, the so-called "keiretsu supplier networks". In contrast to Ford, supplier relationships at Mazda were based on trust, partnership and mutual benefit including synchronization of production and scheduling systems. There relationships to the suppliers were tight, as a result supply disruptions rarely occurred, and when they occurred, the supply disruptions could be quickly mitigated through mutual recovery. Liker and Choi (2005) came to the same result and made recommendations for smooth cooperation with suppliers. Returning from Japan to Germany, the author experienced that Porsche and Mercedes had adopted certain principles and philosophies from Toyota and other Japanese manufacturers. It was visible that their models were also quite successful in terms of SRM, quality defects, quality reports and other significant factors as emphasized by Kalkowsky (2004) in his interview with Prof. T. Jones. Liker and Choi (2005) developed recommendations, which need to be applied to have a resilient supply chain, comparing Japanese enterprises with companies from the U.S.A and Europe. By scrutinizing magazines and books, the researcher found several articles and case studies on SRM whose authors ask if disruptions within supply networks can be avoided by analysing those networks in a more holistic way (Chopra & Sodhi, 2004; Wu & Knott, 2006; Narasimhan & Talluri, 2009; Dust et al., 2010). Recent examples of supply disruptions of the previous chapter led to high recovery costs, waste and a sharp decline in sales. Customers became extremely dissatisfied, which naturally had a negative impact on brand image and sales, as several authors have shown in their articles and books (Zeller, 2010; Connor, 2010; Trkman & McCormack, 2009; Blackhurst, 2008; Kumar, 2001; Tomlin, 2006; Helmold, 2011). In international procurement conferences, the author realized, that senior managers, academics and executives raise similar questions, on the question what best practice elements in SRM are in order to create the resilient supply chain (Automobilproduktion, 2012). Finally, the movement from the automotive to the

railway sector as the head of the procurement in the manufacturing site in Hennigsdorf near Berlin also made the same queries, as this site was faced with a high number of production standstills caused by supplier outfalls and supply disruptions (Bombardier Transportation, 2010). All these aspects led the author to start research in this field in order to identify best practices in SRM and to prevent from such incidents. In addition to the literature and the four *generic* questions from the previous section (Tang, 2006; Cohen & Kunreuther, 2007; Seuring & Müller, 2008; Bozhard et al., 2008; Dust et al., 2010; Helmold, 2011), additional questions from managerial practice in manufacturing companies in the European transportation industry raise more *specific* issues and pose the following questions (Aberdeen group, 2006; Chopra & Sodhi, 2009):

1. How can supply disruptions be avoided? Why?
2. How can supply disruptions be recognized at an early stage?
3. How is SRM linked to the corporate strategy? Why?
4. What are the main values and most important policies concerning SRM?
5. How is SRM organised? Why should it be organized that way?
6. Who is responsible for SRM?
7. How are information systems used in SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) in SRM?
10. How do SRM activities add value? Why?

In line with the addressed questions issues like business processes, methods, tools and the assurance of sustainable measures have been included in the study as recommended by experts in SRM (Gürtler & Spinler, 2010). Scholars and SRM practitioners agree that there is still a considerable gap between the optimal proactive role of SRM in complex and multilayer supply networks on the one hand and reality on the other hand, as shown by Harland et al. (2003) or Gürtler and Spinler (2010). There are companies that are quite successful in managing their supplier relationships (Like & Choi, 2005) and others which face difficulties in SRM. This may be due to the fact that certain companies or organizations developed successful practices, robust principles and sustainable processes in SRM (Bennett & O´Kane, 2006; Dust et al., 2010) which can then be possibly applied to other companies or industries (Tang, 2006; Cohen & Kunreuther, 2007; Seuring & Müller, 2008; Bozhard et al., 2008; Dust et al., 2010; Helmold, 2010). During the author's research journey, he has made several changes, triggered by various influential factors, e.g. supply chain disruptions, existing literature, discussion with the doctoral advisors, attendance of the residential weekends at the modules in

Munich and Cheltenham and other factors. But also family and private matters triggered a change. “Change is a learning process affecting both organizations and personal life”, as outlined by Lewin (1946). It not only comprises philosophical standpoints, methodology or theories, but also private matters and beliefs (Moon, 2004). Coming from a positivist business environment in procurement, in which numerics, hard facts and key performance indicators (KPI) are mostly used, the author has meanwhile adopted a pragmatic interpretivist´s viewpoint, which holds that the world is constructed in social terms, and that the world is to be perceived and interpreted as human construction. One important step during the research journey so far has been discovering that the material which deals with purely hard and positivistic factors is very vague. The shift towards the ontological viewpoint as a pragmatic interpretivist is one of the the most dramatic change the author experienced so far. Basically, it means that the scope of the research needs widening. Furthermore, the methodology and methods had to be amended, too. Whereas the initial focus was on hard facts (e.g. numeric supplier evaluation and supplier performance), soft facts like beliefs and ideologies have now been incorporated into the topic (Moon, 2004). In the philosophy of perception, interpretivismsupports the theory that some of our sense-data (for example, those of primary qualities) accurately represent external objects, properties and events, whereas other sense-data (for example, those of secondary qualities and perceptual illusions) do not (Bhaskar, 2007). Ideally speaking, interpretivismsignifies a mind-dependent view of the world which tries to “understand” the mind-independent world. The research sequence which has developed so far is visible in chapter four. Chapter four will describe in detail the methodology and research plan including four major stages.

3.3. Action Learning Set (ALS): start of the research journey

An effective method of proceeding with the doctoral journey has been the creation of an action learning set (ALS) as suggested by Lewin (1946) and Avison et al. (2009). Pedlar et al. (2003) define action learning (AL) as “a method for individual and organizational development.” People deal with important issues in small groups and learn from their attempts to change things. Taylor (2007) outlines in the article “Learning to Become Researching Professionals” the growth of long-distance learning in the U.K. and describes several difficulties which are faced by post-doctoral students in long-distance learning courses. She stresses that learning and teaching is essential as part of the studies in order to add new knowledge.

The AL approach was considered a suitable tool as contribution to this research. Therefore, an ALS was set up by the doctoral students after the first residential phase in Munich in March 2010 with the intention of meeting on a weekly or bi-weekly basis as recommended in literature (Taylor, 2007).

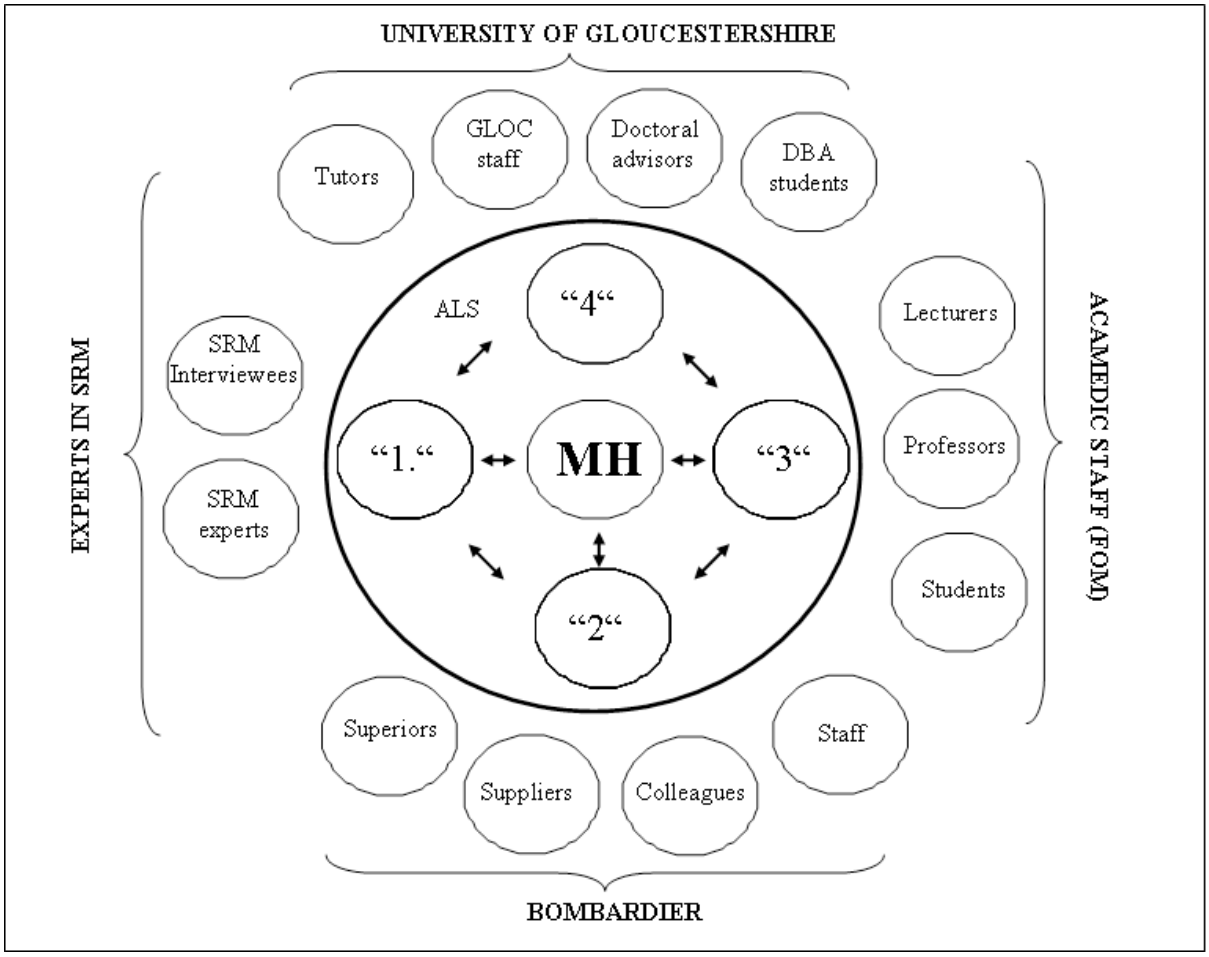
The way of communication selected was telephone conferencing supported by electronic mail. A day and time slot (Wednesday, 19:00 CET) suitable to all members was determined, including a telephone number which was universally available. The ALS aimed to help with the submission of assignments on time and provide a basis of collaboration and networking, as shown in Figure 3-2. Even though not all members were able to attend every meeting, a certain number of students took part regularly in the discussions and exchange of information. Per definition (Lewin, 1946), the ALS helps the individual to get advice from other doctoral students and to exchange ideas, to get insight into other ways of thinking and to obtain different perspectives on the various research topics and philosophical viewpoints. Originally, eight or more students were supposed to join the weekly telephone conferences, but in the end only four to six students actually participated. Unfortunately, the group did not manage to exchange drafts, structures and ideas via email on a regular basis. Certain deliverables (e.g. exchanging the structure of each module, comparing formative assignments) were not met due to the fact that all candidates had a full-time job and therefore were not able to complete the tasks at the same time. In addition to the fact that not all students could meet the deadlines, some students were hesitant about exchanging information. Despite the difficulties, however, it was possible to have a consistent exchange bilaterally or jointly with three to four other students, who could then progress together. The ALS consisted of a core of four to five members (see Figure 3-2 and the inner circle including the numbers one to four) who helped each other regularly with problem-solving and decision-making concerning modules and questions related to their individual research topics. The members of the ALS tried to agree on an agenda in advance in order to have structured discussions. They followed the principles recommended by Revan (1998) in considering change in terms of uncertainty, whereby people need to understand the meaning of the problem by gathering information in small groups. After the submission of all modules the sequence changed to more irregular meetings. The number of participants changed, too, as a lot of members had different progress on executing the doctoral thesis. Few members also decided to suspend their research due to workload or private issues. Currently there are two to three members, which take part in the communication of the ALS.

The different backgrounds and research areas of the participants, e.g. research areas in supplier networks, ballooning, joint development & launch management, human resources development in India, contributed to the fact that issues were discussed openly and without prejudice. Pedlar et al. (2003) describe this process as “taking action and learning from the effects of that action as a fundamental principle for research”. There was also a controversy inside the ALS, on how the research involves and trigger activities and actions. Kurt Lewin (1946) first coined the term Action Research (AR) in his paper “Action Research and Minority Problems”, characterizing AR as “a form

of comparative research on the conditions and effects of various forms of social action and research leading to social action".

He also stresses that AR is a process of "a spiral of steps, each of which is composed of a circle of planning, action, and fact-finding about the result of the action". The implementation of best practices might require "social action and research learning" as proposed by Lewin (1946). The controversial discussion in the ALS has shown that AR may suit research in certain cases where an interventionist approach is appropriate. Even though, AR is not foreseen in this research, it might be a suitable method for future research purposes in the field of SRM and supply networks. The chapter nine will give recommendations, where AR is considered a valuable contribution to further research in this field as recommend by Pedlar et al. (2003).

Figure 3-2: Action learning set (ALS): how the research journey started



The Figure shows ALS core members and their contribution to the research. The numbers 1 to 4 represent the ALS members."MH" represents the author´s initials "Marc Helmold". For the reasons of anonymity, the members of the ALS have been described in these numbers. With the ALS initiation the research journey for all started.

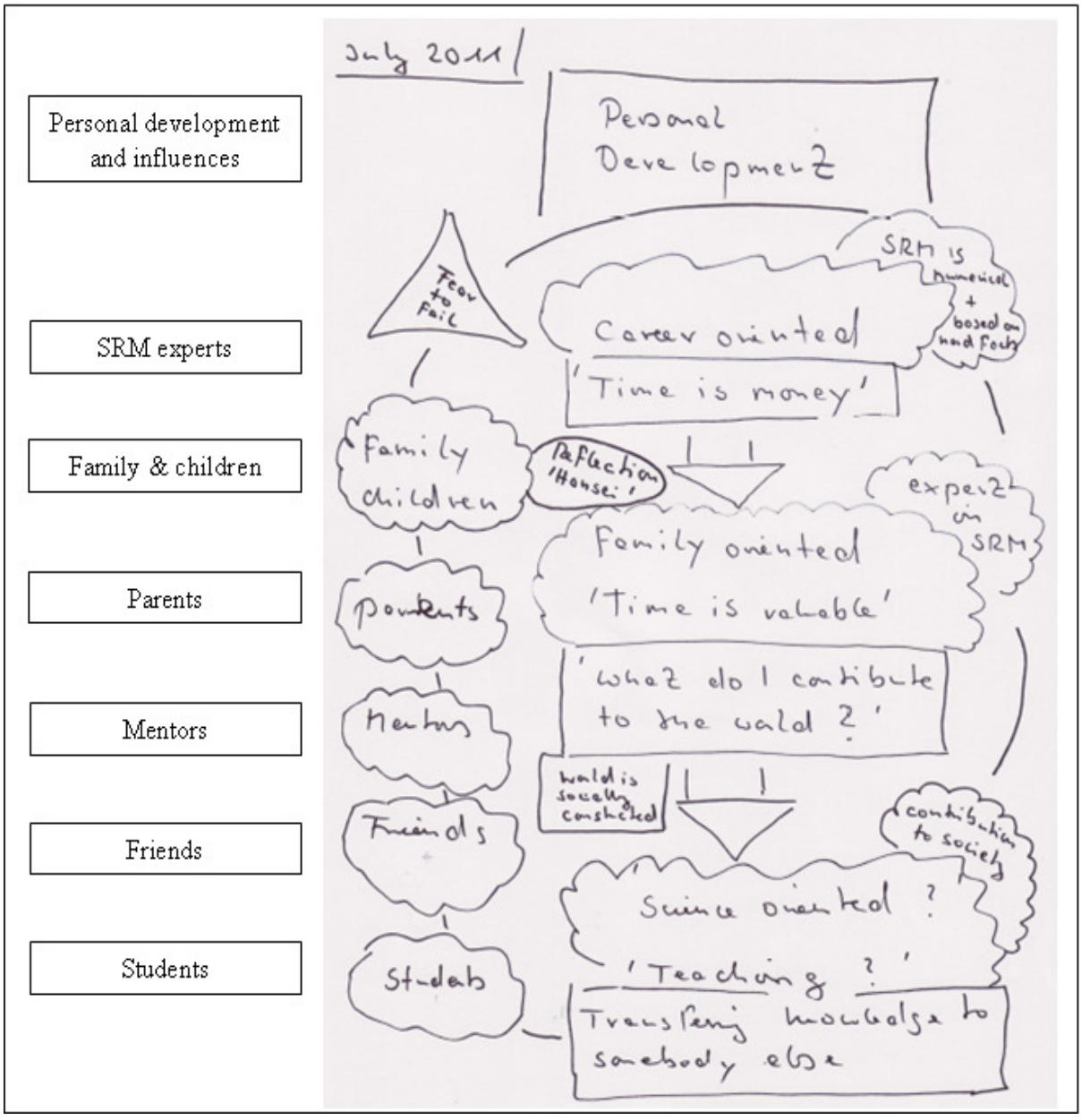
3.4 Personal development during time

The doctoral study on SRM has led to significant changes of the author in terms of time, money and life quality. Change models found in the literature (Lewin, 1946; Beckhard, 1969; Bandura, 2007; Beer & Walton, 1987) emphasize that changes "imply additional workload, anxiety and unpredictability". K. Lewin states that there are factors which drive change and factors which resist change (Lewin, 1946). He defines three stages as part of this model: unfreezing, changing and re-freezing. Such a pattern also applies to the author regarding person-oriented and research-oriented attributes, such as time management, work-life balance, self-motivation, priorities and satisfaction in life. Moreover, the career outlook as well as the objectives and target-setting have been affected by this. Finally, priorities changed and also the behaviour on people he spent time with. Time management has changed significantly in terms of combining work, family life and the doctoral study. As a balancing factor, physical training was intensified, such as jogging, walking or playing Golf.

The goal to accomplish the DBA has had a far-reaching impact on all areas of life. Alongside the job at Bombardier, the author accepted a part-time position as a lecturer for bachelor degree courses in supply management at the University for Economics and Management (FOM) and in distribution management at the Technical University Mittelhessen (THM). Indeed, it has been possible to integrate parts of the findings of the research into the manuscript. The author also takes advantage of the various facilities offered by the respective universities. All these factors have been partially instrumental in changing the philosophy and epistemology of this topic, as described above. A number of people, like wife, children, advisors, staff of the Gloucestershire University and mentors, have influenced the personal development during the doctorate. The personal development in the Figure 3-3 shows the impacts by family, children, parents, mentors, friends, and students including major steps (Moon, 2004). In July 2011, the personal reflective development was drawn on a flip chart during the residential weekend after approximately 18 months after enrolment as recommend by several authors (Moon, 2004). It shows people like SRM experts, family, parents, mentors, friends and other factors, who influenced the research. Research has become a vital part of the author's life and environment. Learning spells are either in the early morning or late evening, so that during the night or at weekends there is time for the wife and children. Although the family naturally has had the greatest influence on any changes regarding time management, self-structuring and motivation, other parties have impacted on the author's doctoral studies and philosophical viewpoint. He has had several discussions with the ALS, for example, which have influenced not only his assignments, but also the viewpoint on SRM. ALS telephone conferences normally took place in the evening. The doctoral advisors and tutors became involved in the modules by making comments and giving advice

on formative submissions of assignments. The research diary serves in this context as a tool to document the impacts as shown below.

Figure 3-3: Personal development throughout the journey



Source: Mindmap of personal reflection and development. July 2011, Cheltenham (UK).

The author started quite career oriented with an overriding attitude “time is money”. Also, the beliefs and paradigms on SRM were based on numerical and quantitative performance indicators. Through the employment and experience in Japan and wife from Japan, now living in Germany, the author

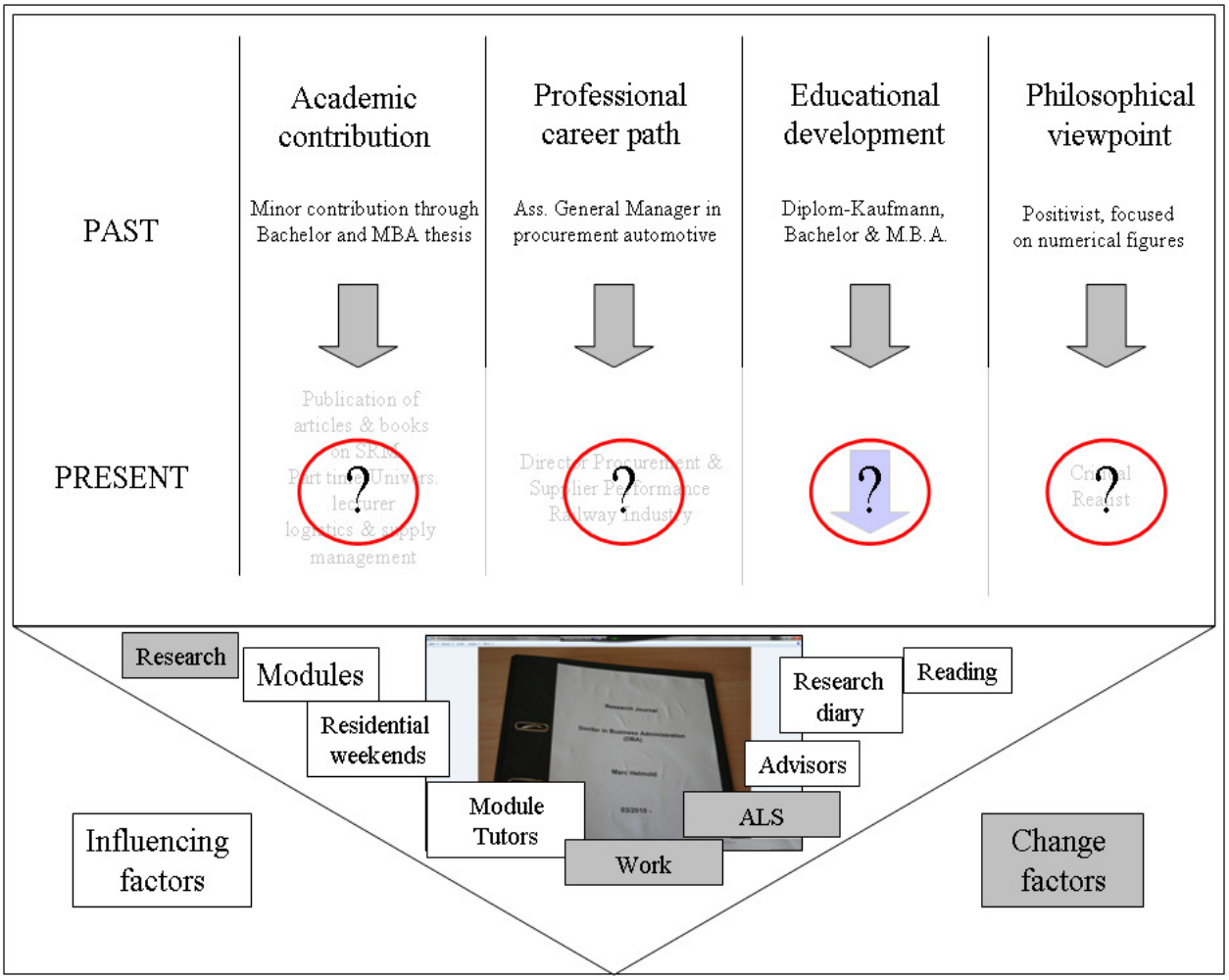
intensified the personal reflection, as old paradigms and patterns did not work out anymore (Moon, 2004). In Japanese “Hansei” means reflection, Hansei is a crucial part of the Japanese society (Roku, 1995). By doing Hansei, the author came to the point where he asked himself about what his contribution to society or science was, and how he can add value to managerial practice and academia as a potential expert in SRM. The answer to this question is not yet clear, he may continue to research in the field of SRM or further teach at Universities or Business Schools. Even though it was clear that a doctorate would require a huge amount of time in terms of studying, research and residential weekends alongside the job, wife, children and friends, the entire family encouraged the author to proceed with the enrolment. Shortly after the start of the doctorate in March 2010, he accepted a new position in Bombardier as the director of Site Procurement and supplier performance. The new position necessitated relocation from Frankfurt (Germany) to Berlin (Germany). The previous position had involved a smaller number of employees (15 direct reports and a material spend of 200 million EUR) and less responsibility compared to Bombardier (65 direct reports and a material spend of 400 million EUR). However, the author knew that it would be his task and responsibility to build up a new sub-department for supplier performance management (SPM), and he was sure that this would help with the thesis and research. Apart from the residential weekends in Munich and Cheltenham, it was difficult at the beginning to find an appropriate rhythm for studying. On the one hand, the new job required the author’s full engagement, on the other hand, his wife and the children also wanted to spend time with him after work and at weekends. It needed about six months to put together a time schedule where he was able to invest 15 to 20 hours per week studying and doing research as recommended by authors on post-doctoral degrees (Taylor, 2007). Prior to submission of an assignment, the level of engagement usually increased. During the residential weekends, a full weekend had to be spent for the doctorate. However, the time management and advanced planning have improved. A diary has been used from the beginning of the doctorate. The diary is recommended to be a guide throughout the research (Fink, 2010) and contains scribbled notes, comments by advisors, outcomes of the ALS and ideas on the research topic. Fink (2010) recommends using the diary as highlighting thoughts, aspects, concerns, progress steps and other areas of the research. The diary has been the permanent guide during the research period and includes a lot of lose papers, mindmaps, details, thoughts, aspects, ideas of the research about SRM in manufacturing companies in the European transportation industry (Fin, 2010). As many ideas during the journey have been discussed with the doctoral advisors or the ALS, the diary contains a high number of printouts from emails with scribbeled comments. The email folder meanwhile contains a high number of emails from comments and remarks of several questions within the research (Fink, 2010).

3.5. Reflective professional development: the past

3.5.1 Work-related issues and philosophical viewpoints

Figure 3-4 shows four categories of standpoint - academic, professional, educational and philosophical. It also shows the attributes and factors (ALS, modules, work, etc.) which triggered certain changes leading to the present situation. The major changes were noted in a research diary, as recommended by Fink (2009) or Moon (2004), and will be illustrated in the next section.

Figure 3-4: Influencing and changing factors during the research journey



Source: Influences and changing factors on research in SRM. Helmold, 2012.

It also shows that there were no major activities on the author's part in the past towards further academic engagement in terms of studying, e.g. doctorating, teaching, publishing. But it also highlights his personal development and reflection on academic, professional, educational and

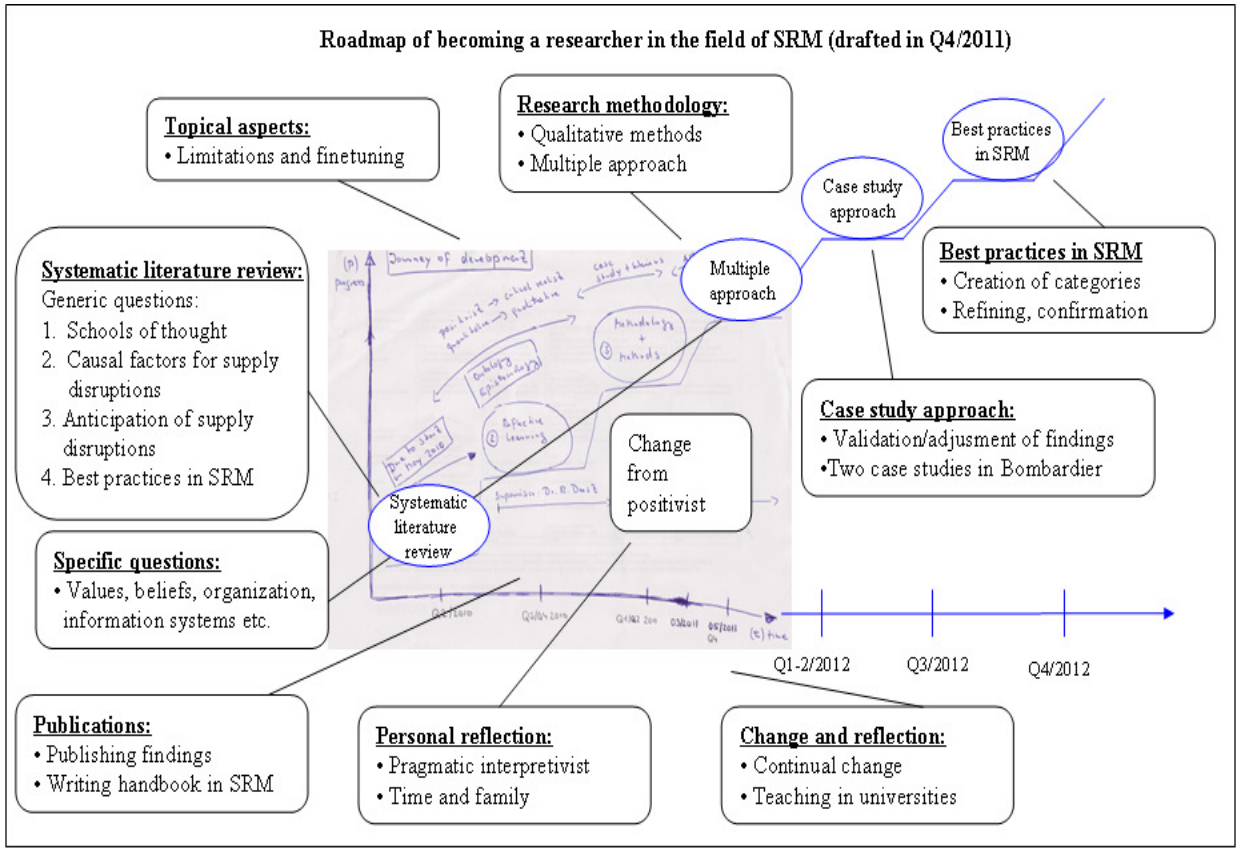
philosophical issues. He was hired in 2007 by Panasonic Automotive Systems Europe (PASE) and left the company Porsche AG. PASE had decided to centralize its European operations from Northern Germany and the Czech Republic to Frankfurt. The consequence was a huge restructuring program including the job opportunity for him. Experience in the automotive industry, above all in procurement and supplier management, was needed, so that PASE recruited him to direct the restructuring. The main focus proved to be on professional activities, especially setting up a new procurement organization in Frankfurt. All supplier issues were put under the researcher´s command. About 200 suppliers had a material spend of 200 million EUR in 2010. As a consequence, he was promoted from a manager's position to that of Assistant General Manager. The previous experience with Ford, Mazda and Porsche helped him in building up a traditional procurement organization. On the question of what an ideal model for supplier relationships should be like, he consulted friends, experts and the literature in the field of SRM. Prior to starting the doctoral thesis, he tended towards a positivistic philosophical stance, trusting in the fact that supplier performance management and relationships are basically measured by numerical key performance indicators (KPI). The researcher believed in quantitative data as being objective and representing the real world, e.g. supplier ratings, supplier parts (defects) per million (ppm). The experience in organizations like Ford had fostered this standpoint. His thinking was that supplier performance management was predominantly based on hard facts and numerical analysis, as stated by several authors (Bertodo, 2002; McNichols & Brennan 2006; Colicchia & Strozzi, 2012; Bozhard et al., 2009). Being a positivist or a logical positivist implies that the world is an "observable social reality" and that the end product is derived from laws or the like. Positivism came with the work of A. Comte (1798-1857). One of the central ideas of positivism was manifested by K. Popper in his book "Logik der Forschung" and is the idea of falsification (1934). Popper argued that science should adopt a methodology based on falsification, because no number of experiments can ever prove a theory, but a single experiment can contradict one (1959). The positivist approach is in contrast to the phenomological approach, which sees behaviour as determined by the phenomenon of experience rather than by externally, objectively and physically described reality (Remenyi, 2003). Meanwhile facing severe difficulties in measuring supplier's performance purely in quantitative terms and on hard figures, the author started to think about alternative ways of how to develop a more advanced SRM model.

3.5.2 Influence on research topic

Figure 3-5 highlights the milestones of becoming a researcher, who focuses on qualitative methodologies. It describes the residential weekends of the modules from one to four and the probably most significant change in terms of ontology and epistemology. The roadmap was drawn in

the fourth quarter in 2011 and adjusted in December 2012 at the very end of the doctoral study. This changed him from a quantitative researcher to a "researcher of a qualitative methodology". The positivist approach is in contrast to the phenomological approach, which sees behaviour as determined by the phenomenon of experience rather than by externally, objectively and physically described reality (Remenyi, 2003). According to Dick (2010), literature about qualitative research and the use of the interventionist approach is growing. However, quantitative and numerical methodologies are still the methodologies suggested in the majority of books and articles on supplier management (Bossert, 1994; Gunasekaran et al., 2004; Kim, 2006; Colicchia & Strozzi, 2012) for evaluating suppliers in terms of quality, cost and delivery performance.

Figure 3-5: Development steps of becoming a researcher on SRM



Source: Development stages of becoming a researcher of SRM; initially drafted in December 2011 and extended on December, 19th 2012.

In SRM, a quantitative approach means that suppliers are only evaluated on hard factors and numerical attributes, e.g. quality performance (process performance management), cost performance, i.e. the actual cost level, and delivery performance (logistics performance in terms of on-time delivery or percentage of meeting the requested and demanded lot sizes). As a consequence,

decisions, like new supplier selection, new business opportunities, business expansion, creation of strategic partnerships, are based on numerical figures only (Bossert, 1994; Emmett & Crocker, 2009). There are certain aspects that critics of the positivist approach (Remenyi, 2003) generally emphasize, e.g. objectivity is almost impossible to achieve, since there are always some preferences involved in each activity. This automatically leads to a degree of subjectivity. Subjectivity is also generated through the restriction of variables and the interpretation of these variables. In conclusion, one can say that social constructs do not behave like molecules (Remenyi et al., 2003). Bombardier for example, evaluates the quality performance of suppliers in a quantitative way on a monthly basis by assessing the incoming quality non conformity reports (NCR). However, the quantitative approach reveals weaknesses in terms of subjectivity and different interpretation of data, if the data are not harmonized. Despite the fact that managerial practice is aiming at applying hard and neutral facts for risk avoidance, it is of the utmost importance that any kind of data are harmonized in order to give the right interpretation as recommended by Remenyi et al. (2003). This will be proven through the case studies in Bombardier in Phase III of the research paper. Remenyi et al. (2003) explain the key features of the quantitative (positivist) and qualitative (non-positivist) approach as shown below.

Figure 3-6: Comparison of the positivist and non positivist approach

	Positivst approach	***Non positivist***
Basic belief:	World is external and objective	World is socially constructed
	Observer is independent	Observer is part of what is observed
	Science is value free	Science is driven by human interest
Researchers should:	Focus on facts	Focus on meaning
	Look for causality and fundamental laws	Try to understand what is happening
	Reduce phenomena to simplest elements	Look at totality of each situation
	Formulate and test hypothesis	Develop ideas through induction from evidence
Preferred methods:	Operationalize concepts so they can be measured	Small samples investigated in depth or over time
	Take large samples	
	Use multiple methods to establish views of phenomena	

Source: adapted from Remenyi et al. (2003) and Denzin & Lincoln (2000).

According to Denzin & Lincoln (2000), one of the key differences between quantitative and qualitative methodology is flexibility and evidence. They maintain that quantitative methods are less flexible than qualitative methods and that the type of knowledge is not the same, and nor are the data (Denzin & Lincoln, 2000). Non positivist research or qualitative methods are based on small samples, which are investigated in depth over time, whereas positivist or quantitative approaches usually apply very large samples (Denzin & Lincoln, 2000; Remenyi et al., 2003). Their ideas are based on other assumptions about the nature of truth, the epistemology, and reality, the ontology. In other words, they represent different views on subjectivity or objectivity. These are portrayed in the table on the page before. Whereas positivists believe in the fact "that the world is external and objective", non-positivists think that the world is "socially constructed". As a consequence, research methodologies and requirements differ. With quantitative methods such as surveys and question lists, researchers ask all participants identical questions in the same order. The response categories from which participants may choose are "closed-ended" or "fixed" (Remenyi et al., 2003). The advantage of such a pattern is according to Remenyi et al. (2003) that it allows for meaningful comparison of responses across participants and study sites. However, it requires a thorough understanding of which questions to ask and the best way to ask those (Denzin & Lincoln, 2000). Non-positivists argue that quantitative researchers fail because they can neither adequately define nor accurately measure enough of the variables to understand complex natural interactions. For their part, positivistic researchers argue that qualitative researchers cannot rigorously examine the detailed structures underlying complex natural interactions (Remenyi, 2003). The main benefits of qualitative research are the close relationship between the researcher and the research subject as pointed out by Denzin and Lincoln (2000) and Remenyi et al. (2003). The qualitative approach has a strong connection with meaning and enables data to be coded into categories. One of the primary aspects of qualitative research is the understanding that objectivity is not achievable for the reasons described above. It has narrative and descriptive aspects and focuses on "how" rather than "what", as stressed by Remenyi (2003). In today's business environment, many companies decide to use a quantitative approach in measuring supplier performance (Dust et al., 2010). Other companies prefer a multi-method approach, combining so-called hard (quantitative) and soft (qualitative) parameters (Tang, 2006). For the research in SRM a qualitative research (case studies and in-depth interviews) is regarded as more beneficial and more flexible for understanding "phenomena and truth". This has led the author to the fact that a qualitative and multiple approach is more suitable in this research than a quantitative approach for drafting a best practice model of SRM and for establishing a SRM framework in manufacturing companies in the European transportation industry.

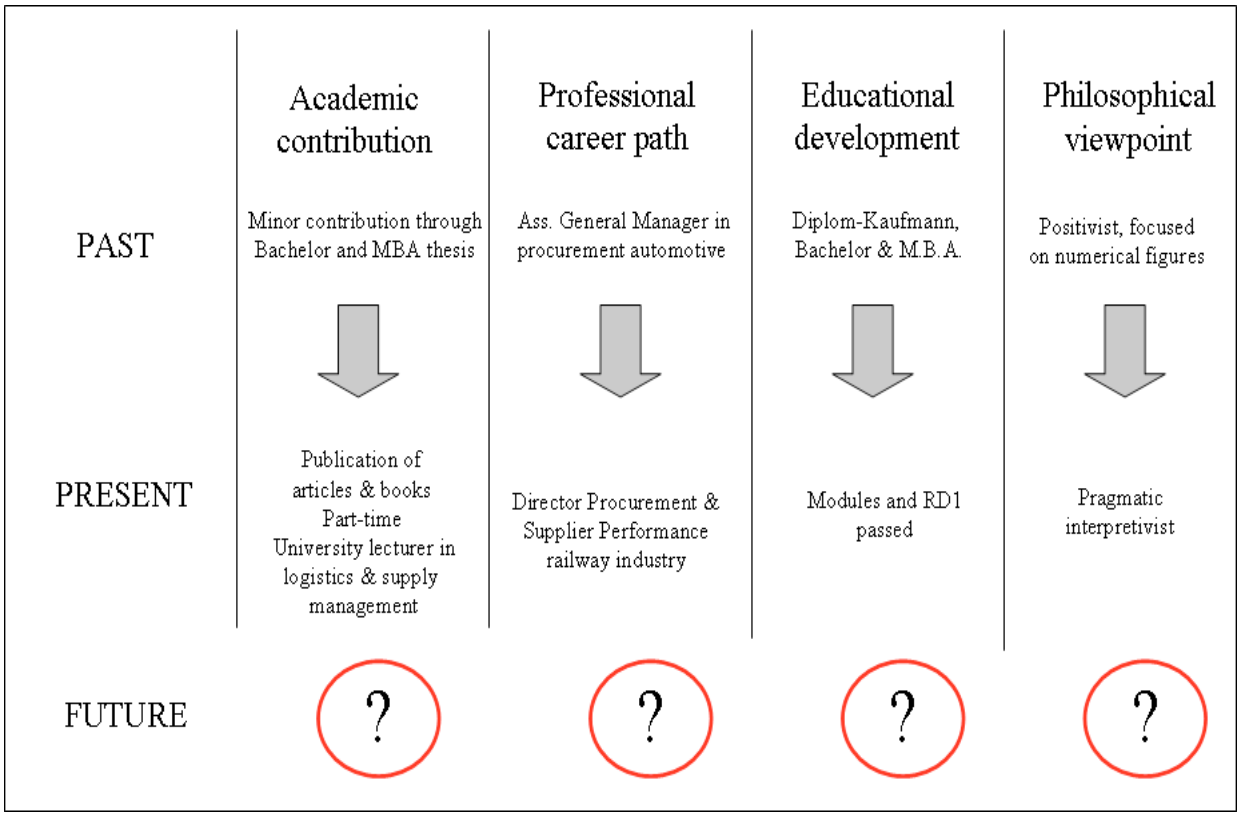
3.6. Reflective professional development: the present

3.6.1 Influential people regarding thesis and viewpoint

All in all, there were a number of factors and people that influenced the change in the author's life as a researcher up to now as shown in Figure 3-7, changes from the past to the presence. On the one hand, the doctoral modules and the residential weekends including the topics "systematic literature review", "reflective professional practice", "methodology and methods" and "action learning" impacted the research, on the other hand specific people. As part of the first modules and assignment "systematic literature review", a lot of literature was screened. The literature review has been ongoing and makes up a large part of establishing best practice categories (Colicchia & Strozzi, 2012). The majority of literature suggested having a broader view on SRM, as recommended by Bozhard et al. (2009). The second assignment dealt with the "methodology and methods" and the appropriate methodology for establishing an SRM best practice model. The third assignment tackled the "action and case research". The action research assignment showed a specific and realistic case, showing that objectivity could not be reached and that quantitative research has certain weaknesses (Remenyi et al., 2003). The last assignment "professional reflective practice" tackled the reflection as an ongoing process (Moon, 2004). On the other hand, there was also an influence, which came also from different people and groups, the most significant of whom were a few people like the advisors. The first advisor, Dr.-Ing. Robert Dust, Professor for SCM at the University of Heilbronn, has been a valuable support on contents and SRM-related issues from the beginning. He was also one of the persons who encouraged the author to enrol for the doctorate programme and, being a professor himself, motivated him to proceed further in academic terms. Assistant Prof. Dr. Brian Terry became the second advisor in summer 2011 and gave profound advice on methodological and programme-related issues concerning the DBA. Especially, in progressing through the research degree approval of the University of Gloucestershire (RD1), he supported the doctoral candidate extensively. His recommendations on articles have already been most valuable. Philippa Ward has been a kind and competent advisor, as have the remaining tutors of the DBA, giving good, prompt advice on course-related issues. Other people who have influenced the researcher on the development of a best practice model for SRM include Prof. Volker Gehmlich from the University of Osnabrueck, various ALS members, and managers within Bombardier. Due to the academic progress, the author has been able to make use of his research and publish a number of articles in German, American, Austrian, Swiss and British magazines and journals, as shown in Figure 3-8. In addition to this, he was asked by the THM and the open business school of the FOM to lecture on "Logistics, Procurement, Production and Supply Management" to bachelor and master degree students. Thus the author could combine practical issues with the research-related factors of the doctoral thesis.

Compared to working at Bombardier, teaching is a different exercise, since the result and the success are measured in another way. Even though marks for presentations or tests are not given until the end of the course, the major aim is that students grasp the main issues and understand how to apply the respective tools in their companies. In the researcher's professional life, research findings have helped him to establish a new sub-department for "supplier performance management" (SPM), which in 2010 was staffed with one person, and in 2011 with four people, in 2012 with five and 2013 with six people. Especially in Bombardier and the railway industry this is a new approach. Figure 3-7 shows the change from past to present as outlined previously.

Figure 3-7: Reflections on the past and present



Reflective professional experience in the past and present, including the elements academic contribution, professional career path, educational development and philosophical viewpoint. Updated in December 2012.

Studying in the field of SRM has encouraged him to combine practical knowledge with research findings and to write articles on various subjects like supplier development, lean methods in supplier management, and claims management. The articles were written predominantly in German and published in German magazines, but some have also been translated into French or English and appeared in British, American and Swiss magazines, as shown in the summarizing table 3-9. At the

beginning of 2010, the author wrote down his experiences in supplier management and published them as a book. When lecturing logistics at the THM in Giessen-Friedberg in Germany, he was asked by the faculty whether he wanted to publish the manuscript in distribution management and logistics as a handbook for future reference. In October 2011, the FOM institute for logistics and research (ILD) published some of the research work on SRM and the necessity to implement lean principles in the USCM. Prof. Dr. Walther, editor of the SCM Magazine IPM, published an article on SRM in the journal SCM Institute for Production Management. Especially the handbook in supplier development is a guide for practitioners and academics who deal with SRM and supply networks. It can be found in online book shops like Amazon and in several university libraries. One major difficulty is to coordinate professional, academic and private affairs time wise. As a consequence, the author has adopted a tough time management structure. The publications are shown in the figure below (see also Appendix 2).

Figure 3-8: Publications in books, magazines and journals

Source: Publications of books and articles.

Every day, he has spent an average of one to two hours on the research, plus three to four hours on Saturdays and Sundays. This has made it possible for him to proceed with the research while still working in a full-time job. Through Gloucestershire University and the engagements as a lecturer, it has been possible to use the facilities of the library in Berlin. Wife and children have supported him

significantly in the activities, knowing that the study time for the doctorate is limited. The following example shows an extract of publications during the doctoral research in various procurement and supplier management magazines (The full scope of publications is shown in see Appendix 3/Appendix 13). Articles have been published in the leading European magazines of the Federal German Association of Materials Management, Logistics and Purchasing (BME-Beschaffung aktuell), the Swiss Association of Purchasing and Materials Management (Procure) and the American Institute for Supply Management (ISM) in German, English or French. Publications in academic and peer read journals are planned, too, after submission of the thesis.

Table 3-9: Table of publications

Date	Title	Language	Magazine
2013/02	Claims management im Einkauf.	German	Beschaffung aktuell
2012/09	Claims management in der Praxis. Leistungsstörungen in der Lieferkette.	German	Procure
2012/06	Leistungsstörungen frühzeitig beheben.	German	Logistik heute
2011/11	Suppliers and Demand. Claims management.	English	SCM Europe
2011/11	Launch Management. Lean Principles in the Strategic Supplier Management.	English	SCM-IPM
2011/09	Transposition durables des principles des la production allegee de la chaine du livraison.	French	Procure
2011/08	Lean Principles in the Upstream Supply Chain Management (USCM).	English	SCM Europe
2011/08	Wettbewerbsvorteile im Upstream Supply Chain Management durch die nachhaltige Übertragung von schlanken Prinzipien.	German	Procure
2010/08	Lieferantenmanagement, Automobilindustrie. An den Kunden denken.	German	Beschaffung aktuell
2010/08	Supply Chain Management. Erschließung von Kostenpotenzialen im Einkauf in der Automobilindustrie.	German	Procure
2010/06	Supply Chain Management. Erschließung von Kostenpotenzialen im Einkauf durch ein Lieferantenmanagement.	German	Procure
2010/06	Supply Chain Management. Driving Maximum Value through Supply Relationships.	English	ISM

Source: published articles and books from 2010 until 2013.

3.6.2. Influence on research topic: Why use a case study approach?

SRM is part of the purchasing, supplier quality and upstream supply chain function, as described by several authors, and represents an integral part of manufacturing enterprises (Choy et al., 2003; Emmett & Crocker, 2008). One of the primary tasks is to link major processes within and across companies into a cohesive and high-performance business model, as explained by Jaspers (2007). A typical supply chain begins with the ecological and biological regulation of natural resources, followed by human extraction of raw materials (Choy et al., 2003). It then involves production links between one's own organization and suppliers (e.g. component construction, assembly and merging), subsequently moves on to different layers or tiers of storage facilities of ever-decreasing size at ever more remote geographical locations, and finally reaches the organization itself. Many authors consider SRM as a possibility for an organization to distinguish itself from its competitors by adding value through optimal interaction of supply networks in terms of quality, cost and delivery (Bertodo, 2002; Choy et al., 2003; Christopher, 2005; Dust, 2009; Helmold, 2011). Increasing use of module and systems suppliers has led to greater dependency (Trkman & McCormack, 2009). This trend has inherently increased the vulnerability of supply chain management and supply networks (Harland et al., 2003). Although literature is already available on this topic, many authors point out the need for a wider and broader approach on monitoring supply chain risks in more detail (Chopra & Sodhi, 2004; Narasimhan & Talluri, 2009). The discrepancy between the proactive role of SRM in a complex and multilayer supply network and the current view on how to deal with supply chain risks (Wu & Knott, 2006) means that further research can make a valuable contribution towards closing this gap by developing a best practice model (Nishat & Ravi, 2006). Additional research will also help to add value and knowledge by showing how to avoid supply disruptions with early and sustainable warning indicators, as recommended by Christoper & Mangan (2005). When evaluating a suitable research strategy in terms of methodology and appropriate measures, the advantages and disadvantages of both quantitative and qualitative approaches were taken into account: one specific case in module "action and case research" revealed several weaknesses in the quantitative methods. Same applies during the case studies in Phase III. Even though quantitative statistics or surveys are often used by companies to measure supplier quality and delivery performance, they do not fully reveal the truth of the phenomena (Gunasekaran et al., 2004). Supplier performance data might hypothetically contribute to good or bad supplier relationships between the customer and the supplier; however, such data do not indicate what a best practice model of SRM in manufacturing companies in the European transportation industry should look like in complex supply networks (Dust et al., 2011). In addition, performance data do not take into account such aspects as patterns, beliefs, values and strategies. As the questions within this research focus on "What should a best practice model in SRM look like?" and "Why do certain criteria contribute to such a system?" a

multiple approach, including interviews and a case study approach for validation or falsification with an ongoing systematic literature review, is more explanatory than surveys, observations or a quantitative approach (Yin, 2009). In addition, it is intended that such best practice elements can be applied by other enterprises, and therefore it needs to consider current trends, beliefs and patterns relating to supply networks. Case studies focus on contemporary events and are a suitable tool for understanding and explaining complex phenomena as outlined by Yin (2009). The case study approach is a sophisticated method in that "it provides valid and reliable evidence of the research process as well as presenting the findings which result from the research" (Remenyi et al., 2003). Therefore this approach is considered to be an appropriate method for confirming and disconfirming categories of best practices for SRM and supply networks. Comments and opinions in the literature differ on the question of how many cases should be used. The majority of recommendations suggest that between one (Yin) and three cases ought to be applied. Yin states that one single case study is sufficient (2009; p. 69) if certain criteria are met. He also states, that more than one case serves as replication (Yin, 2009). A case study approach is an empirical enquiry which helps to investigate SRM in depth both within supply networks and in its real and practical context. It relies on multiple sources and experts in the field of SRM and deals with relationships between supply chains and social behaviour within supply networks. The benefits are high from the prior development of theoretical propositions on SRM for data collection and analysis. Finally, the case study approach copes with the fact that an SRM role model comprises more than one result. When applying the case study approach, it is mandatory that certain competencies are available, as emphasized by a number of authors, e.g. Yin (2009). These competencies will be summarized at the end of this chapter.

3.7 Reflective professional development: the future

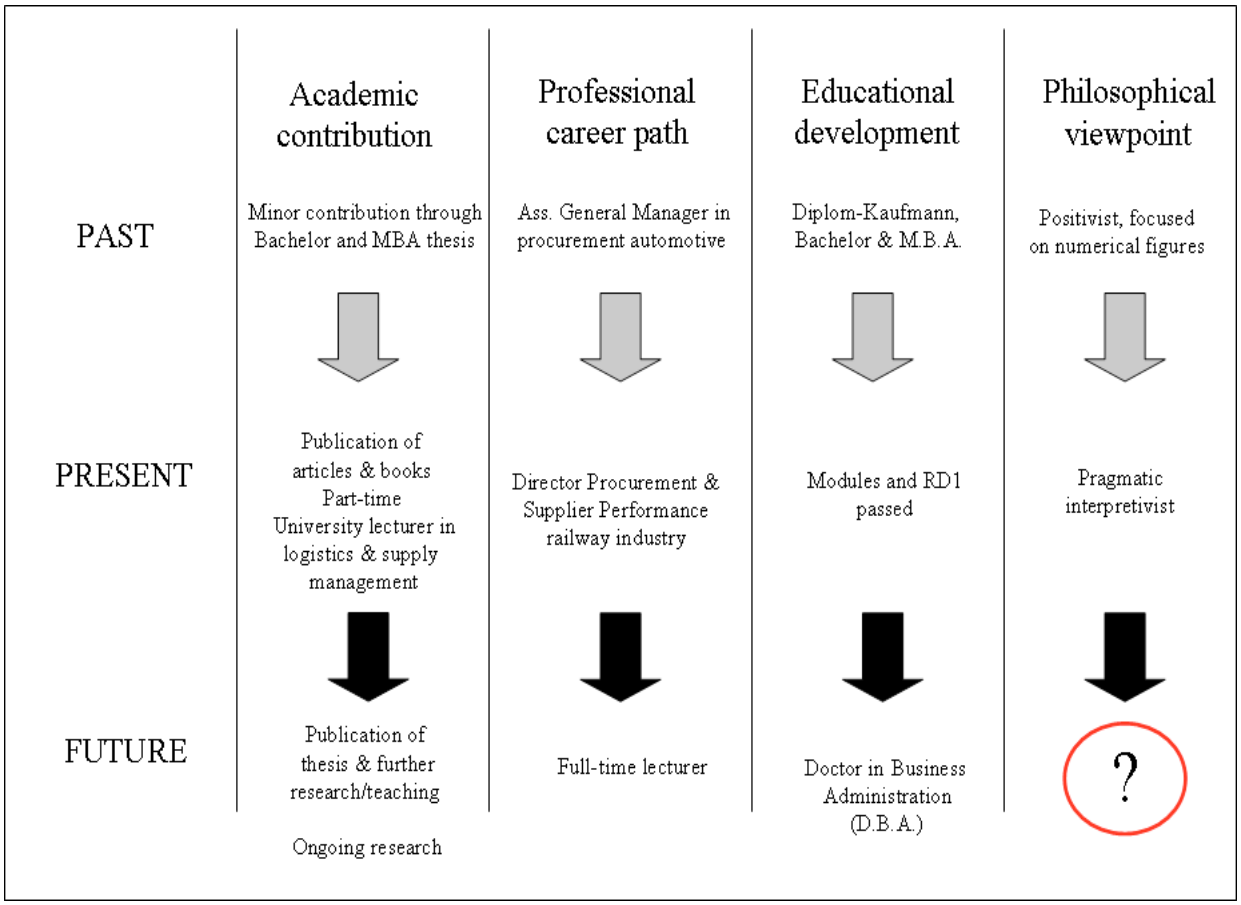
Moon's definition of reflection also takes the future into account, particularly in terms of applying lessons learnt from the past and present (Moon, 2004). It is not easy to look ahead by considering professional reflective practice in the past and present. Nevertheless, the outlook into the future suggests changes with regard to the author's academic, professional and educational development, as shown in Figure 3-10. The development in terms of ontology is unknown at the current situation and might change again during or after the research (Moon, 2004).

As the author is intending to do further research and teaching in the field of SRM, there might be an opportunity of increasing the lecturing activities or even of acquiring a full-time or part-time professorship at a University of Applied Sciences in Germany, or elsewhere. His contact to the FOM and THM and employment is a good possibility for further enhancing the activities in research and

teaching. The Universities of Applied Sciences are currently looking for academics with extensive practical experience in logistics, SCM and related disciplines. A professorship abroad could also be a good opportunity for further development. Prof. Dr.-Ing. Dust and other SRM experts from industry, for example, decided in 2010 to accept a full-time professorship at the University of Applied Sciences in Heilbronn.

A doctorate in business science could also be seen as chance to work in different fields of management (e.g. project management, marketing, quality), or in academia. In addition, the author may publish further articles on SRM and books on supplier networks following the successful completion of the doctorate. The last article on claims management and other findings from the research has been published in February 2013 (Helmold, 2013). A combination of theory, research and practical experience in SRM represents a useful contribution to academia, science and industry, as suggested by Dust et al. (2009). Teaching, researching in the topic itself has become an interesting milestone throughout the life of the author, so that further academic contribution can be expected.

Figure 3-10: Outlook into the future



Source: reflective professional experience of the past, presence and future.

After having published articles and books via official associations of procurement in Germany (BME), Switzerland (procure.ch) and Austria, the author has been asked to outline the concept in presentations in conferences on SRM. Due to the selling of books, specialists and academics are very keen on knowing more about the practical and theoretical implications and relevance of SRM and the research. A conference of the renowned procurement magazine "Automobilproduktion" took place in summer 2012. The researcher acted as a workshop-leader and speaker on SRM and supplier networks, including experiences from the European transportation industry. Moreover, academics are asking him whether he would like to speak in front of undergraduate and postgraduate students in various universities and business schools. The following universities asked him to outline the best practice model of SRM in the European transportation industry:

- Leibniz Academy in Hanover
- University of Applied Sciences of Bochum
- University of Applied Sciences Iserlohn
- University of Applied Sciences of Osnabrueck
- Technical University of Mittelhessen (THM)
- Technical University of Berlin
- European University Frankfort/Oder
- University of Applied Sciences Stuttgart

Although he started as a positivist who believed that supplier performance and relationships are to be measured by purely objective and numerical indicators, the doctorate journey has changed the author's position into that of a pragmatic interpretivist for the reasons outlined before. He therefore considers a qualitative approach with multiple methods and two in-depth case studies as the appropriate methodology for this research and for managerial practice in order to establish best practice model in SRM and to create the resilient supply chain in the respective industry. However, as the research journey is not yet over, this viewpoint might possibly change once again.

3.8. Philosophical stance: from a positivist to a pragmatic interpretivist

3.8.1 Why a pragmatic interpretivist´s position

The nature of interpretivism has been discussed for example by several authors like Burrel and Morgan (1979; p. 28), Bryman and Bell (2011; p. 17), Saunders, Lewis and Thornhill (2012; p. 140) and Robson (2011; 24). Burrel and Morgan explain interpretivism as "the interpretive paradigm is

informed by a concern to understand the world as it is, to understand the fundamental nature of the social world at the level of subjective experience. It seeks explanation within the realm of individual conciousness and subjectivity, within the frame of reference of the participant as opposed to the observer of action" (Burrel & Morgan, 1979; p. 28). Interpretivism is characterised by its focus on looking at the world from a subjective viewpoint in contrast to an objective viewpoint and "sees the social world as an emergent process which is created by the individuals concerned" (Burrel & Morgan, 1979; p. 28). The result is that rather than seeking to explain observations on the basis of objective observations explanation is sought in understanding the subjective interpretation of events by the relevant participants. Bryman and Bell explain that interpretivism is "taken to denote an alternative to the positivist orthodox" (Bryman & Bell, 2011; p. 17). This then means that the goal of research becomes focused on investigating the roles and behaviour of actors in specific situations rather than the recording and analysis of objective measurements (Bryman & Bell, 2011). Interpretivism thus holds that it is the interaction of actors in real situations that is the key to understanding observed phenomena (Bryman & Bell, 2011). Robson (2011) outlines that interpretivism assumes "that social properties are created by human beings and social interaction" (Robson, 2011; p. 24). In interpretivism it is therefore necessary to conduct detailed investigations and analysis of social situations as opposed to the mere collection of objective data. The approach used in this work of "Establishing a best practice model of supplier relationship management (SRM) for multinational manufacturing companies in the European transportation industry" can be described as pragmatic interpretivism. The investigation of the supplier relations behaviour has been made using an approach that interprets the observations as resulting from the behavioural interplay between suppliers and customers in real world situations. This is in contrast to an approach focusing solely on the measurement of objective metrics. One of the limitations of an interpretivist approach however is that the subjective nature of the behavioural interplay between actors which underpins it may be highly contextually dependent. Thus results and explanations derived in a particular situation cannot always be readily translated to other contexts. The empirical part of this research from Phase I to Phase IV has therefore been designed considering the ontological viewpoint as pragmatic interpretivist as proposed by Remenyi et al. (2003). This research takes that into account by seeking to improve the identification of business components and best practices based on the ontological model of an enterprise. In contrast to the positivistic approach, interpretivism emphasizes that SRM and supply networks are socially constructed and subjective and that the interaction of actors in real situations of supplier relationships is the key to understanding the observed phenomena. From an epistemological viewpoint, researchers must focus on the meaning and need to understand the common success criteria of different schools. This means that it is important to understand by the application of qualitative methods with small samples and in-depth analysis as outlined by Saunders,

Lewis and Thornhill (2012; p. 140), what SRM has ideally to look like in specific categories and whether or why these findings can be confirmed or disconfirmed. The synthesis of SRM, which follows the ontology of interpretevism, embraces a programme theory of change, asking questions such as which models and characteristics work for whom and in what circumstances, but keeps open the idea that there may not be a resulting consensus from an aggregation of the evidence. As part of the ontological viewpoint as interpretevist, schools in SRM and supply networks have been scrutinized by in-depth investigations. The systematic literature review and the interviews have revealed three schools of supplier networks which deviate from the traditional paradigm that supplier relationships serve only to effect timely deliveries at the lowest cost (Behrendt, 1996; Bertodo, 2002; Bozhardt et al., 2009; Dust, 2009). The figure below outlines the comparison of research philosophies (Gloucestershire DBA database, 2011; Saunders, Lewis and Thornhill, 2012; p. 140). Chapter four outlines the methodology, methods and and research path applied as part of the interpretivism philosophy.

Figure 3-11: Viewpoints of positivists, pragmatic interpretivists and interpretivists

Ontological viewpoint — Comparison of research philosophies in buiness management and reseach

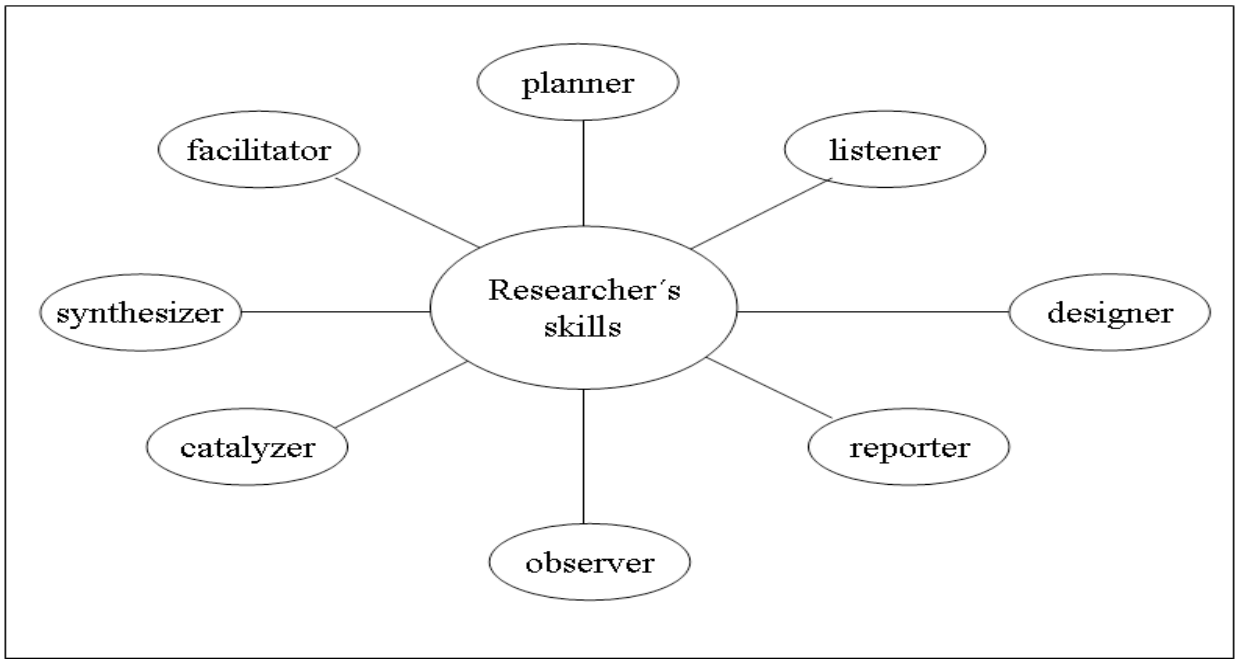
	Positivits	Critical realists	Pragmatic Interpretivists
Ontology: Basic beliefs, that supply networks are	• external and objective • are created based on rational facts	• socially constructed • subjective • human constructs	• socially constructed • subjective meanings and interpretation • changeable and multiple
Epistomology, researchers must:	• focus on facts • be based on objective data	• focus on meaning • try to understand	• Subjective meanings and social phenomena. Focus on the details of situation. Focus upon the details of the situation, a reality behind these details, subjective meanings motivating actions
Methodology and methods:	Operationalization of concepts to measure	Samples over period of time and limited in size	Small samples, qualitative approach and in-depth investigation
Consequence:	Theory of truth laws	Methods follow question	Everything is interpreted

Source: adapted from Gloucestershire DBA database, 2011 and Saunders, Lewis and Thornhill (2012; p. 140). Philosophical position of an interpretevist approach.

3.8.2 Competencies and skills

When using a qualitative and case study approach for research, Yin emphasizes that certain competencies must be available (2009). Yin highlights the necessary skills for doing qualitative research with and without an interventionist approach, e.g. conducting interviews or action research. The Figure 3-12 represents the set of skills that is necessary to conduct a multiple and qualitative research approach as stressed by Yin (2009). Firstly, a proficient case study investigator must be able to ask good questions and interpret them. Secondly, he must be adaptive and flexible, so that newly encountered situations can be seen as an opportunity, not as a threat or a risk. A firm grasp of the issue under study, even in an exploratory model, underpins the ability to remain unbiased by pre-conceived notions. Certain competencies and skills are necessary to carry out the anticipated research, case study and interviews, as outlined by Yin (2009). Facilitation skills are essential for conducting case studies and executing interviews. Moreover, it is necessary to be a good listener and synthesizer. Research must be prepared and designed beforehand, so that advanced planning of the research journey, milestones, methodology, etc. can be applied. Data obtained have to be catalyzed and reported via a protocol, as recommended by various authors like Moon (2004), Remenyi et al. (2003) and Yin (2009). The next chapter four outlines the methodology, methods and research plan utilized for the thesis, followed by the empirical research over four phases.

Figure 3-12: Competencies required for research



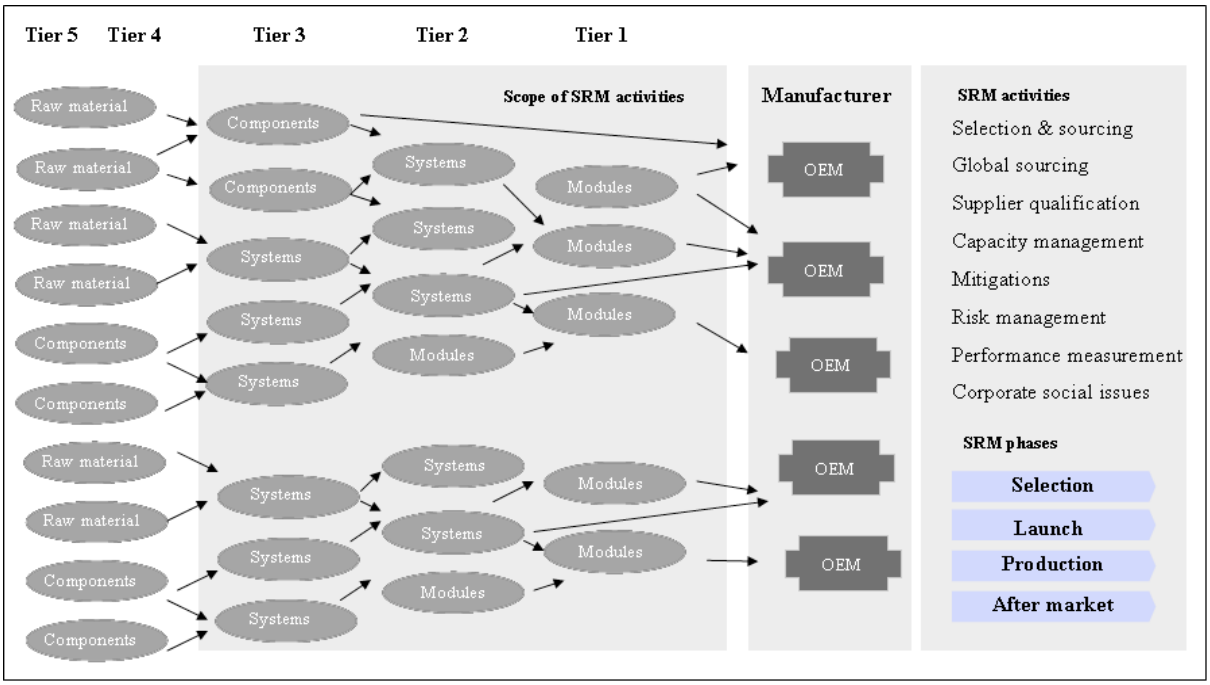
Source: Researcher´s skills and competencies; adapted from Remenyi et al., 2003, Yin, 2009 and Fink, 2010.

4. Research methodology, methods and research plan

4.1 Purpose and objectives

As described in chapter one there is a trend towards the concentration on core competencies in the European transportation industry (Aberdeen group, 2006; Bozhard et al., 2009). As a consequence supply networks or supply chains have become more complex and international, impacting the relationships to international suppliers and the way how supply networks have to be managed. Christopher and Peck (2004) point out that companies target to build a resilient supply chain, as coping with the growing complexity is considered as being a general trend in upstream supply chain management (see Figure 4-1). Complexity is characterized by an increased sourcing of modules, systems and components from suppliers, the increase in number of supply chain layers (tiers), and the internationalization of supply chains (Harland et al., 2003). Academics and practitioners highlight that these trends have direct influences on SRM activities as shown in the figure below (Aberdeen group, 2006; Trkman & McCormack, 2009; Gürtler & Spinler, 2010).

Figure 4-1: SRM activities and phases in the upstream supply chain management



Source: SRM activities adapted from Trkman & McCormack, 2009.

In the last decades, manufacturing companies in the European transportation industry have significantly reduced their own value-adding tasks and implemented efficiency-oriented cost

reductions, e.g. outsourcing, single sourcing, low-cost country sourcing, platform concepts, lean management, design-to-cost approaches (Christoper & Peck, 2004). As a consequence, several authors stress that SRM activities like supplier selection, supplier qualification, global sourcing, capacity management, risk management, mitigations of supply disruption, performance management and corporate social issues have become more important in both core and peripheral SRM business areas (Harland et al., 2003; Trkman & McCormack, 2009). SRM must aim at building resilient supply chains (Christopher & Peck, 2004). In recent years resilient supply chain management is seen with reference to the direct supply base on a tier one level. The traditional paradigm is characterized by a reactive approach after the supply disruptions occurred and not a proactive role as highlighted by the Choy et al. (2003) or Gürtler and Spinler (2010). Mitigations in the old paradigm have been taken after the supply incidents happened, whereas modern SRM considers preventive measures as the key for supply chain resilience (Gürtler & Spinler, 2010). In this context, academics and practitioners stress that that supply chain resilience has to exceed the tier one supplier levels as many supply disruptions are caused by issues or incidents beyond this level (Christopher & Peck, 2004). As a result, SRM measures against the vulnerability and exposure to external disturbances have to focus beyond tier one levels. Not only the examples in the first section during the last years from 2000 until 2011, but also more recent incidents of supply disruptions of manufacturing companies in the European transportation industry in 2012 show the necessity (see Table 4-2 on the next page) for a deeper and more comprehensive scrutiny on what the best practice elements in SRM are and how these incidents can be avoided (Becker, 2012; Witwer, 2012; Odell & Pickard, 2012; Böhler, 2012). In the European transportation industry, activities carried out by enterprises like Bombardier, Alstom, Siemens, MAN, Stadler or BMW itself account for only 20 to 30 percent of its total performance. With the enlarged connections to suppliers and relationship with supply networks (Kersten et al., 2008), risks and incidents have also increased in 2012 for these enterprises. As OEMs and multinational companies like Bombardier, Stadler, Hitachi, Honda or Siemens have been confronted with shortages and disturbances within the supply chain management (SCM), management of these companies addressed the need for a more advanced framework of managing supplier relationships (Becker, 2012; Witwer, 2012; Odell & Pickard, 2012; Böhler, 2012; Chongvilaivan, 2012). Global sourcing activities and the increased transfer of complex modules and services to the upstream supply chain management have changed the layout of supply chains and the needs for SRM in international markets significantly, as highlighted by Hamm (1998) or Choongvilaivan (2012). Besides procurement activities in respect to supplier selection, launch and performance measurement, aspects of corporate social responsibility (CSR) become increasingly important in global sourcing markets. CSR activities normally comprise ethical issues related to supply management as outlined by Emmett and Crocker (2009). SRM has to ensure that

environmental aspects, compliance with laws or antidiscrimination rules are taken into account, when outsourcing goods and services to external suppliers. Besides redundancies in the supply chain, Hendricks and Singhal (2005) point out, that missing CSR guidelines can also have negative impacts on the stock value of an organization. It was revealed that supply chain disruptions caused or incompliance with CSR regulations can cause sharp losses and high cost to the own company (Hendricks & Singhal, 2005). Academics and practitioners stress the need for further research in SRM in a wider scope to avoid incidents as shown in the following table (Narasimhan & Talluri, 2009).

Figure 4-2: Supply disruptions in 2012 in the transportation industry

Year	Description	Source
2012	Delays of deliveries from 133 Stadler KISS trains due to missing homologation of certain modules and parts.	Becker, 2012
2012	Swiss Railway (SBB) delay caused by late design completion and supply delays by Bombardier in 2013.	Witwer, 2012
2012	Supply disruptions from sub suppliers to Hitachi cause a significant delay in train-building project in England for the first high-speed trains.	Odell & Pickard, 2012
2012	High-speed trains to the Deutsche Bahn are delayed by Siemens and Bombardier due to software issues.	Böhler, 2012
2011	Thailand's 2011 flooding caused production standstills in several Honda factories including the Honda UK SWINDON manufacturing site.	Chongvilaivan, 2011

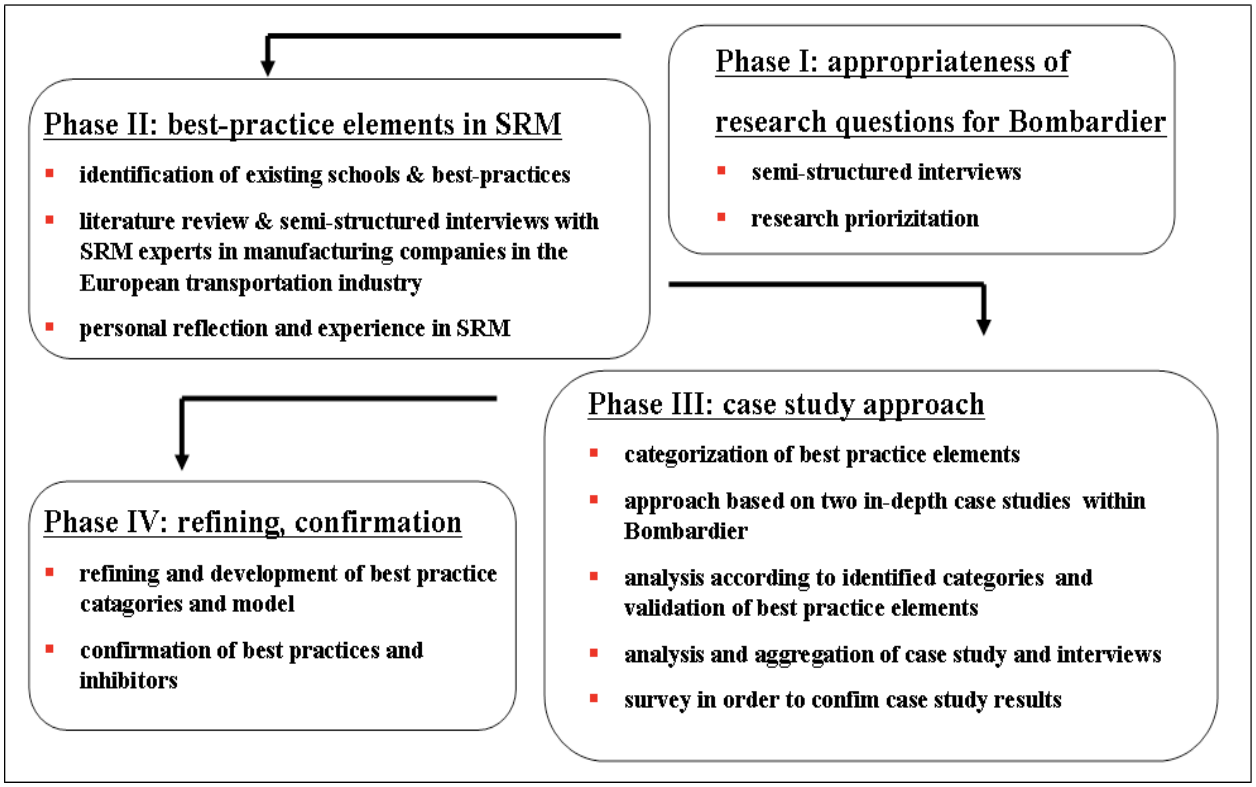
Source: Articles from various authors show recent supply disruptions in the transportation industry.

Roles and responsibilities in complex and global supply networks on how to deal with suppliers require further scientific investigation (Christopher & Mangan, 2005; Aberdeen group, 2006). Supply chain resilience is a rather new area and still largely unexplored area of management (Christopher & Peck, 2004). The present research seeks to address these concerns by outlining risk factors of supply chain disruptions, by investigating how disruptions can be anticipated, prevented and managed and by examining best practices in the respective industry. The typical challenges and issues dealt with in the existing literature are in themselves very similar and raise the questions in terms of "What are the schools in SRM?", "What are best practice elements in SRM?", How can supply disruptions be avoided by means of SRM?", "How can supply disruptions be mitigated?", and "What does a best practice model for SRM look like?". In the following sections the research methodology, methods and sequence of the doctoral thesis will be explained.

4.2 Research Phase I – IV: multiple and qualitative approach

The empirical part of the research on establishing a best practice model of SRM in manufacturing companies in the European transportation industry has been divided into four research phases as shown below. The figure shows, that each of the four phases has its own focus. The major objective is to establish a best practice model of SRM in the relevant industry. The focal aspects of the empirical part consist of the validation and refinement of research questions (Phase I), the identification of schools and best practice elements (Phase II), the validation (or falsification) of best practices through two cases studies (Phase III) and the refining of the best practices (Phase IV), as shown in Figure 4-3.

Figure 4-3: Research sequence: Phases I, I, III and IV



Source: own source; phase model for research on SRM.

Phase I: Appropriateness of research questions

With the help of interviews involving senior management in Bombardier, Phase I has been intended to confirm or disconfirm the appropriateness of the research questions and to determine the contribution of this thesis to managerial practice within Bombardier and the European transportation industry. Five experts from supplier connected functions, such as SRM, procurement, quality or

logistics, have been approached and interviewed through semi-structured interviews. This has generated rich data from which the respective research questions could be addressed. The interview results have helped to prioritize research objectives and to support potential amendment or revision of the research questions. Phase I identified also additional aspects for the research after analyzing the experts' opinions. It was the intention to conduct further interviews with the purpose of adapting the research questions, if appropriateness or contribution to managerial practice in Bombardier could not have confirmed.

Phase II: Identifying best practice elements in SRM

Following verification and amendment of the research questions in Phase I, Phase II has displayed schools of thought in SRM, has revealed risk factors relating to supply chain disruptions and has examined how to manage, anticipate and prevent such disruptions. Through addressing the three questions, best practices have been identified. Qualitative data and a multiple approach, including an ongoing systematic literature review and semi-structured interviews, have been applied (Yin, 2009). Based on ten interviews with senior managers in the respective sectors schools of thought, categories of best practices of SRM in manufacturing companies in the European transportation industry have been inductively identified. Furthermore, risk factors for supply chain disruptions have been defined and categorized. These causal factors could be compared to those identified in the literature in order to develop a unified listing, drawing on both sources. Finally, it has been examined, how supply disruptions can be anticipated, managed and avoided (Yin, 2009). Due to the author's experience as manager and lecturer in the given field, access to a wide range of data and suitable interview candidates has been given.

Phase III: Case study approach

Two in-depth case studies with the suppliers Victall and Jupiter have been used in Phase III to validate or falsify (disconfirm) best practice elements in SRM, to determine risk factors for supply disruptions and to show how such disruptions can be anticipated or mitigated (Yin, 2009). The majority of best practices have been validated. In only a few areas, where no or partial confirmation could be shown, the results have not been incorporated into the study as recommended by Yin (2009) or Remenyi et al. (2003). Here, additional research is necessary as pointed out by Yin (2009). Analytical generalization and pattern-matching techniques have been used as one recommended analysis technique in the case studies (Yin, 2009; p. 38). Identified best practice elements, risk factors and mitigation aspects (from Phase II) have been used as a template with which to compare, confirm or disconfirm the empirical results of the case studies (in Phase III). Two projects involving supply chain disruptions and mitigation activities within Bombardier have been selected as relevant

cases. The two case studies have been related to two separate and independent locations within Bombardier Europe. The first case study has been at the largest site and main location in Hennigsdorf, near Berlin. Headquartered in Berlin, Bombardier is the European market leader and recognized benchmark. The second case study, which has been served as replication, has been based in Görlitz, the second largest site in Germany. Each case study involved five semi-structured interviews with the senior management of the respective functions, e.g. procurement, quality, logistics and the supplier. English was used both for the interview questions and the interviews themselves. As English is the corporate language within Bombardier, linguistic issues did not arise. A matrix of categories equal to those identified and defined in Phase II has been applied for comparing, validating or disconfirming the respective elements. The extension of interviews to operational members of the projects (Remenyi et al., 2003; p. 126) has provided further help in confirming or disconfirming best practice elements. Five operational members have been interviewed per case. As expected, the answers given by the experts have been based on practical experience and thus contributed to the research. Being employed at Bombardier accessibility by the interviewer and researcher to both data and interviewees has been given.

Phase IV: Refining and confirmation

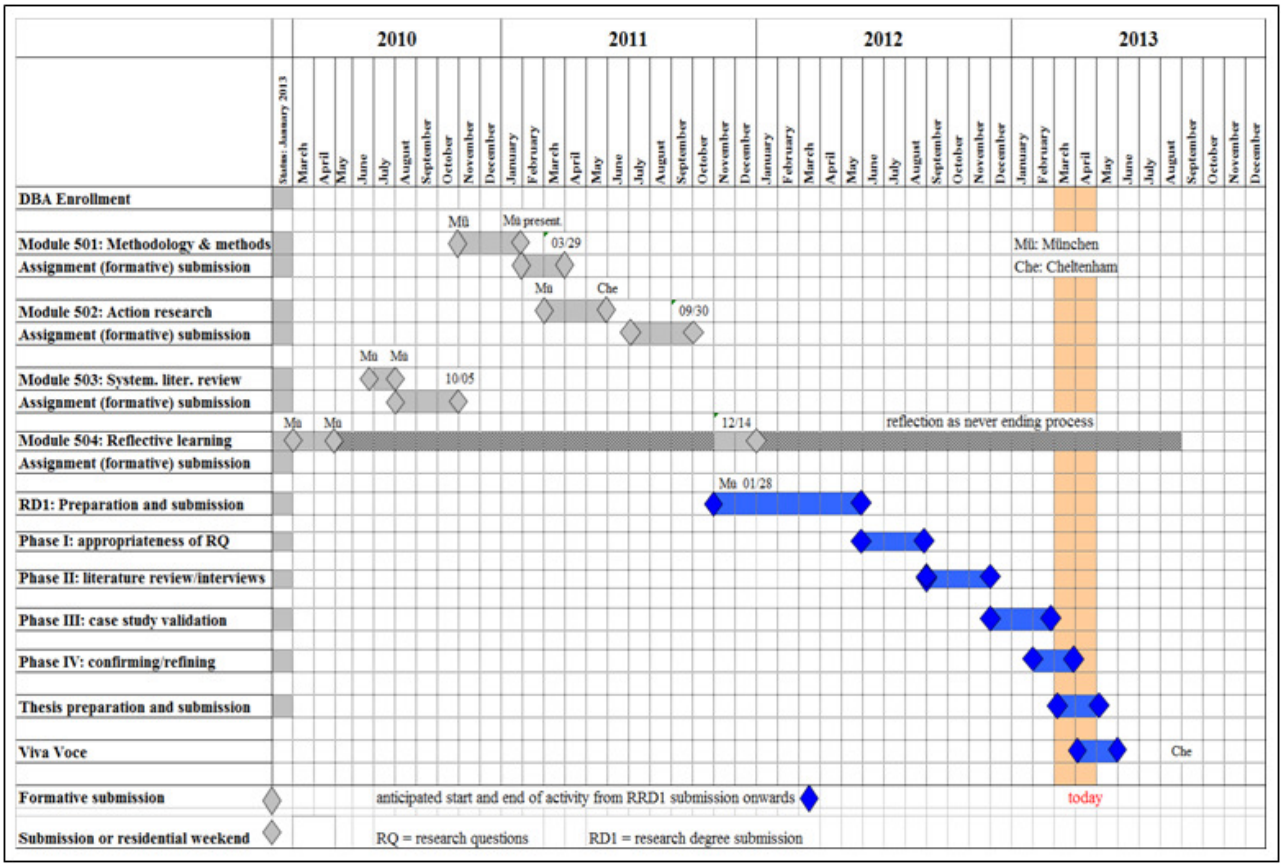
Phase IV has dealt with the confirmation and refining of best practices in the respective categories. For the purpose of analysis and confirmation, the interview protocols have been transcribed while assigning the answers and data to the relevant categories, e.g. best practice, risk factors, and aspects on how to manage, mitigate and avoid supply disruptions (Remenyi et al., 2003). Insofar as the interviews have confirmed the issues at hand, it has been possible to make clear recommendations and statements. Where the opinions of the SRM experts and project members did not correspond to the elements identified in Phase II, they have not been considered as relevant for this study. However, they may be a subject for further investigation.

4.3 Schedule and systematic approach

The complete doctorate and research on SRM has been scheduled for a duration of three to four years as shown in the schedule in Figure 4-4. Enrolment into the doctoral programme started in March 2010, followed by the residential weekends of four modules of “systematic literature review”, “methodology and methods”, “action research” and “professional reflective practice” in Munich (Germany) and Cheltenham (Great Britain). After passing all of them, the research degree form (RD1) was submitted in 2012 to obtain official approval to proceed with the research and to enter the research phase in summer 2012. During the establishment of the RD1 form, both doctoral advisors

supported the author in making their points and recommendations on contents and format. Communication was done either through electronic mail, telephone, video conferencing or face to face meetings in Berlin or Stuttgart. In addition, the author had regular meetings with SRM experts within Bombardier in order to crosscheck the validity and clarity of the research questions, the topic itself and the methodology of the research. As outlined previously, the establishment of a best practice model in SRM in the respective industry will significantly contribute to managerial practice and the author's company. This led to a great interest into the thesis and findings by experts inside and outside Bombardier, as the creation of best practice model and a resilient supply chain will result in a competitive advantage against its competitors as outlined by practitioners and several authors (Christopher & Peck, 2004). After submission and a few corrections the approval of proceeding with the research was officially granted by the Faculty Research Degree Committee (FDRC) and the University Research Degree Committee (URDC) in summer 2012.

Figure 4-4: Research plan for establishing best practice model of SRM



Source: own source, schedule of research.

SRM is closely linked to the purchasing function and represents an integrating factor with primary responsibility for linking major processes within and across companies into a cohesive and high-

performing business model, as explained by Jaspers (2007). SRM can be seen as an opportunity for an enterprise to distance itself from its competitors by adding value through optimal interaction of supply networks in terms of quality, cost and delivery (Ohno, 1988; Bertodo, 1996; Dust, 2009; Helmold, 2010). The ongoing trend towards the use of module and systems suppliers has led to greater dependency (Trkman & McCormack, 2009). This trend has inherently increased the vulnerability of the supply chain (Harland et al., 2003). The companies become inextricably linked and are no longer able to withdraw from the respective networks. Although extensive literature is already available on this topic, several authors point out the need for a more holistic approach on monitoring supply chain risks in greater detail (Chopra & Sodhi, 2004; Narasimhan & Talluri, 2009). There is a gap between the proactive role of SRM in a complex and multilayer supply network and the current view on how to deal with supply chain risks (Wu & Knott, 2006). Further research should therefore contribute to closing this gap by providing criteria and classifications for a best practice model for SRM, as proposed by Choi et al. (2001). As defined below, these recommendations would be applicable to manufacturing companies in the European transportation industry. Furthermore, additional research will contribute to the future avoidance of supply disruptions by formulating early and sustainable warning indicators, as recommended by Christoper & Mangan (2005). When evaluating a suitable research strategy in terms of methodology and appropriate methods, the advantages and disadvantages of the following approaches were taken into account:

1. quantitative research
2. qualitative without an interventionist approach
3. qualitative with an interventionist approach

Various authors point out that a purely quantitative and numerical approach may not fully reveal the truth of the phenomena Remenyi et al., 2003; Yin, 2009). Quantitative statistics or surveys are often used by many other companies to measure supplier quality and delivery performance (Schmitts & Platts, 2003; Dust et al., 2011)**.** Supplier performance data might hypothetically contribute to good or bad supplier relationships between the customer and the supplier; however, such data do not indicate what a best practice model of SRM in complex supply networks should look like (Rao & Goldsby, 2009). In addition, performance data do not take into account aspects like processes, tools and sustainability (Gürtler & Spinler, 2010; Dust, 2009). As the questions within this research focus on “What does a best practice model in SRM look like” and “Why do certain criteria contribute to such a system”, a systematic literature review, interviews and a case study approach are more explanatory than surveys, observations or a quantitative approach (Yin, 2009). In addition, it is intended that such a role model can be applied by other enterprises in the respective industry, and therefore it needs to

consider current trends, beliefs and patterns relating to supply networks. Supply networks and the supplier relationships within these networks are social constructs and created by humans, which need another approach than quantitative analysis (Yin, 2009). As a result it has been decided to apply a multiple qualitative research methodology. Case studies focus on contemporary events and are a suitable tool for understanding and explaining complex phenomena (Remenyi et al., 2003). However, the research will incorporate a qualitative approach without interventionist approach, however, a qualitative approach with an interventionist approach is recommend for further research in this field and transfer of findings to other industries. A systematic literature review combined with interviews have been regarded as appropriate methods for Phase I and II combined with the case study validation or falsification. In this context, the case study approach in Phase III is a sophisticated method in that "it provides valid and reliable evidence of the research process as well as presenting the findings which result from the research" according to Remenyi et al. (2003). Therefore the multiple methods approach including case studies is considered to be an appropriate method for confirming/disconfirming best practice elements of SRM and supply networks, which are grounded on the literature review and interviews from experts of industry benchmarks. Comments and opinions in the literature differ on the question of how many cases should be used. As outlined before, the majority of authors propose one, two or three (Yin, 2009; Eisenhardt, 1989) cases are sufficient. Yin states that one single case study is sufficient (2009; p. 69) if certain criteria are met, any additional cases serve as replication. A case study approach in this context is an empirical enquiry that validates or falsifies findings and best practice elements in SRM from the literature review and interviews. Secondly, it helps to investigate SRM in depth both within supply networks and in its real and practical context. Moreover, case studies rely on multiple sources and experts in the field of SRM. In this research experts of two projects have been interviewed for this purpose. In addition, the case study method comprises a significant contribution to the research in SRM from managerial and industry practice. It deals with relationships between supply chains and social behaviour within supply networks, benefitting from the prior development of theoretical propositions on SRM for data collection and analysis. Finally, case studies cope with the fact that SRM best practice elements and a best practice model comprise more than one result and category. When applying the case study approach, it is mandatory that certain competencies are available, as emphasised by a number of authors (Yin, 2009). The competencies have been outlined in the previous section in detail. A proficient case study investigator needs a set of skills to successfully draw the right conclusions. Yin stresses that the researcher must have competencies to make the right enquiries throughout the interviews and research. The author has been able to acquire presentation, interview and mentoring skills through specific and suitable training measures within and outside Bombardier. In the case of Bombardier, it is important to have the right language skills, especially in

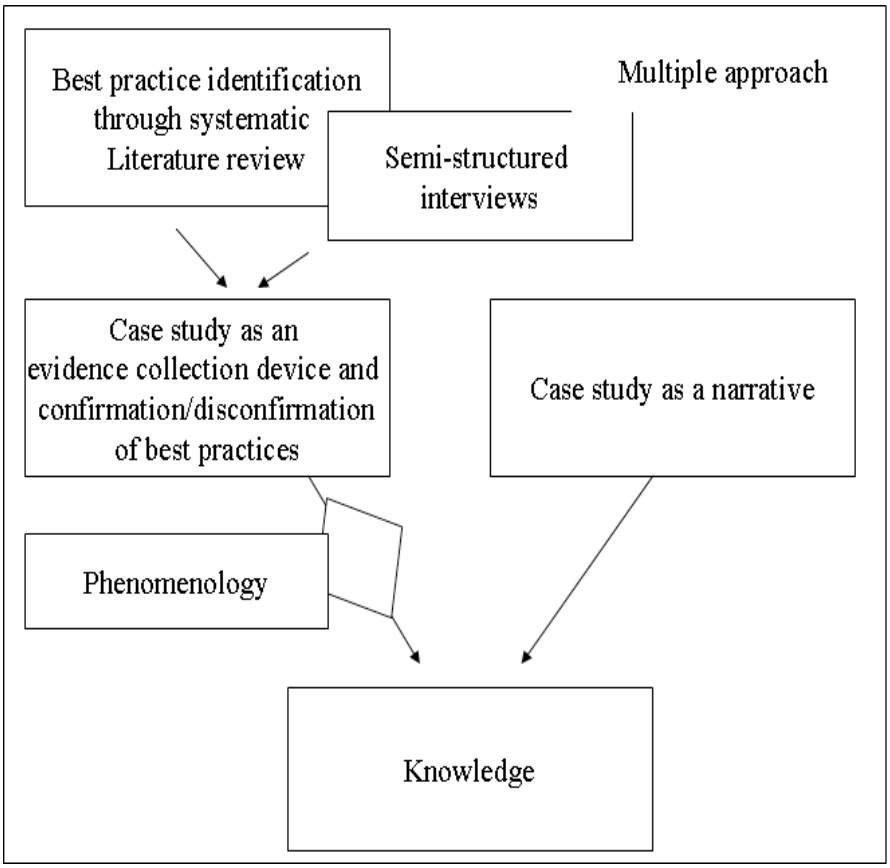
English. In Bombardier, English is the corporate language, so that no issues came up. In certain cases, the author had to rephrase or explain the exact meaning of the questions. Besides the required skills set, anonymity and ethical guidelines have been a crucial aspect of this research. Anonymity of interviewees has been granted by not disclosing the names of interviewees. Ethical considerations in terms of anonymity, disclosure of data and other aspects are outlined in the next chapters in more detail.

4.4 How the case study approach adds value to this paper

Two case studies within Bombardier have been scrutinized for confirming and disconfirming the identified best practices in this research. This section therefore describes the process of applying the theory based on case studies within the field of SRM. It goes from specifying the research questions to reaching conclusions. The theory used deals with the question of how to establish best practice categories of SRM and supplier networks and what aspects to implement. Some features of the process, e.g. problem definition and construct validation or falsification, are similar to hypothesis-testing research. Remenyi states that there have been recent prejudices against case study approaches (2003). Case studies are defined by Yin as an "empirical enquiry that investigates a contemporary phenomenon within its real life context when the boundaries between the phenomenon and context are not clearly evident and in which multiple sources of evidence are used" (Yin, 2003; 2009). The Figure below shows that case studies can be applied as a narrative or evidence-collecting (confirmation or disconfirmation) device in order collect knowledge for the research topic. For the purpose of this paper the latter, the case study as evidence collection device, will be used. Case studies have been viewed by critics as a less desirable form of empirical research methodology (Yin, 2009). Accusations include bias and a tendency to use incomplete evidence. Of course, case studies are not perfectly objective due to the opinions of both the supplier and the recipient of the information. However, case studies represent an ideal approach for collecting evidence of social systems and more deeply question the "how" and "why" of phenomena in social behaviour. As supplier networks and supplier relationships focus on human beings and enterprises, a case study methodology was considered to be a suitable tool for this thesis, especially as the resulting depth of enquiry is significantly greater than with quantitative research methods. Yin gives an example where in-depth interviews are sometimes used to ascertain attitudes by means of question lists; the results are often unsatisfactory as one cannot do justice to the complexity of a standpoint by ticking "Yes" or "No" or rating "one to five". On the contrary, case studies with in-depth interviews are seen as an ideal evidence collection tool (Yin, 2009). Case studies go behind the scenes and are targeted to getting more insight on what the SRM role model should look like. Even though Yin recommends case studies as an appropriate research strategy, he points out that using case studies remains one of

the most challenging of all social science endeavours (2009). The case study approach in Phase III is a significant part of the research in order to confirm, disconfirm or adjust the findings identified in Phase II. Yin (2003; 2009) and Remenyi et al. (2003) outline that case studies can help in detailed and in-depth examination of a setting, a person, principles or groups. They point out that multiple data sources give multiple perspectives.

Figure 4-5: Case study method with two basic approaches

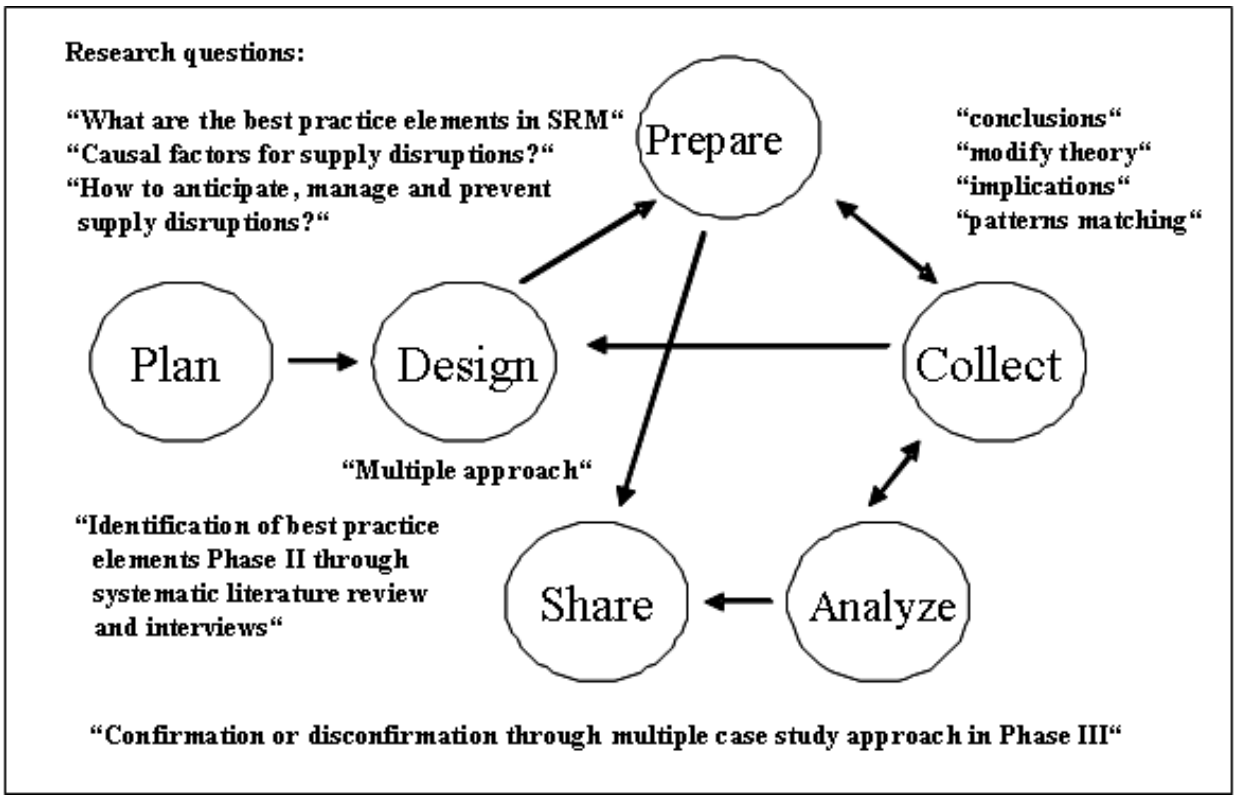


Source: adapted from Yin, 2009.

The focus is on the individual or group, not on the population and meaning is extracted from observation of the case studies with instructive findings rather than generalizable results (Yin, 2009). The results of the case studies will therefore be utilized to establish a logic and uniform set of actions of best practices which can be applied to anticipate, manage and prevent supply disruptions in manufacturing companies in the European transportation industry successfully. These conclusions will help to modify the before identified theory and implications, that were found during Phase II in the systematic literature review and the interviews. For the analysis it is meant to use the methodology of "patterns matching" as recommended by several authors (Trochim, 1989; Yin, 2003; 2009; Remenyi et al., 2003; 2009). Trochim describes this methodology as "to compare the empirical

based patterns of the case studies with the predicted patterns", identified through the systematic literature review and semi-structured interviews in Phase II.

Figure 4-6: Case study approach in research of SRM



Source: adapted from Yin, 2009.

The empirical based patterns can be described as the identified best practice categories from the systematic literature review and semi-structured interviews of senior managers in manufacturing companies of the transportation industry in Europe. Based on these findings, two cases are foreseen for validation or falsification of best practices in the identified categories. The case study approach has a sequence (as shown in the above Figure 4-6) and comprises certain activities as outlined by Yin (2009).

5. Phase I: Confirmation, disconfirmation and refinement of research questions

5.1 Research questions and approach in Phase I

This chapter tackles the confirmation, disconfirmation and refinement of research questions as part of Phase I. This phase focuses on interviews with the senior management of Bombardier with a view to confirming or disconfirming the appropriateness of the research questions. As part of the methodology and pragmatic interpretivist ontology, the reserach is conducted within the transportation industry; it was decided to scrutinize appropriateness of the research questions through managerial evaluation in this environment. Employment at Bombardier and being a director in the field, access to suitable interview candidates and senior managers in SRM has been given. As outlined in chapter one, Bombardier is one of the market leaders in the European transportation industry with a huge supplier network. Thus, confirmation and disconfirmation of research questions by senior management of Bombardier in SRM has been considered a suitable way for preexamining and piloting the research questions and the question list (Remenyi et al., 2003). Prof. Dr.-Ing. Dust provided drafts of question lists and permitted the use thereof. These drafts were amended to the needs of this research as shown in Figure 5-2 (see Appendix 4 and 5). Functions and titles of the interviewees as well as the date of interview are summarized below. The table shows that senior management in this research could be attracted to participate in this study. Remenyi et al. (2003) also stress the importance of pretesting question lists in order to detect potential shortcomings in design and administration. Furthermore, such pretesting can confirm or disconfirm any relevance to Bombardier (Remenyi et al., 2003). The design and individual elements of the question list are the result of ongoing research into SRM and professional literature (Fink, 2010; Remenyi et al., 2003).

Table 5-1: Bombardier interviewees for validation and refining research questions

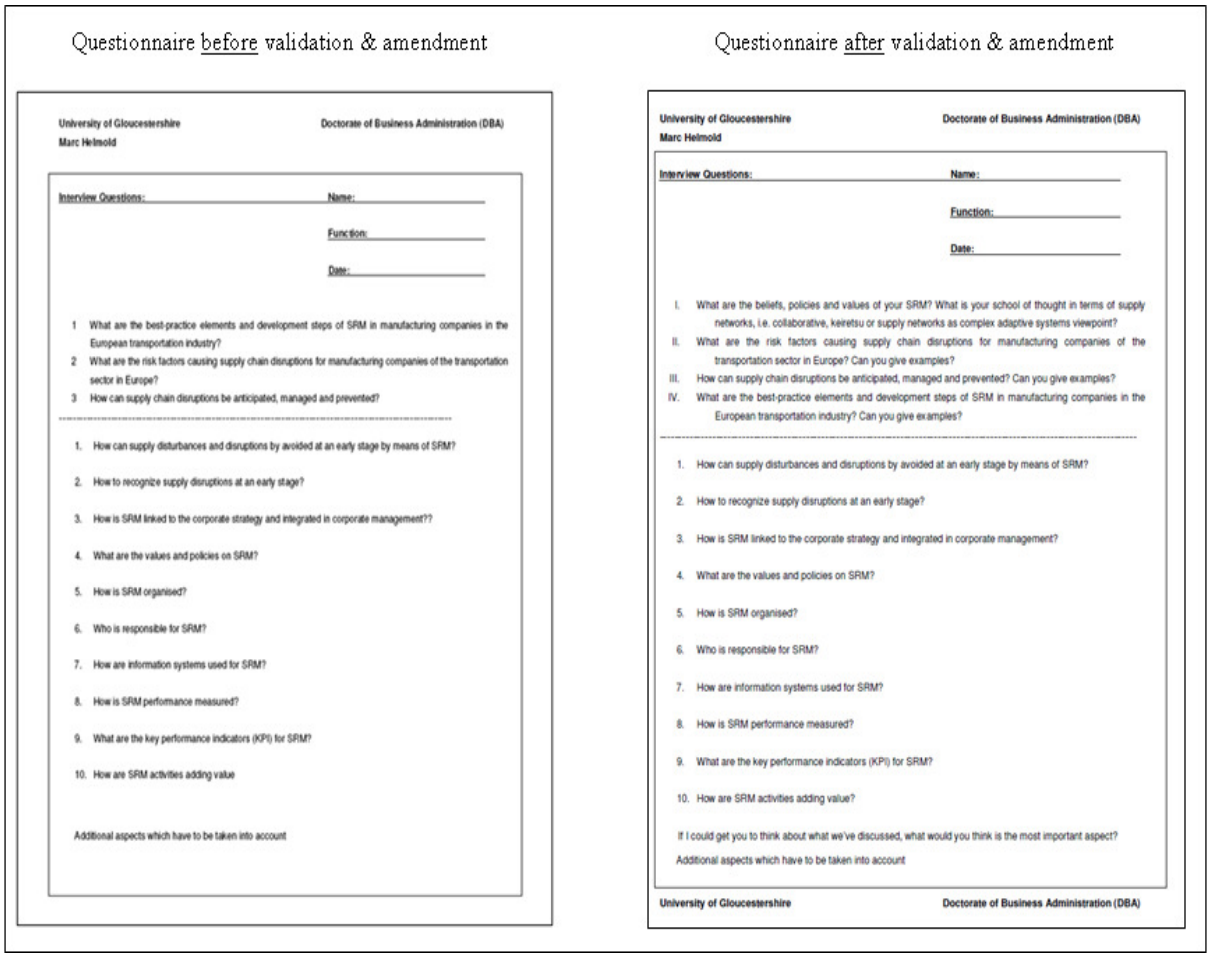
No.	Department	Position	Date of interview
1.	Global Supplier Quality Assurance	Senior Director	2012/07/04
2.	Production Control and Logistics	Director	2012/07/04
3.	Group SRM	Director	2012/07/31
4.	Supplier Performance Management	Head of Supplier Performance	2012/07/25
5.	SQA and Quality	Director	2012/07/31

Interview candidates for confirming, disconfirming and refining the the research questions.

The purpose of the interviews it is to confirm the appropriateness of the research questions and to confirm or disconfirm their contribution to managerial practice within Bombardier as fundamental

part of Phase I (Yin, 2009). Candidates with direct interfaces to suppliers and supply networks were approached approximately four weeks prior to the interviews. The potential interview candidates taken into account for participation have been working in the field of SRM at senior management level. Directors or senior directors have been asked and approached. Five experts from supplier-connected functions have been interviewed. The interviewees showed their interest in obtaining the results after the research later on and to roll out the findings to other manufacturing sites. As English is the corporate language within Bombardier, the interviews were conducted in English. It was agreed to make names anonymous, but to publish title and the name of the department. The question list was handed out personally to the participants five to seven days beforehand to enable them to work on the topic in advance. Since all participants had concerns about being recorded, it was agreed to take only notes by hand rather than recording. All protocols were transcribed after the interview took place and shared with the interviewees. The question list before and after validation/amendment as part of Phase I is shown below.

Figure 5-2: Question lists in Phase I: confirmation/disconfirmation of research questions



Source: Question list for validation, falsification and amendment of research questions. See Appendix 20.

The initial question list comprised three generic questions and ten specific questions. One generic question has been added after the first two interviews, tackling the beliefs, values and patterns in terms of SRM and also the existing schools of thought. Ethical considerations have been involved in this study and are described in the following section.

5.2 Ethical considerations

The purpose of the research and the respective questions was explained to the candidates in person or via phone prior to each interview as recommended by various authors (Remenyi et al., 2003; Yin, 2009). As the author has been a manager himself in Bombardier, interviewee candidates were known and could be persuaded to participate in this study by the goal of establishing a best practice model in SRM. The interview questions were sent to the interviewees approximately three weeks in advance around June and July 2012. None of the five candidates declined participation. If any of interviewees had refused to take part beforehand or withdrawn afterwards, the author would have looked for alternative candidates within Bombardier. Participation was entirely voluntarily, and confidentiality was guaranteed. There were no personal power issues since he only interviewed senior management. Participants were asked if the anticipated findings should be treated confidentially. Had that been the case, a common agreement would have been concluded as to which information could be published and which information should stay confidential. This agreement would have been signed before any publication of the research findings. However, none of the interviewees objected to publication of departments and titles, findings or contents of the interviews. The researcher made it clear that each participant would have the possibility to review any research results before publication. It was explained that the research would be conducted according to the guidelines of "The University of Gloucestershire's Handbook of Research Ethics (2008)". A copy of these guidelines was offered to all participants on request. Full compliance with the rules of ethics underlines the fact that the thesis reports data, information and results honestly while avoiding bias in the interpretation of data analysis. It was understood that all data arising from the interview and protocol as well as any other data would be stored safely on the researcher's personal computer and destroyed after approval of the thesis by the University of Gloucestershire. During the interviews it was highlighted to all interviewees that the author expected this research on SRM in manufacturing companies in the European industry to add both to general theory and to managerial practice. The results would contribute to science and manufacturing companies in the European transportation industry. The thesis on SRM would highlight the values, beliefs and behaviours of SRM and schools of thought (question added). Furthermore, it would define and classify risks factors for supply chain disruptions. In addition, it was pointed out that the research would examine how supply chain disruptions can be

anticipated, managed and prevented. Finally, it would identify best practice elements of SRM in manufacturing companies in the European transportation sector. Thus it would be possible to gain a competitive advantage by giving manufacturing companies the opportunity to distance itself from other companies in the European transportation industry.

5.3 Objectives of research questions

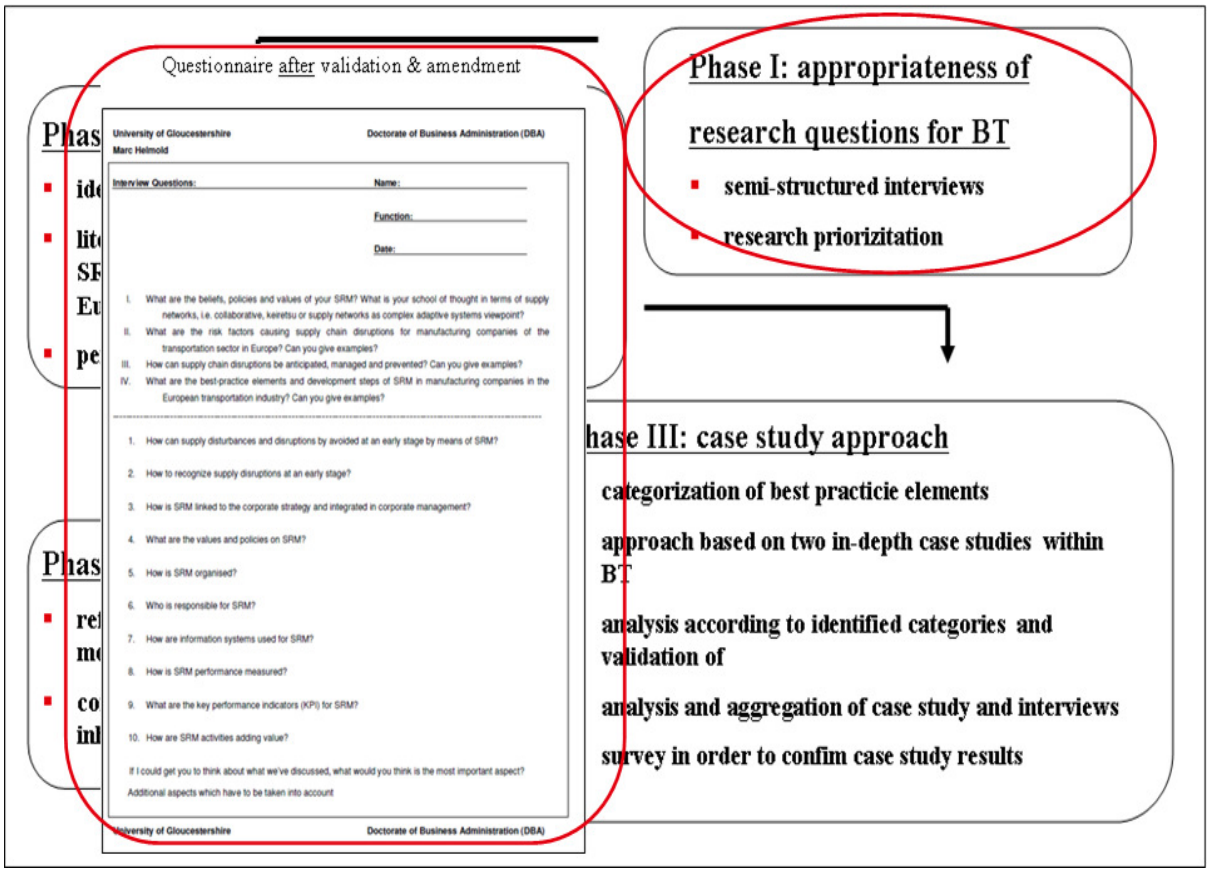
Experts from academia and industry address discuss the following four questions (see questions I, II, III and IV below) as pointed out by several authors (Aberdeen group, 2006; Emmett & Crocker, 2008; Benjamin & Gürtler, 2010). The questions on SRM are relevant for science and managerial practice and tackle issues like "What are the schools of SRM?", "what should a resilient supply network look like?", "what are proactive SRM measures?", and "what are enterprises with best practice elements in SRM doing more effectively than others?" (Harland et al., 2003; Bozhard et al., 2009). Based on this investigation, four *generic* questions (questions I to IV) have been defined and formulated as research questions for this thesis (Remenyi et al., 2003; Fink, 2010). These questions focus on general issues, whereas the remaining questions tackle more *specific* SRM issues in terms of managerial practice (questions 1 to 10). These questions refer to issues like information systems, performance indicators, organizational set up and other aspects which are relevant to managers in SRM. The defined research questions and objectives are:

I. What are the existing values, beliefs and behaviours of SRM in manufacturing companies in the European transportation industry? What are the schools of thought in SRM?
II. What are risk and causal factors for supply disruptions in manufacturing companies in the European transportation industry?
III. How can supply disruptions be avoided, managed and prevented in manufacturing companies in the European transportation industry?
IV. What are the best practice elements in SRM in manufacturing companies in the European transportation industry?

The first question "What are the beliefs, values and behaviours in manufacturing companies in the European transportation industry? What are the schools of thought?" was added to the question list after the first two interviews with the senior director of supplier quality and the group director SRM, as both interviewees stressed that SRM requires certain behaviours, values and beliefs. In the same context, interview candidates questioned what schools were available in SRM and recommended to disclose these existing schools and the respective behaviours, beliefs or values of these schools. In

reply to the second question, all interviewees said that SRM requires a preventive approach with a monitoring function in procurement. Even though Bombardier applies mostly hard criteria in its supplier evaluation system, there was also the point made to utilize soft factors for assessment purposes (Bombardier, 2011). Best practices would consist of certain tools and mechanisms created for SRM during the last years in Bombardier. In addition, it was pointed out that best practice model in SRM requires sophisticated processes, evaluation and IT or B2B environment. Regarding the causal factors for supply disruptions, all candidates validated the question in that respect, that an early warning systems must detect potential supply disruptions on the one hand. On the other hand, if disruptions incidents occurred, it would be possible to have immediate mitigation and recovery actions by understanding the causes for supply disruptions in a systematic way.

Figure 5-3: Phase I: Appropriateness of research questions



Source: own source;initial question list for research questions confirmation/disconfirmation. See Appendix 21.

The figure above shows Phase I and the objectives of this particular phase with reference to the four phases of the research. It involves analyzing the appropriateness of the questions and prioritizing the objectives by conducting semi-structured interviews. Consequently, rich data have been generated from which to address, confirm, disconfirm and refine the research questions. The interview results

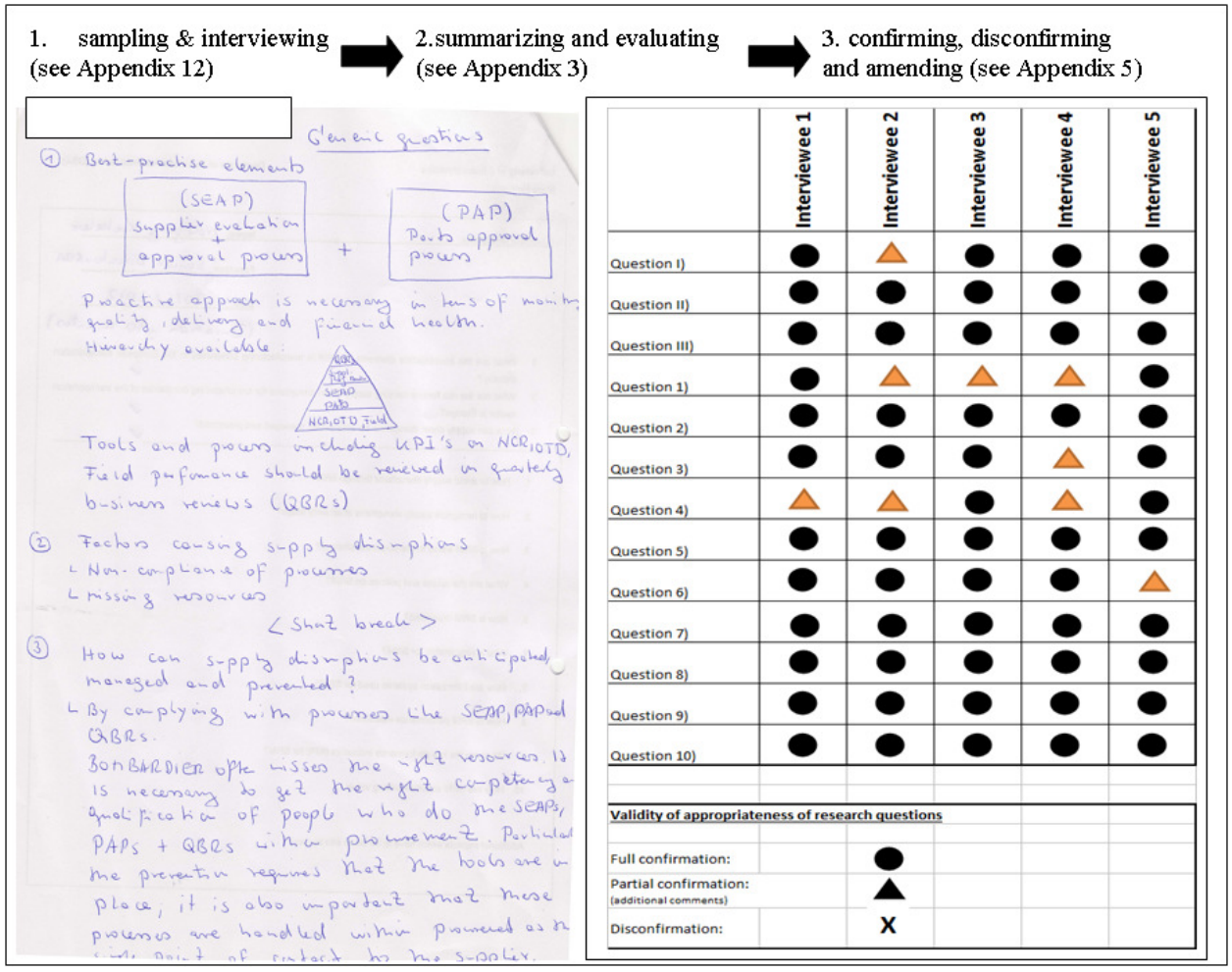
have also supported possible amendment or revision of the research questions and incorporate additional aspects identified during analysis of the experts' opinions. Experts recommended amending the sequence, too. For example, they highlighted to ask in the first questions about schools, then about supply disruptions causes, followed by question how to anticipate and prevent supply disruptions. As a result of this sequence, the fourth questions would automatically and logically lead to answers on the best practice elements, so that the sequence was amended accordingly. If appropriateness or contribution to managerial practice had not been confirmed, the author would have conducted further interviews to achieve these aims. Appropriateness could be mostly confirmed by all participants, where partial disconfirmation was in place additional comments had to be incorporated in the questions or amendments were made, as shown at the end of this section. The selection of the research questions has been an important step in this research into SRM. Fink gives examples on defining research question as initial step in the research (Fink, 2004; p. 20). The researcher has been involved in SRM related issues due to his career background in industrial practice and the involvement in many supplier related issues. Additionally, conferences (Fachtagung Einkauf, BME Symposium), supplier days and round table discussions gave him the opportunity for discussions with experts from managerial practice. The researcher looked into the literature in SRM, through which many issues were similar to the issues raised with the SRM experts. Through this process, which lasted approximately two to three years before the start of the doctorate, it was possible to define four generic research questions (questions I to IV). Whereas the four generic questions derived from the gap in literature, which related to the need to look at SRM more holistically, globally and on a tier 1, 2 and 3 basis (Harland et al., 2003; Christopher & Peck, 2004; Gürtler & Spinler, 2010), the ten specific questions (1 to 10) were raised by discussions with managerial experts on the above mentioned conferences and SRM events. The ten specific questions can be regarded as a supplement and expansion to the question list. Alongside the generic research questions, the ten questions are more definitive issues in terms of processes, tools and best practices and were raised by practitioners as shown below. It is important to stress, that the definition of generic and specific research questions has been done by the researcher himself. Phase I and the involvement of five experts with experience inside and outside the transportation industry has served as supplementary step in verifying or falsifying the appropriateness of the research questions and whether additional aspects might have to be added.

1. How to avoid supply disruptions through SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to corporate strategy?
4. What are the company's policies on SRM?

5. How is SRM organized?
6. Who is responsible for SRM?
7. How are information systems used in SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How can SRM activities add value?

The figure 5-4 shows the three steps for the process of refining the questions and question list: step one is the "sampling and interviewing" of the five candidates, step two tackles the "summarizing and evaluating" and step three the "confirming, disconfirming and refining" in Phase I. After sampling and interviewing, the results of the responses have been summarized and evaluated, which, in turn, has led to confirmation or disconfirmation of the research questions.

Figure 5-4: Phase I: Sequence to confirm and disconfirm research questions



Source: Stages of research question formulation – confirmation and amendment of appropriateness of research and prioritization according to several authors (Fink, 2010; Remenyi et al., 2003 and Yin, 2009).

Based on the Phase I results, interviews have been transcribed and summarized in the following sections as recommended by Fink (2010) and other authors (Remenyi et al., 2003), starting with a senior director of the SRM function within Bombardier. Interviews took place in either the Bombardier site Hennigsdorf, the Brussels office or the headquarters in Berlin (Germany). For the interviews a separate meeting room was reserved in order to have privacy and to focus on the research questions as recommended by certain authors (Yin, 2009). As the candidates were known by the author, the face to face conversation had a high degree of informal approach. As the candidates and the author agreed to make notes rather than recording, it was in certain situations difficult to note the entire context, so that questions had to be asked repeatedly in order to obtain the full message. In accordance with Remenyi et al. (2003) the questions should be pre-coded according to the research objectives, which made the interview transcription easier. The same analogy was used later on for the case study interviews. In contrast to Remenyi et al., there were no direct costs involved in the interviews in Phase I, as facilities and systems within Bombardier could be used (2003; p. 158). The following section five displays the comments of the SRM experts that interviewees confirmed validity and the appropriateness of the research questions to establish a best practice model in SRM in the European transportation industry.

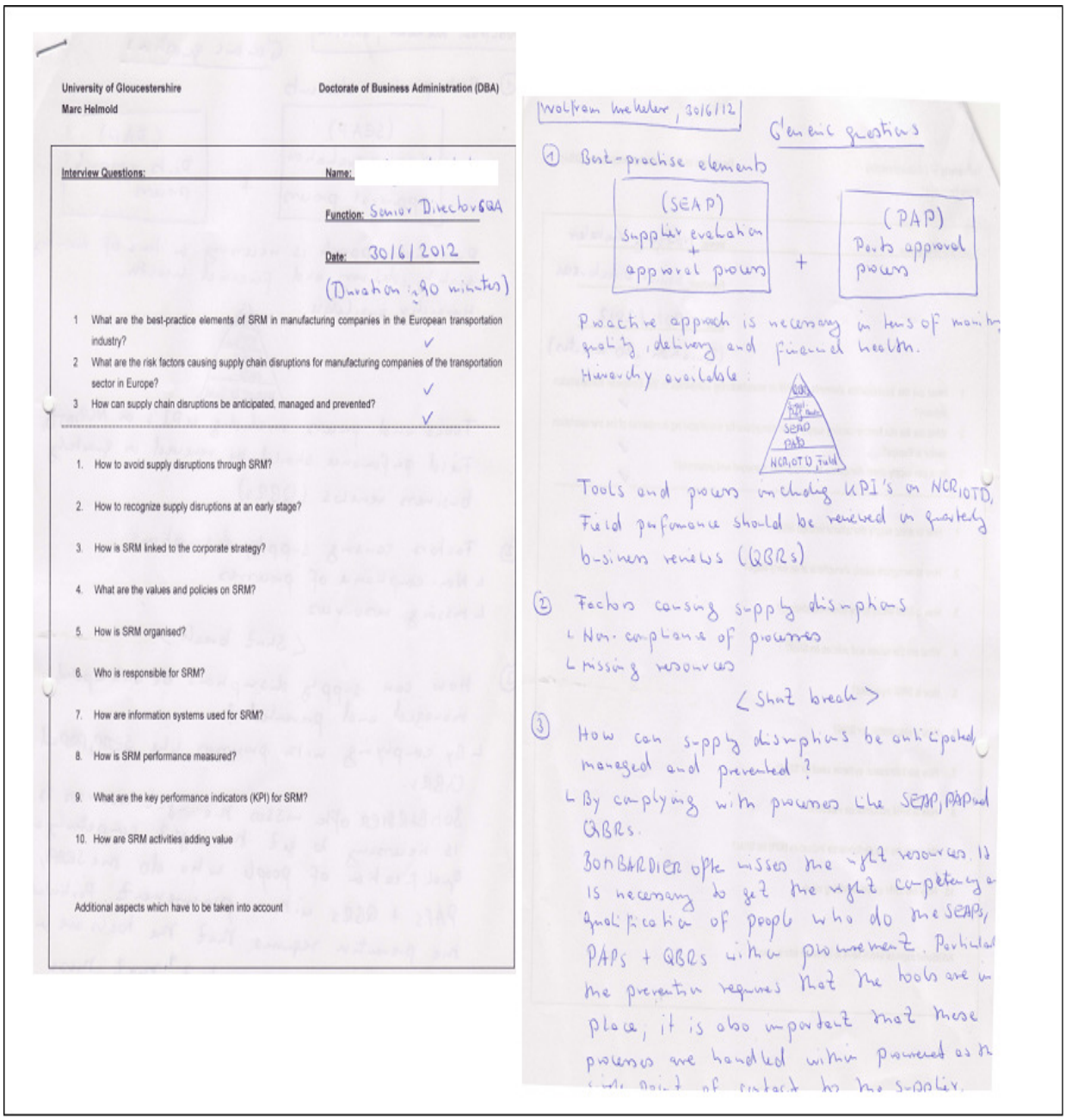
5.4. Interviews for research question validation and amendment

5.4.1 Interview one: Senior Director of SQA in Bombardier

The first interviewee to validate the research questions was Interviewee 1, the senior director responsible for global supplier quality assurance. The interview took place on June, 30th 2012 in Hennigsdorf and lasted about 90 minutes. This interviewee has been in charge of all issues relating to supplier quality and SRM within the procurement team inside Bombardier group. In his role as senior director, he has deep insight into all Bombardier transportation and Bombardier aerospace factories on a global basis, including European, Asian and North American divisions. Interviewee 1 has experience inside and outside Bombardier.

The question list including details on name, title, date and the duration as well as an extract of the answers are shown in the figure below (see Appendix 12). Interviewee outlined the tools landscape “with special focus on the supplier evaluation assessment process (SEAP) and the product approval process (PAP)”, as shown in the strategic supplier assessment and project assessment layout of Bombardier in Figure 5-6. The landscape shows three major phases in SRM, the strategic phase, the selection phase and the execution phase. Each phase would contain subcategories in terms of specific supplier issues.

Figure 5-5: Example of question list for confirming or disconfirming research questions



University of Gloucestershire — Doctorate of Business Administration (DBA)
Marc Helmold

Interview Questions: Name:

Function: Senior Director SQA

Date: 30/6/2012

(Duration: 90 minutes)

1. What are the best-practice elements of SRM in manufacturing companies in the European transportation industry? ✓
2. What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe? ✓
3. How can supply chain disruptions be anticipated, managed and prevented? ✓

1. How to avoid supply disruptions through SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to the corporate strategy?
4. What are the values and policies on SRM?
5. How is SRM organised?
6. Who is responsible for SRM?
7. How are information systems used for SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How are SRM activities adding value

Additional aspects which have to be taken into account

Wolfram Meheler, 30/6/12

Generic questions

① Best-practise elements

(SEAP) supplier evaluation + approval process + (PAP) Parts approval process

Proactive approach is necessary in terms of monthly quality, delivery and financial health.

Hierarchy available:

Tools and process including KPI's on NCR, IOTD, Field performance should be reviewed in quarterly business reviews (QBRs)

② Factors causing supply disruptions
- Non-compliance of processes
- missing resources

< Short break >

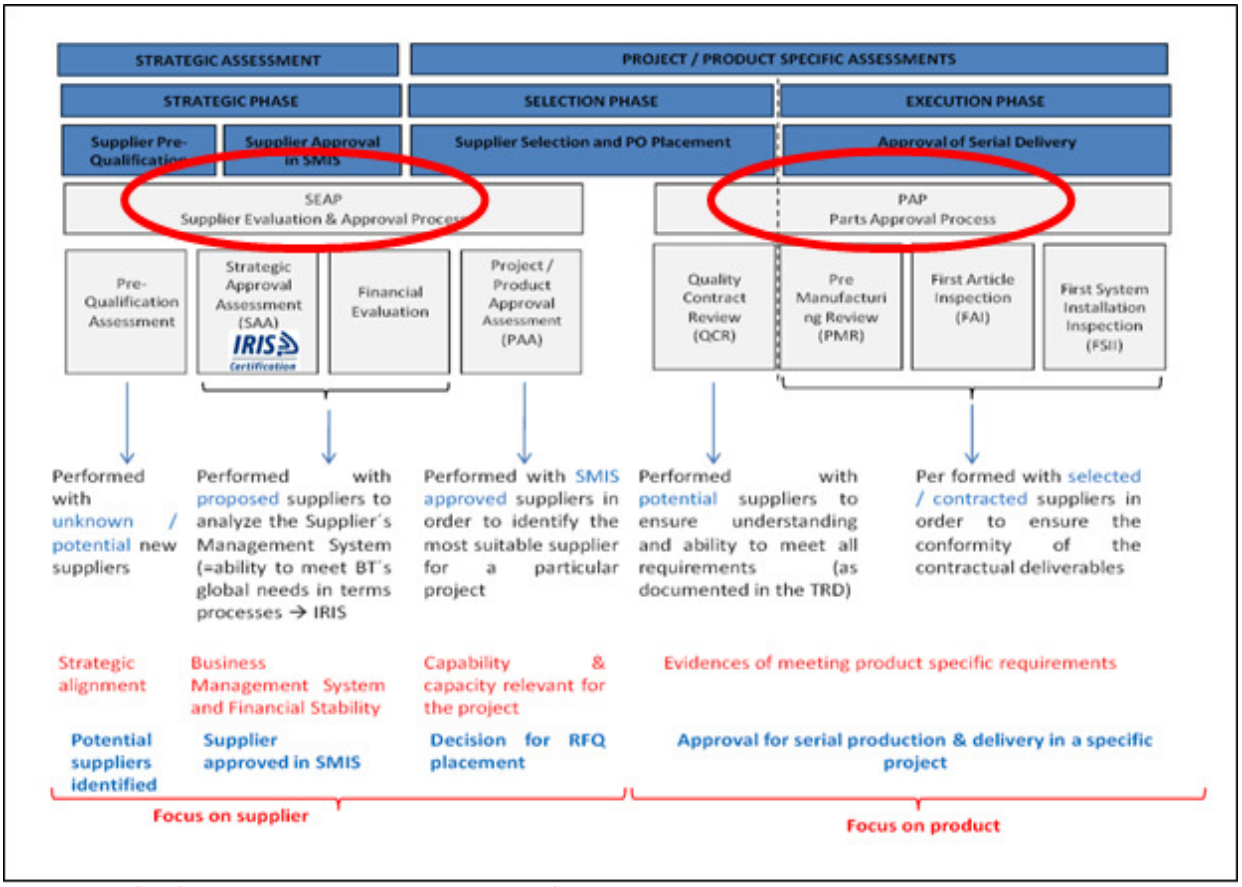
③ How can supply disruptions be anticipated, managed and prevented?
- By complying with process like SEAP, PAP and QBRs.

Bombardier often misses the right resources. It is necessary to get the right competency + qualification of people who do the SEAPs, PAPs + QBRs within procurement. Particular the prevention requires that the tools are in place, it is also important that these processes are handled within procurement as the single point of contact to the supplier.

Source: Interview question list from first interview in Phase I.

Interviewee outlined the tools landscape "with special focus on the supplier evaluation assessment process (SEAP) and the product approval process (PAP)", as shown in the strategic supplier assessment and project assessment layout of Bombardier in Figure 5-6. The landscape shows three major phases in SRM, the strategic phase, the selection phase and the execution phase. Each phase would contain subcategories in terms of specific supplier issues.

Figure 5-6: SEAP and PAP landscape within Bombardier



Source: Bombardier Transportation, 2010 – SEAP and PAP.

The interviewee pointed out the fact, that values, beliefs and schools of SRM should be added to the generic part of the question list. In the case of Bombardier, he outlined, "that a collaborative approach with a strong focus on partnership would be the key success factor for best-in-class supplier management and SRM. SRM activities have to be incorporated into the corporate policy and must be to mutual benefit, the supplier and the customer." As highlighted previously, based on the first two interviews, this was added within the Phase I (new question I.). Regarding the second question (see question II.) on causal factors for supply disruptions, he pointed out several risk factors, which would be derived from only partial existence or non-existence of this early warning mechanism. By applying a systematic supplier evaluation approval process (SEAP), parts approval process (PAP) and first article inspection (FAI), including the pre-manufacturing review before placing orders, it is possible to secure stable and robust supply chains. With the help of a systematic non-conformity process, the NCG performance measurement and an early warning mechanism, supply disruptions can be identified at an early stage (see question III.). Interviewee 1 pointed out that "non-compliance or discrepancies throughout the approval processes, can lead automatically to slack and supply disruptions". In addition to this, a strong focus on early supplier involvement and selection by

appropriate monitoring tools would be a suitable way for securing a stable supply chain or network. On question four (see question IV.) on best practice elements in SRM, he pointed out that SRM always has to have a proactive monitoring function in order to ensure resilient supply chains or networks and to avoid supply disruptions in terms of quality, cost, financial health or deliveries. Questions 1 to 10 were answered more specifically by Candidate 1. He emphasized "that SEAP, PAP and FAI had been adopted as best practices within the transportation industry, and implemented globally". The monthly low performance supplier management (LPSM) tool, which measures defective parts in comparison to the total quantity of delivered and assembled parts, as well as on-time delivery (OTD), serves as a form of monitoring governance. Any supplier that shows critical weaknesses in terms of quality or delivery is asked to implement a full action and mitigation plan (see question 1. and 2.). "Such incidents are reported to the supplier's top management to ensure full awareness within the organization." Ideally, the monitoring function is integrated in the overall procurement procedure. Objectives in terms of quality, cost savings and delivery performance are part of the corporate strategy through tools like balance score card or other action plans and reviewed within the board (see question 3.). Procurement itself ought to be part of the management team in order to guarantee that full attention is paid to the supply network and SRM. The SQA function has to assure compliance with Bombardier's code of conduct and CSR regulations. In the same context, SRM related people have to be in line with the same principles when dealing with suppliers. Within Bombardier, supplier performance management (SPM) is an integral part of the site management team, with its own director in a leading position. SRM is the core responsibility of the procurement function, and in an ideal world, there would be one contact to the supplier (see question 4. and 5.). SRM has to be structurally organized including sophisticated tools. "A web-based tool should be utilized for measuring supplier quality performance and SRM" (question 6. and 7.). It must be accessible for both parties, i.e. customer and supplier. "In addition to the hard factors, e.g. NCG, OTD, field errors, there are also a number of soft factors which are relevant for SRM, e.g. innovativeness, responsiveness, staff qualifications" (see question 8. and 9.). All in all, SRM would thus contribute to the aspect of customer satisfaction and the achievement of monetary targets like profitability and turnover (see question 10.). The interview ended after approximately 90 minutes.

5.4.2 Interview two: Head Director of Production control

The second interview took place a few days later in Hennigsdorf. Candidate 2, Head of Production Control and Expediting, also deals with suppliers and the procurement of modules and systems in the upstream supply chain. He has a long history within Bombardier including several divisions like Production Control, logistics and project management. He can look back on an in-depth experience with Bombardier and has worked in several different divisions, e.g. Powertrain and Propulsion

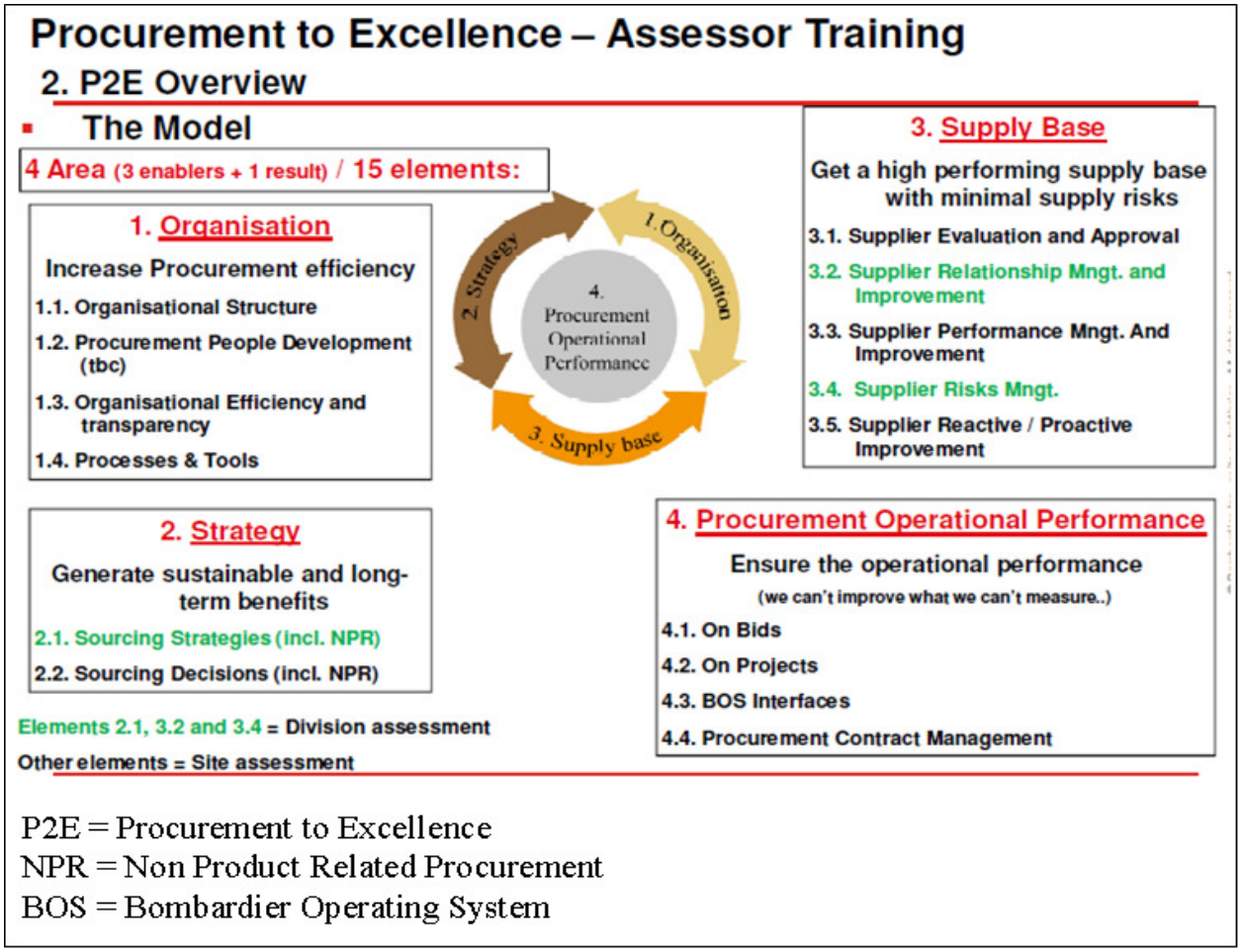
Control (PPC). On his remark to “investigate on beliefs, schools and patterns” (see question I.), he pointed out the fact, “that supplier relationships should be based on trust and collaboration”. Relationships would be essential for any organization and have to be maintained professionally. When asked the second and third generic questions (see question II. and III.) about supply disruptions and the anticipation of supply disruptions, he referred to a monitoring system, which needs to be in place. Monitoring selected criteria in terms of quality and delivery ensures a resilient supply chain. Such alert systems should be implemented using a sophisticated web-based tool. In his opinion, most major disruptions were caused by slack in the supply chain, insufficient capacities on the part of the suppliers and waste throughout the value chain. Concerning the third generic question, he explained that it was possible to anticipate supply disruptions via joint logistics concepts, particularly if suppliers are sourced globally. “Early supplier selection together with lean and flexible processes are levers for avoiding any disruption”. In reply to the first specific question on how to avoid disruptions within upstream supply chain management, Interviewee 2 mentioned the importance of a logistics protocol, which would have to be agreed upon with the supplier. The logistics protocol is a contract which regulates logistical requirements in terms of delivery schedule, JIT deliveries, packaging and other relevant aspects. Specially trained logistics experts within Bombardier discuss different aspects of the logistics set up with the suppliers. One essential preventive tool for overcoming various issues is disturbance management. As a result, best practice elements (question IV.), would logically be aspects as explained in before. He referred to three important examples within Bombardier. Firstly, he referred to the “newly created supplier performance and development group”. Secondly, he stressed “that a strong focus on monitoring suppliers was essential for detecting abnormalities at an early stage”. And thirdly, he highlighted the “implementation of joint supplier logistics concepts, including vendor managed inventory (VMI) or consignment stocks”. In reply to the first and second specific questions (see questions 1. and 2.) on how to recognize supply disruptions at an early stage, Interviewee 2 mentioned “the back order process. Back orders, parts that are ordered but not delivered, are factors which may disrupt production”. They are reviewed on a daily basis by a cross-functional team and include supplier performance, procurement, etc. Back order meetings are conducted by logistics or expediting experts within Bombardier. Ideally, a back order covers a forecast and a period of eight to twelve weeks of material that is required. With regard to the relationship between SRM and corporate strategy/management (see question 3.), Interviewee 2 answered that the procurement function should report to the site’s general manager and to group functions. “Values and policies would comprise of aspects like partnerships, fairness and trust on both sides” (see question 3.). “The values of SRM have to be driven by facts, relationships have to be fair and open both externally and internally. If the performance of the supplier in the long term is deemed inadequate, he or she may have to be

substituted". Some aspects of ethical and social responsibility are of relevance, especially when receiving consignments from low cost countries. He mentioned the global supplier code of conduct is in place within Bombardier, that is signed by suppliers. He stressed in terms of responsibility and organization that the procurement function should incorporate all SRM activities (see question 4. and 5.). Key performance indicators, e.g. delivery performance and quality aspects, are part of the balanced score card (BSC) within Bombardier (see question 6. and 7.). The SRM function should be an integral part of procurement and have a close interface to functions like production, logistics or quality. In an ideal world, the supplier would have one single point of contact, similar to a key account manager in marketing. Interviewee 2 then explained that a centralized tool would ensure better supply chain visibility on a part-by-part basis. Forecast models and ERP systems are key success factors in this respect (see question 7.). "With the help of indicators such as OTD and NCG, a supplier's performance can be measured beyond tier one, two and three levels. Besides hard factors like those described above, the willingness of suppliers to liaise, improve and cooperate is also essential for advanced SRM". Focus should be on continuous improvement and the implementation of lean principles within the supply chain (see question 8.). With the answer to the question nine he referred to KPI, which were described as the indicators used by Bombardier on a global basis, e.g. OTD, NCG, field performance, reaction time, flexibility to changes in logistical requirements. For suppliers to achieve such best practices it would be necessary to focus on lean and flexible processes, to eliminate waste and to employ qualified personnel (see question 10.). As there are yet too many supply disruptions and back orders, it would be crucial to work on these issues throughout the supply chain and the tier one layer. Sub supplier management and project management have to be considered, when obtaining modules and systems supplies from a global supply base. In summary, the interviewee Interviewee 2 confirmed the logical sequence and essence of research questions and proposed to add the first question about schools, values, processes and beliefs. The interview took approximately 70 minutes.

5.4.3 Interview three: Group Director of SRM

Interviewee 3, Director of SRM Bombardier served as the third interviewee. He is responsible for the Bombardier Procurement Guide and Excellence initiative, which act as the basis for all respective activities (Figure 5-7 and Figure 5-9). As part of a group initiative, he outlined a best practice in the training for all employees to understand procurement processes and tools. This training is divided into the subsections organization, strategy, supply base and operational procurement performance. The guide, which contains a specific section on SRM/supplier development and related processes, highlights best practice in terms of SRM and supplier management (see question IV.).

Figure 5-7: P2E Overview and objectives in terms of SRM



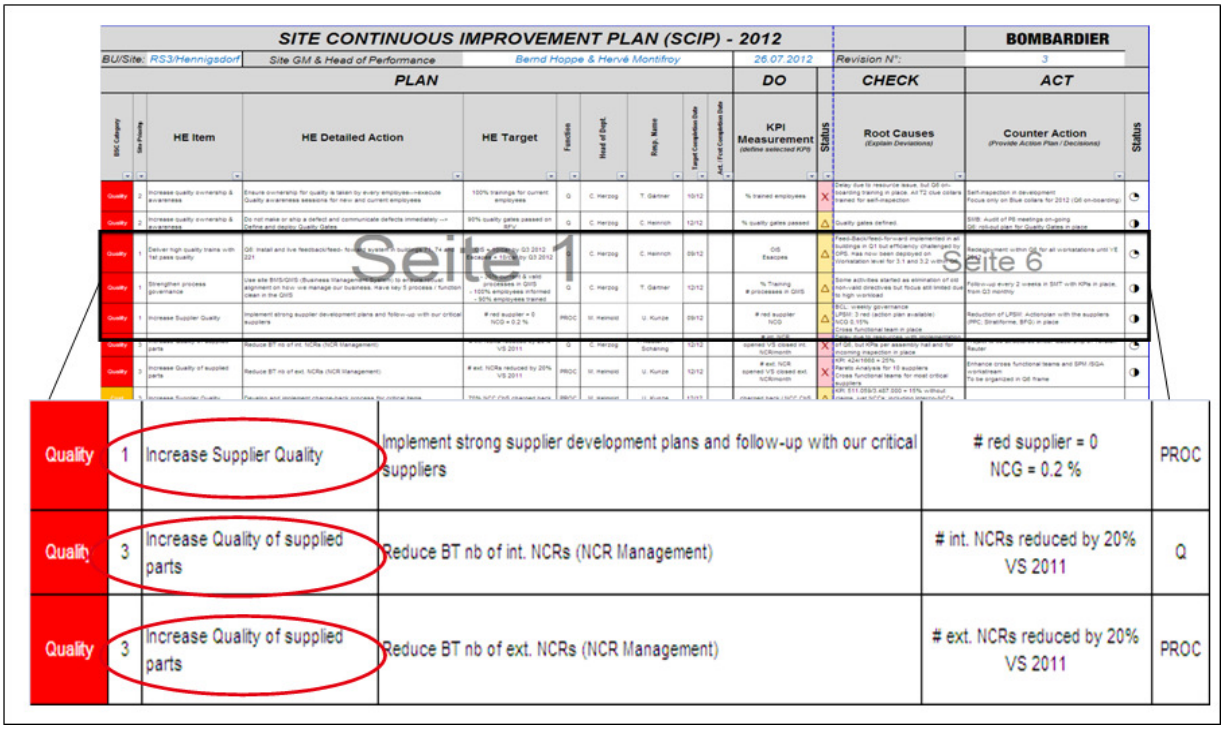
Source: Procurement to Excellence (P2E) initiative, Assessor Training Guide.

In addition, Interviewee 3 mentioned the procurement to excellence (P2E) initiative, which has been rolled out to all sites within Bombardier (see question IV.). "The P2E imitative has been mentioned by more candidates as an evaluation and improvement tool of the own organization". Participant three stressed, that even though the group related function Bombardier was ensuring standardized processed and tools in SRM, however, due to cultural and geographical differences, there would be also differences in the current SRM performance of the manufacturing sites. P2E describes four levels for improving and achieving excellence in SRM. These levels comprise the four mentioned key aspects are organization and personal development of procurement and SRM activities. Secondly, P2E concentrates on supply base management including SRM. Thirdly, it tackles supplier contracts and strategies from an SRM perspective and last but not least P2E contains as of operational performance and project management. "The P2E activities represent a framework within Bombardier, which aims at identifying the baseline where each manufacturing site with Bombardier

stands in each category, and an action plan which shows potential improvements to move to the next and more advanced level". Senior managers acted as assessors within Bombardier as auditors for multiple sites. The levels reach from one (basic SRM activities) and reach up to level four (excellent SRM activities). A key factor in this respect is the development and improvement of relevant organizational structures, tools and sustainability together with the key suppliers as partners. Such partnership would be based on levels of collaboration and closeness of relationships (see question I.). "This requires a proactive approach, including suitable resources, and a supplier academy. In contrast, if these aspects are lacking, excellence in SRM will not be achieved". In his opinion (see question II. and III.), P2E implementation enables consequently a system and philosophy which anticipates supply disturbances and discrepancies, thus enabling the organization to have early mitigations actions in place. These mitigations could be alternative sourcing or specific supplier actions. On the specific questions (see question 1. and 2.), he answered as follows: "in order to avoid supply chain disruptions, it is necessary to have the above mentioned preventive approach as well as an early warning tool for supplier monitoring." That tool should be present at each individual site that receives material from suppliers. Factors, already highlighted before in interview one, like SEAP, PAP and FAI are essential for parts approval and flawless execution. Such processes have to be combined with sustainable monitoring activities in order to create supply chain resilience. The organizational allocation of SRM activities is supposed to be within procurement. SRM targets should be monitored by the general management, as is done by Bombardier through the balance score card (BSC) and the site continuous improvement plan (SCIP) as management tools, which comprises generic and specific supplier targets in terms of cost, quality and delivery (see question 3., 4. and 5.). "The BSC and SCIP objectives consist of group and site objectives. Group objectives are applicable for all manufacturing sites in the divisions, site objectives are emphasizing the site only and are determined by the site general management. Whereas the BSC is a brief overview of major objectives, the SCIP contains a detailed action plan on important actions for the manufacturing sites of Bombardier". In the case of Hennigsdorf, there are additional objectives defined in the BSC and SCIP for the SRM activities. Nevertheless, the SCIP targets in Bombardier are still quantitative and numerical, e.g. number of red suppliers in terms of quality performance. A red supplier is a supplier, that has delivered more than 0.2 percent defect parts based on the total deliveries. Other performance indicators comprise the total number of non conformities. Non conformities are measured by the percentage of non conforming goods (NCG) in relation to the total number of parts assembled into the trains (see question 8. and 9.). Systems should be based on "smart" information systems (portals, ERP systems) and be accessible by the own organization and its supply base including tier one and two (see question 7.). "According to the SCIP, the total for internal and external number has to be reduced by 20 percent from this year to the last year". The next figure shows the Bombardier

Hennigsdorf SCIP including the categories in terms of red suppliers, internal and external NCG as significant actions for the site management.

Figure 5-8: Site Continuous Improvement Plan 2012 (SCIP 2012)



SITE CONTINUOUS IMPROVEMENT PLAN (SCIP) - 2012 — BOMBARDIER

BU/Site: RS3/Hennigsdorf | Site GM & Head of Performance: Bernd Hoppe & Hervé Montifroy | 26.07.2012 | Revision N°: 3

PLAN | DO | CHECK | ACT

BSC Category	Site Priority	HE Item	HE Detailed Action	HE Target	Function	Head of Dept.	Resp. Name	Target Completion Date	Act. / End Completion Date	KPI Measurement (define selected KPI)	Status	Root Causes (Explain Deviations)	Counter Action (Provide Action Plan / Decisions)	Status
Quality	1	Increase Supplier Quality	Implement strong supplier development plans and follow-up with our critical suppliers	# red supplier = 0 NCG = 0.2 %	PROC									
Quality	3	Increase Quality of supplied parts	Reduce BT nb of int. NCRs (NCR Management)	# int. NCRs reduced by 20% VS 2011	Q									
Quality	3	Increase Quality of supplied parts	Reduce BT nb of ext. NCRs (NCR Management)	# ext. NCRs reduced by 20% VS 2011	PROC									

Source: Bombardier Transportation, 2010 - SCIP 2012. Extract of BSC, NCRs = Non conforming reports. Red supplier means red supplier in terms of business critical (BCL) and quality performance (non conforming parts/reports, NCR) Because of confidentiality reasons, only the three elements are enlarged.

The same candidate pointed out that SRM values have to be grounded on a fair and fact-oriented relationship with suppliers and external partners. In addition to this, it is a good idea to have specialized supplier managers. These managers can train suppliers or internal staff on processes, tools and other aspects of SRM. Advanced Information systems tools and sophisticated software is recommended for supplier web-based monitoring (see question 10.). “Bombardier has recently introduced a web-based tool to measure on time delivery (OTD) and quality criteria in terms of incoming quality and non-conforming goods. As these are predominantly hard facts, it is also important to consider other aspects, such as project management, responsiveness, etc. Hard factors are crucial performance indicators for SRM”, however, the interviewee pointed out the need for soft factors, too. Especially, when comparing suppliers, aspects like size, technology capability, turnover, importance to Bombardier are important for such assessment. As a function, which establishes supplier relationships and that prevents or mitigates disturbances, SRM adds value and leads to

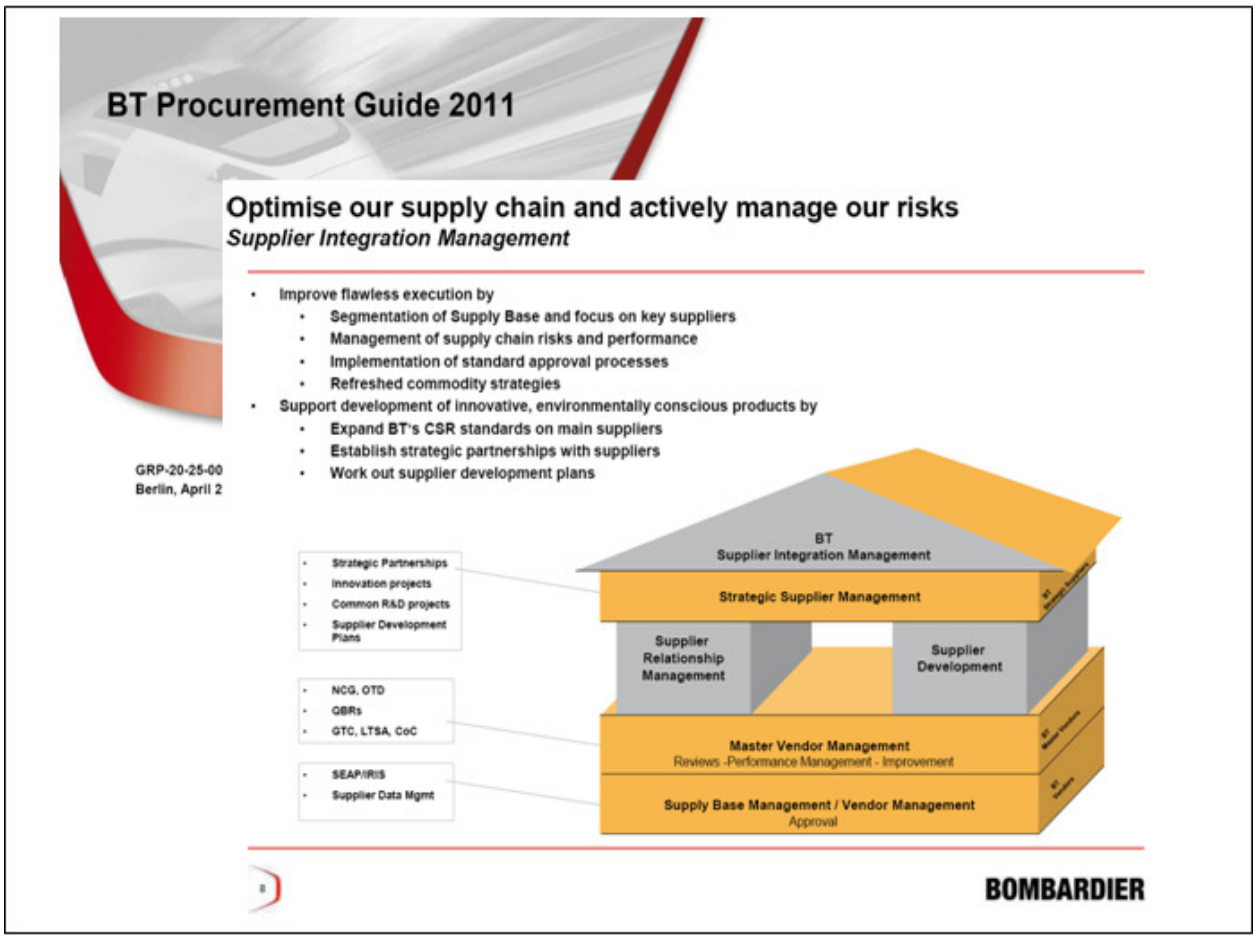
customer satisfaction (see question 10.). The interview with Interviewee 3 took about 90 minutes and was carried out in Berlin at the Bombardier headquarters.

5.4.4 Interview four: Head of Supplier Performance Management

The next interviewee was interviewee number 4, Head of Supplier Performance for the sites in Görlitz, Hennigsdorf and Aachen (all in Germany). He started his time with Bombardier in procurement. After resigning as Director of Procurement, he was transferred to the supplier performance group with a strong focus on preventive actions. The interview was done at a joint workshop in Germany. A joint and collaborative approach would be the key for success, given the fact that about 80 percent of the organization's activities are outsourced (see question I.). On questions about supply disruptions and the avoidance (see questions II. and III.), he stressed the procurement handbook as the leading document with Bombardier for SRM activities (see Figure 5-9). Concerning the first question on best practice elements, he referred, among other things, to the benchmarks within Bombardier in connection with P2E. He mentioned "the newly created supplier performance group who, together with their colleagues from logistics, deal with issues like low performance supplier management (LPSM represents the non-conforming goods ratio), business critical (BCL), supplier financial health assessment and measuring on-time deliveries (OTD)" (see question IV.). "Major supply chain disruptions are caused by reactive rather than proactive measures. Clearly defined roles and responsibilities are essential for professional and preventive monitoring of supplier performance". In reply to the third generic question, Candidate 4 explained that early warning and rapid alert systems are essential for anticipating, managing and preventing supply disruptions at an early stage. With reference to the first specific question on how to avoid supply chain disruptions within upstream supply chain management, he mentioned the reviews carried out at Bombardier sites for looking at NCG, OTD and other relevant aspects (see questions 1. and 2.). Moreover, "audits and regular visits to suppliers must be seen as essential mechanisms within any warning system. Qualified and competent SRM managers should serve as an interface and interact with suppliers on a regular basis". Concerning the question on how to recognize supply disruptions at an early stage, Interviewee 4 referred to the back order process, which was mentioned before. Back orders represent parts which are missing for production. They are reviewed on a daily basis by a cross-functional team and are linked to supplier performance, procurement and other relevant functions. Back order meetings are held on a regular basis by logistics or expediting specialists within Bombardier. Ideally, a back order has a forecast of eight to twelve weeks. Concerning the relationship between SRM and corporate strategy/management and its values (see question 3. and 4.), Interviewee 4 emphasized the importance of installing site reviews and strict governance based

on key performance indicators regarding delivery and quality as well as a balanced supplier performance dashboard and balanced score card (BSC). SRM values must be competency-based, relationship-driven and fact- or performance-related. If supplier performance is seen to be deteriorating, an escalation model has to be put in place. Such a model would entail management meetings, supplier audits and/or supplier workshops. The SRM function should be incorporated in supplier-related quality assurance activities and have a close interface to company-related production, logistics and quality control (see questions 5. and 6.).

Figure 5-9: Bombardier Procurement guide



Source: Bombardier Transportation, 2010 - Procurement Guide 2011. See Appendix 6.

In reply to question seven (see question 7.) on what information technology to be used, Candidate 4 pointed out that a centralized web-based tool or ERP system would help to ensure preventive supply chain visibility. Measuring should be carried out monthly, or even weekly, and create trend models Important performance indicators in this process include OTD and NCG. Besides the above mentioned hard factors, the willingness of suppliers to liaise, improve and cooperate is also essential

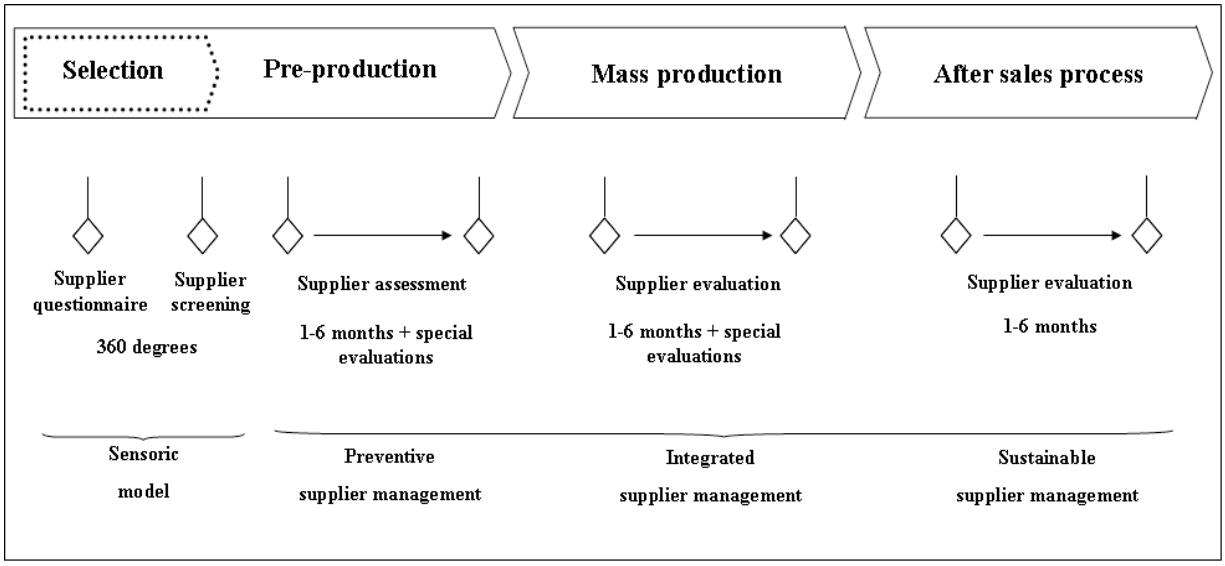
for advanced SRM. Focus should be on continuous improvement and the implementation of lean principles within the supply chain. In answer to question nine, Interviewee 4 mentioned "the key indicators and KPI which are used by Bombardier at several sites, e.g. OTD, NCG, field performance, reaction time and flexibility regarding changes in logistics requirements". Various resources and competent personnel are essential for maintaining preventive SRM. Any disconformities on the part of suppliers would also require a claims management or charge back process, including reimbursement for damage caused through disruptions. Especially for non conformities, which are caused by external suppliers, it is a crucial task to ask the suppliers to contribute to the damage through a professional claims management (question 8. and 9.). As SRM helps to secure the resilient supply chain, it adds value to the own organization on the one hand (see question 10.); on the other hand a professional claims management assures that the suppliers contribute to damages caused by supply disruptions.

5.4.5 Interview five: Director of Quality

The last interview was conducted with interviewee 5, who is the Director of Quality and Supplier Quality Assurance (SQA) at the Hennigsdorf site. Interviewee 5 has a proven track record of success in quality and supplier quality from companies outside Bombardier. She joined the site at Hennigsdorf about one year ago. When asking the first question, a quite long explanation on a phase model started. As the interviewee was quite convinced about the framework, the author listened closely to the outline the model. The model is shown in Figure 5-10, similar models have been identified as best practice element during the Phase II literature review and interviews. With regard to schools, benchmarks and best practices in SRM, she referred to similar items as those put forward by the previous four interviewees (see questions I. and IV.). "A centralized SPM or SRM function should be the focal point for supplier relations". The candidate mentioned a number of aspects as being essential for advanced SRM, e.g. staff qualifications, facilitation skills, appropriate KPI, adequate information systems. In this context, it should be noted that SPM has a long-term focus on developing and improving relationships with suppliers, whereas SQA emphasizes actual part approval. Supply disruptions can occur due to missing or insufficient processes, tools and responsibilities. On questions II. and III., she pointed out, "that only the introduction of clear-cut responsibilities and processes will lead to a resilient supply chain in which potential disruptions can be detected at an early stage". Early involvement of suppliers throughout upstream supply management is fundamental for avoiding disruptions caused by general defects, capacity discrepancies or disturbances in the supply chain itself. "Every supplier selection necessitates a 360 degrees evaluation, which evaluates the supplier´s capability to design, produce and deliver the

required systems or modules. This analysis needs to be applied to tier one and two levels at a minimum requirement. Usually, a 360 degrees analysis incorporates the evaluation of design, quality, financial and logistical aspects". Only if all criteria are met, the supplier can be selected and sourced. From the point of supplier selection it is a crucial task of SRM to establish an early warning or alert model, in which supply disruptions can be detected at an early stage. After selection, the supplier starts into the preventive mode and so-called supplier prevention phase. The objective is here through performance indicators to pro-actively evaluate key characteristics and milestones of the supplier. Figure 5-10 shows the importance of regularly assessing certain criteria, such as quality, cost and delivery, in all phases from supplier selection through pre-production and mass production to after sales.

Figure 5-10: Evaluation model from supplier selection up to after sales



Source: drafted by the interviewee candidate five.

After start of production, the integration phase starts with regular assessments based on standard indicators from the previous phases. If there are abnormalities, special assessments or activities could be incorporated into such integration phase. "For such supplier visits, specific assessment would be available throughout the transportation industry". For the after market, same evaluation would be necessary in order to secure the resilient supply of goods. Candidate 4 called this phase sustainability phase. "Tools and processes like PAP and FAI are also important in this respect. An efficient monitoring sequence from supplier selection up to the after sales level is necessary for creating adequate supply chain resilience". Regarding question one (see question 1.) of the specific questions Candidate 5 outlined the importance of cooperating with suppliers. Especially within Bombardier, a strong monitoring of launching activities of selected suppliers would be important to ensure flawless

execution. Tools and processes like PAP and FAI serve as warning indicators following supplier selection and should be reviewed on a regular basis by a cross-functional team, including quality, procurement and other related functions (see question 2. and 3.). SRM must be part of site management and key indicators need reviewing constantly (see question 5. and 6.). In Hennigsdorf, SCIP is one of the tools used for carrying out the monthly review. SRM must be internally and externally transparent and preventive. Suppliers should be confronted with good or bad performance in a fair and fact-based way. In terms of organization, SPM should be incorporated in areas which are relevant for quality or procurement. In reply to the next question (see question 10.) Candidate 5 stressed the need for a stable and robust IT system, e.g. SAP, web-based tool. Many companies use a system where they can see their performance on a daily basis. A supplier evaluation model drawn at the beginning with the suggested evaluation cycles and periods were recommended for the question how to measure SRM performance (see questions 8. and 9.). All these aspects would help the own company to optimize its performance and to add value (see question 10.). The interview took about 70 minutes and took place in Hennigsdorf.

5.5 Summary of interviews and refinement of research questions

In total, five interviews have been conducted in Phase I with Bombardier senior managers in SRM or SRM-related functions to confirm appropriateness of research questions and to utilize this as a pilot as recommended by Remenyi et al. (2003) or Yin (2009). Participation was voluntary. All candidates were pre-informed about the respective questions and scope and voluntarily participated. The appropriateness of the majority of research questions has been confirmed and validated by the selected senior managers within Bombardier as shown in the summary in Figure 5-11. For the summary, three symbols being used in managerial practice have been applied. The same symbols have been used in many companies, so that the application will be easily understood. For confirmation a circle (●), for practical confirmation a triangle (▲) and for disconfirmation a cross (✖) have been chosen. In such cases, the questions were modified and amended in line with comments made by the interviewees. Two interview appointments (candidate two and five) had to be postponed due to other commitments on the same day. The dates of the interviews are shown in the table at the beginning of Phase I. As all interviewees were on the same hierarchy level (or higher), power relationships did not apply. The question lists, including notes, have been added to the appendices (see Appendix 3). With the help of the interviews with senior management in Bombardier, it has been possible to confirm the appropriateness of the research questions and to affirm their contribution to managerial practice within Bombardier. Five experts from supplier-connected functions have taken part in semi-structured interviews. A summary of the key statements

made by the interviewees has been compiled. These statements have generated an abundance of data with which to address the research questions. The interviews helped to prioritize research objectives, support potential amendment to the research questions and incorporate additional aspects resulting from in-depth analysis of the experts' opinions. Since it was possible to confirm the appropriateness of the interviews and their contribution to managerial practice in Bombardier, further interviews have not been conducted. As shown in the Figure 5-11, the responses to each individual question have been scrutinized in terms of matching and confirming the research objectives. Regarding the generic research questions one to three, there was agreement by all senior managers that they tackle the right issues of the thesis. The summary is shown in Appendix 8.

Figure 5-11: Summary of Phase I

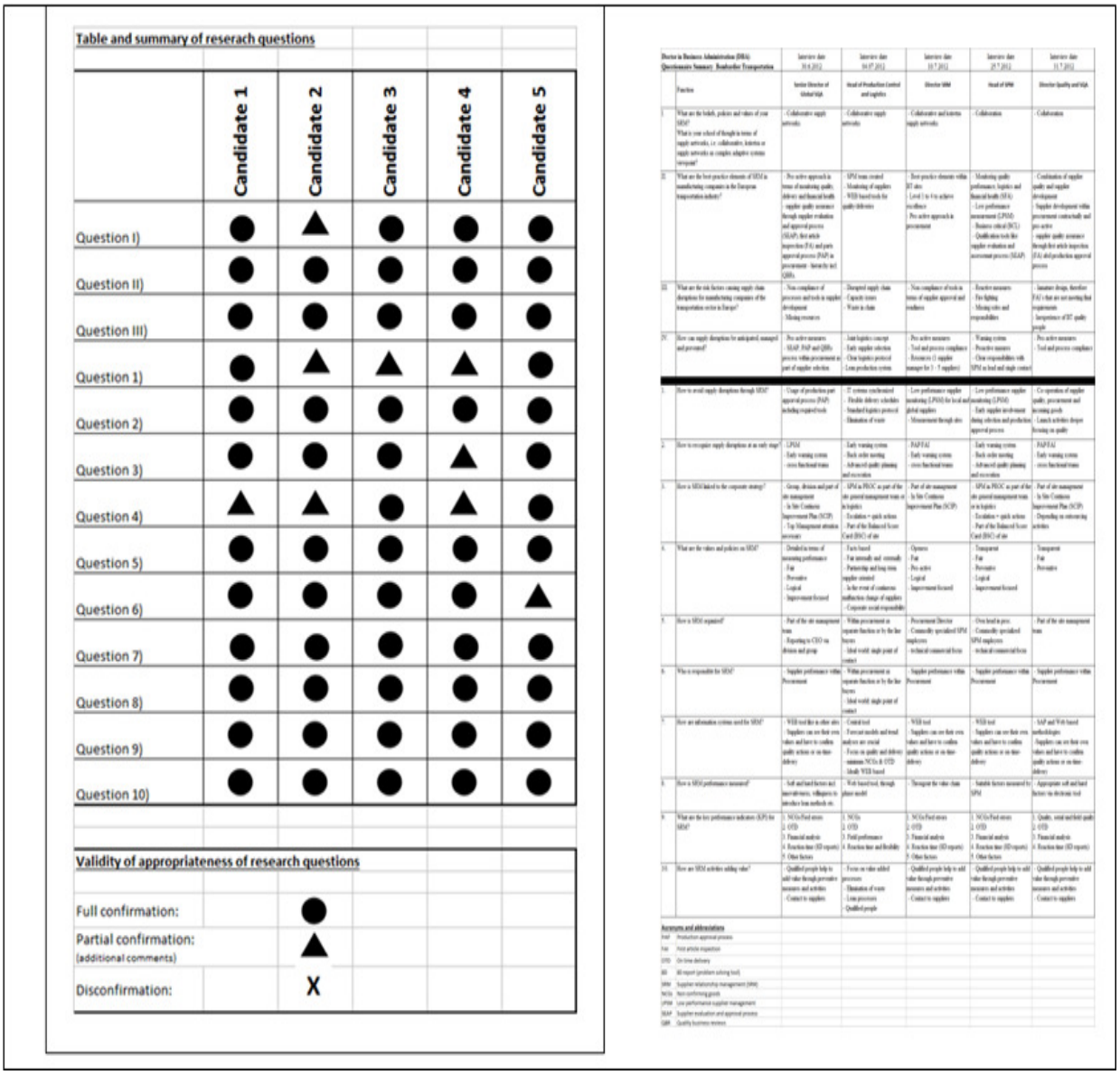


Table and summary of reserach questions

	Candidate 1	Candidate 2	Candidate 3	Candidate 4	Candidate 5
Question I)	●	▲	●	●	●
Question II)	●	●	●	●	●
Question III)	●	●	●	●	●
Question 1)	●	▲	▲	▲	●
Question 2)	●	●	●	●	●
Question 3)	●	●	●	▲	●
Question 4)	▲	▲	●	▲	●
Question 5)	●	●	●	●	●
Question 6)	●	●	●	●	▲
Question 7)	●	●	●	●	●
Question 8)	●	●	●	●	●
Question 9)	●	●	●	●	●
Question 10)	●	●	●	●	●

Validity of appropriateness of research questions

Full confirmation:	●
Partial confirmation: (additional comments)	▲
Disconfirmation:	X

Source: own source; a complete and detailed summary of results is included in Appendix 3.

On question I, the first two candidates questioned themselves what schools of SRM would prevail in the European transportation industry and what beliefs or values would be behind such schools. There was a strong tendency to address these issues, especially when identifying best practices throughout the literature review and the subsequent interviews. As a consequence, a generic question was added to the question list as follows: "*What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint?"*.Candidate 4 pointed out that diverse companies within Bombardier or in industry might have differing maturity levels, which need to be taken into account, when identifying best practices. For P2E, there are in total four different maturity levels reaching from one to four. He recommended certain improvements in terms of development stages and maturity levels of best practices in SRM in the generic question two. Consequently, the research question was rephrased as follows: "*What are the best practice elements, milestones and development steps of SRM in manufacturing companies in the European transportation industry? Can you give examples?"* The participant also proposed to ask for examples in order to judge whether these behaviours or best practices can be adopted in the own organization. Besides the two amendments of the generic questions (I to IV), the appropriateness of the remaining questions have been generally confirmed, too. There have been no further changes. On the specific questions (1-10), three changes had to be incorporated as outlined in the following paragraph. As supply disturbances can harm the supply chain to the same extent as disruptions, question two of the specific questions had to be revised to include the term "disturbances" The question was then altered as shown below: "*How can supply disturbances and disruptions be avoided by means of SRM?"*. Question three of the specific questions was amended to make the meaning of corporate strategy more precise. Corporate strategy requires functional participation in top management. Many companies buy in more value added activities from external companies than they produce internally. Therefore, SRM ought to be part of the corporate strategy and strategic management of each organization. The question was amended as follows: "*How is SRM linked to the corporate strategy and integrated in corporate management?"*. Three out of four experts recommended having more clarity on values and policies concerning SRM. For that purpose, the question was revised as illustrated below. All the experts stated that rewording would provide additional clarity on this research question. "*What are the values and policies on SRM, and how does SRM add value to the organization?"*. The remaining questions remain unchanged as the five experts confirmed clarity of the questions. The outcome of the results and pilot interviews in Phase I has been a significant contribution to the research. On the one hand, relevance to managerial practice and Bombardier has been confirmed. The author has been surprised, how much the experts have been interested in the objectives, set up, methodology and results of the research on SRM. Results could be generically implemented throughout Bombardier and standard

rules, procedures could be applied as standard SRM philosophy. On the other hand, the appropriateness of the research questions has been validated. With the successful confirmation of the appropriateness of the research questions to establish the a best practice model in SRM in manufacturing companies in the European transportation industry and the partial amendment of research questions, the wording of the question list was amended accordingly. The question list in Appendix 5 addresses the before mentioned aspects with respect to manufacturing companies in the European transportation industry, identifying schools of thought, outlining causal factors for supply disruptions, highlighting how supply disruptions can be prevented, managed and anticipated, and by showing the best practice elements. The question list is therefore showing the following *generic questions* (see Appendix 5):

I. *What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint or others?*
II. What are risks and causal factors for supply disruptions?
III. How can supply disturbances and disruptions be anticipated, managed and prevented?
IV. *What are the best practice elements, milestones and development steps of SRM in manufacturing companies in the European transportation industry? Can you give examples?*

The *specific questions* (1. to 10.) also found the acceptance of the interview candidates. All interviewees expressed their happiness to participate in this research and asked for a copy of the doctoral thesis after completion. The specific questions 1, 3 and 10 were revised according to the Phase 1 needs and comprise the following issues.

11. *How can supply disturbances and disruptions by avoided by means of SRM?*
12. How to recognize supply disruptions at an early stage?
13. *How is SRM linked to the corporate strategy and integrated in corporate management?*
14. What are the company's policies on SRM?
15. How is SRM organized?
16. Who is responsible for SRM?
17. How are information systems used in SRM?
18. How is SRM performance measured?
19. What are the key performance indicators (KPI) for SRM?
20. *What are the values and policies on SRM, and how does SRM add value to the organization?*

The question list has therefore been amended, the design is shown in Appendix 5. This chapter has dealt with the confirmation and disconfirmation on of the appropriateness of the generic research questions (I to IV) and specific questions (1 to 10) and completes Phase I. This stage has served as an ideal pilot in terms of questions, question list, research priorization and interview proceeding to the author (Yin, 200). In summary, the proposal of Yin (2009) and Remenyi et al. (2003) to have a pilot phase for interviews was an important aspect of this thesis. Appropriateness could be confirmed and through the comments of senior experts, the research prioritization could be executed. The interviews took about 90 minutes on average, so that the same time frame was foreseen for the semi-structured interviews in Phase II. The following chapter six deals with Phase II, addressing the research questions through the multiple approach of a systematic literature review and interviews with senior managers.

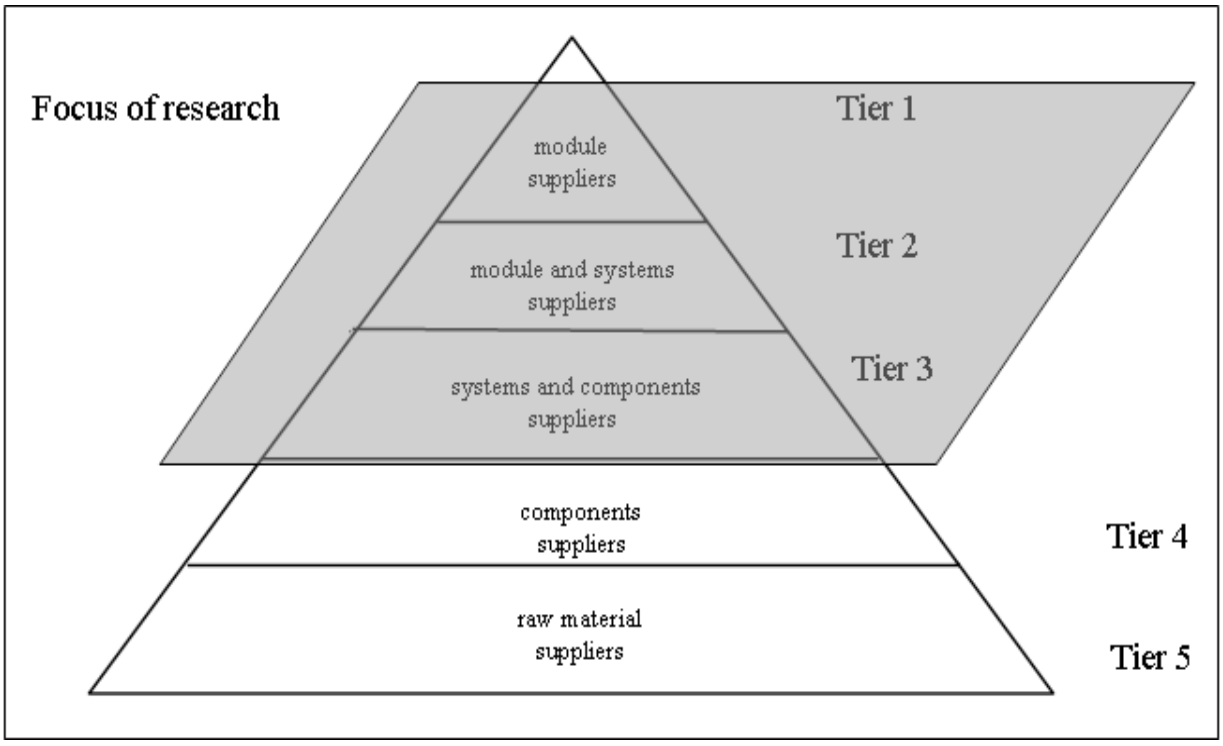
6. Phase II: Identifying best practices in SRM

6.1 Systematic literature review and semi-structured interviews

In accordance with pragmatic interpretivist epistemology, pragmatic and qualitative research includes interviews and a case study approach coupled with a respective ongoing literature review. The empirical component of the research in SRM has been conducted over four phases within a time period lasting 18 to 24 months. Relevant ethical issues and aspects of data handling or storage have been considered in the previous part of the thesis. Results have limitations and are applicable to the defined sector; any transfer to other industries would require further investigation. After validating the appropriateness and subsequent adjustment of the research questions in the previous chapter five, the next section six deals with highlighting schools of thoughts, outlining, clustering risk factors for supply chain disruptions, examining how to manage, anticipate and prevent such disruptions and identifying hereof best practice elements in SRM. Due to the shortcomings in the current literature with regard to the extended scope of supply chains and a widened scope (including tiers one, two and three), these questions have to be addressed in the systematic literature review and through the interviews with practitioners in the relevant industry as recommended by several authors (Harland et al., 2003; Gürtler & Spinler, 2010; Bozhard et al., 2008). The supplier pyramid in Figure 6-1 shows that this research is limited to module, systems and partially component suppliers. Later on further limitations will be outlined through the application of inclusion and exclusion criteria as recommended by Fink (2010). As pointed out before supply chain risks and best practices have mainly been investigated on a reactive basis and the level of module or systems suppliers (tier one), but consideration has not extended to sub-suppliers (Harland et al., 2003). The present research seeks to incorporate these aspects by closing this inconsistency and by addressing the generic and specific research questions throughout the literature review and in the interviews. Qualitative data and a multiple approach, including an ongoing systematic literature review and semi-structured interviews, have been applied (Fink, 2010; Tranfield et al., 2003; Yin, 2009). An inductive approach has been used to identify best practice elements of SRM in manufacturing companies in the European transportation industry with the help of the literature screening and ten interviews of senior managers in the European transportation industry. By applying the above mentioned interviews, existing schools have been revealed, risk factors for supply chain disruptions have been categorized into macro/micro and ex ante/ex post incidents, and subsequently compared to those identified in the literature, thus providing a unified list drawn from both sources. The systematic literature review and interviews have been used to examine how supply disruptions can be anticipated, managed and avoided (Yin, 2009). Through the addressing of the questions, best practice element could be

recognized and listed uniformly into some thirteen categories. Based on personal experience in both the research area and the European transportation industry network, the author has access to a wide range of data and suitable interview candidates. Figure 6-1 shows the limitations in terms of tier one, two and three layers.

Figure 6-1: Research focus including tiers one, two and three



Source: own source, limitations of research to tier one, two and three levels.

6.2 Conducting a systematic literature review

6.2.1 Motivation for conducting a systematic literature review

Fink (2010) stresses that a systematic literature review is a "systematic, explicit and reproducible method for identifying, evaluating and synthesizing the existing body of completed and recorded work". Such a review focuses on identifying, appraising, selecting and synthesizing the literature in the relevant field (Fink, 2010). It serves as a key tool in creating an evidence base for contextualizing the respective research, as stated by Tranfield et al. (2003). Systematic literature reviews represent a significant method for researchers and is widely used in different areas, e.g. health sector (Mulrow, 1994) and other disciplines (Tranfield et al., 2003; Higgins & Green, 2008). The first screening of

literature and discussions with managers from the respective industry disclosed, that research in SRM is largely focused on the perspective of the OEM, their tier one suppliers and corresponding reactive measures (Colicchia & Strozzi, 2012). As a result, it is very difficult to find best practices in the literature which can be transferred into management implications. Tranfield et al. identified evidence-based research as a way of forming guidelines for the decision process of managers and thus helping them to create competitive advantage (Tranfield et al., 2003). Therefore, the author considered a combined and qualitative approach (systematic literature review coupled with the interviews) for this research as suitable tool for addressing the research questions and for identifying best practice elements. Supply chain resilience in global and heterogeneous supply networks is a relatively new and still largely unexplored area in literature and managerial practice (Christopher & Peck, 2004).

6.2.2 Creating an expert panel for validating literature review

The intention of the author in the present study has been to gain an overview of actual literature and research activities in SRM with an emphasis on aspects addressed in the research questions (I to IV), i.e. schools of thought, the causal factors for supply chain disruptions, measures for anticipating, managing and preventing supply disruptions and best practice elements in the manufacturing companies in the European transportation industry. Additionally, the more specific questions (1 to 10) have been subject to incorporation in this phase of the research. With this aim in mind, the author decided to conduct the literature review in a systematic and structured manner (Fink, 2010). Prior to the start of the systematic literature review, a panel of experts from industry and academia was created to review the most important aspects, e.g. research steps, databases, search terms, inclusion and exclusion criteria, as recommended by Tranfield et al. (2003) and Fink (2010). The establishment of the panel took about two to three months, members had been carefully selected in terms of the specific role, academic background, experience in SRM. There is no firm guideline, how many participates should be in an expert panel, however, the author regarded quantity as sufficient in connection with the roles inside this panel (Fink, 2010). Issues like anonymity have been considered as proposed by Fink (2010). With the exception of one participant, the experts agreed to publish their names and role within the research. Table 6-2 shows the panel members in terms of name, company, function, and specific role in this panel. They are all academics or professionals in the field of procurement, supply chain management and logistics, and thus concerned with issues associated with SRM. All panel members were asked beforehand whether they would like to participate. The main task of the panel was to review, validate and confirm the execution and outcome of the literature review as a supporting and supplementary method. The panel also acted as a forum for appraising the

quality of the literature. The individual roles to promote the research inside the industry, to validate the questions, to appraise the literature or to judge on inclusion/exclusion criteria are described in the table below. Nevertheless, the decision to use what inclusion and eclusion criteria was made by the researcher.

Table 6-2: Expert panel including names, company, function and roles of experts

Name	Company and function	Role in expert panel
Panel member 1	OEM in transportation industry Director SRM Group (worldwide)	Promotion within industry and BOMBARDIER and quality appraisal of identified literature in relation to needs of industry. Discussion of practical relevance for BOMBARDIER.
Panel member 2 **Mitja Schulz**	ZF FRIEDRICHSHAFEN Head of SRM	Validation of research questions, methodology and literature review.
Panel member 3 **Volker Gehmlich**	UNIVERSITY OF APPLIED SCIENCES IN OSNABRÜCK Professor Supply chain Management	Academic feedback on literature review, review and validation of research questions, research methodology, inclusion and exclusion criteria. Quality appraisal of identified literature.
Panel member 4 **Dr. Diethardt Freye**	UNIVERSITY OF APPLIED SCIENCES IN OSNABRÜCK Professor Logistics	Academic feedback on literature review, review and validation of research questions, research methodology, inclusion and exclusion criteria. Quality appraisal of identified literature.
Panel member 5 **Alexander Braungart**	CONTINENTAL Manager Supplier Quality Assurance	Validation of research questions, inclusion and exclusion criteria, discussion of search terms. Quality appraisal of literature.
Panel member 6 **Benjamin Gürtler**	MB TECH (DAIMLER) Assistant to CEO and doctorate candidate in supplier management	Validation and confirmation of literature review and databases. Quality appraisal of identified articles and literature.

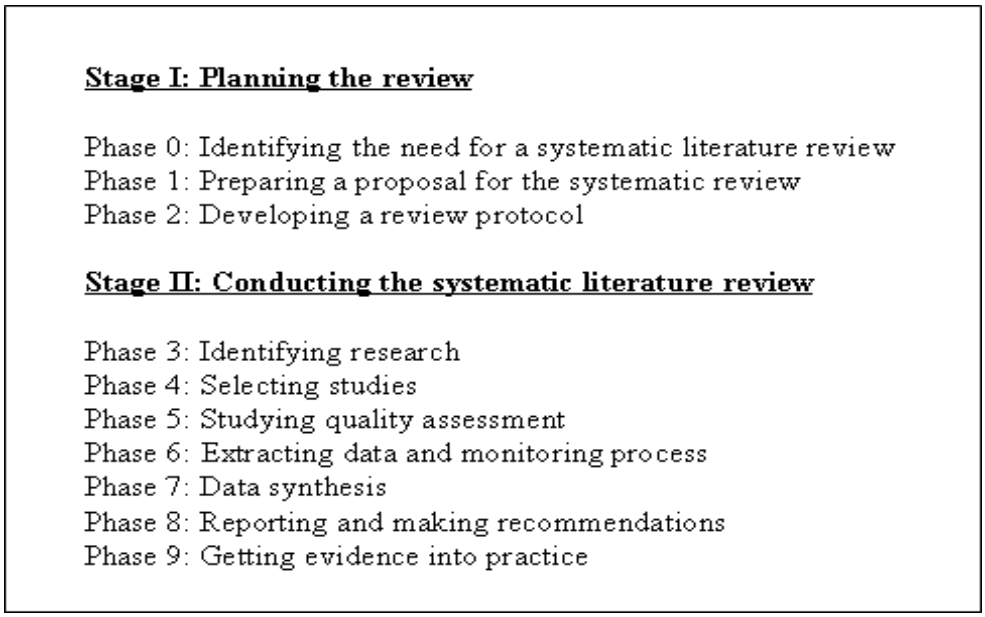
Source: adapted from Fink (2010). Expert panel for conducting a systematic literature review on SRM.

The purpose of conducting a literature review is to enable the researcher to orientate in his field of research and to identify gaps in the existing body of work on SRM in the respective area. Tranfield et al. (2003) point out that through the literature review the researcher can validate his research questions or even redefine them, if necessary. Since it plays such an important role in the research process, the literature review should provide a complete overview of the existing intellectual territory. At the present time, research in management is mainly based on narrative reviews (Tranfield et al., 2003). Many researchers postulate that narrative reviews often lack thoroughness

and completeness, and only give a descriptive account. Moreover, the choice of topic for the study is frequently biased by the researcher (Fink, 2010; Hart, 1998). In order to avoid redundancy, it is essential to take into account all research work already carried out in the field. This allows researchers to make an original and novel contribution. In many cases, practitioners and academics ask for a re-evaluation of the management review processes (Tranfield et al., 2003). The idea of reviewing the existing literature systematically was first applied in the field of medical research (Fink, 2010). Before that, it had been observed that the practice applied was based on evaluations of insufficient quality and thus the respective medical recommendations might be inadequate (McDermott, Graham, & Hamilton, 2004). Mulrow and Cook (1998) identified a systematic literature review as being a way of improving the overall research process (including the possibility of detecting discrepancies) and enabling the researchers themselves to integrate valid information more efficiently, thus providing a basis for rational decision-making. With reference to reviews in medical science, Mulrow (1994) spoke of a significant improvement in terms of transparency, reproducibility and synthesis quality. Systematic literature reviews are, by definition, retrospective, since the studies included can only be identified after they have been published. The review process itself should be as rigorous and well-defined as possible (Light & Pillemer, 1984), while maintaining a practical perspective (Higgins & Green, 2008). It is essential that any form of bias is limited. Explicit and systematic methods lead to more reliable results, which in turn act as a basis for drawing conclusions and making decisions (Antman et al., 1992; Oxman & Guyatt, 1993; Higgins & Green, 2008). This is particularly important in the context of dynamic business environments and fierce competition in the European transportation sector (Roland Berger Strategy Consultants, 2012). In the context of SRM, it is crucial that the respective research studies are in line with modern developments. In recent years, supply chains have become increasingly global and more complex, and especially up-to-date literature can provide a valuable contribution to research. By carrying out a systematic review, the researcher is able to develop a set of “field-tested and grounded technological rules” (Fink, 2010), and thus achieve a satisfactory result. The managers of today are expected to work in a well- structured and systematic manner and to use clear processes to coordinate the work they do. It stands to reason that those working in management science should also have a well-organized, systematic approach. In medical and other research disciplines it is possible to find complete databases which only refer to systematic reviews (Cochrane Database) (Higgins & Green, 2008). Higgins and Green (2008) outlined the following six steps for preparing and maintaining a systematic review. The review starts with formulating the problem, followed by locating and selecting studies. Thirdly, the quality assessment of studies is carried out. Step four and five deal with the collection of data, analyzing and presenting results. The results are then interpreted, improving and updating the reviews in step six. Tranfield et al. (2003) and Fink (2010) also

recommend to apply a similar approach and sequence to management research needs and listed the following nine points consisting of the two major stages of planning the review (stage I) and conducting the review (stage II) as shown in the following figure:

Figure 6-3: Tranfield´s nine points for conducting a systematic literature review

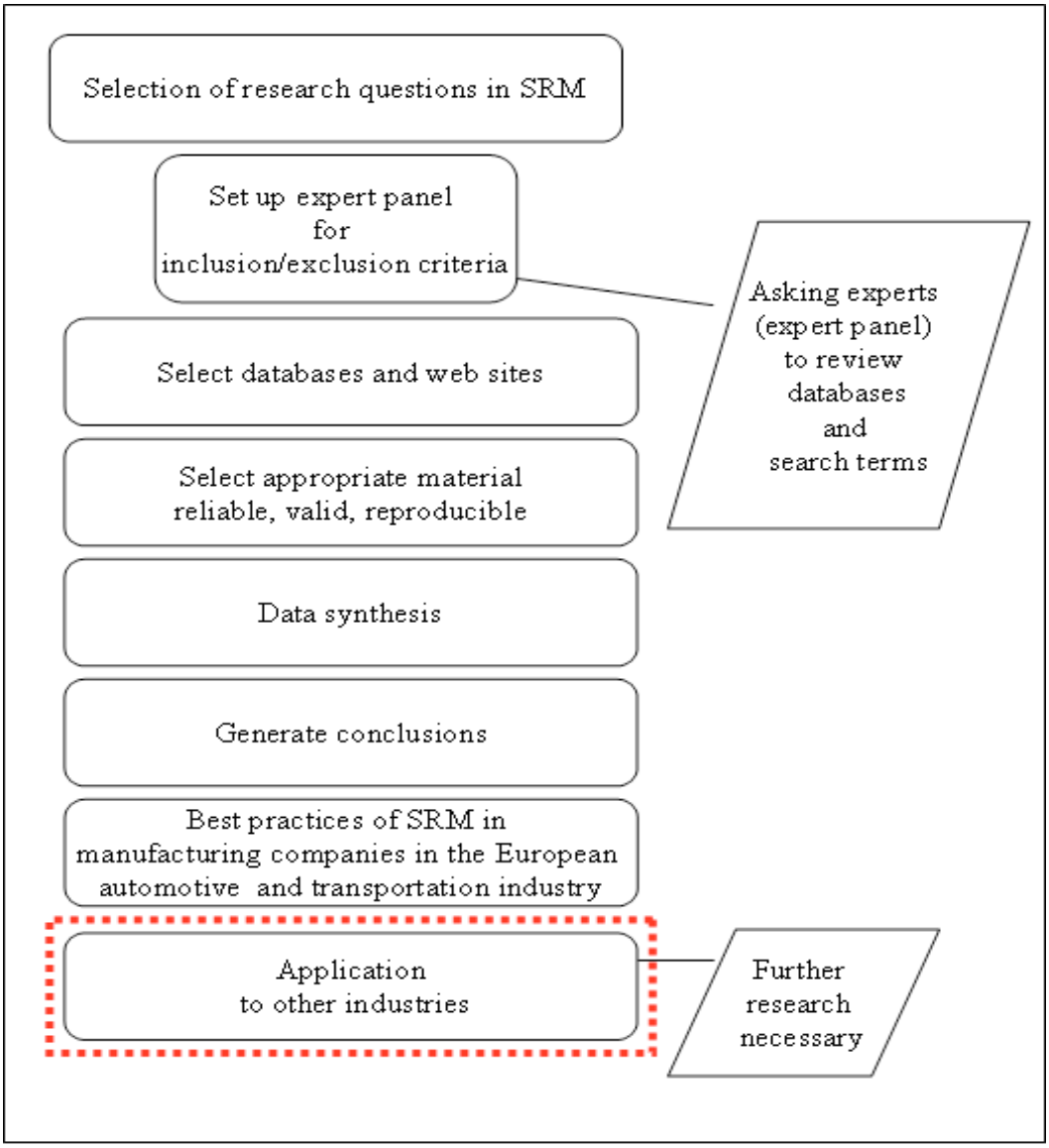


Source: Tranfield et al., 2003.

Tranfield et al. (2003) concentrate specifically on the execution of the review from phase three to phase nine. When comparing these two approaches, one can say that Tranfield et al. (2003) and Fink (2010) are closer to management practice. For the systematic literature review on SRM, it has therefore been decided to apply the recommendations made by Tranfield et al. (2003) combined with the suggestions of Fink (2010) by using the following sequence. The aim of this systematic literature review is to identify best practices in SRM which can be applied to manufacturing companies in the European transportation industry. But it has to be said that systematic research also has its weaknesses. In the medical field, it has been noted that systematic reviews are not always fully reliable (Moher, Tetzlaff, Tricco, Sampson, & Altman, 2007). The use of guidelines and standards, e.g. Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2008), improves the standard of reporting, but such guidelines do not yet exist for systematic reviews in management. Hence, the researcher in management conducting a systematic review needs to learn from the guidelines used in medical research in order to perform a systematic review of high quality and reliability. Management science is a rapidly changing field as manifested by several authors (Fink, 2010; Higgins & Green, 2008). In their study, Shojania et al. (2007) came to the conclusion that especially in rapidly changing fields, systematic reviews are quickly obsolete and need updating,

sometimes even at the time of their publication. It has thus been suggested that grey literature should be included. This suggestion is also valid in management research and has therefore been applied in the present review. An important part of the systematic review is data synthesis as shown in Figure 6-4. The figure shows the sequence of conducting a literature review according to Fink (2010). There are several methods for synthesizing data, e.g. the meta-synthesis, the meta-analysis or the thematic analysis.

Figure 6-4: Steps in conducting the literature review



Source: Sequence of systematic literature review, adapted from Fink, 2010.

Management and related topics form a relatively new field of science and thus the respective research questions are not always comparable. Moreover, the various studies may not measure the phenomenon in the same way (Tranfield et al., 2003). The management researcher is generally not so

interested in the effectiveness of an intervention, but wants to gain a better understanding of organizational and management processes. It is therefore unlikely that meta-analysis is appropriate for management research. On the other hand, meta-synthesis does not hinder the synthesis of comparable studies because the respective author is required to construct interpretations and reveal analogies between studies (Noblit & Hare, 1988). In other words, meta-synthesis offers the researcher the possibility of including both quantitative and qualitative studies in the review. In the context of SRM, qualitative studies can be important, and consequently it was decided to apply a meta-synthesis as the method of choice. This also complies with the author's ontological viewpoint as a pragmatic interpretivist. The systematic literature review is therefore meant to tackle the research questions on SRM in a systematic and structured way as outlined by Fink (2010). In global and more complex supply chains, authors address the questions on how to avoid supply disruptions, how to create resilient supply networks and how to build a robust SRM model for manufacturing companies (Bozhard et al., 2009), as incorporated within the four generic questions:

I. What are the prevailing schools of thoughts in SRM and supply networks?
II. How to avoid supply disruptions through SRM? Why?
III. How to recognize supply disruptions at an early stage? Why?
IV. What are the best practice elements in SRM derived from questions I to III?

Moreover, management in SRM queries how SRM performance can be implemented and measured in manufacturing companies in the respective industry (Bozhard et al., 2009). These challenges and issues raised in literature are therefore combined with more specific issues like beliefs, organizational set up of SRM activities, roles and responsibilities, processes, assurance of sustainability, usage of IT environment for supply chain resilience and many more (Bozhard et al., 2009).

6.2.3 Search strategy for systematic literature review

Prior to the physical search process, a review protocol was established, in which results and searches were recorded. Because current research in the field of SRM is mostly focused on the OEM and their tier one suppliers, it was assumed that studies would be found with a focus on SRM, but not with a focus on the extended upstream supply chain, e.g. tier one, tier two and tier three suppliers. It was therefore decided to conduct a wide search, to ask the expert panel to review the search, and to include all accessible, relevant research databases, as shown in the Figure 6-5. The databases Emerald Group Publishing Limited, ISI Web of Knowledge and Google Scholar showed the majority

of results. Other databases have been used, too, and are outlined later in this chapter. The selected search terms are referred to in English and German. These two languages cover the majority of papers published in this field of research. SRM is a topic of growing interest among academics and practitioners. The transportation industry in Europe is dominated by European countries, which means that the majority of papers are published in English or German. Even though Asian automotive and transportation companies are trying to penetrate European markets, the respective studies are mostly written in English. The transportation industry includes automotive, truck-related and railway-related companies. As there is a lot of literature available in these areas, it was agreed by the panel of experts that all papers, journals and articles connected with SRM-related research should fall within the inclusion criteria.

6.2.4 Search terms, inclusion and exclusion criteria

For the definition of the search terms, a panel of experts in SRM has been consulted as recommended by Fink (2010) and Tranfield et al. (2003). This panel supports the thesis by assuring that all requirements for the search are met and that a very detailed but exhaustive search is executed and performed. The first research started in 2010 commencing with the doctorate and has been continuously updated. The latest review was conducted in October 2012 and is illustrated in the following sections. Managers, academics and scholars from SCM and SRM functions performed several brainstorming activities together with the author in order to identify the search terms. Four categories have been defined:

(I) schools of thoughts in SRM, supply networks and its business environments,
(II) best (business) practices in SRM,
(III) causal factors of supply disruptions in SRM,
(IV) examples of how to anticipate, prevent and manage supply disruptions in SRM.

The field of research of this literature review is the establishment of a best practice model in SRM in the manufacturing companies in the European automotive and transportation industry. At the first screening of literature, it could be observed that different schools existed which are related to SRM and the handling of supply networks and supply chains. Therefore in (I) the term schools of thought in SRM, supply networks and its synonyms like supply chains have been defined. All retrieved evidence not dealing directly with this terminology has been excluded. Looking at SRM and its related schools, three schools and its common characteristics have been identified, to be explained in the following section. SRM and the handling of supply networks require the application and

execution of best practices, either hard or soft factors. Therefore the terms “supplier relationship management in manufacturing companies”, “best practices” and “supply disruptions” have been used as search term including “anticipation”, management” and “early detection and prevention of supply disruptions”. As SRM is related to “supply chain resilience”, this search term has been added. For the research, it has been assured, that only studies, which have been published in the year 1995 and later, have been taken into account. The data on which the study relies is acquired before the publishing date. Other aspects like population, language, sample and industry haven been considered prior to the execution of the literature review (Fink, 2010). In this review, no study has been found in which the data was acquired more then four years before the publishing date. Thus, the data acquisition for the included studies was performed earliest in 1995. The publishing date was used as restriction for the searches. If the used database did not permit to make this restriction, all older studies have been excluded manually. As recommended by the panel experts of the systematic literature review, the definition of inclusion and exclusion criteria is crucial to assure that the retrieved papers are in the scope of the review.

Figure 6-5: Inclusion and exclusion criteria for systematic literature review on SRM

Area	Inclusion criteria	Exclusion criteria	Remarks
(1) Language	English and German	Other languages	Only using German and English articles
(2) Timeline	1995 until today	Literature older than 1995	
(3) Sample	Studies focusing tier 1, 2 and 3	Beyond tier 1,2 and 3	Integrated approach of the supply chain
(4) Study type	Qualitative	Quantitative	Focus on qualitative research
(5) Geography	Europe	Area outside of Europe	Focus
(6) Population	Experts in SRM	Other Specialists of other disciplines	Focus on SRM experts
(7) Industry	Manufacturing companies in transportation industry	Service sector and other industries	In a wider scope transportation comprises automotive, truck and railway industry

Source: adapted from Fink, 2010. Inclusion and exclusion criteria.

The criteria comprise the (1) language area in which the study was performed and published, (2) the timeframe, in which the study was published, (3) the sample, on which the study bases its results, (4) the study type, qualitative or quantitative, (5) the geographical scope, (6) the population relevant for

this research, (7) and the industry in which the research is executed. SRM has become more important in core and peripheral business areas (Trkman & McCormack, 2009) and is aimed at building resilient supply chains (Christopher & Peck, 2004). Resilient supply chain is referred to as "the anticipation, management, prevention of supply chain disruptions and mitigations at an early stage" (Christopher & Peck, 2004) as with the increased dependency on supplier networks (Kerstenet al., 2008) supply risks have increased, too. As this dependency has been increased significantly, the terms "anticipation, prevention and management of supply disruptions" have been applied.

Figure 6-6: The databases and search terms used for the systematic literature review

Database/link		Search term(s)
Emeraldinsight		Supplier relationship management in manufacturing companies
http://www.emeraldinsight.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
	and/or	European transportation industry
	and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*
ISI Web of knowledge		Supplier relationship management in manufacturing companies
http://www.apps.isiknowledge.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
	and/or	European transportation industry
	and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*
Google scholar		Supplier relationship management in manufacturing companies
http://www.scholar.google.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
	and/or	European transportation industry
	and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*
E-Journals (EBSCO)		Supplier relationship management in manufacturing companies
http://www.ebscohost.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
	and/or	European transportation industry
	and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*
IPM		Supplier relationship management in manufacturing companies
http://www.IPM.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
Institute for Purchasing and	and/or	European transportation industry
Marketing	*and/or*	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*
BME		Supplier relationship management in manufacturing companies
http://www.BME.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
Federal Association of Proc., Mat.	and/or	European transportation industry
Management and Logistics (GER)	*and/or*	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*
AMAZON		Supplier relationship management in manufacturing companies
http://www.Amazon.com	and/or	best-practices, supply disruptions
	and/or	anticipation, management and prevention of supply disruptions
	and/or	European transportation industry
	and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, proactive SRM*

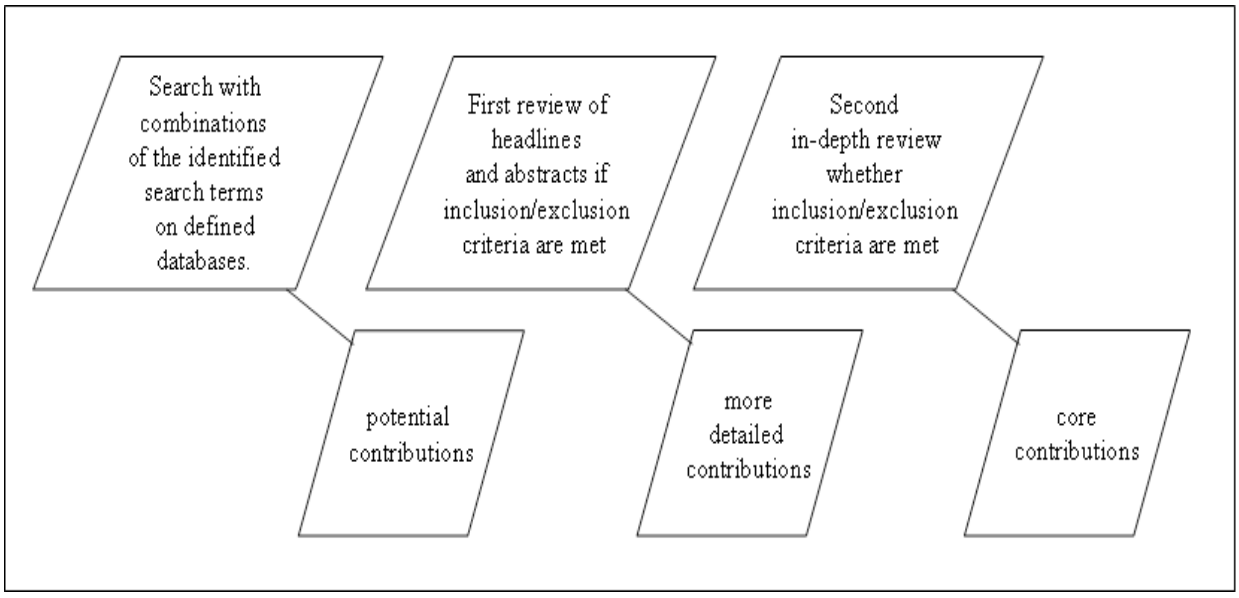
The systematic reviews showed that authors predominantly have used qualitative methods in SRM and in management science. According to Tranfield et al. (2003) qualitative research can make major contribution to management practices (Dixon-Woods et al., 2007). Hence, the review takes into

account qualitative studies only, as quantitative studies hardly exist. The resulting search terms are presented in the table above. The combinations of these search terms have been used for searching the literature. As per recommendation of panel experts, the following search terms “tier one, two and three” supply chain resilience”, “risk mitigations” and “pro-active SRM” were added to identify appropriate contributions to the research itself. By entering the search term “supplier relationship management”, the database Google showed more than two million hits. This example illustrates the vast interest in this topic and shows how important it is to narrow down the search criteria. However, it was not possible to find a previous systematic approach on this topic. Based on the recommendations of the expert panel the following electronic databases were used as shown in Table 6-6, Emerald, ISI Web of Knowledge, Google Scholar, EBSCO, IPM and BME.

6.2.5 Execution process and results of literature review

The systematic literature research has been carried out on a linear basis, as shown in Figure 6-7. For each search on a database, various combinations of the search terms were applied. The bibliography tool Zotero (www.zotero.org) was used to ensure that no duplication occurred.

Figure 6-7: Execution of systematic literature review



Source: own source, the figure shows the search process, identifying new and relevant contributions for the thesis.

With regard to the search results, a first review of potential contributions was carried out. This was followed by a review of headlines and abstracts to determine more details. If the studies met the inclusion criteria, they were considered to be relevant. All studies selected after the first review were subject to a second review. In this case, not only the headlines and the abstract, but the whole text

body and conclusion were evaluated for their relevance to the study. The expert panel together with the author evaluated the databases in terms of reliability.

Figure 6-8: Search terms and results of applied databases

Date	Database/link		Search term(s)	Results	
12.10.2012	Emeraldinsight		Supplier relationship management in manufacturing companies	1211	
	http://www.emeraldinsight.com	and/or	best practices, supply disruptions	98	
		and/or	anticipation, management and prevention of supply disruptions	36	
		and/or	European transportation industry	15	19
		and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM*	*4*	
12.10.2012	ISI Web of knowledge		Supplier relationship management in manufacturing companies	653	
	http://www.apps.isiknowledge.com	and/or	best practices, supply disruptions	54	
		and/or	anticipation, management and prevention of supply disruptions	11	
		and/or	European transportation industry	7	7
		and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM*	*0*	
15.10.2012	Google scholar		Supplier relationship management in manufacturing companies	62.000	
	http://www.scholar.google.com	and/or	best practices, supply disruptions	849	
		and/or	anticipation, management and prevention of supply disruptions	11	
		and/or	European transportation industry	8	8
		and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM*	*0*	
15.10.2012	E-Journals (EBSCO)		Supplier relationship management in manufacturing companies	3.209	
	http://www.ebscohost.com	and/or	best practices, supply disruptions	123	
		and/or	anticipation, management and prevention of supply disruptions	35	
		and/or	European transportation industry	4	6
		and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM*	*2*	
25.10.2012	IPM		Supplier relationship management in manufacturing companies	82	
	http://www.IPM.com	and/or	best practices, supply disruptions	9	
		and/or	anticipation, management and prevention of supply disruptions	5	
	Institute for Purchasing and	and/or	European transportation industry	3	5
	Marketing	*and/or*	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM*	*2*	
25.10.2012	BME		Supplier relationship management in manufacturing companies	154	
	http://www.BME.com	and/or	best practices, supply disruptions	54	
		and/or	anticipation, management and prevention of supply disruptions	15	
	Federal Association of Proc., Mat.	and/or	European transportation industry	7	10
	Management and Logistics (GER)	*and/or*	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM*	*3*	
27.10.2012	Aamazon		Supplier relationship management in manufacturing companies	1.597	
	http://www.Amazon.com	and/or	best practices, supply disruptions	5	
		and/or	anticipation, management and prevention of supply disruptions	0	
		and/or	European transportation industry	0	
		and/or	*tier 1, 2 and 3 supply chain resilience, risk mitigation, pro-active SRM, SRM and lean supply chains, SRM and value adding activities, SRM and innovations*	*15*	15

The table shows the databases used and the search terms used (Fink, 2010). The very right numbers show the articles and books selected for the research.

Table 6.8 shows the results of the literature review including 70 results (including books and articles) from the databases used in the systematic literature review. Amazon was used to identify books with the results of some 15 contributions to the research. In the following chapter, the process is explained

in detail. The meta-analysis in Table/Figure 6-9 shows the abbreviation (A) for an article and the abbreviation (B) for a book. In addition, reports have been marked with the letter (R). The search process started with initial research on the literature database of Emerald Group Publishing Limited (http://www.emeraldinsight.com/) in July 2010 as part of the doctorate. It was repeated in October/November 2012 as shown in the previous table. The result of this search was 15 studies, 4 after adding the terms “tier 1,2 and 3”, “supply chain resilience”, “risk mitigation” and “proactice SRM” (based on the inclusion/exclusion criteria), which were put on a short-list after a first reading of the headlines and abstracts. These 19 papers were considered for the research as shown in Figure 6-8.

The same day, a second search was performed on ISI Web of Knowledge with the search criteria “supplier relationship management”, “best practices” and “supply disruptions”, which revealed 653 studies. The first review of these studies produced the result that 7 contributions met the inclusion and exclusion criteria. The further application of the search terms “Tier 1, 2 and 3 supply chain resilience” “risk mitigation” or “proactive SRM” led to no findings. The seven papers were considered for the research a shown in Figure 6-8. The same process was used for the remaining databases. In summary, the databases showed 55 (Emeraldinsight: 19, ISI Web of Knowledge: 7, Google Scholar: 8; Ebsco: 6; IPM: 5; BME: 10) results after the systematic literature review as outlined in Figure 6-8.

The last search relating to this systematic literature review was conducted on 27 October, 2012 in Amazon (WWW.Amazon.de) in order to find out whether there are suitable books on SRM, best practices and supply disruptions. When applying the term “supplier relationship management”, 1,597 hits were shown. After narrowing down the search by using the term “best practices and supply disruptions”, only five books remained. Due to the limited number of results, it was decided by the researcher to widen and expand the search.

Search terms others than the defined ones were applied including terms such as “SRM and value adding activities”, “SRM and innovations” and “SRM and lean supply chains” in order to identify novel and new aspects in SRM for this research. The three search terms were used after careful consideration of the most suitable search terms. The number of results in this supplementary search of books ended up with a larger number of more than 50 books which were considered for usage.

After having a look at the table of contents and after applying inclusion and exclusion criteria, some 15 books remained. The content of the books was often similar, special focus was put on novelties

and innovations in SRM. The expert panel was also consulted as advisory body to give recommendations about what additional books to utilize as recommended by Fink (2004). The final decision in selecting books was made by the researcher himself. As the majority of books had similar contents with regard to the following books in terms of SRM issues and the generic questions (Blodijk & Emero, 2008; Emmett & Crocker, 2009; Lenders et al., 2006), it was decided to select additional books, which deal especially with SRM in the context of "innovations", "value adding activities" and "lean supply chains". As a result the number of additional books was added to the list in Figure 6-9 (Blokdijk & & Von Emero, 2008; Brauweiler, 2006; Emmerett & Crocker, 2009; Gabath, 2011; Harris & Chris, 2012; Helmold, 2010; Hildebrand, 2002; Helmström & Huttunnen, 2001; Lenders, 2006; Liker, 2004; Ohno et al., 2009; Schuh, 2011, Müller, 2011; Appelfelder & Bucholz, 2010; Thaler, 2003).

6.2.6 Discussion and summary of papers

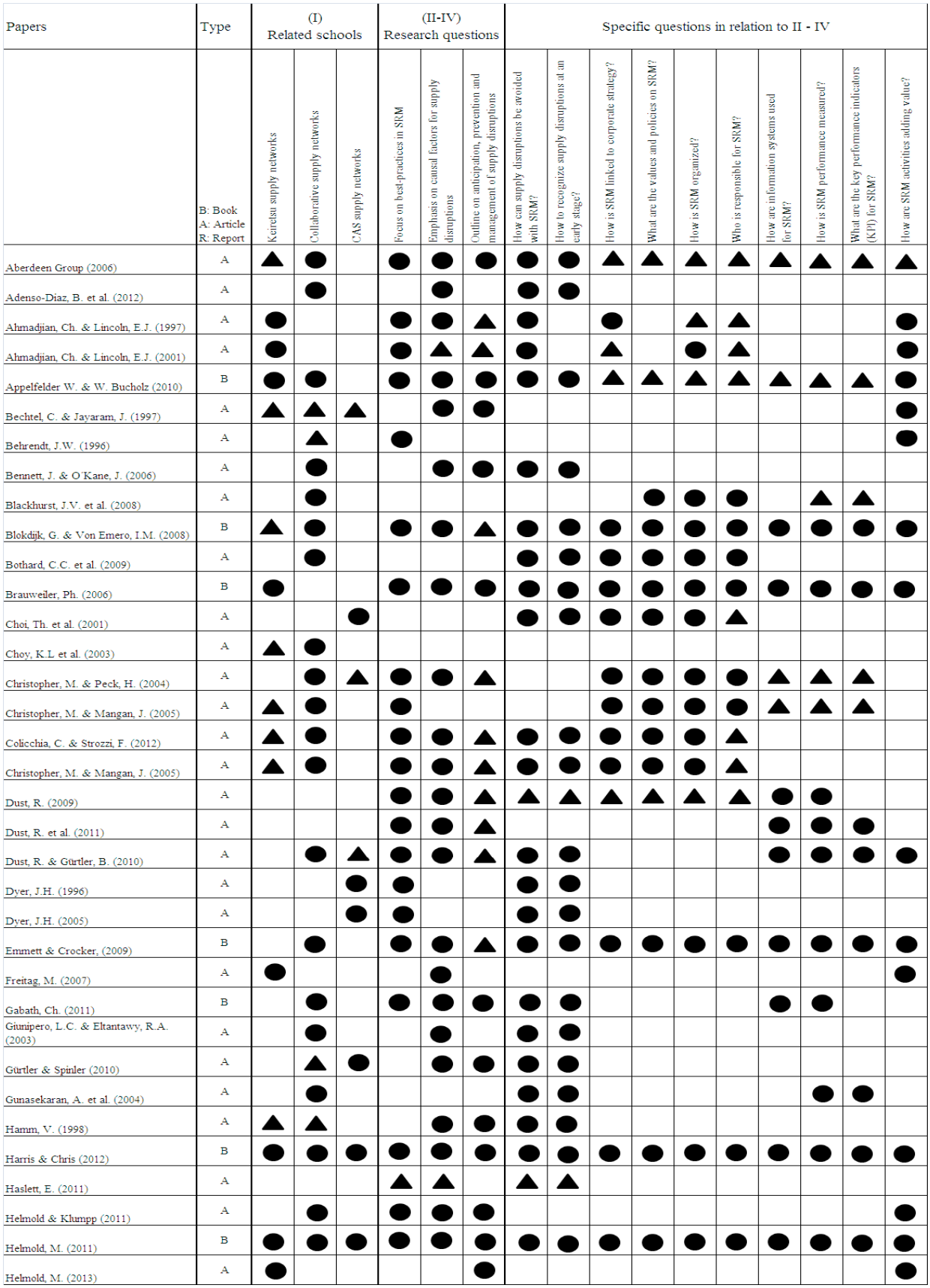
6.2.6.1 General findings, critique and meta-synthesis

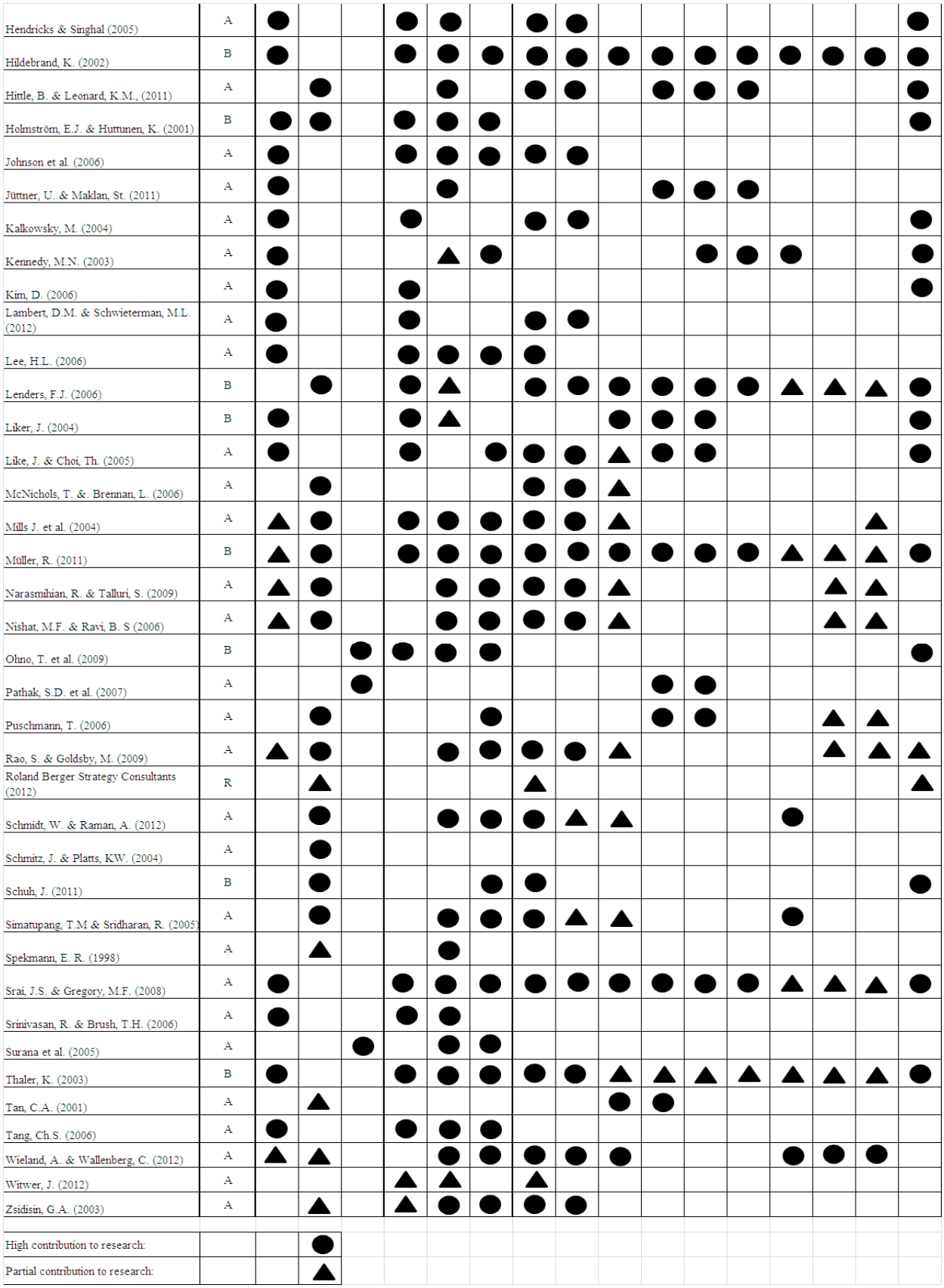
There follows a critique related to the systematc literature review: in this systematic literature review, literature for establishing a best-practice SRM model has been examined using specific search terms. Overall, one can find that although the research community has tackled SRM in various aspects, SRM and supply networks have not been tackled on a tier 1, 2 and 3 basis (Harland et al., 2003; Christopher & Peck, 2004). Moreover, only a few articles and books deal with the proactive management of complex and global supply chain issues, few articles comprehensively address an early warning system on how to manage SRM and supply networks (Gürtler & Spinler, 2010; Dust et al., 2010). The following section deals with the discussions of papers and critique in more detail.

Scholars point out that supply chains have changed into multiple, agile and wide-layered global supply networks (Christopher, 2005; Emmett & Crocker, 2009; Bozhard et al., 2009; Gürtler & Spinler, 2010). The Aberdeen group and Christopher and Peck describe the trend of transferring goods, activities and processes to suppliers, increase in number of supply chain layers (tiers), and internationalization of supply chains (2006; 2004). The consequence is that vulnerability of supply networks has risen significantly (Harland et al., 2003). Even though SRM is not only related to supply chain resilience or supply disruptions, the critique of the literature is, that only few authors outline tools, processes or systems in SRM and how to set up an early warning system for suppliers (Gürtler & Spinler, 2010; Dust et al., 2010).

Further critique can be raised in terms of the involvement of the supply network beyond tier 1 levels. The literature review has shown, that few authors suggest an investigation of supply networks in a more holistic way beyond tier 1 or 2 levels as recommended by (Narasimhan & Talluri, 2009). Behrendt (1995) and Bennett and O´Kane (2006) point out that the majority of supply chains have not yet been synchronized and that alliances hardly exist. They propose to closely synchronize supply chains and production systems, taking the automotive industry as an example (Bennett & O´Kane, 2006). There is also criticism in managerial practice and the literature, that the literature hardly shows qualitative tools of performance measurement of SRM (Dust et al., 2010; Gürtler & Spinler, 2010). Measurement is mainly based on numerical factors, i.e. non conformities, number of defect parts. Later in the summary of best practices, it is visible, that a qualitative investigation of supply network discrepancies can add value and be considered a best practice element (see Chapter 8). A few authors like Kalkowsky (2004), Kim (2006), Christopher and Peck (2004), Colicchia & Strozzi (2012) or Bozhard et al. (2009) highlight the importance of certain characteristics as a key for supplier relationships, i.e. collaboration, partnerships or common values. Supply chain resilience and the behaviours of the related schools of thought in terms of co-operation with suppliers and their best practices have become more important. This systematic literature review aims to address these concerns (Kim, 2006; Colicchia & Strozzi, 2012; Bozhard et al., 2009). However, there is with few exceptions, a lack of giving clear recommendations to managerial practice of behaviours, beliefs and characteristics (Liker, 2004; Christopher, 2005). Another critical aspect of the review is the fact, that a proactive SRM adds value to the organization and contributes to customer satisfaction, especially in the context that the organization´s own value adding activities normally amounts to 20 to 30 percent (Liker & Choi, 2005; Mills et al., 2004; Emmett & Crocker, 2009). A few authors such as Liker and Choi (2004) or Kalkowsky (2004) point out that a proactive SRM adds value to the organization, but the majority is missing this point. Finally, it has been observed during the systematic literature review that the articles or models of SRM are missing aspects in how to organize SRM in managerial practice (Dust et al., 2010). The interviews in Phase II revealed, that practitioners are particularly interested in best practices of organizing and managing SRM in order to add value to the own organization. Even though, the articles show certain models in forming supply networks or SRM, the transfer to other industries is considered to be difficult due to the generality of models, concepts and descriptions. As a consequence, this research will contribute to the closing of this gap in establishing a best practice model for multinational manufacturing companies in the European transportation industry. Figure 6-9 classifies the various articles, studies and findings. The following section meta-analysis synthesizes the retrieved evidence, using four categories: author, year and the categories in line with the generic and specific questions.

Figure 6-9: Meta-analysis of systematic literature review and key contributions





This table classifies the identified papers and evidence in terms of (I) schools of thoughts in SRM, the (II) best practices, the (III) causal factors for supply disruptions, and the (IV) anticipation, management and prevention of supply disruptions. In addition it outlines contributions to the specific questions (1-10).

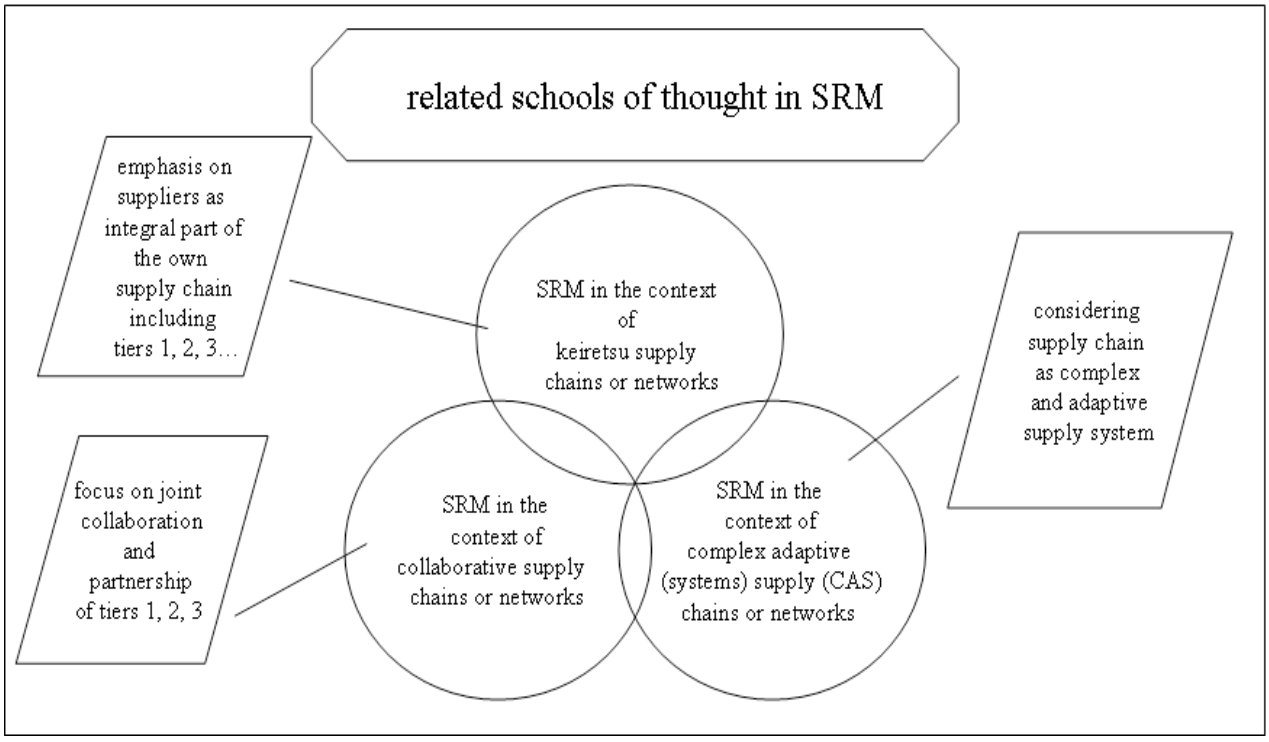
The following sections describe the key findings of the meta-analysis of the systematic literature review as the first part of Phase II, followed by the same analysis through industry and SRM expert's experience. The description of results starts with findings of the generic questions, followed by addressing the more specific questions and aspects. The meta-analysis utilizes symbols like a triangle (▲) for partial contribution to the research and the individual question and a circle for high contribution to the thesis (●).

6.2.6.2 Schools of thought in SRM and supply networks (I)

Literature on best practices in SRM regarding the anticipation, management and prevention of supply disruptions in manufacturing companies in the European transportation industry emphasizes the importance of co-ordination and integration mechanisms in managing logistics and the supplier base successfully across supply networks (Kunke, 2004; Pathak et al., 2007; Liker, 2004). In this respect, academics and practitioners must know which driver variables are to be addressed, since they determine how such processes can be designed and managed. It is also important to understand how co-ordination and integration mechanisms interact with such variables and, as a consequence, with logistic processes. The meta-synthesis has shown groups of people who share the same attitude and way of thinking about SRM, including how to manage supply chain networks (Ohno, 1988; Choi et al., 2000; Christopher & Peck, 2004). Such groups have common characteristics regarding their opinion and outlook. Whereas Bechtel and Jay Aram categorized supply chain management into five major schools of thought (1997), no such classification is available for SRM. Mills et al. point out that the existing literature on SRM emphasizes joint characteristics, beliefs and cooperation of certain groups (2004) as shown below. These groups can be described as schools of thought due to the joint collection of beliefs and principles (collaboration, multilayer or integrative approach) as to how to manage the supply base. The screening of the literature as part of the systematic literature review has revealed three major schools of thought, as shown in the Figure 6-10. These are keiretsu supply networks, collaborative supply chains/networks and complex adaptive supply chains/networks (CAS). The existing schools have individual and specific characteristics within their own system and supply network. Keiretsu emerged from the Japanese model of managing supply chains, which has also been adopted by European companies as outlined by Liker (2004). Companies focus on the elimination of waste within their supply networks, additionally they concentrate on lean process integration of suppliers into the own organization (Liker & Choi, 2005). Keiretsu supply networks have a long-term scope and relationship (Liker, 2004). Collaborative networks focus on partnerships in terms of technology, strategies and logistics, but are not as tight as the keiretsu supply networks in the way of synchronizing production systems (Choi et al., 2001). Collaborative relationships have looser ties and rely on trust and common strategies. Collaborative systems also

focus on long-term relationships. CAS emphasize that supplier relationships must have a long-term focus, too, but look into the supply chain from a more natural science perspective, like a biological or molecular system. Figure 6-10 summarizes the major overlappings and differences of the schools.

Figure 6-10: Schools of supplier networks and SRM



This figure classifies the schools of thought in SRM into three groups with specific characteristics, behaviours and common beliefs, values and policies.

Keiretsu supply networks

A keiretsu supply network (Japanese: integration, order or system of suppliers) represents a means of mutual security, especially in Japan, and usually includes large manufacturers and their suppliers of raw materials, systems and components (Ahmadin & Lincoln, 2001; Freitag, 2007). Keiretsu networks have received much attention in the European automotive and transportation sector through the success of Japanese companies like Toyota, Hitachi and other conglomerates in achieving improved customer service, better inventory control and more efficient overall channel management (Freitag, 2007). Keiretsu, which is a form of Japanese business network, shares many of the goals of SCM. The concept of keiretsu supply networks was introduced by Toyota in the mid-1980s (Imai, 1986; Ohno, 1988) and transferred to affiliates and suppliers outside Japan (Kalkowsky, 2004). Keiretsu networks often include partial ownership of the respective supplier. Control relationships

between pairs of firms represent a form of bilateral exchange. The school of keiretsu may lead to broad functional and cultural changes for those companies which use the system (Freitag, 2007). Keiretsu networks with financial and commercial connections develop quasi-administrative ties through cross-shareholding, as stated by Ahmadjian & Lincoln (1997, 2001). Keiretsu networks have two sides: (1) *horizontal relationships* based on mutual support, and (2) *vertical structures* based on asymmetric exchange and control between financial firms and industrial firms. In various articles and books, Liker explains the Toyota way and the principles of keiretsu supply networks (Liker, 2004). Many OEMs and their suppliers have meanwhile adopted this system (Liker & Choi, 2005).

Complex adaptive supply networks

With the advent of information technology, supply chains have acquired a complexity almost equivalent to that of biological systems, as stated by various authors (Choi et al., 2001; Surana et al., 2005; Pathak et al., 2007). One of the major challenges that companies are facing in SCM is the deployment of coordination strategies that lead to adaptive, flexible and coherent collective behaviour in supply chains. Within the concept of a complex adaptive system (CAS) the main hurdle has been the lack of principles governing how supply chains with sophisticated organizational structures and functions develop, and what organizational structures and functions are attainable, given specific kinds of lower-level constituent entities. It is the aim of research to find common characteristics and formal distinctions among complex systems and to define diverse domains, as is the case with other fields such as biology, sociology, ecology and technology (Dyer, 2000). In this way, one can develop a better understanding of how supply network complexity arises, whether it follows any general laws and if it comprises an element of simplicity. According to some authors who have researched into CAS, traditional supply chains have to change into adaptive supply networks (ASN). It is important to examine the concept, characteristics and enabling technologies of ASN in a contemporary market environment (Dyer, 1996, 2000). ASN have gained focus in both academic and practical areas.

Collaborative supply chain networks

In today's highly competitive global marketplace, the pressure on organizations to find new ways to create and deliver value to customers is becoming stronger due to increasing collaboration throughout supply networks (Emmet & Crocker, 2009; McNichols & Brennan, 2006). There is growing recognition of the fact that the twin goals of cost reduction and service enhancement can be achieved through efficient logistics and effective management of the supply chain, as summarized by Christopher & Peck (2004). Logistics and supply chain management look more closely at the tools, core processes and initiatives required to ensure that businesses can achieve and maintain

competitive advantage. Key characteristics covered by collaborative supply chain networks include the idea of a logistics system which adds value due to identified service priorities and customer segmentation according to individual requirements. There are many ways in which logistics management and supply networks can impact on the overall return on investment and, ultimately, shareholder value. Collaborative and the other networks share common characteristics, as described by various authors (Liker, 2004; Christopher & Peck, 2004; Choi et al., 2001). According to McNichols & Brennan (2006), the aim to achieve greater integration with trading partners can transform relationships into collaborative/keiretsu/CAS supply networks. However, organizations have to meet the challenge of selecting suitable partners or risk not attaining collaborative advantage at all. In order to make things easier, a framework has been devised to assist in the process of selecting suitable collaborative partners. A typical supply framework is composed of five connecting features: collaborative performance system, information sharing, decision synchronization, incentive alignment, and integrated supply chain processes (Simatupang & Sridharan, 2005).

The literature review has identified three schools in SRM. Notwithstanding the fact that each of the schools has specific and individual beliefs and policies, there is some common ground for all organizations, which can be summarized as follows (Liker, 2004; Christopher & Peck, 2004; Choi et al., 2001): the three schools identified build on partnership and collaboration with suppliers in upstream supply chain management. Moreover, they aim to have a resilient supply chain through risk avoidance or collaborative risk mitigation and view the supply chain in a multilayer perspective (tiers one, two, three etc.). In addition, all schools focus on early supplier involvement. They work with specific values, beliefs and policies and consider the proactive involvement of the suppliers into the own supply chain as adding value to the own organization. Finally, these schools build relationships on a long-term basis and integrate these ideas into corporate philosophy, strategy and management.

6.2.6.3 Causal factors for supply disruptions (II)

Supply disruptions are defined by Kleindorfer and Saad (2005) as "unplanned and unanticipated events that disrupt the normal flow of goods and materials within the supply chain". They distinguish between coordination risks and disruption risks. Supply chain complexity is described by Adenso-Diaz et al. (2012) as “the sum of the total number of nodes and the total number of forward, backward and within-tier material flows” in the upstream supply chain network. Such complexity has a huge impact on supply chain reliability and supply chain stability. The overall recommendation made in several papers is to reduce the number of suppliers, since supply chain complexity increases the risk of disruption (Christopher & Peck, 2005). Adenso-Diaz et al. (2012) highlighted the

definitions of various authors, using a variety of criteria: 1. function (Harland et al., 2003), 2. type of risk (Spekman & Davies, 2004), 3. drivers of risks (Chopra & Sodie, 2004) and 4. likelihood of occurrence (Cox & Townsend, 1998). While the literature on SRM is growing, there is no organized structure regarding the sources of causal factors for supply chain risks and supply disruptions. Several papers show that supply disruptions can lead to high monetary recovery cost, waste and sharp decreases in sales as pointed out in one of the previous sections by Haslett, 2011; Jing, 2011 or Grant, 2010. Equally to the findings in literature, field research, internal reports and interviews display, that supply disruptions had recently severe impacts on companies in the analyzed European transportation industry, which participated in the interviews.

Figure 6-11: Examples of supply disruptions in 2011

Year	Description	Source
2013	Missing capacity at suppliers for interior and exterior modules delayed a production ramp up, causing penalties and image loss in public and media.	Bombardier, 2013
2012	Flood in the Philippines caused shortages at suppliers. Train manufacturer had to reduce production for weeks.	Bombardier, 2012,
2012	BMW recalls 1.3 million cars world wide because a battery cable cover in the trunk may have been incorrectly installed.	Schwartz, 2012
2012	Earthquake in Italy stops deliveries to BMW and necessitates BMW to reduce production.	BMW, 2010
2011	Module and component supplier for printed circuit boards went into receivership (PASE).	PASE, 2011
2011	Earthquake and Tsunami in Fukushima (Japan) stops deliveries of electronic components, affecting Production sites in Europe.	PCS, 2011
2011	Alstom faces supply disruptions due to quality discrepancies of its key suppliers in Europe.	Alstom, 2001
2011	Siemens has temporarily to stop production in Krefeld due to supply disruptions form China.	Siemens, 2006

Supply disruptions and their associated risks have been classified in the literature using a variety of criteria, e.g. function (Harland et al., 2003; Christopher and Peck, 2004), type of risk (Spekman & Davis, 2004), drivers of risk (Chopra & Sodhi, 2004). Hendricks and Singhal (2005), who are quoted

quite frequently in the literature, pointed out that enterprises without operational slack and redundancies in their supply chains experience negative stock effects. They also revealed the tremendous impacts of supply chain disruptions on stock price performance and shareholder value. Causal factors for supply disruptions are automatically associated with risks in the supply network, as stated by Zsidisin (2003), Tomlin (2006) or Wieland and Wallenberg (2012). Several authors outline incidents in which supply disruptions caused production standstill or temporary stops in manufacturing companies in the European industry (Tomlin, 2006). Other authors refer to capacity management in terms of supply disruptions and as being a crucial risk factor for supply chain discrepancies. Due to such risks, specific measures are necessary in terms of overcoming potential supply disruptions caused by supplier capacity shortages (Hittle and Leonard, 2011). Mitigations and preventive measures can take the form of diverse capacity management, back-up equipment or alternative manufacturing locations, as recommended by Hittle and Leonard (2011).

During the systematic literature review, there was no evidence of a systematic classification with regard to causal factors for supply disruptions. In his paper, Tomlin outlines a few examples of supply disruptions which occurred in March 2000, e.g. lightning caused a fire that shut down the Philips semiconductor plant in Albuquerque, New Mexico, for six weeks, leading to a shortage of components for both Ericsson and Nokia. According to The Wall Street Journal, company officials say Ericsson lost at least $400 million in potential revenue when the company revealed the damage from the fire for the first time publicly last July, its shares tumbled 14 percent in just hours (Latour 2001). In February 1997, a fire in a Toyota brake supplier plant led directly to a two-week shut down of 18 Toyota plants in Japan, with a resulting cost of $195 million (Treece 1997). Fires, of course, are not the only cause of disruption. Hurricane Mitch caused catastrophic damage to banana production in several parts of Central America in 1998. It took many growers over a year to recover, leading to a prolonged loss of supply for Dole and Chiquita (Griffy-Brown 2003). An earthquake in Taiwan severely disrupted the supply of essential components to the personal computer industry in the lead-up to the 1999 holiday season (Burrows 1999). Bombardier faced in 2012 missing capacities of important suppliers for windows, doors and other modules, leading to a delay of finished trains to the customer. As a consequence, the customer imposed high penalties against Bombardier and the image was harmed by news and media (Bombardier, 2013). The flood in the Philippines in 2012 caused supply shortages in leading manufacturing companies in Europe, leading to a reduction of production output (Bombardier, 2012). Other companies like BMW were hit by recall actions of 1.3 million vehicles in 2012, which were caused by supplier defects (Schwartz, 2012). The same company had to reduce production due to missing supplies as the suppliers´ facilities were hit by an

earthquake in Italy in 2011. It might be useful to compare the supply chain strategies of companies and their resulting ability to cope with some of the above mentioned disruptions. Zsidisin (2003), Rao and Goldsby (2009) created models which can be used by managers to measure and assess the vulnerability of their company and supply chain in relation to the associated risks. Typology may also provide avenues for future research and thus guide practitioners in the management of their supply chain risk portfolio. Such a classification is a useful tool for supply chain managers in differentiating between independent and dependent variables and the mutual relationships which would help them to focus on those key variables that are most important for effective risk minimization in a supply chain (Nishat & Ravi, 2006). Zsidisin typologized causal factors for supply disruptions into different categories - high, medium and low risk - based on managerial perception (Zsidian, 2003). Other authors besides Zsidian have build on this typology and outlined causal factors for supply disruptions as follows, which comprise the following (Tomlin, 2006; Nishat & Ravi, 2006; Rao & Goldsby, 2009; Wieland & Wallenburg, 2012):

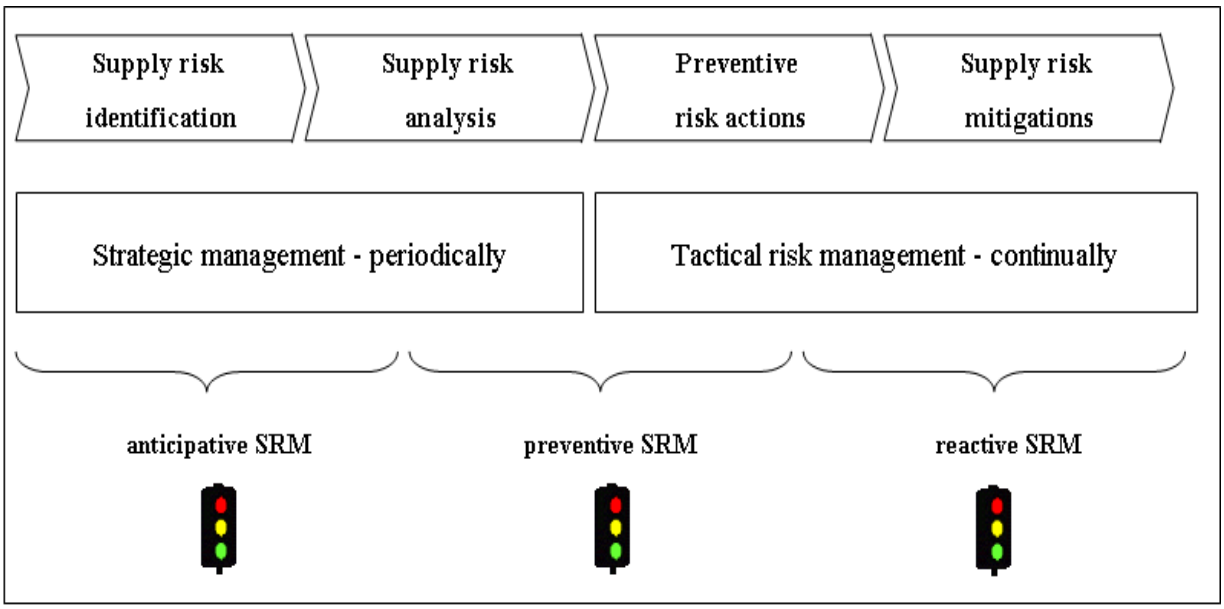
- capacity shortages
- new product launches
- disaster issues (e.g. earthquake)
- lack of supply chain transparency
- labour-related issues (e.g. strike)
- constraints on market capacity
- pricing instabilities
- quality discrepancies
- transport issues
- product transfers to sites or plants
- inflexible production capacities

6.2.6.4 Anticipation, prevention and management of supply disruptions (III)

The systematic literature review illustrates that few specific papers on the anticipation, prevention and management of supply disruptions exits. Several authors have outlined factors that help to select the appropriate SRM strategy to anticipate and prevent supply risks with respect to internal or external context factors (Christopher & Peck, 2004; Blackhurst et al., 2008). On the operational management of how to manage supply disruptions, also not much literature was found. The

validation of research questions by senior management of Bombardier has given here a very broad perspective in contrast to the literature review. Moreover, a gap exists on the question on how deep of the tier level to involve the supply chain network into the management of SRM activities (Gürtler & Spinler, 2010). Gürtler and Spinler outline strategic supply risk management areas, which need periodical assessment and tactical actions which need continual measurements as shown in the figure below (Gürtler & Spinler, 2010).

Figure 6-12: Risk management to anticipate, prevent and manage supply disruptions

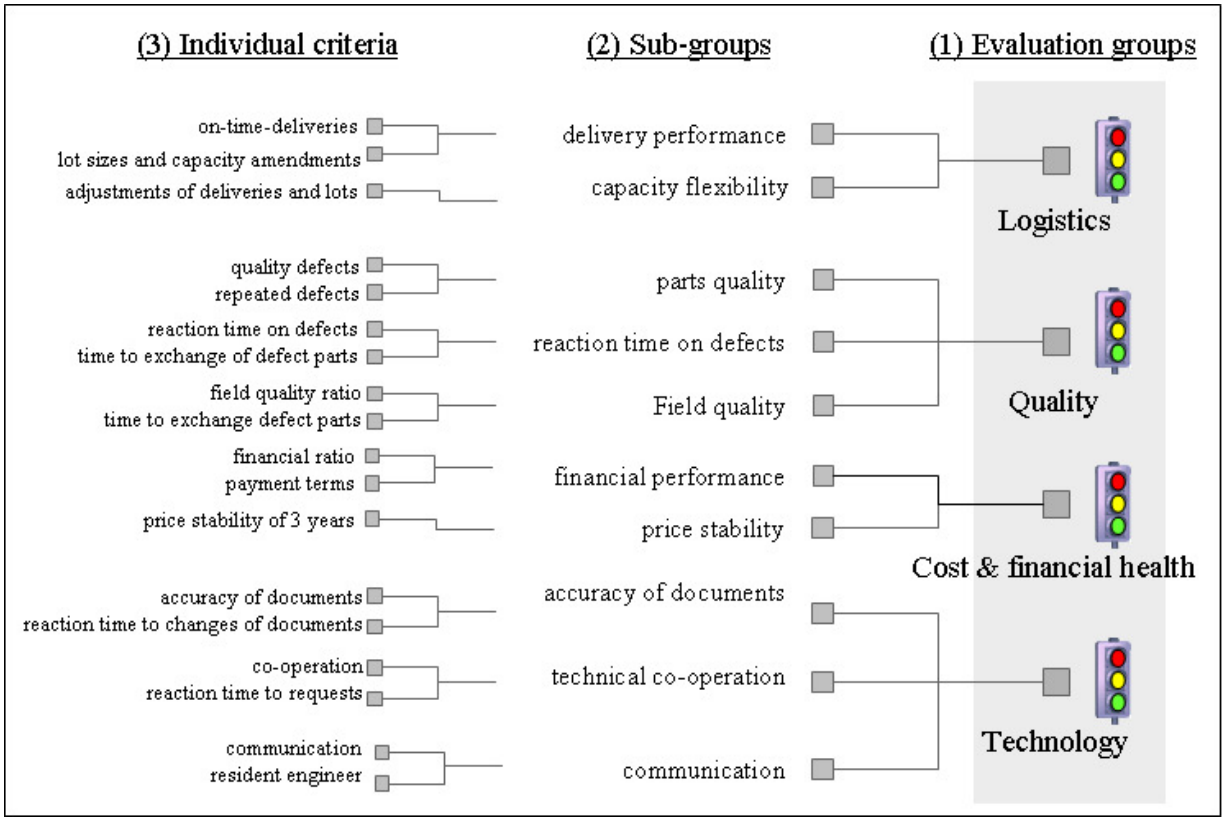


Source: adapted from Gürtler & Spinler, 2010.

While certain context factors can affect the supply chain negatively, choosing appropriate strategies can help to overcome these effects. In this respect, the view is supported that supply chain strategies and SRM (i.e., the implementation of strategies to manage both everyday and exceptional risks along the supply chain based on continuous risk assessment with the objective of reducing vulnerability and ensuring continuity) can be seen as being a "two-sided coin" (Juttner & Maklan, 2010). As it will be demonstrated, both proactive (i.e. robust) and reactive (i.e. agile) supply chain strategies reduce the vulnerability of global supply chains and are in that way necessary. There is, however, a lack of research about how and to what extent a structured SCRM approach that involves the identification, assessment, controlling, and monitoring of possible risks within the supply chain (Christopher & Peck, 2006) fosters improved agility and robustness and, in turn, better performance. Especially the need for corresponding empirical work has been pointed out by several authors (Guertler & Spinler, 2010). Academics and practitioners emphasize that the anticipation, prevention and management of supply disruptions necessitate the proactive involvement of suppliers from a very early stage on and

common effort to improve supply chain visibility, supplier quality (Gürtler & Spinler, 2010). The early involvement of suppliers from selection process can result in major benefits in terms of supply chain stability. Authors agree also that SRM activities should be based on collaboration (Aberdeen group, 2006). Several authors elaborate on the need for an early warning system (sensoric system) in order to establish a trend on supplier performance. (Dust, 2009; Gürtler und Spinler, 2010). In line with a mechanism to evaluate supplier from supplier selection up to the end of the life cycle of a product (Dust et al., 2009) such supplier evaluation has to cover criteria in terms of quality, cost, delivery performance (logistics), cost, financial health and technical performance as recommended by Emmett & Crocker (2009) or Blokdijk & Emero (2008). The definition of criteria for such supplier evaluation system is dependent on the company´s supply chain set up. The figure below shows that the aforementioned main criteria have been classified into sub-categories.

Figure 6-13: Supplier evaluation model



Source: Supplier evaluation model for anticipating and managing supplier disruptions and siturbances. Adjusted from Dust (2009); Emmett & Crocker (2009).

These sub-categories have in line with their criticality a specific score. If the criterion is not or partially fulfilled, there will be a deduction from the score of this category. The evaluation serves to show the performance of suppliers in their categories and to create trend models for the future. The evaluation results are to be shared with suppliers in order to jointly define future improvements in

lacking areas as recommended by Dust (2009). Advanced companies allow their supplier to check the evaluation results on a real-time basis through internet-based applications. It is found that SRM is important for agility and robustness of a company as highlighted by Wieland and Wallenberg (2002). Both agility and robustness are shown to be important in improving supplier performance. While agility has a strong positive effect only on the supply chain's customer value, but not directly on business performance, robustness has a strong positive effect on both performance dimensions (Wieland & Wallenberg, 2012). This important finding directs the strategic attention from agility-centred supply chains to ones that are both robust and agile. The case studies in Phase III provide insights to the fact that robustness can be considered a basic prerequisite to deal with supplier-side risks, while agility is necessary to deal with customer-side risks. Wieland and Wallenburg (2012; p. 8) give the example of a train manufacturer, who is faced with constant changes of product requirements in terms of norms, design and other legal or technical requirements. The amount of agility and robustness needs to fit to the competitive strategy (Wieland & Wallenberg, 2012). Based on their research Wieland and Wallenburg (2012; p. 8) recommend therefore a proactive SRM strategy.

6.2.6.5 Best practices in SRM (IV)

Several authors identified in their studies that many companies are inadequate in their automation and staff support regarding global, complex supply chains on a multilayer basis (Aberdeen group, 2006; Christopher & Peck, 2004; Lambert, & Schwieterman, 2012). To keep up with global trade growth and increased competitive pressure, corporations are finding that they must make significant changes in how they run their activities concerning SRM and supply chain operations (Liker & Choi, 2005). According to the Aberdeen group (2006) and other authors (Harland et al, 2003; Christopher & Peck, 2004; Dust et al., 2010), the most critical areas that companies with best practices of SRM include the following elements. The first aspect is that SRM has to be in line with corporate strategy and corporate management. Secondly, SRM requires a focus within the organizational set-up of enterprises. The third area is the supplier selection and involvement, where best practice companies involve and select suppliers at an early stage and based on smart tools, processes and sustainability. The fourth area is the supply chain visibility throughout the supply network. Global supply networks necessitate a transparent monitoring by using sophisticated B2B collaboration systems. B2B integration of the supply chain is therefore the fifth aspect. Cost transparency within the supply network and competitiveness are the seventh item, through which companies distance themselves from their competitors according to Christopher & Peck (2004) or the Aberdeen group (2006). The eighth area consists of risk management and contingency plans, followed by the ninth area in terms

of demand and scheduling system synchronization with the suppliers of various tiers. Finally, quality performance and the logistics agility are the tenth and eleventh categories of best practice elements identified by the study of the Aberdeen group (2006). The best practice elements are summarized in the following table.

Figure 6-14: Industry best practices as part of the systematic literature review

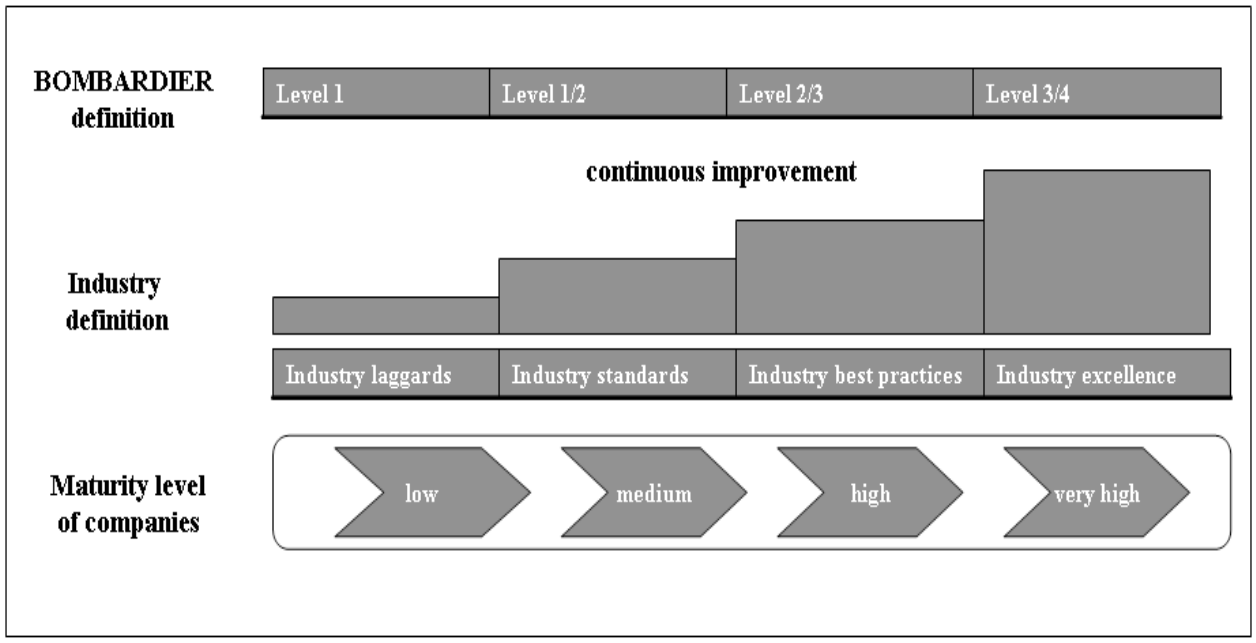
Criteria/dimensions	Industry best practices
Coporate strategy	Integration of SRM function into corporate objectives including hard and soft factors. Usage of reporting tools and criteria, e.g. balanced score cards (BSC).
Organization	SRM is partially or fully integrated into core procurement and logistics function. Few interfaces to the supplier exist in procurement or SRM.
Supplier selection	Case-by-case early supplier involvement and long-term strategies. Suppliers are monitored during launch phase to secure flawless execution.
Supplier co-operation	Collaborative supply chains. Partial implementation of lean principles at suppliers by excecuting lean workshops at suppliers.
Supply chain visibility	Usage of customized systems to monitor shipments and inventories in supply chain. Internet-based applications support SRM and make supply chain visible.
B2B collaboration	Collaboration across multiple processes across two to three tiers. Application of sophisticated internet-based information systems.
Cost transparency	Detailed open book policy on main category level. Executing joint cost optimization workshops.
Risk management	Managing supply chain resiliency to risk-related events on tier one, two or three level.
Demand scheduling and production systems	Application of lean principles. Pull system, but autonomous production systems. Inventory management is optimized through consignment stock or vendor-managed inventories (VMI).
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Pro-active and anticipative supplier actions like audits, early supplier involvement, and trend models.
Logistics agility	Frequently perform tier 1, 2 and 3+ logistics agility actions.

Source: Best practice elements in SRM and patterns, adapted from several authors (Aberdeen group, 2006; Harland et al., 2003; Christopher & Peck, 2004; Dust et al., 2010).

Literature points out that the majority of manufacturing companies in the European transportation industry have not yet achieved a best practice level, as they have not yet implemented a proactive and multilayer supply chain approach (Dust, 2009; Aberdeen group, 2006). The Aberdeen group (2006) or Wieland and Wallenburg (2012) therefore propose to conduct an assessment, in which the maturity levels for each ceatogory can be determined and on which elements companies should focus. Scholars point out that greater complexity has significantly increased the risk of supply

disruptions and supply chain vulnerability. Therefore best practice companies must integrate SRM as an essential part of their corporate objectives (Liker, 2005; Wieland & Wallenburg, 2012). Figure 6-15 shows maturity levels from low to high (Bombardier, 2010). According to the Aberdeen group (2006), there are several levels for each of the eleven categories, ranging from industrial laggards to industrial best practice companies. Bombardier uses levels 1 to 4, whereby level 3 is seen as best practice, level 4 as industry excellence.

Figure 6-15: Industry and Bombardier maturity in SRM



Source: own source adapted from Bombardier Transportation, 2010.

6.2.6.6 Specific questions on SRM (1-10)

The research questions have been addressed to the identified articles, books and journals. The analysis has shown significant results as shown in the following section.

1. **<u>How can supply disturbances and disruptions be avoided at an early stage by means of SRM?</u>**

The systematic literature review showed that supply disruptions and potential risks are classified according to function (Harland et al., 2003), type of risk (Spekman & Davies, 2004), drivers of risk (Chopra & Sodie, 2004), or the likelihood of occurrence (Cox & Townsend, 1998). They were caused by natural catastrophes, political problems, economic disasters, supply discrepancies, quality issues, or bankruptcies (Tang, 2006; Tomlin, 2006). The literature review also revealed that in the opinion of academics, practitioners and existing schools, SRM has to involve suppliers at a very

early stage in order to identify potential supply disturbances and avoid disruptions (Aberdeen group, 2006; Christopher & Peck, 2004; Liker 2004). In addition, many authors stress the need for an agile supply chain, in which suppliers are involved more or less from the beginning (Kim, 2006). Such early supplier involvement has to be integrated into the entire supply chain (i.e. tiers 1, 2, 3 and beyond). The prevention of discrepancies within the supply chain requires a mature and stable set-up, supported by suitable tools (Gürtler & Spinler, 2010).

In the analysis of the Aberdeen group, managers stated the following areas for monitoring the supply chain and improving visibility (2006):

- project execution plans, including tiers 1, 2 and 3
- supplier launch and production milestones
- order processing and acknowledgement
- advanced shipment notes
- goods arrival (tiers 1, 2 and 3)
- carrier pickup of goods and customs clearance
- in-transit status of goods
- electronic proof of delivery

Other authors have emphasized the correlation between the number of suppliers and complexity of the supply chains on the one hand and the level of risk and frequency of supply disruption incidents on the other hand (Adenso-Diaz et al. 2012; Kim, 2006; Emmett & Crocker, 2009). A general recommendation is to minimize the complexity of the supply chain by reducing the number of nodes and suppliers (Adenso-Diaz et al., 2012). Kim considers collaboration with suppliers in a partner-oriented environment to be one of the crucial success factors in creating a “triple-A” supply chain (Kim, 2006).

Several authors point out that early supplier involvement, supply chain monitoring, and an alert system at all stages are essential tools for the prevention of supply disruptions. However, the literature contains only a few propositions concerning criteria for monitoring or alert systems (Emmett & Crocker, 2009; Gürtler & Spinler, 2010; Dust et al., 2010). Whereas Gürtler and Spinler propose evaluating risks either continuously or periodically (2006), Emmett and Crocker (2009) and Dust et al. (2010) recommend utilizing a supplier evaluation model including a trend analysis combined with risk factors supported by specific actions in SRM. This model includes categories such as quality, cost, financial stability, delivery and technology (Dust et al., 2010; Emmett &

Crocker, 2009). It is also combined with a strong focus on preventive measures and the involvement of suppliers at an early stage. As the question of how supply disruptions can be avoided at an early stage by means of SRM is crucial for the development of best practices, it is important to obtain some substantial answers during the expert interviews.

2. How to recognize supply disruptions at an early stage?

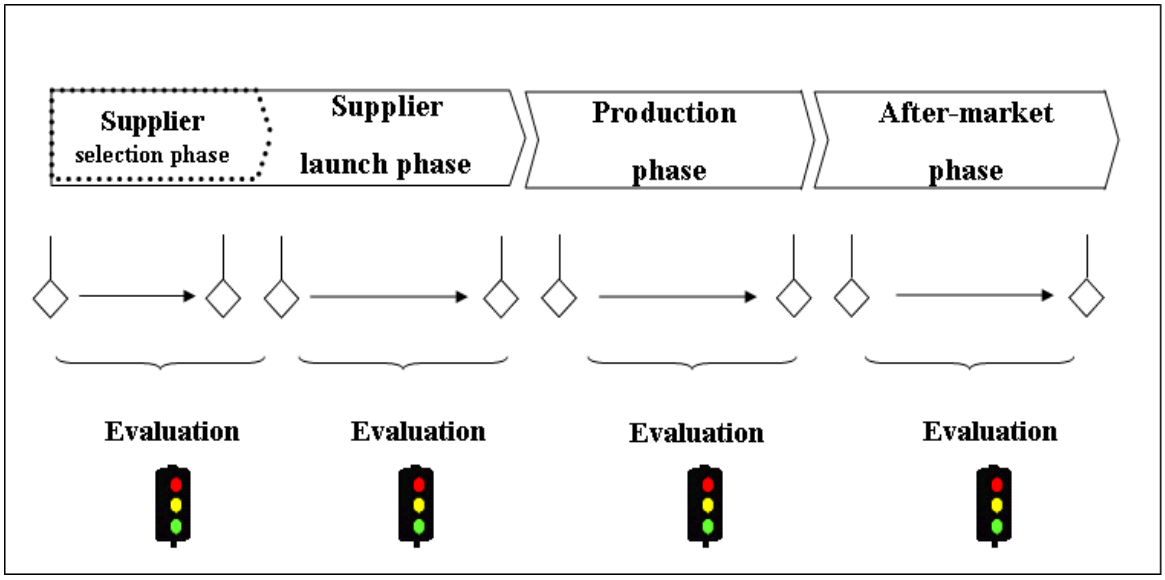
The systematic literature review has shown that on the question of how to recognize supply disruptions at an early stage, there is neither a systematic analysis available nor a common viewpoint on what an early warning mechanism should look like. The review has shown that disruptions can occur on a macro or micro level. The macro level is related to political, economic, social and technological areas, e.g. civil war, natural catastrophes like earthquakes, environmental disasters like Fukushima (Aberdeen group, 2006; Lambert, Schwieterman, 2012).

Other authors highlight supply disruptions on a micro level, which is more related to supplier or supply network issues (Lambert, & Schwieterman, 2012; Rao & Goldsby, 2009). On the micro level, Hittle and Leonard (2012) outline the importance of having sustainable capacity management. Kalkowsky stresses that the production system must be lean and synchronized with the supply chain in order to be able to react to capacity fluctuations at an early stage (2004). Although many authors stress the importance of early recognition on both micro and macro level, there is no systematic method available for detecting supply chain deteriorations at this stage. A few authors refer (Giunipero, & Eltantawy, 2003; Blackhurst et al., 2008) to a phase and evaluation model, simlar to the model of Gürtler & Spinler (2010), and to the point in time when supply disruptions have to be recognized, e.g. supplier selection phase, launch phase, serial phase and after-market phase (as shown in Figure 6-16).

According to Gürtler & Spinler (2010), an evaluation of supplier performance will help to identify potential risks or supply chain abnormalities at an early stage. They suggest using certain criteria like quality, cost, delivery and financial health either periodically or continuously. There has to a strong focus on the supplier selection and supplier launch phase, where potential risks can be prevented through appropriate actions (Dust, 2010; Gürtler & Spinler, 2010). Dust et al. (2009) created a model of “total supplier management” which recommends the establishment of a warning system, including several layers of investigation. In layer 1, all suppliers are screened and potentially critical ones identified, so that any necessary operational actions can be implemented. In layer 2, a supplier

steering committee carries out further analysis and actions. In layer 3, any risk prevention measures that may be required have to be implemented.

Figure 6-16: Phase evaluation model in order to avoid supply disruptions at an early stage



Source: Evaluation model for SRM to anticipate supply disruptions.

3. How is SRM linked to corporate strategy and integrated into corporate management?

Over the past decade supply chains have become more complex and global, transforming the traditional purchasing and logistics functions into a broader strategic approach to SRM (Lenders, 2005; Liker, 2005; Tan, 2001). Many companies in the European automotive and transportation industry have reduced their own value-adding activities to a minimum, so that SRM has become increasingly important (Tan, 2001; Liker, 2005; Choi, 2006). To compete effectively in global supply chains, a company must have a competent and strategically integrated SRM function (Choi, 2006; Dust, 2009). It is important that all functional areas, strategies and capabilities are consistent with the competitive strategy of an organization (Dust et al., 2009). It is also critical that a company's suppliers have the capability to meet its strategic priorities. Concerning the question of how to link SRM to corporate strategy and integrate it into corporate management, Tan proposes fusing purchasing and supplier-related, upstream logistics into a key corporate function (Tan, 2001). The need to be increasingly competitive, flexible and efficient has led to increased focus on core competencies. In addition, recent economic problems have led firms to look at their entire value chain. It became clear in the late 1980s that inefficiencies in production and supply management could not be passed on to the customer in the form of increased prices (Liker & Choi, 2005). Kim (2006) outlines if firms wish to operate globally, they need to compete on this basis for resources,

markets and talent and must not think that they are protected from events that occur in other parts of the world. The ability to move production and sourcing around the globe is a key to real competitive advantage Tan, 2001). Virtual firms are no longer an illusion. In many cases, they have replaced the bureaucratic, vertically integrated company. These days, companies do not simply compete manufacturer to manufacturer. A lot of real and fierce competition occurs on the level of supply chains, as described by certain authors (Blackhurst et al., 2008; Blokdijk & Emero, 2008; Bozhard et al., 2009). This leads to the statement that a company itself is as strong as its weakest supply chain partner (Choi, 2006). Ahmadjian and Lincoln suggest therefore linking SRM to the corporate policy and management, creating key hard and soft performance indicators (KPI) and supplier objectives (1997, 2001) to be discussed and agreed upon with the supply base.

4. What are the values and policies of SRM?

The systematic literature review revealed three schools with different characteristics, but common values and policies. All schools strive towards creating supply chain resilience and minimizing or avoiding risk as supply chains compete on an international and global level. In this context, the values and policies of SRM build on partnership and collaboration with suppliers in upstream supply chain management as outlined by Dust et al. (2011). All schools regard suppliers as equal partners within a multilayer perspective (tiers 1, 2, 3). The respective relationship management is based on early involvement and proactive strategies, which build on value-adding activities (Christoper, 2005). With regard to keiretsu supply networks, the focus is on lean principles and the elimination of waste throughout the supply chain (Ahmadin & Lincoln, 2001). In this case, everything is synchronized by lean measures and the focus is on a pull production system. SRM is considered to be a critical success factor for the organization, and so the respective values and policies have to be integrated into corporate philosophy (Dyer, 2000). This will then lead to substantially better results concerning supply chain agility, flexibility, competitiveness and sustainability (Liker & Choi, 2005; Christoper & Peck, 2004).

5. How is SRM organized?

On the question of how SRM is organized, the systematic literature review has not shown many detailed results. Although all authors emphasize the importance of SRM in global and more complex supply chains, one finds only a generic recommendation of how to organize it in today's environment (Ahmadjian & Lincoln, 2001; Blackhurst et al., 2008; Bozhard et al., 2009; Choi et al., 2001). Tan (2001) proposes integrating the purchasing and logistics functions with other key corporate functions which have a link to the upstream supply chain, leading to supply chain resilience and quality assurance (Tan, 2001). Such integration creates a closely linked set of

manufacturing and distribution processes and allows organizations to deliver products and services to both internal and external customers in a more timely and selective manner. To further exploit the competitive advantage associated with integrated processes, some leading organizations adopt a strategic approach to managing the value chain, such as forming alliances with suppliers and distributors instead of integrating vertically (Hamm, 1998); inter-company competition is elevated to the level of inter-supply chain competition. Indeed, in many companies, SRM activities are already executed by various sub-functions like procurement, supplier development, logistics, expediting, supplier quality assurance, and so on (Dust, 2009). The general feeling, however, is that SRM activities should be organized with as few interfaces to the suppliers as possible (Dust et al. 2010). Suppliers of excellence have a unique interface to each supplier, where a customer relationship manager or key account manager acts as the only go-between. This set-up corresponds to best practice (Dust et al., 2010). For some authors, the important thing when collaborating with suppliers is to have consistency of approach and a defined set of tools and activities. Simatupang and Sridharan (2005) point out that SRM requires not only institutionalizing new ways of collaborating with key suppliers, but also actively dismantling existing policies and practices which might impede collaboration and limit the potential value that can be derived from key supplier relationships. At the same time, SRM should entail reciprocal changes in processes and policies at the supplier's end (Trkman & McCormack, 2009).

SRM and supply chain functions are typically responsible for defining the respective governance model, which includes a clear and jointly agreed framework for top-tier strategic suppliers. Effective governance should comprise not only the designation of senior executive sponsors and dedicated relationship managers at both customer and supplier level (Christopher & Mangan, 2005), but also a face-off model connecting company personnel in engineering, procurement, operations, quality and logistics with their supplier counterparts. This leads to a regular cadence of operational and strategic planning and review meetings, as well as well-defined escalation procedures to ensure a speedy resolution of problems or conflicts at the appropriate stage (Dust et al., 2010). While Wieland and Wallenburg (2012) outline that there is no common or standardized model for deploying SRM at an organizational level, there is a set of structural elements that are relevant in most contexts (Christopher & Mangan, 2005):

- a formal SRM team or office at corporate level
- a formal Relationship Manager or Supplier Account Manager
- an executive sponsor for a cross-functional supplier development team

The purpose of a formal SRM team or office at corporate level is to facilitate and coordinate SRM activities across functions and business units. SRM is inherently cross-functional and requires a good combination of commercial, technical and interpersonal skills. Such "soft" skills relating to communication, listening, influencing and managing change are critical to developing strong and trusting working relations. Relationship Managers or Supplier Account Managers often sit within the business unit that interacts most frequently with the respective supplier, or such positions are filled by a category manager in the procurement function. The role itself can be a full-time, designated position, but it may be part of a broader role depending on the complexity and importance of the supplier relationship (see Supplier Segmentation). Christopher and Mangan (2005) point out that "SRM managers of the future" understand their supplier's business and strategic goals, and are able to see issues from the supplier's point of view while balancing their own organization's requirements and priorities. The role of the executive sponsor, or in more complex supplier relationships that of a cross-functional steering committee, is to form a clear link between SRM strategies and overall business strategies, while at the same time determining the relative prioritization among a company's varying goals as they impact on suppliers. In this last case, it may be necessary to act as a dispute-resolution body.

6. Who is responsible for SRM?

The systematic literature review has shown that on the research questions of "How should SRM be organized?" and "Who is responsible for SRM? And why?", only a few authors make proposals. Some authors recommend that SRM issues should be part of the procurement function, as recommended by Kim (2006). Christopher and Mangan (2005) make suggestions for the supplier relationship manager of the future, but do not describe how SRM has to be organized. The literature has revealed that most of the companies bundle their upstream supply chain management in various sub-functions, e.g. contract management, procurement, expediting, supplier quality (Harland, 2003). Even though there are no systematic recommendations in the literature on how to organize SRM in general, a few authors suggest that supplier-related issues should be centralized into procurement (Gürtler & Spinler, 2010; Dust, 2009). In this context, it is highlighted that SRM should be handled via the supplier relationship manager as the single point of contact (SPOC) (Dust et al., 2010). It is to be expected that the interviews with senior management will lead to some informative answers on best practices in SRM.

7. How are information systems used for SRM?

Puschman (2005) and the Aberdeen group (2006) outline in their qualitative studies that supply chain automation and e-procurement have substantially streamlined procurement and SRM tasks through

the application of information systems. Many organizations operate multiple e-procurement solutions for supplier selection, evaluation or risk mitigation. The most common examples in manufacturing companies in the European automotive and transportation systems are enterprise resource planning systems (ERP) or manufacturing resource planning systems (MRP), which concentrate on one's own organization or manufacturing process, but not on the upstream supply chain (Puschmann, 2005). However, in certain companies, there is no ERP or MRP system available. These organizations still use spreadsheets or other tools for managing their supply chain. However, the vast majority of companies that use information systems like ERP or MRP to control and manage their own processes have not yet included the supply chain. As a result, the supply chain is non-automated and separated from the company's information system (Aberdeen group, 2006). The potential risks associated with a non-automated and non-synchronized information system are (Aberdeen group, 2006):

- insufficient supply chain visibility
- lack of business to business collaboration
- non-compliance due to interrupted supply chains
- lack of risk management to ensure resilient supply chains

Such a lack of automation and visibility causes longer lead times, larger inventories, budget overruns and ongoing demand-supply imbalances (Christopher & Peck, 2004). Mature companies apply information systems that cover the entire supply chain, including tiers one, two and three (Choy et al., 2003). Puschmann (2005) and Emmett et al. (2009) recommend fusing such comprehensive information systems into the procurement strategy, with a corresponding alignment of various e-procurement solutions to meet the need for integrated system architectures. However, companies should realize that there are no standardized e-procurement solutions and that success factors are often "non-technical" in nature. Kim (2006) and Emmett and Crocker (2009) stress that in addition to integrating e-procurement tools, lean processes also have to be installed.

8. How is SRM performance measured?

The systematic literature review has shown widespread agreement that SRM performance has to be measured through performance indicators, as suggested by several authors (Emmett & Crocker, 2009; Schmitz & Platts, 2004; Blokdijk & Von Emero, 2008). On the question of how SRM performance is to be measured, Schmitz & Platts (2003) propose that all relevant activities between one's own organization and the supply chain should be considered (i.e. inter-organizational measurement and intra-organizational measurement). With reference to inter-organizational measurement, several authors recommend an integrated approach, including tiers one, two, three of

the supply chain (Schmitz & Platts, 2003). Monitoring selected minimum criteria in terms of quality and performance ensures a resilient supply chain. Alert systems should be implemented using consistent data and a sophisticated web-based tool (Dust et al., 2011). These must be spread out to the extended supply chain network. Hendricks and Singhal (2006) point out that many disruptions are caused by slack in the supply chain, insufficient capacities of the suppliers, and waste throughout the value chain. In this context, Emmett and Crocker (2009), Dust et al. (2010) recommend monitoring the supply chain using specified criteria. These criteria should comprise quality, cost, financial stability and logistical aspects and consist of hard factors (e.g. on-time delivery) and soft factors (e.g. flexibility to schedule changes). SRM can lead to competitive advantage by harnessing talent and ideas from key supply partners and translating this into product and service offerings for end-customers. One tool for monitoring performance and identifying areas for improvement is the joint, two-way performance scorecard. A balanced scorecard includes a mixture of quantitative and qualitative measures, including how key participants perceive the quality of the relationship. The KPI are shared between customer and supplier and reviewed jointly, reflecting the fact that the relationship is two-way and collaborative, and that strong performance on both sides is required for it to be successful. Advanced organizations conduct 360 degree scorecards, where strategic suppliers are also surveyed for feedback on their performance, the results of which are built into the scorecard (Schmitz & Platts, 2003). Leading organizations track specific SRM savings generated at an individual supplier level, and also at an aggregated SRM program level, through procurement benefit measurement systems (Dust, 2009). Part of the challenge in measuring the financial impact of SRM is that there are many ways in which it can contribute to financial performance. These include cost savings (e.g. most favoured customer pricing, joint efforts to improve design, manufacturing, and service delivery for greater efficiency), incremental revenue opportunities (e.g. gaining early or exclusive access to innovative supplier technology, joint efforts to develop innovative products, features, packaging, etc., avoiding stock-outs through joint demand forecasting) and improved risk management (Bozhard et al., 2008).

9. What are the key performance indicators in SRM?

The systematic literature review has highlighted recommendations on which key performance indicators (KPI) to focus on in SRM and identified which indicators should be measured on a periodic and continuous basis, as shown in the previous section on anticipation, prevention and management of supply disruptions (Gunasekaran et al., 2004; Schmitz & Platts, 2003; Tomlin, 2006; Dust et al., 2010). These KPI can be described as inter-organization measurements (Schmitz & Platts, 2003). The identification of suitable key performance indicators can be based on certain categories and should be linked to corporate objectives (Emmett & Crocker, 2009). There are also

propositions by some authors as to how organizations can measure the performance of SRM activities by themselves, i.e. intra-organizational key performance measurements (Emmett & Crocker, 2009). Most authors stress that KPI have to be applied to measure the performance of the suppliers and the supply network (Schmitz & Platts, 2003; Emmett & Crocker, 2009). They also recommend approaching suppliers in the areas of electronic data interchange, long-term contracts, supplier councils, and supply base optimization and reduction in order to improve supplier performance continuously (Emmett & Crocker, 2009). Tan recommends that these KPI should include hard and soft factors (2001). While discussing the right KPI on a supplier-by-supplier level, other authors emphasize the need for KPI on a macro level. Disasters like the Fukushima earthquake and nuclear fall-out cannot be measured on a micro level (Wieland & Wallenburg, 2012). Choy et al. (2003) and the Aberdeen group (2006) propose an intelligent SRM tool on a web-based application in order to measure time delivery reports, inventory level reports, defective items reports, and cost information. Dust et al. (2010) suggest evaluating criteria in a three-phase model, as outlined in a previous section. The supplier evaluation key performance indicators in the appendix show an example from industry best practices. Regarding the question of which key performance indicators are suitable for SRM activities, Emmett and Crocker (2009) recommend establishing specific criteria. As supply disruptions can negatively affect the shareholder value of one's own organization (Hendricks & Singhal, 2005), such performance indicators should also be part of the evaluation of SRM activities. Emmett and Crocker define a supplier evaluation card as being an ideal tool in this context (2009).

10. How do SRM activities add value?

Increasingly, supplier relationship management (SRM) is being viewed as strategic, process-oriented, cross-functional and value-creating for both buyer and seller, and as a means of achieving superior financial performance (Christopher, 2005). This paragraph seeks to analyze how SRM is adding value by creating resilient supply chains and by managing business-to-business relationships between the customers and suppliers (Christopher & Peck, 2004). According to supporters of the keiretsu school, SRM has the primary goal of increasing value for both the buying organization and the supplier (Liker, 2005). One way to do this is to look at the core or peripheral processes that deliver value along the supply chain and work together on projects to improve them. A key tool in this school of SRM is lean design within own processes and the supply network. The purpose is to eliminate waste throughout the own organization and the supply chain. Waste can be classified in terms of open waste and hidden waste according to Ohno (1988). In this context a detailed scrutiny is necessary. Root causes of performance deficiencies in processes that already exist. These

deficiencies may be causing real pain for the organization or they may be preventing it from working as efficiently and effectively as it could (Liker, 2004). Such waste is applicable to processes in both the own manufacturing process and the supplier´s manufacturing process. Tan (2006) outlines value-adding activities from the suppliers of raw materials to the buying organization, including recycling. However, it is not surprising that the various descriptions overlap in some cases. Genuinely integrated supply chain management requires a massive commitment by all members of the value chain. For example, a buyer may have to overhaul its purchasing process and integrate a supplier's engineering teams and product designers directly into its own decision-making process. Since the cost of changing a partner can be huge, the purchasing organization can become a captive of its suppliers according to Freitag (2004). Poor supplier performance is not the only risk; the buyer needs to worry about the possibility of a supplier passing on trade secrets to competitors or, with its newly found abilities, venturing out on its own. Trusting suppliers may be good business sense, but for many organizations hostility may still be more profitable in the long run. There are many other pitfalls of supply chain management, such as conflicting objectives and missions, inadequate definition of customer service, and separation of supply chain design from operational decisions (Liker & Choi, 2005).

6.2.6.7 Findings of the systematic literature review

The present systematic literature review has been conducted to recognize different schools of thought, causal factors for supply disruptions, the anticipation, prevention and management of supply disruptions and best practice elements in manufacturing companies in the European transportation industry. It is based on the assumption that a gap exists in the literature and on the need to have a more holistic view on SRM (Harland et al., 2003; Aberdeen group, 2006; Narasimhan & Talluri, 2009). The systematic literature review confirmed the relevance of both the research into SRM and the research questions in themselves for academics and practitioners. Existing literature predominantly focuses on tier one supplier relationships and not beyond, as postulated by the Aberdeen group (2006), Harland et al. (2003), and Gürtler & Spinler (2010). There is a discrepancy between the proactive role of SRM in complex and global supply networks and the traditional view of how to create relationships in the upstream supply network management with suppliers to achieve a resilient supply chain (Aberdeen group, 2006). The literature review confirmed that supply chain resilience is a relatively new and still largely unexplored area (Christopher & Peck, 2004). The literature review also revealed that there is a lack of certain aspects which are of great relevance to practitioners, e.g. how to organize SRM activities, what criteria are needed for measuring and evaluating SRM performance, what information systems should be used (Schmitts & Platts, 2003;

Gürtler & Spinler, 2010). Even though a number of authors stress the need for measuring intra-organizational and inter-organizational performance indicators, there is no systematic approach available in the literature regarding this point (Schmitz & Platts, 2003; Gunasekaran, 2004). The summary of contributions to the research has shown that there are different beliefs and behaviours regarding the question of how to deal with suppliers, supply chains and supply chain networks. The findings prompted a classification into three schools of thought (Liker, 2004; Christopher & Peck, 2004; Choi et al., 2001):

1. keiretsu supply networks,
2. collaborative networks,
3. supply networks as complex adaptive systems (CAS).

The identified schools have common values in managing supplier relationships and supply networks (Liker & Choi, 2005). One such value is that all schools build up their relationship with suppliers in upstream supply chain management in a collaborative manner. The supply chain is seen from a multilayer perspective (i.e. tiers 1, 2, 3 and beyond), in which partners strive for resilient supply chains with the help of risk avoidance or collaborative risk mitigation (Aberdeen group, 2006; Harland et al., 2003). For this purpose, suppliers are integrated into the organization's own process at an early stage (Gürtler & Spinler, 2010; Dust et al., 2010). Whereas collaborative supply networks focus on co-operation of independent but synchronized supply networks (Chirsstoper, 2005), keiretsu supply networks focus on general value-adding activities with a strong emphasis on reducing waste (Liker, 2004; Ohno, 1988). In keiretsu supply networks, production systems are very often synchronized and include the application of lean principles. In certain cases, the relationship also involves cross-shareholding (Liker, 2004). According to the concept of CAS, the main hurdle has been the lack of principles governing how supply chains with complex organizational structures and functions develop, and what organizational structures and functions are attainable, given specific kinds of lower-level constituent entities (Pathak et al., 2007). It is the aim of research to find common characteristics and formal distinctions among complex systems and to define diverse domains, as is the case with other fields such as biology, sociology, ecology and technology (Dyer, 2000; Pathak et al., 2007). Several authors point out that competition has become fiercer and that supply networks have become more global and complex in terms of nodes and interfaces within the supply chain (Aberdeen group, 2006). Companies concentrate on their core competencies and outsource goods and services to the suppliers. This transfer of products and services to the supplier means that there must be close co-operation between the two parties (Behrendt, 1995), together with a mechanism for measuring performance (Schmitts & Platts, 2003). As a consequence, values,

beliefs and policies include relationships on a long-term scale and a pro-active involvement supply chain to add value to one's own organization. The results also show that the majority of scientific papers on SRM are related to supply disruptions, risk mitigations and the generic characteristics of how relationships have to be, whereas few papers were found on more specific issues, e.g. how to anticipate and prevent supply disruptions, what information systems are to be used, how to integrate SRM into corporate policy, how to organize SRM, who is responsible for SRM. Nevertheless, these questions are of significance for practitioners who are trying to understand best practices in SRM. Prior to the literature review, one had expected to find more papers on specific aspects of organization, performance measurement and information systems.

The systematic literature review confirmed the need for a more holistic view on SRM in manufacturing companies in the European automotive and transportation industry with reference to (1) beliefs and values (schools of thought), (2) supply disruptions and their mitigations, (3) anticipation, prevention and management of supply disruptions and (4) best practice elements. Through the systematic literature review, it has been possible to analyze managerial implications by identifying best practice categories and maturity levels as shown in Figure 6-17.

Companies focus on their core competencies and outsource products, activities and processes. As a result, supply chains are becoming more complex, global and agile, thus creating the need to build resilient supply chains. In order to achieve this, organizations have to adopt certain thoughts, policies and values in how to deal with suppliers. At present, many companies are still focusing on their tier one relationship rather than considering the supply chain as an integrative factor. Consequently, supply chain intransparency and non-visibility are leading to supply disruptions and slack. Recent examples of supply disruptions in the European transportation industry led to high recovery cost, waste and sharp decreases in sales as described before. Customers were dissatisfied, which had negative impacts on brand image and sales, as shown by many authors (Haslett, 2011; Jing, 2011; Grant, 2010; Connor, 2010; Trkman & McCormack, 2009; Blackhurst, 2008; Kumar, 2001; Tomlin, 2006). Hendricks and Singhal (2005) postulated that enterprises without operational slack and redundancies in their supply chains experience negative stock effects. In addition, they revealed the tremendous impacts of supply chain disruptions on share price performance and shareholder value (Hendricks & Singhal, 2005). One of the outcomes of the systematic literature review is that partnership and collaboration with suppliers in upstream supply chain management are crucial for creating visibility and supply chain resilience (Dust, 2009; Liker, 2004; Christopher & Peck, 2004; Choi et al., 2001). SRM does not only execute activities, but also includes values, beliefs and policies which are integrated into corporate strategy and philosophy (Cavinato, 2004). As they strive for

excellence, companies aim constantly to improve the maturity of SRM-related functions, activities and processes. Companies with a high level of maturity in their SRM activities can generally create a resilient supply chain through risk avoidance and/or collaborative risk management in upstream supply chain management (Dust et al., 2010). The supply chain is regarded from a multilayer perspective (tiers 1, 2, 3) with an emphasis on early supplier involvement (Harland et al., 2003; Hittle, & Leonard, 2011; Christopher & Peck, 2004; Gürtler & Spinler, 2010).

Due to the findings in the systematic literature review, it has been possible to generate a framework of SRM criteria and dimensions, showing the maturity levels of laggard, standard, best practice, and excellence companies (Aberdeen group, 2006; Dust et al., 2010; Gürtler & Spinler, 2010; Hittle & Leonard, 2011). The following table on the next page summarizes the development phases from laggard to excellence in terms of corporate strategy, organization, supplier selection, supplier co-operation, supply chain visibility, B2B collaboration, cost transparency, risk management, demand scheduling, production systems, supplier quality performance and logistics agility. Best practice companies focus on both soft and hard factors in SRM and integrate their SRM objectives into corporate strategy, whereas excellence companies extend this to corporate objectives, mission and vision (Harland et al., 2003). SRM should be organized with as few interfaces to the supplier as possible (Dust et al., 2010). Scholars recommend a single point of contact in supplier relationship management, comparable to best practices in customer relationship management. Customer relationship managers or key account managers function in best practice organizations as a single point of contact for the customer.

The same pattern should be applied in SRM. Regarding supplier selection, best practice is to have a long-term strategy approach with individual suppliers. In this context, strategic suppliers are considered to be partners who should become involved in the project at an early stage (Behrendt, 1995). Supplier collaboration is built on trust, partnership and a lean supply chain (Christoper, 2005). A lean supply chain is created by applying lean principles throughout the production system and transferring it partially to the supply network (Liker & Choi, 2005). In certain cases of best practice, the production systems have been synchronized by applying lean principles to the suppliers, conducting lean workshops and/or jointly improving activities on a continuous basis. SRM activities with a high level of maturity reflect B2B collaboration exceeding the tier one layer and including several processes of development, procurement, logistics, production or quality: cost transparency, financial stability and health, risk management, demand scheduling and production systems, quality of supplier performance, logistics and supply chain agility and technical innovation.

Although this systematic literature review is limited to defining best practice elements in manufacturing companies in the European automotive and transportation industry, it may be possible to use the results in other industries. Any application to other sectors would require a separate approach and research to validate the findings. This section will be supplemented in the following by interviews with senior managers in the respective industry. In addition, two case studies will be used to verify, falsify and adjust the best practice elements.

Figure 6-17: SRM summary of industry laggards, standards, best practices and excellence

Criteria and dimensions	Industry laggards	Industry standards	Industry best practices	Industry excellence
Corporate strategy	Focus on cost reductions and on-time-delivery (OTD).	Key performance indicators (KPI) and supplier objectives on hard and soft factors available.	Integration into corporate objectives including hard and soft factors.	Integration into corporate objectives, corporate strategy, mission and vision.
Organization	No specific SRM focus. All departments individually responsible for suppliers.	SRM integrated into logistics, procurement and quality functions. Many interfaces.	Partially integrated in parallel to core procurement and logistics function. Few interfaces.	Integration of all SRM activities to single point of contact (SPOC) to suppliers.
Supplier selection	Short-term sourcing based on hard factors, i.e. cost and lead time.	Short-term and medium-term sourcing decisions include hard and soft factors.	Case-by-case early supplier involvement and long-term strategies.	Joint and long-term strategy (3-5 years) and early supplier involvement.
Supplier co-operation	Day to day business without any specific collaboration with suppliers.	Collaboration with suppliers on a case-by-case basis.	Collaborative supply chains. Partial implementation of lean principles at suppliers.	Collaborative supply chains and synchronization of lean production and quality systems.
Supply chain visibility	No visibility technology.	Usage of logistics service provider systems to monitor status of shipments.	Usage of customized systems to monitor shipments and inventories in supply chain.	Usage of systems to monitor order line status, inventories and mobile assets in supply chain.
B2B collaboration	Collaboration across 1 process across 1 tier.	Collaboration across 2 processes across 2 tiers.	Collaboration across multiple processes across 2 to 3 tiers.	Collaboration and synchronization across multiple processes across 3+ tiers.
Cost transparency	One price including everything.	Partially open-books policy on main category level. Joint cost optimization workshops.	Deatailed open-books policy on main category level. Joint cost optimization workshops.	Itemized open-books policy on process level. Cost optimization from development phase onwards.
Risk management	Concerned about supply chain resilience but no action.	Assessing supply chain resilience to risk-related events on tier 1 level.	Managing supply chain resilience to risk-related events on tier 1-3 level.	Proactively managing supply chain resilience to risk-related events on tier 3+.
Demand scheduling and production system	Scheduling according to demand.	Scheduling in line with forecasting system. High inventories in case of fluctuations.	Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI etc.	Pull system and application of lean principles. Synchronization with supply chain. Low inventories.
Supplier quality performance	Monitor and visit suppliers on a case-by-case basis. Reactive actions.	Monitor (monthly or less) and visit suppliers on a systematic basis. Reactive actions.	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions.	Monitor (real time basis) and visit suppliers and create trend model. Proactive actions.
Logistics agility	Rarely perform logistics agility actions (e.g. redirection, supplier drop shipments etc.).	Sometimes perform 3+ logistics agility action.	Frequently perform 3+ logistics agility actions.	Logistics agility actions 3+ belong to a standard process.
Maturity level	low	medium	high	very high

Source: Maturity and best practice elements, adapted from several sources:Aberdeen group (2006), Christopher & Peck (2004), Bombardier (2010). Best practice elements clustered according the individual maturity level of each category.

6.3 Semi-structured interviews

6.3.1 Preparation of interviews

As part of the qualitative, multiple research approach, this section (Phase II, part 2) deals with semi-structured interviews and the objective to outline best practice elements in SRM by answering the research questions "What are the beliefs and values in SRM (School of thought?)?", "What are the causal factors for supply disruptions?" and "How can one anticipate, prevent and manage supply disruptions?". This process involves experts and senior managers in manufacturing companies in the European transportation industry and is part of Phase II (Yin, 2009). Based on ten interviews with senior managers in the respective industry, as shown in Table 6-18, the applied schools of SRM have been examined, supply disruptions categories have been inductively identified, and the anticipation, management and prevention of supply disruptions have been scrutinized. Based on the findings, best practice elements have been outlined and compared to those identified in the literature, leading to a unified listing drawn from both sources. The particpating candidates in this research on SRM best practices are all experts in SRM or SRM-related functions in manufacturing companies in the European transportation sector.

The majority are employed in companies that manufacture railways or vehicles as OEM in the respective industry. The remaining interviewees work in the module or systems producer area. All candidates were pre-informed via telephone or personally and asked whether they would participate in this doctoral research. Participation in several conferences on SRM or supply management helped the author to identify suitable candidates in higher management in manufacturing companies in the transportation industry in Europe. Once the participants had agreed to take part in the doctoral study, they were sent a question list via email one to two weeks prior to the interview date. Figure 6-19 shows a sample question list from MELCO. Ethical considerations were addressed by pointing out that the research would be conducted under the guidelines of "The University of Gloucestershire's Handbook of Research Ethics (2008)". Compliance with the ethical rules means that the thesis reports data, information and results honestly and avoids bias when interpreting the data analysis. Prior to each interview, the purpose of the research and the respective questions was explained to the candidate personally or via phone. It was decided that the names of the participants would remain anonymous. However, company name and position were to be given, with one exception. The majority of the interviews took place in Berlin (Germany), as there was a purchasing conference going on which offered an ideal opportunity to meet and interview the candidates. Most of the interviewees provided comments prior to the actual interview in the form of typed or handwritten notes on the question list, which was sent out beforehand. Interviews were protocolled in writing, as

the interviewees had concerns about being recorded. This procedure was discussed previously with the doctoral advisors, who had given their approval. Each interview lasted between 60 and 90 minutes on average. At the end of the interview, a summary was made by the author and affirmed by the candidates.

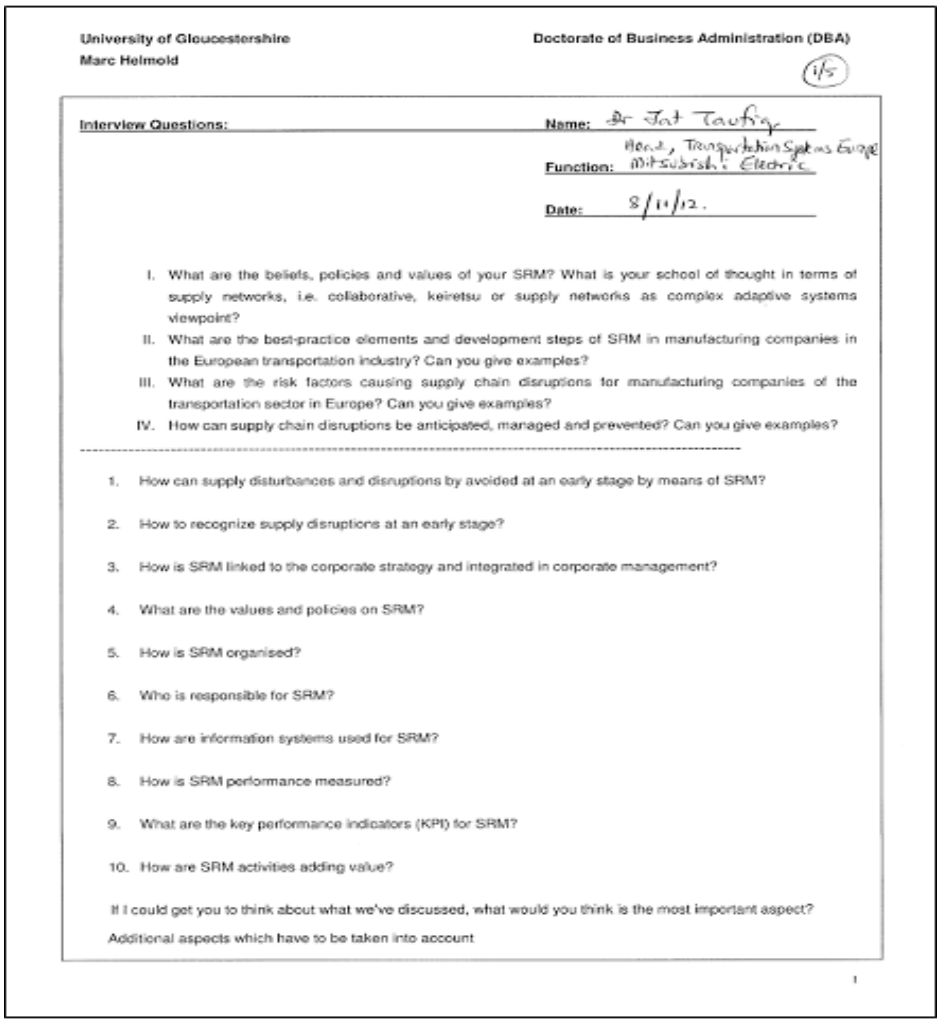
Table 6-18: Interview participants in Phase II

No.	Company	Position	Date of interview
1.	Siemens Transportation Systems Europe (SIEMENS)	Head of Strategic Purchasing	2012/11/02
2.	Mitusbishi Electric Europe (MELCO)	Head of Transportation Systems Europe	2012/11/08
3.	MAN, Site Oberhausen (MAN)	Head of Procurement and Supplier Development	2012/11/19
4.	BMW, Site Berlin (BMW)	Head of Procurement and Supplier Management	2012/11/08
5.	Power Converter Solutions (PCS)	General Manager	2012/11/09
6.	ZF Friedrichshafen (ZF)	Head of Supplier Development	2012/11/17
7.	Thales Transportation Europe (THALES)	Senior Purchasing Manager	2012/11/20
8.	European Manufacturer of regional & high-speed trains	Site General Manager	2012/11/25
9.	Panasonic Automotive Systems Europe (PASE)	General Manager Procurement and Supplier Performance	2012/11/26
10.	Alstom, Site Salzgitter (ALSTOM)	Site Director, Procurement	2012/12/04

Interestingly, all candidates wanted to know more about the study results, since the topic has significant relevance to industrial practice and the literature. The practitioners, themselves, stressed the need for a more holistic approach to SRM and felt that this thesis would be of great value for

manufacturing companies in the European transportation industry. Figure 6-19 shows a question list from one of the particpents of the interviews.

Figure 6-19: Sample of question list from participant MELCO



University of Gloucestershire
Marc Helmold

Doctorate of Business Administration (DBA)

1/5

Interview Questions:

Name: Dr Tat Taufiq

Function: Head, Transportation Systems Europe Mitsubishi Electric

Date: 8/11/12.

I. What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint?
II. What are the best-practice elements and development steps of SRM in manufacturing companies in the European transportation industry? Can you give examples?
III. What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe? Can you give examples?
IV. How can supply chain disruptions be anticipated, managed and prevented? Can you give examples?

---

1. How can supply disturbances and disruptions by avoided at an early stage by means of SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to the corporate strategy and integrated in corporate management?
4. What are the values and policies on SRM?
5. How is SRM organised?
6. Who is responsible for SRM?
7. How are information systems used for SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How are SRM activities adding value?

If I could get you to think about what we've discussed, what would you think is the most important aspect?

Additional aspects which have to be taken into account

1

The following sections outline the motivation and results of the interviews. Through the interviews, it was meant to obtain more data on best practices, especially from managerial practice as recommended by Yin (2009).

6.3.2 Motivation for conducting semi-structured interviews

A qualitative and multiple approach was used for the research, as recommended by some authors (Remnyi, 2003; Fink, 2010). The systematic literature review provided answers on the research questions outlined by Fink (2010) and showed the existing schools of thought in SRM. Moreover, it

identified best practices in SRM in manufacturing companies in the European transportation industry, revealed causal factors for supply chain disruptions and gave suggestions as to how to anticipate, prevent and manage supply disruptions (Fink, 2010; Yin, 2009). The motivation to conduct interviews with an ongoing systematic literature review was to obtain more data from managerial practice and to compare the findings with the results from the literature (Fink, 2010). According to Yin (2009), personal interviews "require a face-to-face conversation between interviewer and interviewee", samples are to be preferred, and the question list has to be prepared using several steps:

- defining objectives, collecting evidence,
- determining sample size and sample frame,
- producing and validating questions,
- generating question list layout,
- conducting a pre-test,
- revising the question list,
- distributing the question list,
- collecting results,
- editing and coding,
- analysing and interpreting.

On some specific questions regarding SRM, the systematic literature review revealed gaps and shortcomings, e.g. how to organise SRM, who is responsible for SRM, what information systems are to be used, how to measure key performance indicators, and what key performance indicators are to be measured. Therefore, it was decided to gather further qualitative data by using a multiple approach based on ten semi-structured interviews, as recommended by Yin (2009). The purpose of the interviews was to identify best practices of SRM in the respective industry inductively. A further aim was to define and categorise risk factors for supply chain disruptions, compare them to those identified in the literature, and develop a unified listing drawing on both sources. A last point was to examine how supply disruptions can be anticipated, managed and avoided (Yin, 2009). After gathering the data, it was necessary to summarise the results of both the systematic literature review and the semi-structured interviews by creating a unified listing of categories of best practices. Due to his experience as manager and lecturer in the research area, the author had access to a wide range of data and suitable interview candidates within Germany. Existing research has shown that SRM is seen, to a large extent, from the perspective of one's own organization, tier-one suppliers and corresponding reactive actions.

6.4 Semi-structured interviews: creating a listing of categories in best practices in SRM

6.4.1 Results and findings of semi-structured interviews

The systematic literature review resulted in extensive findings on best practice elements in terms of corporate strategy, organizational set-up, risk management, quality and logistics performance measurements, scheduling and production systems, and logistics agility actions. However, the literature also revealed gaps and difficulties with regard to applying best practices at manager level in manufacturing companies in the European transportation industry. Tranfield et al. (2003) identified evidence-based research as a way of forming guidelines for the decision processes of managers, thus helping them to create competitive advantage (Tranfield, Denyer, & Smart, 2003). Best practice elements have been inductively gathered and categorized through the systematic literature review and interviews as shown below:

Figure 6-20: Best practices categories in SRM, identified through interviews

Criteria & dimensions	Industry best practices
Coporate strategy	SRM is part of the procurement strategy and integrated into executive board or site generla management. SRM performance is measured via balance score card (BSC) or other means.
Organization	SRM is sub-division of procurement or SCM function. In all organizations, procurement or SRM is part of the excutive board or site general management.
Supplier selection	Early supplier selection based on commodity strategies, in certain cases concurrent engineering for key technology or systems.
Supplier co-operation	All companies pursue a collaborative approach in respect to supply networks. Supplier workshops eliminate waste in few cases after supplier selection.
Supply chain visibility	SRM performance is predominantly measured on tier one level, in certain cases extended to tier two levels, but rarely to tier three levels.
B2B collaboration	Application of sophisticated internet-based information systems in best-in-class comapnies. Few companies synchronize common ERP and SCM systems via electronic data interchange (EDI).
Cost transparency	Detailed open book policy on main category level with cost templates. Best practice companies conduct joint lean, quality and cost optimization workshops.
Risk management	Best practice evaluate companies in terms of Q-C-D-SF on tier one levels, pursue a double sourcing startegy and transfer technology to low cost countries after production and quality maturity is given.
Demand scheduling & production	Application of lean principles. Pull system, but autonomous production systems. Inventory management is optimized through consignment stock or vendor-managed inventories (VMI).
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Pro-active and anticipative supplier actions like audits, early supplier involvement, and trend models.
Logistics agility	Companies perform 3+ logistics agility actions in the event of potential supply disruptions, i.e. resourcing, substitution etc.
Supplier academy	SRM best pactice have a supplier academy, who train and coach internally but also externally. Some companies have also consultants, who perform coaching inside or outside their organizations.
Claim management	Systematic claim management based on performance indicators and facts. Best practice companies have a claim manager with a background in law and business.
Global sourcing	Best practice companies establish a sourcing office including procurement, quality, engineering andlogistics experts in low cost countries, e.g. China, Eastern Europe or India.

Uniform listing of best practice categories identified through systematic literature review and semi-structured interviews.

The Table shows a uniform listing of identified best practice categories: “corporate strategy”, “organization”, “supplier selection”, “supplier co-operation”, “supply chain visibility”, “B2B collaboration”, “cost transparency”, “risk management”, “demand scheduling and production”, “supplier quality performance”, “logistics agility”, and describes the findings of the semi-structured interviews. The interviews revealed three extra categories, namely “Supplier academy”, “claims management” and “global sourcing”, which were added to the uniform listing.

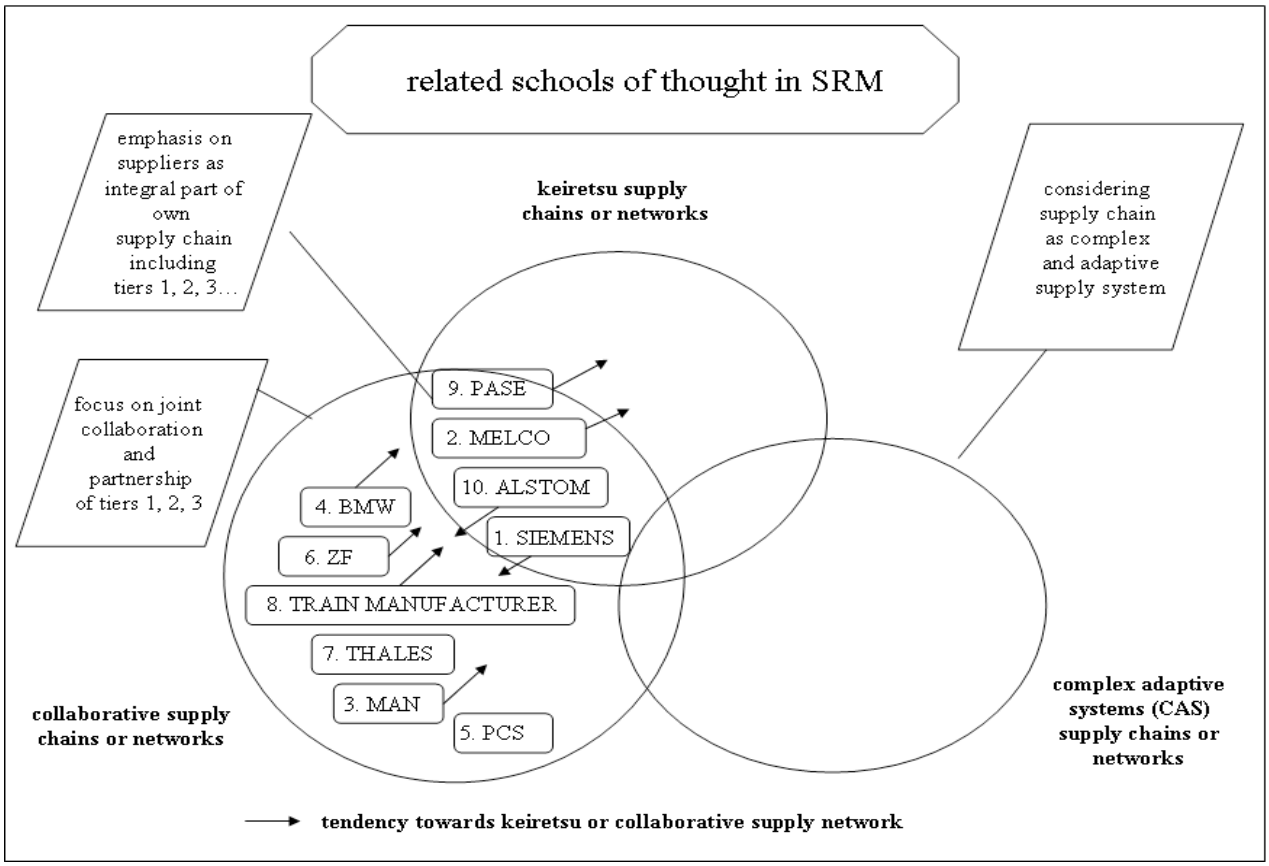
The following sections will describe the findings of the interviews (see Appendix 15 and 16), the best practice elements and the conclusion in more detail. As pointed out in the previous section, supply chain resilience is a relatively new and still largely unexplored area of applied management (Christopher & Peck, 2004). Although literature is available on this topic, Narasimhan & Talluri (2009) point out the need for a wider and multiple approach in SRM research, since there is a discrepancy between the proactive role of SRM (Harland et al., 2003). Therefore, semi-structured interviews with senior managers in SRM can give a good impression on what best practices in SRM look like, how SRM is organised, and what information systems and key performance indicators are used in industrial practice. A multiple approach helps to provide additional data and indicate best practices which are applicable to managerial practice. In the study, it was possible to identify additional best practices which were not evident in the systematic literature review, e.g. claims management, Supplier academy, and global sourcing. These categories have been added to the listing of best practices as shown in the following section. Equally to the previous section, maturity levels have been developed for each category.

6.4.2 Schools of thought in SRM (I)

The semi-structured interviews in Phase II disclosed that most of the ten manufacturing companies in the European transportation industry see SRM as playing a crucial role in the success of the organization. All strive for a collaborative approach with suppliers. Four of them, i.e. Mitsubishi Electric Transportation Europe (MELCO), Panasonic Automotive Systems Europe (PASE), Siemens Transportation Systems Europe (Siemens) and the Salzgitter site of Alstom Rolling Stock (Alstom), also show characteristics of keiretsu supplier networks (see Figure 6-21). In all four cases, the keiretsu relationship involves vertical integration through partial ownership or cross-shareholding with suppliers (Liker, 2004). The interviews also disclosed that CAS supply networks are more predominant in academia than in managerial practice. One reason for this might be that managers find it difficult to supervise supply chains and networks in biological or mathematical terms. Choi et al. (2003) stress the need to recognise supply networks as a complex adaptive system (CAS). They

suggest that many networks emerge from purposeful design on the part of a singular entity and can be managed more easily through positive feedback, which allows for autonomous action (Pathak et al., 2007). Imposing too much control detracts from innovation and flexibility; conversely, allowing too much emergence can undermine managerial predictability and work routines. Choi et al. (2001) point out that managers must be careful in balancing these two factors. In contrast to the recommendations of Choi et al. (2003), some senior managers recommend imposing control on the supply chain by using appropriate key performance indicators either continually or periodically (Gürtler & Spinler, 2010).

Figure 6-21: Companies of interviews and the related schools



Source: Assessment of interviewees in Phase II on the question to what school their organization belongs to. The majority of participants explained to have a collaborative approach.

The interviews revealed that for supporting key systems and modules as well as any value-adding activities on the part of the supplier, it is necessary to have a close relationship and stable supply chain, i.e. supply chain robustness and materials flow. Such key systems consist of significant items relating to the end product, e.g. car bodies, bogies, propulsion and control systems. Therefore, many

companies strive for vertical integration via keiretsu relationships and partial or full ownership. Keiretsu relationships also require synchronisation of the production systems and subsuppliers in order to secure stable production, robust materials flow and low inventories, as outlined by Ellram and Cooper (1990). Several authors, like Bechtel and Jayaram (1997) or Lincoln et al. (1997), highlight that Japanese manufacturing companies or their affiliates have a stronger tendency for keiretsu supplier networks and vertical integration. Especially MELCO and PASE have established a large global keiretsu supply network. Siemens (market leader in the European transportation industry and one of Bombardier's main competitors in manufacturing trains and parts) attach great importance to mutual benefits in their supplier relationships. In order to understand what mutual benefits are, it is essential to listen to and understand the requirements of the individual supplier. This idea is supported by the results of Gürtler & Spinler (2010) and involves periodic or continual monitoring. Such collaboration not only comprises joint product development and project execution, but also joint staff development, especially for those who work closely with suppliers. This is a new aspect which was not identified through the systematic literature review. For key modules, e.g. car bodies or bogies, various factors are important, such as synchronisation of production and materials and information flow. Another of Bombardier's competitors is Alstom. On key components like car bodies, bogies and electrical parts, Alstom have a similar approach to that of their main competitors (e.g. Siemens, Bombardier) and have keiretsu suppliers in this area. According to their site-sourcing directors, it is of the utmost importance to have a collaborative approach with regard to suppliers. Concerning the question as to why collaboration is so important, the answer was that only partnerships make it possible to obtain the most innovative technology. A partnership is also helpful in having joint objectives in quality, cost and delivery issues.

The head of procurement at BMW has read a lot about keiretsu and complex adaptive supply systems (CAS), but supports a collaborative approach. He mentioned that "supplier performance with a strong focus on supply chain stability, agility and quality is an integral part of this. BMW has a global supply network and transfers activities outside Europe once the launch of a new production line has been executed flawlessly. The company follows a dual-sourcing strategy on all major components in order to substitute products, systems or modules in the event of supply disruptions." ZF Friedrichshafen (ZF), a major producer of transmissions and modules for the European transportation industry, "applies a collaborative approach". According to the interviewee, "ZF are on the verge of establishing keiretsu supply networks for key suppliers. Key suppliers are identified as those suppliers that have a competitive advantage in technology or other aspects. For the keiretsu networks, ZF's approach is to integrate direct suppliers and subsuppliers, i.e. tiers one and two, in terms of early supplier involvement, concurrent engineering, production synchronisation and launch

management". The head of procurement of MAN in Oberhausen, Thales, and a general site manager of a manufacturing company of TRAIN MANUFACTURER in Europe highlighted "the need for cooperation and collaboration based on hard and reliable key performance indicators (KPI)". Such collaboration involves early supplier involvement from supplier selection to the aftermarket. He stated that "KPI comprise four main elements: cost, quality, delivery and supplier financial health". PCS, a manufacturer of transportation components and trucks, consider strategic alliances for key technology items as a crucial aspect of the SRM function. "The remaining suppliers are selected on a total cost of ownership (TCO) basis and substituted if the supply performance is not sufficient". The interviews with senior managers of manufacturing companies that rely on keiretsu relationships underline the fact that proactive measures are essential for a resilient supply chain. "In order to achieve supply chain resilience, specific teams are involved at an early stage and concentrate on value-adding capacities such as logistics, production and elimination of waste" (qoted from MELCO). These teams generally consist of supplier managers, launch managers, supplier readiness managers, or supplier quality integration managers. The interviews revealed that there are sometimes workshops and activities on the supplier's premises lasting from two days up to six weeks. The teams work on synchronising output and eliminating waste throughout tiers one, two or three of the supply chain. The main aim of such integrated involvement is to avoid supply disruptions from the beginning. In contrast to that, companies like Bombardier have a reactive approach and install sourcing inspectors at supplier level to establish a firewall and act as quality gate or control. The figure below summarizes the schools.

Table 6-22: Tendency towards school of thought in SRM

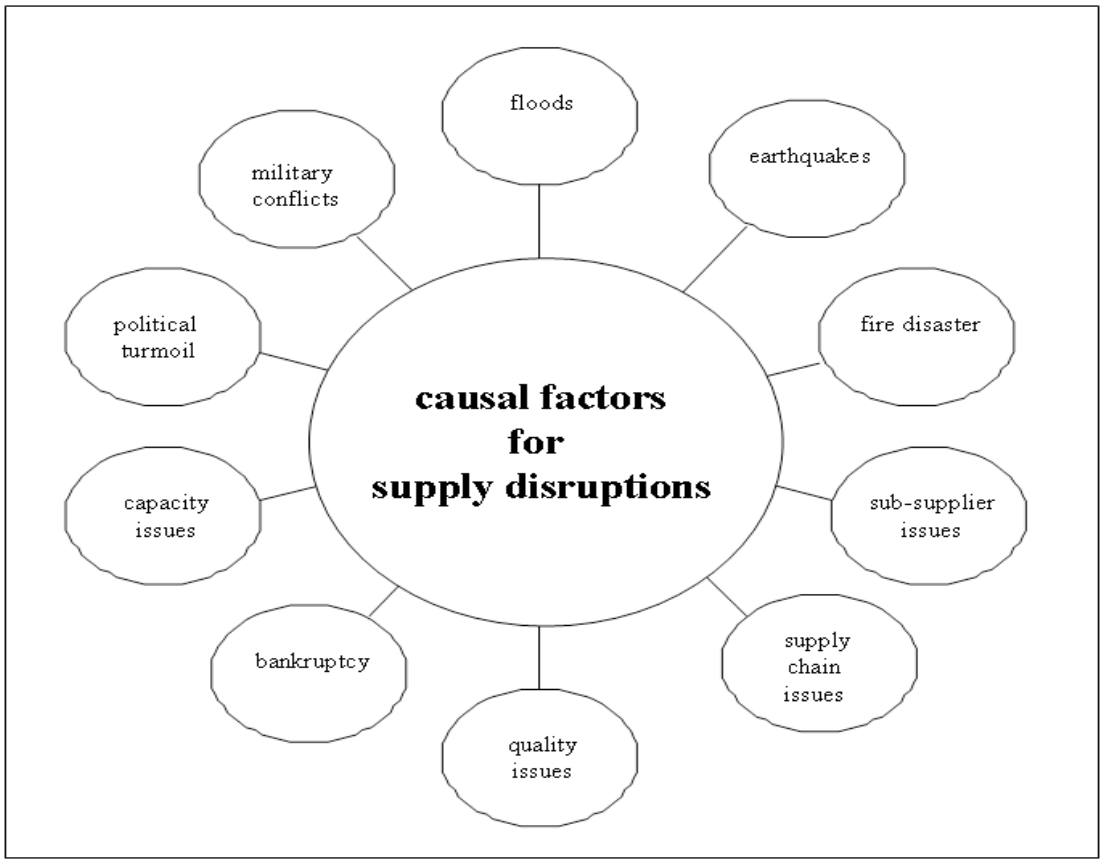
No.	Company	School of thought in SRM
1.	SIEMENS	Collaborative and keiretsu supply networks
2.	MELCO	Keiretsu supply networks for majority of systems
3.	MAN	Collaborative supply networks
4.	BMW	Collaborative supply networks
5.	PCS	Collaborative and loose supply networks
6.	ZF	Collaborative supply networks
7.	THALES	Collaborative supply networks
8.	TRAIN MANUFACTURER	Collaborative supply networks
9.	PASE	Keiretsu supply networks for majority of systems
10.	ALSTOM	Collaborative and keiretsu supply networks

6.4.3 Causal factors for supply disruptions (II)

In semi-structured interviews, senior managers from different manufacturing companies in the European transportation industry highlighted the same causal factors for supply disruptions as had been identified through the systematic literature review. The interviewees outlined many examples of each category (as shown in the figure below) and, like several authors (Aberdeen group, 2006; Gürtler & Spinler, 2010), stressed the fact that upstream supply chains have become more complex and global, thus exposing them to more risks and increasing their vulnerability (Bozhard et al., 2009). On the question about supply disruptions, the systematic literature review as well as the interview show "natural disasters, technical misinterpretation, insufficient design maturity, capacity constraints or fragile supply chains as the major root causes". The interviewees from BMW, Siemens, MAN, MELCO and PASE pointed out that supply chain managing has been subject to various changes in last twenty years as markets opened up and free trade areas were created (Aberdeen group, 2006; Roland Berger Strategy Consultants, 2012). Globalisation of SRM, outsourcing non-core competencies and reducing buffer levels throughout the chain by JIT concepts are some of the more common trends. "The main aim of such trends was to improve competitiveness and reduce costs across the entire supply network", as highlighted by the interviewees from ZF and PCS. The General Manager of PCS outlined that when it was a subsidiary of Bombardier, PCS could also rely on a global SRM organization; nowadays, "PCS has to carry out SRM activities autonomously. As global supply chains become more complex, they are automatically more vulnerable to supply disruptions. This is, firstly, because globalisation and the increasing length of the supply chain and materials flow lead to more risk factors. In addition, the impact of disruption spreads through the entire network much faster because of lower buffer stocks and single sourcing" (see Appendix 15, results of interviews). In the past, before globalisation, many risk factors (e.g. currency exchange rate fluctuations, social instability and even natural disasters) were considered to be local or regional events, a point which was stressed by the interviewees. However, with increasing global sourcing, they are not local anymore; they easily influence the manufacturing process of companies located thousands of miles from the origin of risk. All interviewees indicated that their organizations were faced with supply disruptions through natural disasters like the earthquake and tsunami of Fukushima (Japan) in 2010 or the flood on the Philippines in 2012. For some companies, the Arab Spring caused temporary shortages in 2012, especially regarding products from Tunisia and Morocco. Bombardier receives modules from Bahrain, which was also affected by the Arab Spring. Fortunately, no shortages or supply disruptions occurred because the modules were delivered by air freight (Bombardier, 2012). The mentioned supply disruptions are equal to those identified in the systematic literature review, however, senior managers did not explicitely classify the supply

disruptions. Figure 6-23 shows the causal factors as indicated during the interviews. The interviews disclosed, that managerial practice focuses on measures to avoid supply disruptions by installing suitable means for supply chain resilience as outlined in the following section.

Figure 6-23: Causal factors for supply disruptions



Source: Several sources. causal factors for supply disruptions.

Increasing globalisation in international business presents another significant challenge. Manufacturing companies in the European transportation industry have to cope with longer lead times and, consequently, greater uncertainty in their extended supply chains. As a result, another problem has appeared in the risk profile of global companies, namely risks associated with subsuppliers, the supply chain and logistics. The interviewees from PASE, MELCO and MAN pointed out that “their tier-one suppliers also outsource many value-adding activities, thus exposing themselves to greater risks with regard to subsuppliers”. Besides globalisation, the outsourcing of activities on tier-one, tier-two or tier-three supply levels has added several new risks to the supply chain. All this means that greater dependency on the quality of modules and products from the insourcing companies, as highlighted by the heads of procurement and supplier management at

BMW and ZF. Performance measurement of subsuppliers in terms of quality and logistics has become a fundamental activity of SRM. The situation may be further aggravated by the fact that a disruption in one specific part of a global supply chain can ripple down the rest of the chain much faster nowadays. This effect is mainly due to the lack of inventories and buffer resources throughout the supply network. Traditionally, supply chains were designed with redundancies in different segments. However, "hoping to eliminate all forms of waste, many companies adopted approaches like lean implementation and JIT. By having fewer inventories across the upstream supply chain and working with fewer suppliers, the operating costs of business were decreased significantly. Besides, companies could save money due to less investment, for example in storage facilities". But the adverse effects of the initiating event spreading quickly from one part of the downstream supply chain to another means that there is practically no time for companies to find appropriate solutions. Furthermore, due to outsourcing and management fragmentation in a given chain, the decision-making process for handling disruptions is slower than before. Increasing risk factors in supply chains and the rapid spread of disruption impacts in the network have put many companies in a challenging situation, since they have to work in a more insecure business environment. Companies no longer have so many possibilities for managing disruptive events for two reasons. Firstly, due to implementing the lean philosophy, fewer resources (e.g. finished goods, work-in-process, materials inventory) are available. Secondly, due to extensive outsourcing, most companies have lost control of the resources as well as visibility across their supply chain (Zsidisin, 2003). This loss of control and visibility impairs the ability of the company in question to detect disruption and have a complete picture of the situation. All in all, companies have a relatively limited degree of freedom to cope with abnormalities in their supply network. Consequently, while supply chains have, in themselves, become more risky nowadays, the essential resources for handling disruptive events are scarce and their control is shared among different parties. The explicit outcome of this paradoxical situation is growing vulnerability in supply chains and higher impact on the respective company's performance. Having a smooth operation in supply chains and providing reliable service to the customers seem more challenging now. To handle these challenges, two options might be considered: a passive option in which companies do not take into account the risk of modern trends at all, and an active option in which the risks resulting from these trends is accepted and the companies try to manage the situation in a systematic way. The impact of the above mentioned trends on daily business, especially in an otherwise stable environment, is so significant that for most managers the active option is the final and probably only choice. The question that will be tackled in the next section is: "How can manufacturing companies in the European transportation industry anticipate, manage and prevent supply disruptions?"

6.4.4 Anticipation, prevention and management of supply disruptions (III)

The interviewees pointed out that the handling of disruptions in complex global supply chains might require new forms of organization, new processes and new activities. From a time perspective, activities for preventing or mitigating disruptions can be classified into two major categories: ex-ante activities (beforehand) and ex-post activities (afterwards). Ex-ante activities are proactive measures, whereas ex-post activities are reactive measures. Interviewees stressed that in SRM, "activities and measures must be taken by companies beforehand to minimise any exposure to potential disruptions". These activities must be implemented at the point of supplier selection or before. However, the experts also outlined that, despite all efforts, disruptive events might happen at any time across the supply chain and their influence must be managed to restore the system to its normal condition. Proactive risk management has to focus on taking precautionary measures to tackle the risk of disruptive events in advance. Ex-post activities, which refer to reacting once the event has materialised, should be immediate and mitigatory. Although the interviewees used different terminology, there was a consensus that managers must use a systematic approach in order to identify potential disruptions and recognise the resources needed to manage them in advance rather than when they happen. The first process (ex-ante activities) for handling disruption is broadly recognised as supply chain risk management (Aberdeen group, 2006) or supply chain risk analysis, which primarily deals with pre-disruption activities, e.g. identification, assessment and mitigation of potential disruptions. The second process (ex-post activities) is called disruption management or mitigation, which gives the necessary support in handling actual disruption after it has materialised. For effectively managing disruptions in supply chains, both views are crucial and need to be addressed. By investing in risk prevention, many problems and disruptive events can be avoided. Moreover, without plans and the necessary resources, the disruption management process will be very slow. However, for obvious reasons, a company cannot make investments and have plans for every possible disruption. First of all, some of disruptions are not known beforehand, and even if companies might reckon with certain disruptions, they cannot afford to invest in preventing all of them. The major aspects of risk anticipation and disruption prevention strategies can be summarised as follows: prevention strategies in SRM require a sophisticated macro-analysis which can identify political, economic, social and technological risks. Regarding supplier selection, it is necessary to carefully execute the selection of suppliers based on process audits, milestones and an advanced product and quality plan. For low cost country sourcing activities (LCCS) global sourcing offices or inspectors must be installed to monitor suppliers proactively and to secure speed and efficiency. The transfer of technology to suppliers can only be allowed, once products, supply chains and production systems have a high degree of maturity. Best practice companies have a dual-sourcing of

components, systems and modules in order to provide rapid redundancy in the event of supply disruptions. Permanent performance measurement of suppliers in terms of quality, cost, logistics and supplier financial health must be done with alternative global supply chains and the possibility of substituting means of transportation. The interviewee of ZF stressed, "that a monitoring system from supplier selection to the after-market would be a fundamental tool for the proactive and collaborative evaluation of the performance of suppliers". Table 6-24 summarizes the major activities of each interviewed company in the European transportation industry.

Table 6-24: Anticipation, management and prevention of supply disruptions

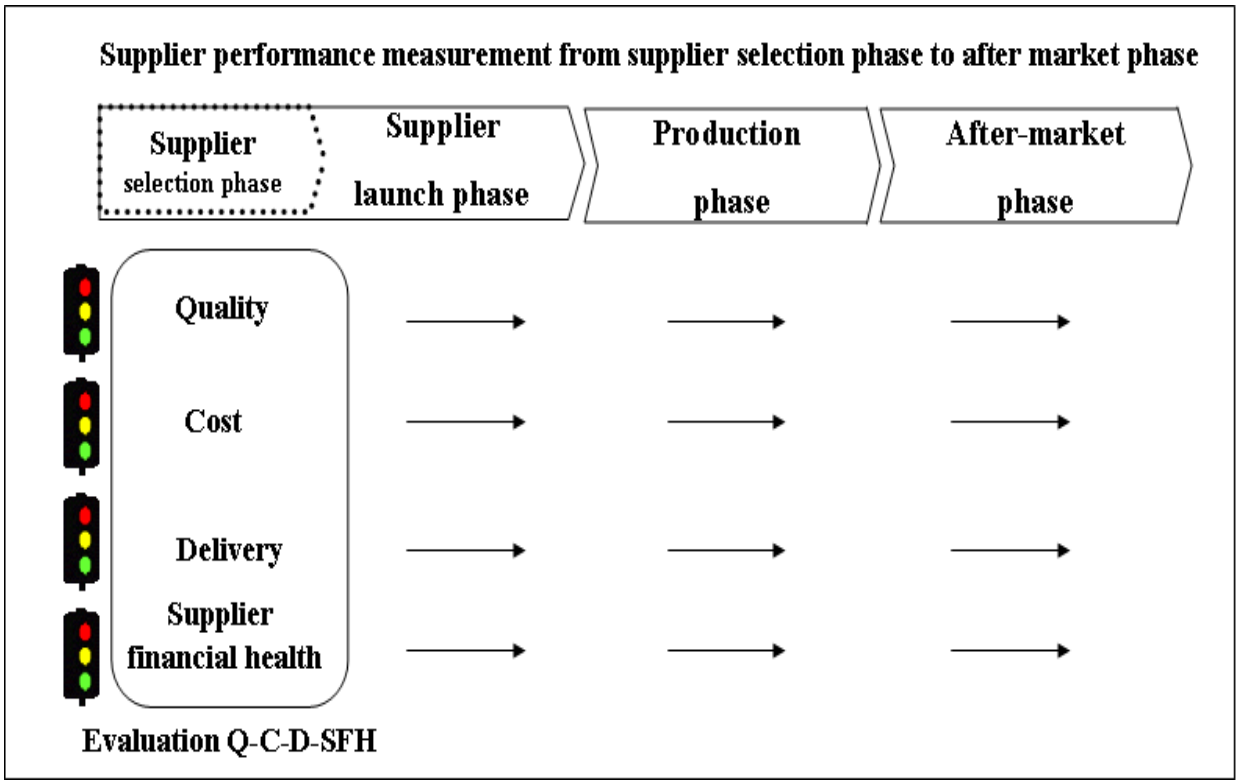
No.	Company	Activities to avoid or manage supply disruptions
1.	SIEMENS	Proactive: macro analysis including risk assessment Proactive: annual performance measurement of Q-C-D-SF Reactive: SRM trouble shooter team to mitigate supply disruptions
2.	MELCO	Proactive: annual performance measurement of Q-C-D-SF Reactive: SRM trouble shooter to form a team at supplier
3.	MAN	Proactive: monthly performance measurement of Q-C-D-SF Reactive: SRM Task force visiting suppliers
4.	BMW	Proactive: hard performance indicators Q-C-D-SF Proactive: double sourcing strategy Reactive: SRM front office as one face to the supplier
5.	PCS	Proactive: Supplier selection based on audit evaluation Reactive: quality engineer visiting supplier case-by-case
6.	ZF	Proactive: supplier selection based on audit evaluation Proactive: launch management of SRM task force Reactive: trouble shooting workshops at suppliers
7.	THALES	Proactive: supplier evaluation Q-C-D-SF Reactive: SRM engineers to visit suppliers
8.	TRAIN MANUFACTURER	Proactive: China & Eastern European sourcing office Proactive: supplier evaluation Q-C-D-SF Reactive: SRM or quality engineers to visit supplier
9.	PASE	Proactive: process audits and supplier evaluation Q-C-D-SF Proactive: supplier qualification group at suppliers Reactive: SRM task force at suppliers
10.	ALSTOM	Proactive: global offices and supplier evaluation Q-C-D-SF Reactive: SRM engineers to visit supplier

Source: Interview results as part of Phase II.

Best practice organizations have special SRM task force who are able to conduct quality or logistics workshops at the supplier's end in order to prevent disruptions or to react flexible to capacity fluctuations and insourcing capabilities for key modules and systems. It is neither possible nor economically sensible to attempt to deal with every possible disruption in the supply chain. Regarding circumstances that cannot be prevented, more attention should be paid to the response side of the disruption management process. For instance, for rare events like an earthquake, companies would prefer contingency tactics, since contingency costs are incurred only in the event of a disruption (Tomlin, 2006). Furthermore, simply having response plans and resources in place does not guarantee success in handling disruption. Companies must also have the necessary guidelines on "when" and "how" to use the plans and resources. Having a well-designed plan and executing the plan effectively at the time of the disruption are two separate issues and call for different capabilities. Such capabilities, sometimes called predictive intelligence and real-time supply-chain reconfiguration (Blackhurst, et al., 2005) or smart supply chain, help companies to make optimum use of the available resources to manage disruptions when they happen. Some authors have even questioned whether one can rely on static plans for managing disruptions that are inherently dynamic (Iakovou et al., 2010). Most response plans are developed on the basis of some assumptions beforehand which are seldom reviewed over a longer period. Indeed, when a disruption occurs, gathering accurate information about the event and the actual state of affairs and revising the pre-defined plans based on the information available are as important as the response plan itself. What companies do before and after a disruption are equally important. These two views should not be seen as mutually exclusive (Micheli et al., 2008). Both of them should be implemented and coordinated to achieve the best result in handling a disruption in the supply chain. They must be seen as integrated and interconnected cycles that give feedback to and receive feedback from each other. This calls for integrated frameworks to handle pre- and post-disruption activities. Such frameworks can support companies in minimising their exposure to risk and, at the same time, facilitate a quick response to disruptions when they happen. All interviewees stressed that pre-disruption measures require permanent evaluation of performance indicators, starting with supplier selection and ending in the aftermarket phase at the end of the life cycle of the product. The generic performance categories were described as quality-cost-delivery-supplier financial health (Q-C-D-SFH). The interviewee of Thales pointed out that "subcriteria may vary from company to company, but that the overriding categories would be similar". Subcriteria differ among the companies and depend on individual needs. "Evaluation should be continual and has to be shared with the suppliers in order to identify deviations at an early stage". This is in line with the recommendations of Gürtler and Spinler (2010) or Dust et al. (2011) from the systematic literature review. Even though academia propagates trend analysis, the semi-structured interviews showed that, even today, this approach is still rare in

manufacturing companies in the European transportation industry. Furthermore, the systematic literature review proposes that best practice companies should measure performance indicators at tier-one, tier-two and, in part, tier-three levels. Managerial practice in the companies which participated in the research revealed, however, that evaluation beyond tier-one level is still a visionary goal. Besides continual supplier evaluation, companies like "BMW pursue a dual-sourcing strategy for major components, systems or modules" as highlighted by the head of procurement in the interview. "If the supply chain is disrupted at one supplier, BMW can use the second source. Although, in certain cases, this strategy involves additional investments for the supplier, it secures the continuation of goods in the event of disruption". Best practice companies use a sophisticated web-based tool which can be accessed by both the evaluating company and its supply base as shown below. Perfomance is measured in terms of quality, cost and delivery aspects over all phases.

Figure 6-25: Supplier performance measurement (Q-C-D-SF)



Source: own source as result from Phase II interviews.

Regarding supplier financial health (SFH), all companies use service providers like Dun and Bradstreet or Creditreform in order to obtain financial performance data of their tier-one suppliers. Companies like BMW or ZF even combine this with their own database. However, all the experts questioned underlined the fact that financial evaluation in itself is a retroverse and reactive measurement tool.

6.4.5 Best practices in SRM (IV)

The interviews with senior managers in SRM resulted in a large spectrum of findings for this research. After defining the school of thought and tackling the two questions on supply disruptions, the interviewees were asked about their ideas on best practices in SRM, as summarised in the table below.

Table 6-26: Findings of best practices in interviews with SRM senior management

No.	Company	Best practices in SRM
1.	SIEMENS	• early supplier involvement • co-operation on raw materials pricing • joined human resource development
2.	MELCO	• management of total supply chain • measure and shape SRM • early involvement through concurrent engineering
3.	MAN	• early supplier involvement • supplier task force • extension of SRM to suppliers on tier 1,2 & 3
4.	BMW	• clear responsibility with back office and front office (task force) • claims management based on performance indicators • low stock and capital, double sourcing and transfer of technology.
5.	PCS	• early involvement of key suppliers • European supply chain to secure supply chain resilience • joint sourcing with customer involvement
6.	ZF	• supplier academy and supplier coaching • lean supplier workshops at suppliers • qualification offense: global standards on SRM
7.	THALES	• supplier selection at early stage • supplier performance cockpit and KPI • global supply networks
8.	TRAIN MANUFACTURER	• early supplier involvement • supplier evaluation based on neutral and hard KPI • trend analysis on supplier performance
9.	PASE	• early supplier involvement • keiretsu relationship with key suppliers • introducing lean principles and low stock
10.	ALSTOM	• evaluation on quality, cost, financial health and delivery • strategic alliances for key modules • loose relationships for substitutable components

The head of strategic purchasing at Siemens outlined that SRM is part of corporate strategy and corporate management, represented by a procurement member on the executive board of the company. One example of best practice at Siemens is to involve suppliers at an early stage. For key modules (e.g. bogies, car bodies, propulsion, controls), Siemens has a close relationship or

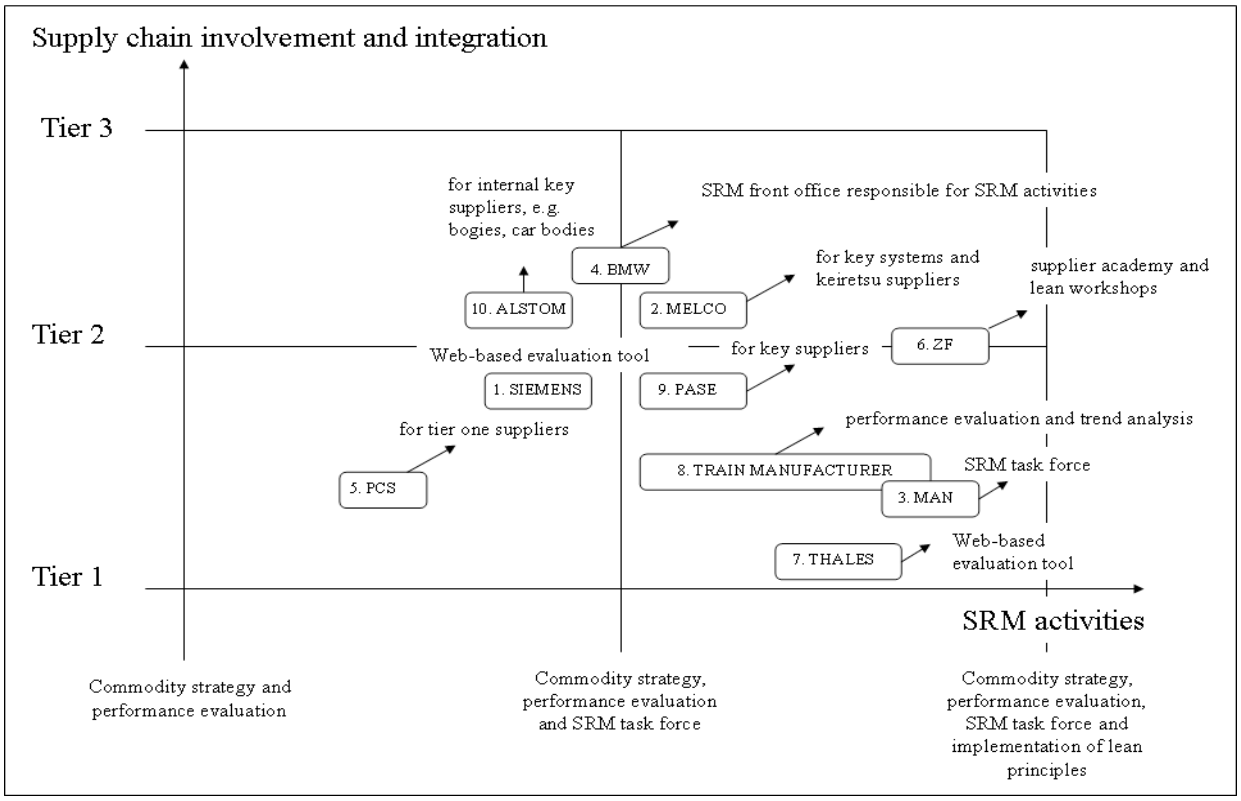
ownership. With regard to these components, scheduling, quality and production systems are synchronised and even include the same information systems. In order to have competitive raw material or component pricing, Siemens pools demands. In certain cases, Siemens strives for joint human resources development with key suppliers. The head of strategic purchasing indicated, however, that SRM activities are limited to the immediate layer of the upstream supply chain (tier one). The next interview was carried out with the General Manager of MELCO, a manufacturing company in the European transportation industry and Japanese affiliate. He also explained that SRM "activities are integrated into the corporate strategy, since many products have become increasingly outsourced and the company's own value-adding activities are constantly decreasing" (in the meantime to below 30 per cent). This statement is in line with the observations of Christopher and Peck (2004), who described increasing complexity as a general trend in upstream supply chain management, e.g. growing transfer of activities to suppliers, increase in number of supply chain layers (tiers), and internationalisation of supply chains (2004). As a result, supply chains have become more volatile and more exposed to external risks (Dyer, 1996; 2000; Aberdeen group, 2006). During the interview it was mentioned that MELCO now concentrates more on core competencies, such as module assembly. Therefore it is important to develop the SRM function in order to manage the entire supply chain and involve suppliers at an early stage through concurrent engineering. A fundamental task of SRM is to measure and shape the supply chain and network including tiers one, two and three. "MELCO regularly evaluates supplier performance in terms of quality and delivery. It also relies on keiretsu supply networks for key modules, systems and components beyond tier one and, sometimes, tier two levels. Such relationships with suppliers are based on common efforts with regard to scheduling, quality and production systems". The third interview was held with the head of procurement and supplier management at MAN, who explained that "the company pursued SRM on a tier one level, including early supplier involvement, performance evaluation and SRM task forces". He emphasised the need for extending supplier involvement in key technologies beyond tiers one, two and three. However, he also stressed that in the case of MAN, "SRM targeted the tier one layer, since subsuppliers (tiers two or three) have to be managed by the suppliers. MAN deploys a special launch task force consisting of experts from the quality, logistics or development department for the early involvement of direct suppliers". These experts conduct workshops and sourcing inspections at the supplier's end. Standard audit tools and question lists are used for the supplier visits. The next senior manager to be interviewed came from BMW and was the head of procurement and supplier management at a manufacturing site in Berlin, Germany. "BMW has established a back office and front office in SRM with clearly defined responsibilities. The front office acts as a single interface to the suppliers and is involved from the point of supplier selection onwards. BMW sees the role of the SRM function as being proactive in securing supply chain resilience. It measures supplier

performance via a web-based tool in terms of quality, cost, delivery and supplier financial health. The company has low stocks and inventories, so a dual-sourcing strategy is established for most of the components. If there are difficulties, BMW can mitigate supply disruptions and substitute the supplier immediately". Low-cost country advantages are realised once a stable supply network has been established and the appropriate technology transfer completed. Even though BMW applies a collaborative approach on tier one level, the head of procurement and supplier management stressed the need for monetary penalties in the event of supply disruptions. The company actually claims penalties and liquidated damages against suppliers that perform badly in terms of quality or delivery. BMW focuses strongly on KPI. Performance is measured daily and can be accessed by the supplier via a web-based data base. The fifth interview was conducted with the General Manager of PCS, a module and systems manufacturer for the European transportation industry. He explained "that PCS belonged to Bombardier until 2010 and now operates as a module and systems supplier in the European railway sector. Compared to the companies mentioned above, PCS has rather loose relationships to suppliers and only involves them at an early stage when selecting key components for new projects. In other cases, suppliers are selected during a normal bidding process. For their key components, PCS has established resilient Europe-wide supply chains". At the moment, the feeling is that global sourcing would jeopardise supply chain resilience due to possible disasters or an unstable environment. However, fierce competition from China and Asia may force PCS to move to these countries, too. For certain projects, suppliers are jointly selected with customers like Bombardier or Siemens in order to ensure high quality and technology standards. In such cases, suppliers are jointly audited by SRM experts. The next interview on best practices in SRM was done with the head of supplier development at ZF. A few years ago, "ZF established an academy with global and uniform standards on SRM and supplier performance. Such an academy ensures that SRM experts are internally coached in terms of supply chain activities, quality standards and other related issues. In addition, the academy offers access to external suppliers for training in quality and production standards and tools, e.g. advanced quality and product planning, problem solving, supply chain resilience". For key suppliers and modules, a task force implements lean principles in the form of a workshop with an emphasis on eliminating waste throughout the supply chain. The workshop generally focuses on tier one suppliers, although in special cases tier two and tier three suppliers are involved. As the seventh candidate, the senior purchasing manager of Thales provided some interesting new aspects of SRM. Like most of the other companies, Thales involves its suppliers at an early stage as part of a global commodity strategy. For assessing its suppliers, Thales mostly uses hard performance factors (e.g. number of quality defects, non-conformities, warranty incidents, unpunctual deliveries) and a so-called evaluation cockpit. The KPI are quality, cost and logistics, which form the basis for generating trend models. Participant number eight was a former general site

manager of a train manufacturer and integrator in Europe. He was the only one who requested anonymity of name and company. But, as he was very interested in this research, he volunteered to participate in the study. He made similar recommendations to the other interviewees on early supplier involvement and performance requirements for securing a resilient supply chain. The early sourcing of suppliers should be based on a global commodity strategy and a TCO approach. Supplier evaluation must be based on neutral and hard KPI, including a trend analysis on supplier performance in order to secure a robust supply chain. Supply chain agility is a crucial factor for reacting to capacity fluctuations. SRM has to include disaster management, since supply disruptions may exist on both macro- and microlevels. The ninth interview was carried out with the General Manager of PASE, a European subsidiary and manufacturer of Panasonic. He said that "early supplier integration within PASE implies the application of common production and scheduling systems on a tier-two and tier-three basis. Normally, these systems are integrated into an ERP system". In addition, keiretsu relationships with key suppliers ensure a stable and long-term prognosis in terms of demand. Thus it is possible to have low stocks and inventories. "Eliminating waste is a fundamental principle within the keiretsu supplier relationships". As the last of the ten interviewees, the Alstom procurement director of manufacturing sites in Germany and Europe was questioned. The best practice elements of Alstom were described by this interviewee "as a web-based supplier evaluation tool, ranging from the process of supplier selection to the aftermarket phase".

In certain areas, Alstom could establish strategic alliances for key components and carry out concurrent engineering projects with advanced suppliers. All interviewees stressed the necessity of supplier involvement, integration and specific SRM activities, as summarised in the figure below. Synthesis of the interviews revealed that certain manufacturing companies in the European transportation industry involve and integrate suppliers to a greater extent than others. Whereas companies like BMW, MELCO, Alstom or ZF involve suppliers on tier-one and tier-two levels, other companies like PCS or Siemens focus on their direct supply chain (tier one) and consider the management of tier-two and tier-three suppliers as being the responsibility of their direct suppliers. With regard to SRM activities, all interviewees emphasised the need for measuring supplier performance. Companies like ZF, MELCO or BMW carry out special workshops, implement lean principles, execute launch activities or synchronise production systems in the supply chain. During the interviews, the author received the assessment of all interview candidates, where they consider their enterprises in terms of SRM activities and supply chain involvement/integration. The figure on the next page (Figure 6-27 shows the companies in terms of SRM and integration activities) shows the summary from the interviews. Even though all interviewees stressed the need for an integration beyond tier one, two, three layers, the majority of companies has not yet executed this aim.

Figure 6-27: Best practices terms of supply chain integration and SRM activities



Source: Results from interviews.

6.4.6 Specific questions on SRM (1-10)

In the following section the specific questions have been summarized. A large quantity of data could be collected through the interviews. Analogue to the generic questions, interview protocols have been transcribed and analysed (a summary is available in Appendix 16).

1. **<u>How can supply disturbances and disruptions be avoided at an early stage by means of SRM?</u>**

The semi-structured interviews revealed that supply disruptions are caused by natural disasters, political problems, political turmoil, supply discrepancies, quality issues, or bankruptcies. This is in line with the findings of the literature review (Tang, 2006; Tomlin, 2006). Interviewees stressed that a flawless execution requires involvement on the part of suppliers at an early stage. All companies in the research conducted macrolevel analyses of political, economic, social and technological factors to identify potential supply chain incidents. This was especially important in cases where supply chains are prone to natural disasters (earthquakes in Italy and Japan, floods in Indonesia and the Philippines, political turmoil in Arab countries). BMW, ZF and PASE recommend monitoring the

macrofactors continually to have an ongoing risk evaluation. Besides, companies should have redundant supply chains, i.e. permanent dual-sourcing or the possibility of establishing dual-sourcing immediately. Interviewees from Siemens, MELCO and PCS emphasised the importance of communicating technical, quality and logistics requirements to the supply base. In addition, it was mentioned by the interviewee of MELCO "that a lot of slack existed throughout the supply chains due to inappropriate design or insufficient transfer of such requirements". Practitioners pointed out that SRM should identify potential supply chain discrepancies or weaknesses at the point of supplier selection. Managerial practice underlines the need for task forces, launch managers or lean implementation teams in order to qualify the production system of the suppliers and build up the supply chains. In certain cases like ZF, BMW or PASE, SRM teams pursue lean workshops and eliminate waste throughout the supply chain. Furthermore, interviewees stressed the need for "performance measurement based on hard criteria, e.g. Q-C-D-SF". Even though there are several recommendations in the literature about applying a proactive alert system for supply disruptions, many companies maintain reactive alert systems. Interviewees like the head of SRM in ZF explained "that the development of such early warning system could be a fundamental benefit out of this thesis". Gürtler and Spinler propose using a proactive warning system based on evaluating risks either continually or periodically. Emmett and Crocker and Dust et al. recommend a supplier evaluation model which includes a trend analysis combined with risk factors and supported by specific actions in SRM. This model comprises categories such as quality, cost, financial stability, delivery and technology (Dust et al., 2010; Emmett & Crocker, 2009). It is also combined with a sfocus on preventive measures and the involvement of suppliers at an early stage. In summary, interviewees proposed the following activities for the anticipation and prevention of supply disruptions:

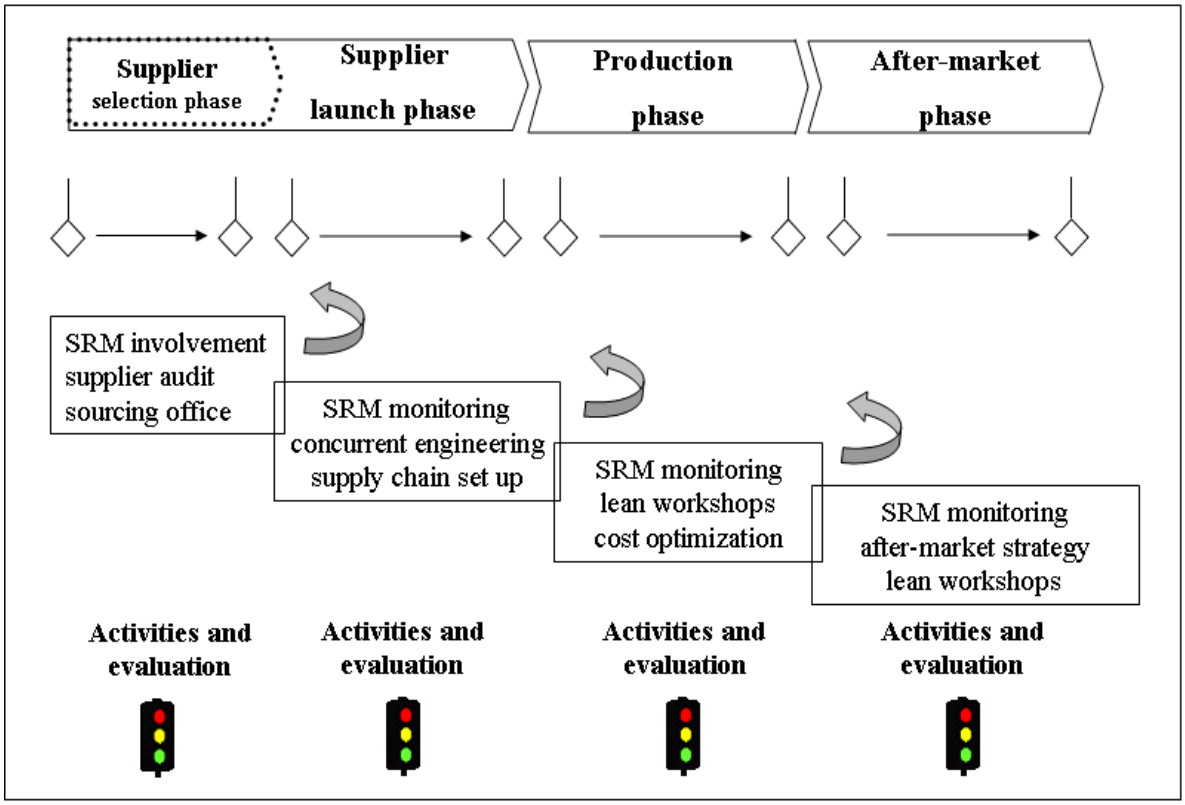
- involving SRM function at an early stage and conducting audits for new suppliers
- pursuing macro- and micro-analyses of supply chain fragilities
- evaluating supplier performance based on Q-C-D-SF criteria
- dual-sourcing or establishing redundant supply chains
- pursuing subsupplier management
- conducting joint workshops with a focus on production, quality and delivery
- implementing lean activities and eliminating waste

2. <u>How to recognize supply disruptions at an early stage</u>

There are different views in managerial practice on the question of how to recognise supply disruptions at an early stage. The interviews revealed that disruptions can occur on a macro- or

microlevel. All interviewees pointed out that “suppliers have to be evaluated continually”. However, there was a controversial discussion in the majority of interviews as to whether existing evaluation systems and performance indicators can foresee supply disruptions on different levels. Most of the existing systems have a retroverse background (i.e. gathering performance data from the past), rendering them reactive in nature. In addition, they measure tier-one performance and do not reach beyond this level. Best practices at BMW, ZF, MELCO and PASE were described as having an SRM team which accompanies the suppliers and subsuppliers from the point of selection to the aftermarket phase. Parallel to the participation of SRM managers in supplier selection, production launch and aftermarket activities, all companies apply hard factors for performance measurement in terms of Q-C-D. For evaluating financial health most suppliers use special service providers, while others, like ZF, have a customised tool. The majority of SRM experts indicated the need for physical presence at the supplier’s end through audits, concurrent engineering activities, lean workshops and/or cost optimisation, as shown below. In some cases, companies have LCCS offices which can pursue or support these activities. Feedback and feedforward cycles are a useful means of applying best practices throughout different projects. In the case of ZF, a special academy educates its own staff and the staff of the supplier to apply standard tools and processes.

Figure 6-28: Evaluation and activities in order to avoid supply disruptions



Source: drawn from an interviewee in Phase II.

3. How is SRM linked to corporate strategy and integrated into corporate management?

As all the interviewed companies began focusing more and more on core competencies, interviewees like the head of procurement from Thales mentioned that "global outsourcing activities rapidly increased". At the same time, their own value-adding activities decreased significantly. "Therefore it is important that SRM is linked to corporate strategy and part of corporate management". Another common factor is that the SRM function is represented in the executive board, senior management and site management teams. All companies which took part in the interviews use various criteria for measuring SRM performance. The following list comprises the most important points mentioned during the interviews:

- number of suppliers with a Q-C-D-SF performance higher than 80 percent
- number of financially weak suppliers
- percentage of suppliers in LCCS
- number of suppliers per module, system or component
- rate of cost reduction and productivity improvement during product life cycle
- number of successful audits for new suppliers
- number or percentage of suppliers linked to the EDI system
- number or percentage of suppliers that responds to changes of deliveries within a given period of time

4. How is SRM organised?

There was general agreement among the interviewees that SRM should be organised by a special group or pool of experts in terms of the skills required. BMW uses its front office as a single reference point for suppliers. ZF and PASE utilise SRM engineers for the relevant activities. Other companies like Siemens, MELCO, MAN, Thales, Train Manufacturer and PCS use experts together with strategic purchasing or procurement departments for SRM activities. In these cases, the buyer or respective procurement employee deals with the commercial issues. "Concerning audits, workshops and supplier visits, SRM experts are involved", as outlined by the interviewee of ZF. For downstream and key account management, senior managers recommend having one face to the supplier, although managerial practice shows that this has not yet been fully implemented. Such a concept requires a wide range of skills in terms of project management, product or quality knowledge, commercial expertise and lean production methods competencies, all of which require training the respective employees. A few years ago, "ZF started a qualification offensive with a view to improving standard competencies in all supplier-related functions". This offensive is coordinated

by the central SRM department in the corporate headquarters and rolled out to all manufacturing sites.

5. Who is responsible for SRM?

Regarding the question of who is responsible for SRM, there was general agreement that the main tasks are part of the procurement or purchasing function. A further point (like indicated by the BMW interviewee) "was that supplier quality assurance should belong to SRM, although in many cases it was actually incorporated into the overall quality function". Bombardier is on the verge of integrating supplier quality assurance activities into procurement and SRM with the aim of stabilising the process during production launch and production approval. In Siemens the suppliers are selected by procurement, but the engineering department is responsible for product approval. In many companies, supplier selection and the respective SRM activities are jointly executed by different departments, e.g. procurement, quality, engineering, logistics. In such cases, if selection criteria are not met in terms of quality, cost, delivery or technical aspects, all departments have the right to reject a supplier. The coordination is done by procurement or purchasing.

6. What are the values and policies of SRM?

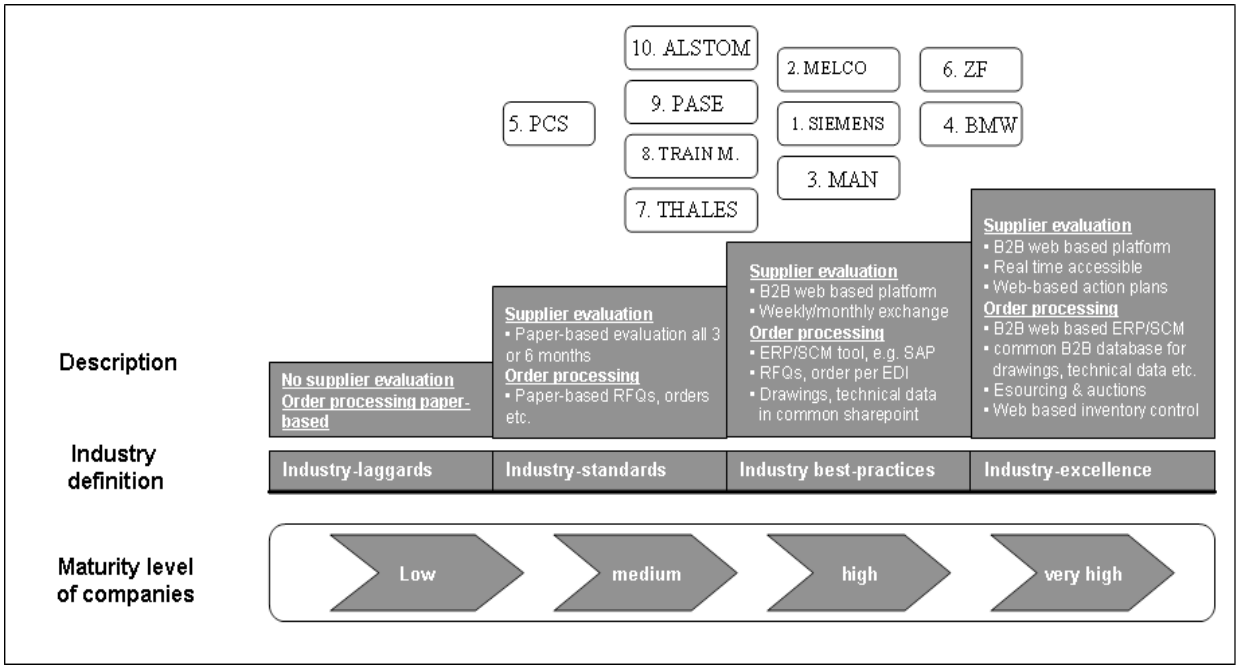
The interviews revealed in contrast to the systematic literature review the application of two schools (collaborative and keiretsu supply networks) with different characteristics, but common values and policies. These schools aim at having a resilient supply chain and at avoiding risks. In this context, the values and policies of SRM "build on partnership and collaboration" with suppliers in upstream supply chain management as outlined by several interviewees and Dust et al. (2011). "In contrast to traditional paradigms these two schools regard suppliers as equal partners within a multilayer perspective (tiers 1, 2, 3)". The respective relationship management is based on collaboration in loose or deeper forms (Hamm, 1998). Keiretsu supply networks, which focus is on lean principles and the elimination of waste throughout the supply chain (Ahmadin & Lincoln, 2001), are quite common in Japanese companies like MELCO or PASE. In these cases, production systems are aligned by lean measures and the focus is on a pull production system.

7. How are information systems used for SRM?

All companies apply enterprise resource planning (ERP) or manufacturing resource planning (MRP) based on SRM data. For SRM evaluation, companies like MAN, BMW and ZF use a customised tool linked to ERP/MRP, which consolidates supplier performance data. A few companies, like Siemens, Train Manufacturer and PASE, "use e-procurement or online auction tools". For example, PASE or Train Manufacturer use Excel databases and templates, whereas ZF and BMW apply web-based B2B

solutions where data are accessible on a real-time basis and certificates, audit reports or action plans can be uploaded. Order processing, including the request for quotation (RFQ) or the order itself, is also supported by this web tool. The internal ERP and SCM system feed data into such web bases. Best-in-class companies carry out electronic sourcing and online auctions. Inventory management and control are synchronised with tier-one suppliers via the same B2B web portal solution. The interviews showed that most of the companies use a B2B web-based platform in order to exchange evaluation data on a weekly or monthly basis. Placing and processing orders, including RFQ, is either paper-based or done via EDI using an independent ERP tool, e.g. SAP. Drawings, technical data and certificates are distributed via email or via a common sharepoint. Supplier evaluation remains paper-based and is shared with suppliers every three to six months. The figure below classifies the maturity levels of the companies interviewed. Whereas ZF and BMW utilise web-based B2B tools, other companies still have room for improvement in their upstream supply chain B2B environment.

Figure 6-29: Maturity level of information systems



8. How is SRM performance measured?

All interviewees were of the opinion that SRM performance has to be measured either continually or periodically. This is in line with the results of the systematic literature (Emmett & Crocker, 2009 or Dust, 2010). There was general agreement that both hard and neutral factors were needed for supplier evaluation. The interviews revealed that in managerial practice hard factors are considered to be

more objective than soft factors. Hard factors are applied quantitatively and deal with quality figures, cost reduction ratios and field defects. They may also refer to the response time in days in the event of non-conformities. Unlike hard factors, soft factors are more subjective and comprise aspects like the cooperation or innovativeness of suppliers. During the interviews it was also stressed by interviewees like the head of SRM in BMW, "that supplier evaluation has to be carried out as an ongoing process at all stages, e.g. supplier selection, supplier launch phase, serial production, aftermarket". Whereas most interviewees said that web-based supplier evaluation was available daily, the General Manager of PASE said "that quality and delivery data were distributed to suppliers on a monthly basis via email. Without doubt, the evaluation system is important". Companies like Thales, BMW and ZF use an advanced internet-based B2B system, which can be accessed by their own organization and by the suppliers on a real-time basis. Data are entered automatically through the interface to an ERP system. (The market leaders for ERP are SAP or IBM.) According to the site-sourcing director of Alstom, SRM should be measured principally via hard performance indicators and accessed via a web-based solution. Any evaluation should incorporate a 360-degree feedback and comprise Q-C-D-SF aspects. As an additional point, it was indicated by the ZF interviewee, "that corporate social responsibility would become more and more important. Alstom insists that all suppliers, particularly in Asia, comply with the laws, environmental requirements, non-discriminating behaviour and proprietary data".

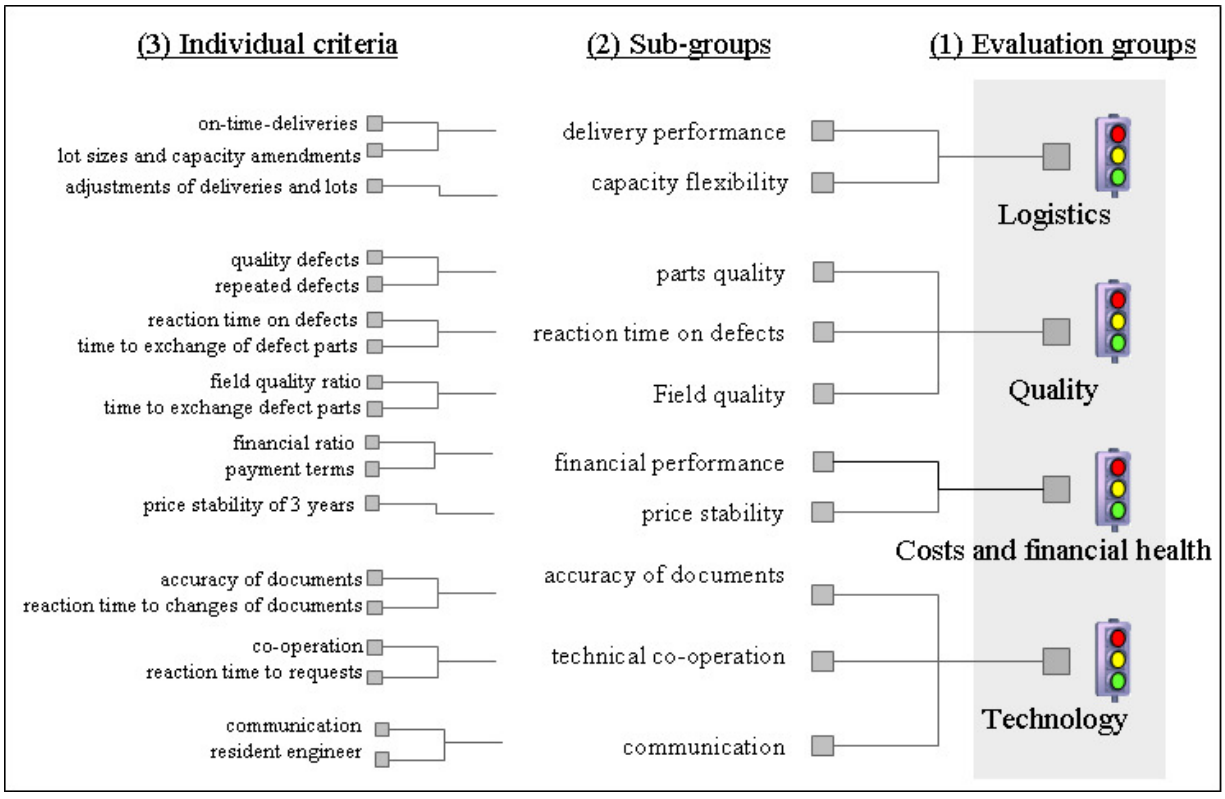
9. <u>What are the key performance indicators in SRM?</u>

All interviewees agreed that key performance indicators (KPI) in SRM must comprise quality, cost, delivery and financial health of suppliers, as shown in Figure 6-30. Moreover, technological capabilities and resources are a crucial factor of performance measurement if suppliers have to develop products, systems or modules independently or concurrently. Many companies (e.g. BMW, ZF, PASE, Alstom, Thales and Train Manufacturer) "also outsource development activities to external partners and service providers, which necessitates close involvement of suppliers and a joint engineering approach at an early stage". This generally corresponds to the systematic literature review. Emmett & Crocker (2009) and Dust et al. (2010) also propose using such criteria for evaluating the performance of suppliers. Interestingly, the interviews revealed that many companies have created subcriteria of Q-C-D-SF according to their own needs. Regarding the question of how often manufacturing companies in the European transportation industry measure supplier performance, what they do internally with the data and how they communicate the results to suppliers, several different answers were given. In the best case, data was updated on a weekly basis and made available to suppliers through a web-based tool. Concerning the evaluation of supplier performance, all interviewees outlined three to four categories, like traffic lights:

- category one (green): acceptable with minor deviations and without conditions
- category two (yellow): acceptable with conditions
- category three (red): not acceptable

In category one (green), the evaluation is approved and accepted with minor deviations. In category two (yellow) the evaluation is accepted with conditions. Conditional acceptance means that any subsequent action plan has to be approved by the SRM department. If a supplier shows severe deficiencies and is categorised three (red), the evaluation is not accepted. This can mean that a new supplier is not allowed to supply parts. In cases where category three is measured during serial production, specific SRM actions (e.g. management escalation, supplier audits, dual-sourcing) might be the consequence.

Figure 6-30: Supplier evaluation criteria of PASE

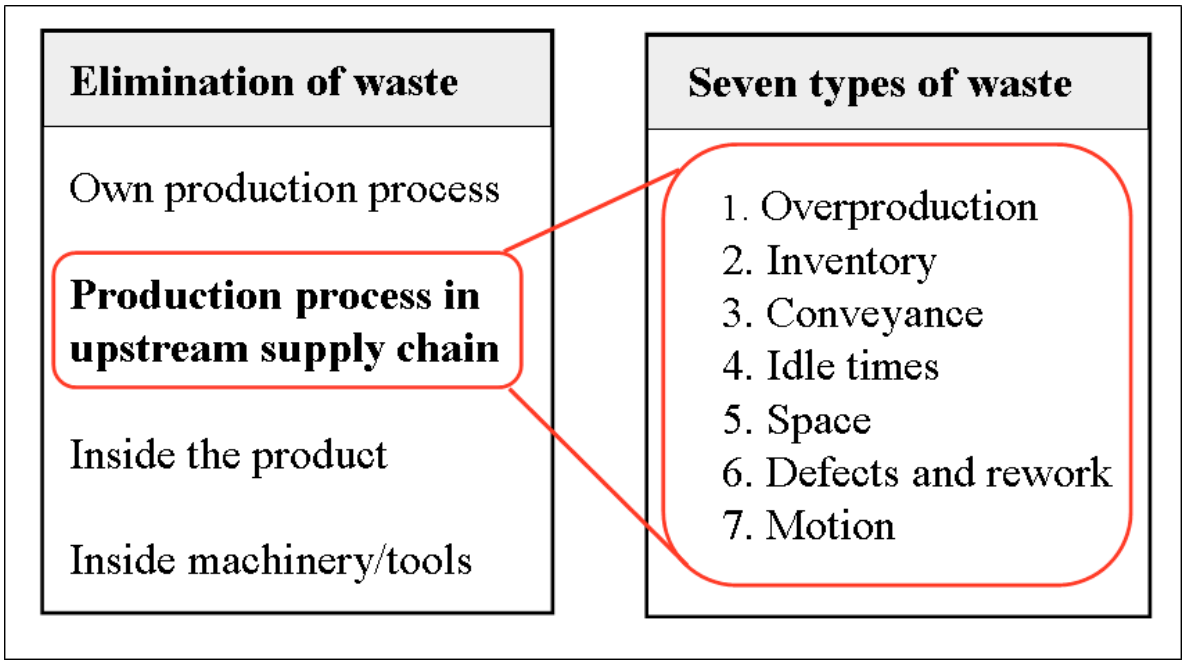


10. How do SRM activities add value?

Increasingly, supplier relationship management (SRM) is being viewed as strategic, process-oriented, cross-functional and value-creating for both buyer and seller, and as a means of achieving superior financial performance. On the question of how SRM activities add value, all interviewees stressed the importance of customer satisfaction. It was made clear that a solid and robust upstream supply

chain contributes to the goal of meeting end-customer requirements in terms of quality, cost and delivery. These comments match the results of the systematic literature review (Christopher et al., 2005; Gürtler & Spinler, 2010). BMW and ZF consider value-adding activities in their SRM policy. Even though the activities involved in customer satisfaction are not easy to quantify in monetary terms, certain areas of quality, cost and delivery clearly play an important role. Keiretsu-oriented companies like MELCO and PASE highlighted "the elimination of waste throughout the supply chain as being crucial for the success of their organization". Ohno (1998) defines waste as the opposite of value-adding and, as such, it must be eliminated, not only in one's own organization, but also throughout the upstream supply chain beyond tiers one, two and three. Although all the experts claimed that lean production and lean principles had been implemented in their own company, only four of them transferred these principles to the suppliers. Such a transfer must start at an early stage after supplier selection and aim at synchronising production quantities and supply chains. Figure 6-15 shows the seven types of waste to be eliminated, e.g. overproduction, high inventories, transport, idle times, space, defects and reworking, transport times. All these factors may affect the company's own production process, the production of suppliers, the product itself, or machines and tools (Ohno, 1998). Thus elimination of waste throughout the upstream supply chain would systematically increase the extent of value-adding activities, leading to benefits for one's own organization. Best-in-class organizations transfer their production processes and methods to their suppliers, including the synchronisation of material and information flows.

Figure 6-31: Eliminating waste and adding value



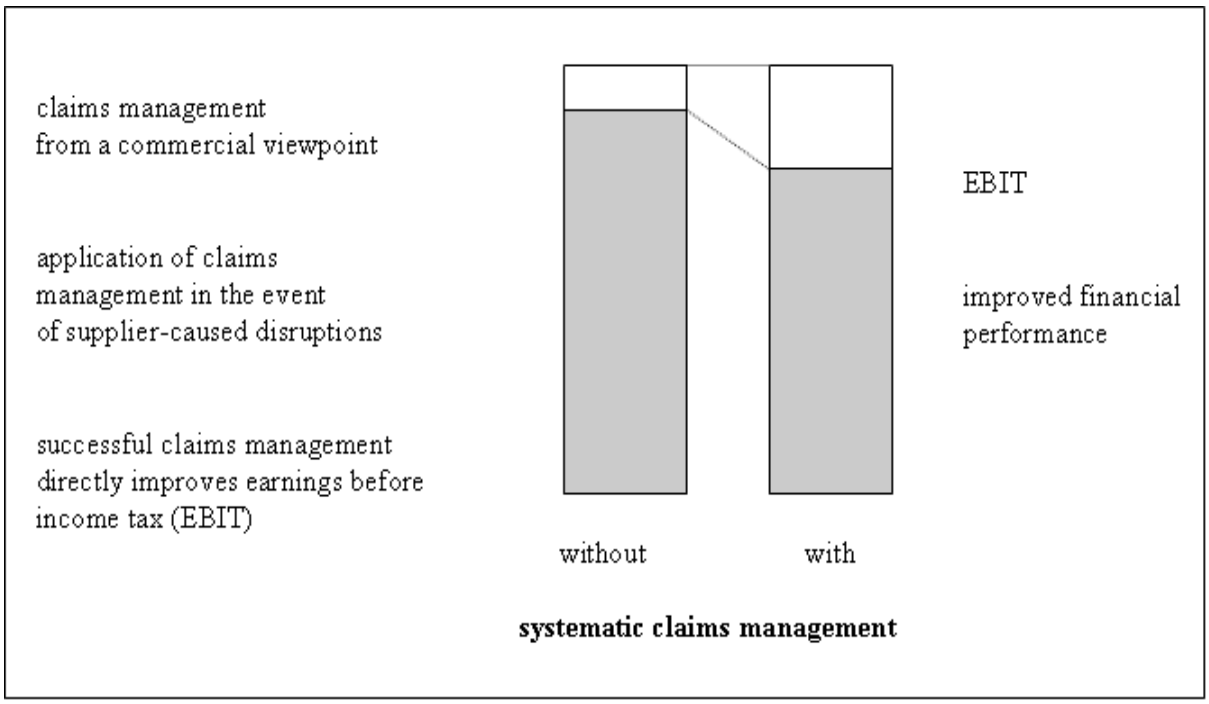
Source: adapted from Liker (2005) and Ohno (1988).

Organizations with a keiretsu supply network have close links to their key suppliers, who, in many cases, are partially owned by the company, or the relationship between them is based on a strategic alliance. Such suppliers are bound into the production system of the organization and have a similar production system themselves. These organizations for their part have specialised teams that are trained to execute lean workshops with the supplier during the launch of a product and before serial production starts. The workshops are designed to identify and eliminate waste throughout the supply chain, synchronise demands and capacities, and concentrate on value-adding activities. Most of the companies with a tendency towards a collaborative supply network have a more reactive approach. They also deploy teams at the supplier end in specific situations (e.g. capacity increases and quality issues) with a view to implementing lean principles. Alstom and Train Manufacturer see SRM as "adding value to their own processes as it contributes to customer satisfaction if the optimal combination of quality, cost and delivery performance is maintained".

Claims management as a possibility to improve supplier performance

An additional aspect pointed out by companies like BMW, ZF and PASE is that SRM also entails professional claims management, whereby suppliers bear possible costs if they cause the disruption. The interviews also showed that supply shortages and performance discrepancies can result in significant cost overruns and opportunity costs.

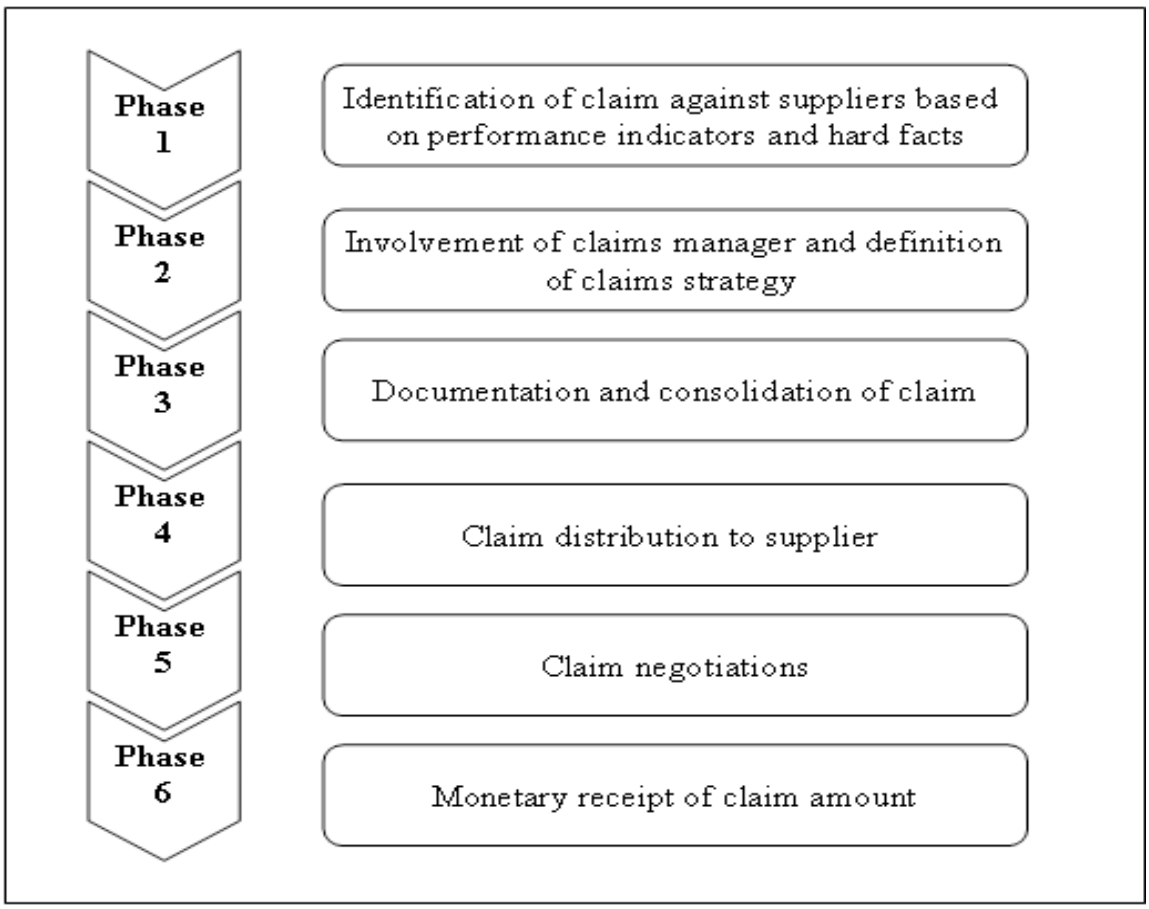
Figure 6-32: Professional claims management improves the EBIT



Source: Helmold, 2010.

Ultimately, this can lead to a deterioration of image and reputation towards the customer. Even though customer-supplier relationships are supposed to be on a partnership basis, enterprises must implement sophisticated and professional claims management. This will encourage suppliers to meet their commitments, thus avoiding costs and overruns. At the same time, if incidents occur and if these incidents happen within the upstream supply chain, the suppliers can be made liable. Proactive claims management directly improves EBIT. Best practice companies like BMW, Siemens or Bombardier claim between one and five percent of the material spent and use the amounts for supplier workshops and supplier integration activities. The heads of procurement of these companies pointed out that "the primary objective of each organization is to prevent supply disruptions, and indeed, penalties and claims lead to immediate improvement among suppliers and consequently to more robust supply chains". Suppliers have to understand that production standstills through defective or missing parts have a severe impact on a company's financial performance and image. The interviewee of PASE proposed the application of the six-phase model and the deployment of a professional claims or contract manager.

Figure 6-33: Phase model for an advanced claims management



Source: Helmold, 2010.

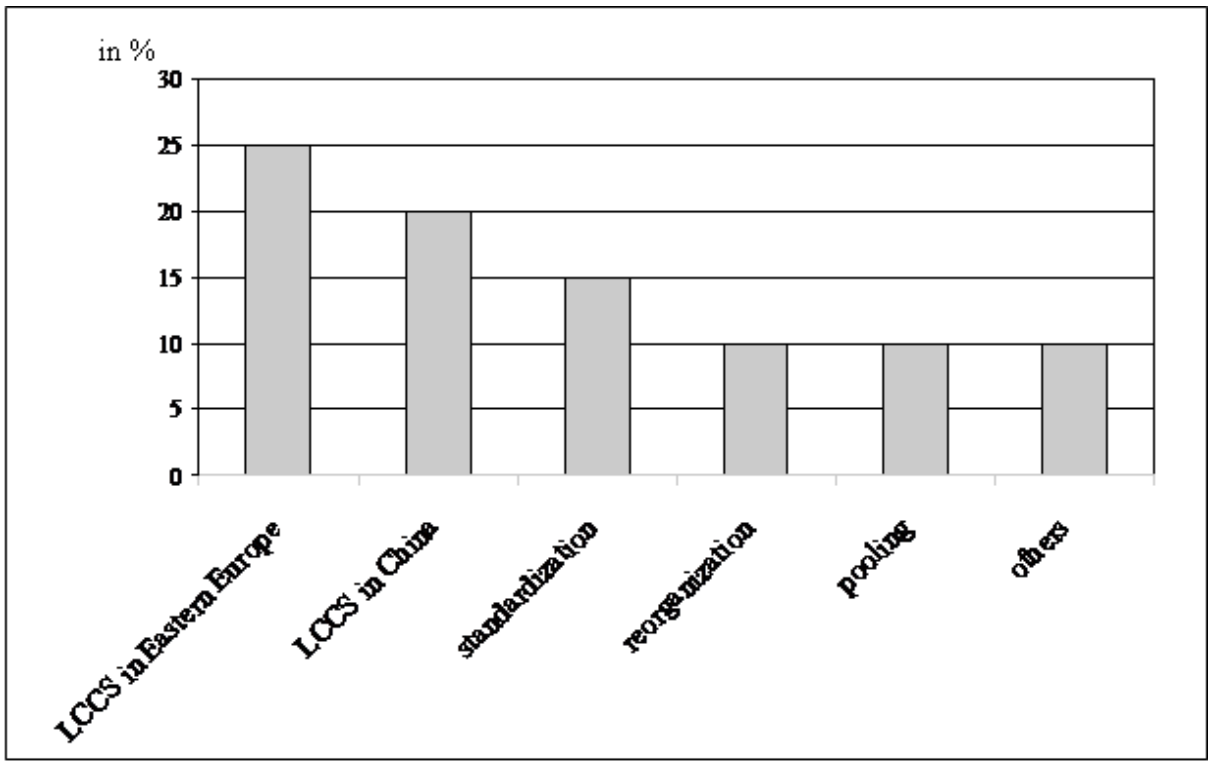
"The claims manager should have a university degree in law and business studies and support an organization's SRM and procurement in terms of legal governance, claims management, contract issues and legal training. Claims management starts with the selection of new suppliers and stops at the end of production". Claims managers are responsible for executing the six phases. They must pay attention to a number of small details, e.g. starting date of the incident, description, calculation, evidence. Evidence may consist of photographs, witnesses, correspondence or expert analyses. Advanced enterprises consolidate this electronically, although most companies still use paper. Besides the ability to understand technical issues, claims managers should also be experienced in financial, legal and contractual matters. A negotiation strategy has to be agreed upon for obtaining payment from the supplier in question. Due to the cash effect, claims immediately improve financial performance. The main task of claims management is to supervise all contractual matters in the upstream supply chain. Claims managers ensure that claims are made against suppliers (offensive claims) for any damage. Requests made by suppliers (defensive claims) have to be defended. An important task for claims managers is to analyse, prepare and consolidate any documentation pertaining to the claim. Naturally, no claims can be made against suppliers unless they are justified. Ideally, discrepancies within the upstream supply chain can be avoided at an early stage. However, if this does not work, suppliers must contribute to and pay compensation for the damage they have caused.

LCCS offices as a possibility to integrate global suppliers

Fierce competition in manufacturing companies in the European transportation industry has led to greater concentration on core competencies, as highlighted by all interviewees. The study of the Aberdeen group (2006) confirms this trend. As a consequence, companies are working more and more towards global supply chains and low-cost country sourcing (LCCS). LCCS still offers an opportunity for significant cost reduction, especially on labour-intensive components like harnesses or electrical parts. But in order to stay competitive, companies also outsource capital-intensive products (e.g. tools, machinery, appliances) to low-cost countries, and, in doing so, often have faster lead times. Global companies with worldwide production sites do not only foster LCCS for the purpose of local content, but also to achieve greater competitiveness for manufacturing sites in the Western hemisphere. In many cases, companies like Siemens, MAN, Bombardier and PASE stipulate a certain percentage of material spend for LCCS. The Alstom interviewee explained "that there is a certain percentage of material spend which needs to be allocated to global sourcing activities". This statement was also made by other interviewees, "having corporate objectives of the share in low cost countries" (MELCO interviewee). Figure 6-34 outlines the cost reduction potential derived from sourcing components in Eastern Europe or China (taken from an internal Bombardier

report). The data show that LCCS in Eastern Europe or China has a cost reduction improvement potential of between 20 and 25 per cent. Further motivation for outsourcing, especially LCCS, comes from the shorter product life cycles. The rapid growth of numerous economies (mainly developing countries) and increased customer demand in many markets have led to greater production volumes and varieties. Elasticity has become a key success factor. As a matter of fact, many emerging economies, such as China, Eastern Europe or India, have turned into important sales regions in recent years.

Figure 6-34: Potential cost reductions opportunities through LCCS

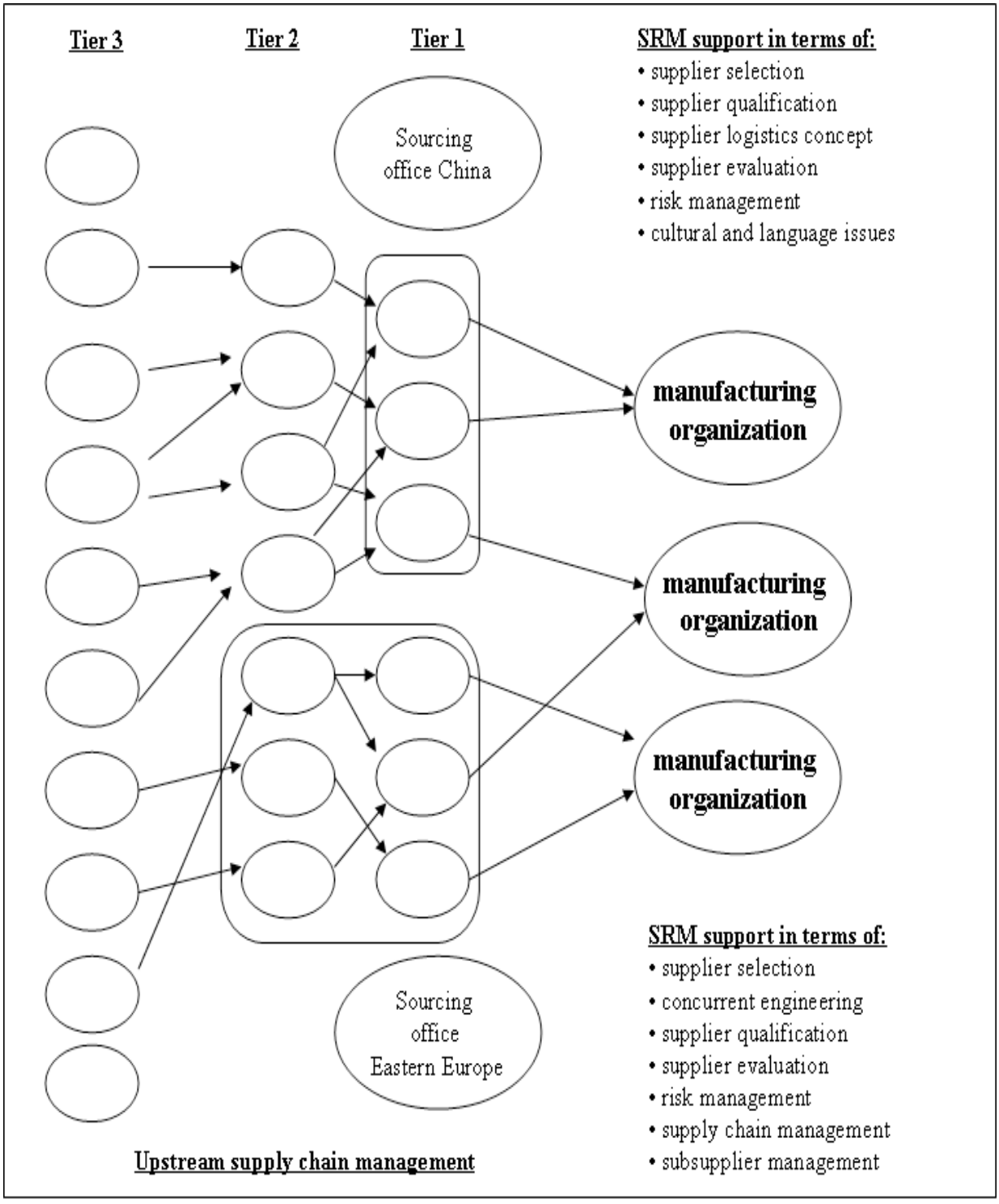


Source: Bombardier internal report on cost reduction potentials on LCCS.

Last but not least, interviewees from Siemens or Alstom mentioned "that a company which decides to take advantage of LCCS has an opportunity of securing availability of resources, reducing dependency on one (local) market and spreading risk through the creation of an international supply base". Particularly in the case of high currency fluctuations, LCCS can help compensate for losses incurred in other parts of the world. Companies like Siemens, PASE, Train Manufacturer and Bombardier utilise LCSS offices to support their manufacturing sites in terms of supplier selection and qualification. Moreover, the offices serve as an interface to the suppliers with regard to technical

understanding, cultural differences or language issues. As corporate social responsibility is also an integral part of SRM, such offices can secure compliance with laws, environmental standards or anti-discrimination rules.

Figure 6-35: LCCS offices in China and Eastern Europe



SRM activities in Bombardier including the of LCCS offices in Eastern Europe and China.

Supplier and SRM academy, lean task force

The interviews showed that coaching is a significant task in managing global suppliers. “ZF implemented a supplier academy which educates not only internal employees, but also suppliers in topics such as problem-solving, lean principles, total productive maintenance (TPM), and other SRM activities”. ZF combined the establishment of the supplier academy with a quality offensive for employees in the manufacturing sites of ZF that deal with suppliers. “A central and web-based database serves as a learning tool with best practices. ZF also created special implementation teams for securing the product launch phase and to eliminate waste at the supplier’s end”. BMW uses front office engineers, who represent a single point of contact for the suppliers. These engineers are trained in the areas of project, lean and quality management, and can also set up workshops with suppliers during the launch or production phase. “PASE now synchronises scheduling and production with their key keiretsu suppliers”, as described by the interviewee of PASE. Before that, the organization had faced launch issues in Europe involving immature suppliers, which resulted in the creation of a supplier qualification group (SQG). The SQG members accompany key module and system suppliers from selection to execution. MAN has a department which works together with the supplier in critical situations or in the event of disruptions. In certain cases, sourcing inspectors are installed at the supplier’s end. The concept of sourcing inspectors is also applied at Train Manufacturer. Whereas supplier audits are conducted for product approval, sourcing inspectors have a more reactive scope. MELCO synchronises scheduling and production systems with their key suppliers. The interviewee mentioned that “especially with Japanese suppliers a common synchronization would be easy, as they are familiar with the principles. European suppliers would be willing to participate, but would need specific coaching about the principles”. Thales and PCS do not have specific teams with the competency to coach suppliers. Launch and qualification activities are done by the procurement or supplier qualification department. Best practices of managerial practice which could not be found in the literature review are:

- strategic alliances with key suppliers
- proactive and early involvement of suppliers
- standardising processes, tools and SRM practices
- establishing a supplier academy for internal employees
- using a web-based learning data base for SRM best practices
- rolling out SRM standards to all manufacturing sites
- coaching suppliers through special workshops
- implementing lean principles through special SRM teams

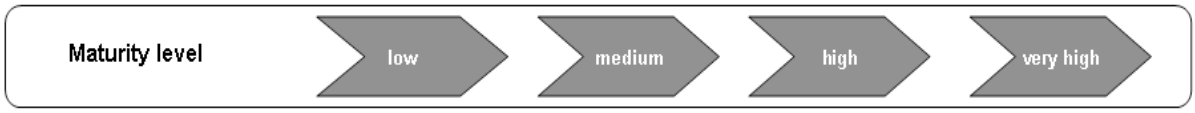
6.5 Conclusion of systematic literature review and semi-structured interviews

The systematic literature review and semi-structured interviews with senior managers in manufacturing companies in the European transportation industry in Phase II outlined the existing school of thought in academia and managerial practice, identified elements of best practice in SRM, revealed risk factors for supply chain disruptions and examined how to manage, anticipate and prevent them. A multiple and qualitative approach was applied in order to gather a large spectrum of data from SRM experts in academia and managerial practice (Yin, 2009). The research showed that the majority of companies strive for a collaborative approach throughout the upstream supply chain. In a few cases, keiretsu supply networks were identified for key modules and systems. The ten interviews conducted with senior managers in the respective industry helped to detect best practices of SRM in the relevant area. These were compared with examples from the literature review. Through this multiple approach, it was possible to develop a comprehensive listing of best practices and development phases from industry laggards to industry excellence (see Figure 6-36). Moreover, causal factors and categories of supply disruptions could be derived from the results of the systematic literature review and the semi-structured interviews. Finally, processes and tools for the anticipation, management and prevention of supply disruptions were defined in the research (Yin, 2009). The findings are of use for managerial practice and academia in the field of SRM. Although literature and studies are already available on the research topic, several authors and practitioners point out the need for a more holistic and wider approach, especially regarding how to avoid supply disruptions (Narasimhan & Talluri, 2009).

Supply chain resilience is a rather new and still largely unexplored area of management, as outlined by Christopher & Peck, 2004. Supply chain risks have mainly been investigated on the direct level of tier-one relationships, but consideration has not extended to the subsuppliers, i.e. tiers two and three (Harland et al., 2003). There is a discrepancy between the proactive role of SRM in complex and global supply networks and the traditional view of how to deal with suppliers (Aberdeen group, 2006). This research addressed these concerns by identifying best practice elements of SRM in manufacturing companies in the European transportation industry, by outlining risk factors of supply chain disruptions and by developing methods and tools as to how disruptions can be anticipated, prevented and managed. Due to the author's managerial and lecturing experience in the research area, access to a wide range of data and suitable interview candidates was given. The identification of best practices in SRM in manufacturing companies of the European transportation industry through the systematic literature review and semi-structured interviews has led to a large set of principles and rules for SRM (see Figure 6-36).

Figure 6-36: Best practices in SRM including maturity levels

Criteria & dimensions	Industry laggards	Industry standards	Industry best practices	Industry excellence
Coporate strategy	Focus on cost reductions and on-time delivery.	Key performance indicators (KPI) and supplier objectives on hard and soft factors available.	Integration into corporate objectives including hard and soft factors.	Integration into corporate objectives, corporate strategy, mission and vision.
Organization	No specific SRM focus. All departments individually responsible for suppliers.	SRM integrated into logistics, procurement and quality functions. Many interfaces.	Partially integrated in parallel to core procurement and logistics function . Few interfaces.	Integration of all SRM activities to single point of contact (SPOC) to suppliers.
Supplier selection	Short-term sourcing based on hard factors, i.e. cost and lead time.	Short-term and medium-term sourcing decisions include hard and soft factors.	Case-by-case early supplier involvement and long-term strategies.	Joint and long-term strategy (3-5 years) and early supplier involvement.
Supplier co-operation	Day to day business without any specific collaboration with suppliers.	Collaboration with suppliers on a case-by-case basis.	Collaborative supply chains. Partial implementation of lean principles at suppliers.	Collaborative supply chains and synchronization of lean production and quality systems.
Supply chain visibility	No visibility technology.	Usage of logistics service provider systems to monitor status of shipments.	Usage of customized systems to monitor shipments and inventories in supply chain.	Usage of systems to monitor order line status, inventories and mobile assestes in supply chain.
B2B collaboration	Collaboration across 1 process across 1 tier.	Collaboration across 2 processes across 2 tiers.	Collaboration across multiple processes across 2 to 3 tiers.	Collaboration and synchronization across multiple processes across 3+ tiers.
Cost transparency	One price including everything.	Partially open books policy on main category level. Joint cost optimization workshops.	Detailed open books policy on main category level. Joint cost optimization workshops.	Itemized open books policy on process level. Cost optimization in development phase.
Risk management	Concerned about supply chain resiliency but no action.	Assessing supply chain resiliency to risk-related events on tier 1 level.	Managing supply chain resiliency to risk-related events on tier 1-3 level.	Pro-actively managing supply chain resiliency to risk-related events on tier 3+.
Demand scheduling and production system	Scheduling according to demand.	Scheduling in line with forecasting system. High inventories in case of fluctuations.	Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI etc.	Pull system and application of lean principles. Synchronization with supply chain. Low inventories.
Supplier quality performance	Monitor and visit suppliers on a case-by-case basis. Reactive actions.	Monitor (monthly or less) and visit suppliers on a systematic basis. Reactive actions.	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions.	Monitor (real time basis) and visit suppliers and create trend model. Proactive actions.
Supplier academy	Training needs not systematically available.	Internal training needs available. Training for SRM related staff.	Needs and training internally available. Supplier development and coaching case-by-case.	Development and training needs intenally and externally available. Supplier academy.
Global sourcing, e.g. Asia or East. Europe	SRM not systematically pursued for global suppliers.	SRM pursued by procurement or supplier quality related departments..	SRM pursued by SRM managers. Case-by-case involvement of other functions.	SRM performed by regional offices (Eastern Europe, China) incl. quality and engineering.
Claim Management	Rarely claim suppliers, performance not systematically measured.	Claim suppliers case-by-case, quality and delivery performance measured.	Claim suppliers in a systematic way. Performance measured, contractual governance available.	Performance systematically measured. Claim management through claim manager.



Source: adapted from Aberdeen group, 2006. Best practice elements and maturity levels.

The multiple approach identified best practices in SRM strategically and operationally. Whereas the literature review revealed more generic and strategic aspects of SRM, the interview results highlighted specific and operational aspects in how to manage supplier relationships. Both research methods (systematic literature review and semi-structured interviews) revealed that SRM has to be

integrated into corporate strategy and corporate management. SRM activities must be coordinated and managed by a centralised organization within procurement. In cases of supplier interaction, it is necessary to have an integrated approach, including the entire supply chain from tier one, tier two and beyond. Best practices show that SRM activities should be managed by a single point of contact to the supplier. Companies with professional SRM standards set up regular steering committees to deal critical issues regarding quality, delivery, logistics or the financial situation on a cross-functional level. Such forums are managed by the procurement or SRM department and attended by other sections, e.g. production, logistics, development. Suppliers are part of a commodity strategy which gives an outline of projects, technology and sourcing for up to five years in companies with SRM excellence. These companies have a collaborative approach towards their suppliers, including tier-two and tier-three layers for key systems and components. Advanced suppliers conduct launch or lean workshops through specialised SRM experts. The focus of these workshops is flawless execution, elimination of waste and synchronisation of production systems. Web- based B2B information systems and supply chain visibility are available for tier-one, tier-two and tier-three suppliers. Thus capacity fluctuations can be managed mutually and chain agility is secured in these collaborative networks. Risk management is proactively pursued by the SRM function through solid and automatic measurement of agreed performance indicators in terms of quality, cost, delivery and financial stability. Such continual measurement generates trend analyses and helps to define future risk potential. Best practices in SRM show that manufacturing companies are synchronising their production and scheduling systems in order to avoid overproduction or a bullwhip effect in the upstream supply chain. The bullwhip effect on the upstream supply chain occurs when changes in customer demand cause the companies in a supply chain to order more goods to meet the new demand. It usually flows up the supply chain (e.g. customer, manufacturer, module or systems supplier, components supplier, supplier of raw materials). This effect can be observed in most supply chains across several industries. It occurs because the demand for goods is based on demand forecasts from companies rather than actual consumer demand. Best practice companies use a supplier academy or supplier coaching school, in which internal staff and suppliers are educated in standardised tools and processes in each SRM-related area. Many companies deploy former managers and senior staff in their SRM departments, as they have the competency, knowledge and network to drive complex and international workshops and projects with suppliers. They also act as trainers on the job to qualify new SRM employees. The interviews revealed that companies with a global supply base utilise LCCS offices in emerging markets (e.g. China, Eastern Europe, India, Turkey). These offices are both a cultural and geographical interface and support the manufacturing companies in Europe in engineering, quality and logistics. Some interviewees highlighted the need for professional claims management in the event of supplier-related disruptions. Supply disruptions

can be classified into macro-causal or micro-causal factors. Supply disruptions on a macrolevel can be caused by natural disasters, political turmoil, economic crises or socio-technological issues. The systematic literature review and the interviews showed that all companies recently faced supply disruptions. The level of risk and prevention management influences the extent of damage to the companies. All the companies interviewed propagated early involvement and monitoring of suppliers, proactive risk management, performance measurement based on hard criteria, contingency plans such as dual- sourcing, and implementation of SRM task forces at the supplier's end for mitigation purposes. In contrast to traditional viewpoints of supplier networks, best practice companies keep inventory levels throughout the supply network low and emphasise the importance of introducing flexible and lean principles among their suppliers.

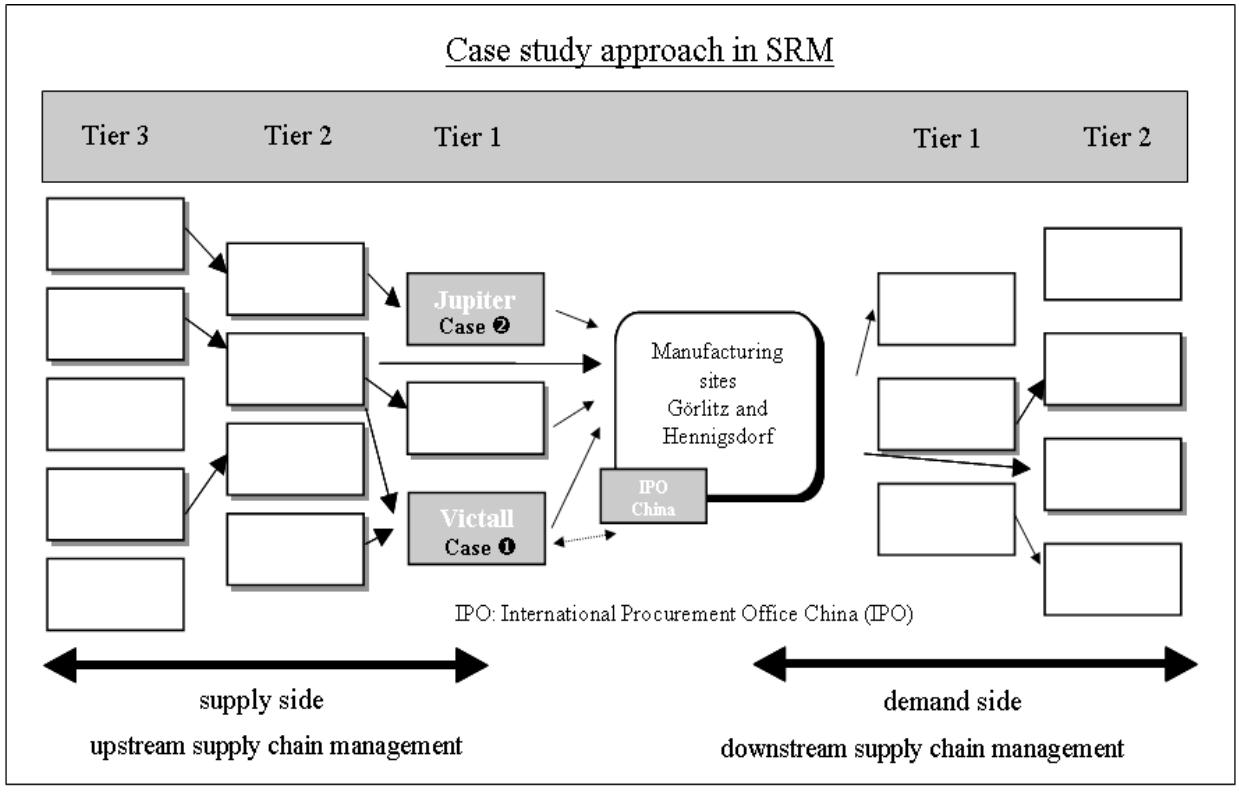
7. Phase III: Confirmation and disconfirmation of best practices

7.1 Purpose of case study approach: Victall and Jupiter case

The previous phase, including a systematic literature review and semi-structured interviews, helped to identify causal factors for supply disruptions, measures for anticipating, managing, preventing supply disruptions and best practice elements of SRM through a multiple and qualitative approach (Yin, 2009; Fink, 2010; Remenyi, 2003).

In the present Phase III two in-depth case studies have been used in order to confirm or disconfirm the before best practice elements in SRM as recommended by Yin (2009). The two case studies have been analysed within two separate and independent locations within Bombardier Europe with the suppliers Victall and Jupiter as shown in Figure 7-1. Both companies are suppliers to Bombardier and other OEMs in the transportation industry with subsuppliers and a supply network on tier two and three levels. In the case of Victall, the China international procurement office (IPO) is involved in global sourcing activities (Bombardier Transportation, 2011).

Figure 7-1: Case studies of Victall and Jupiter in SRM



Source: adapted from Slack et al., 1995. Phase III: Case study approach with two suppliers to Bombardier from China and Denmark.

Analytical generalization and pattern matching were used in the case studies as validation techniques (Yin, 2009; p. 38). The identified best practice elements, risks factors and mitigation aspects (Phase II) were used as a template with which to compare, confirm or disconfirm the empirical results of the case studies (Phase III). SRM activities were selected from two projects at manufacturing companies within Bombardier (Europe), involving SRM activities, supply chain disruptions, mitigation activities and anticipative actions for supply security.

The case study with Victall took place at their largest site and main location in Hennigsdorf in Brandenburg near Berlin (Germany) where approximately 2,500 people are employed. The site in Hennigsdorf is specialized in manufacturing high speed (ICE) and regional (Talent 2) trains for the European market. The case study focuses on a new supplier from China. Victall manufactures a range of interior and exterior parts for customers in the railway, automotive and truck industry. Victall was introduced by the China office IPO in China to several sites in Europe for supplying this spectrum of components. The IPO acts as connecting instrument between manufacturing sites world-wide and suppliers from China. Multinational companies like Siemens, Alstom, Bombardier or BMW have sourcing offices in many developing regions like Eastern Europe, India or China. Usually, the global sourcing offices are staffed with local teams, who establish relationships to local suppliers. These officies support the suppliers in multiple aspects, such as export business, quality, administration, local regulations, cultural or language issues.

The respective SRM activities were compared with the list of best practices in Phase II in order to confirm or disconfirm the relevant findings. Five semi-structured interviews were carried out with the relevant parties (i.e. procurement, quality, logistics, and the supplier). English was used for the questions and the interviews. As English is the corporate language within Bombardier, language issues did not arise. A matrix of categories equal to those identified and defined in Phase II was used for comparing, validating or disconfirming best practices. Extending the interviews to operational members of the projects (Remenyi et al., 2003; p. 126) also helped to confirm or disconfirm best practice elements. The author's position of procurement manager at Bombardier provided accessibility to data as well as to interviewees. The second case study served as replication and took place at the Görlitz site in Saxony (Germany), which is the second largest location in Germany with approximately 1,500 employees. This case study focuses on SRM activities with regard to the supplier Jupiter. Jupiter produces and delivers interiors, modules and other systems to Bombardier's manufacturing site in Görlitz. As in the first case study, best practice elements, risk factors and mitigation aspects identified in Phase II were used as a template for comparing, confirming or disconfirming empirical results. The Görlitz site specializes in the pre-assembly of car bodies and the

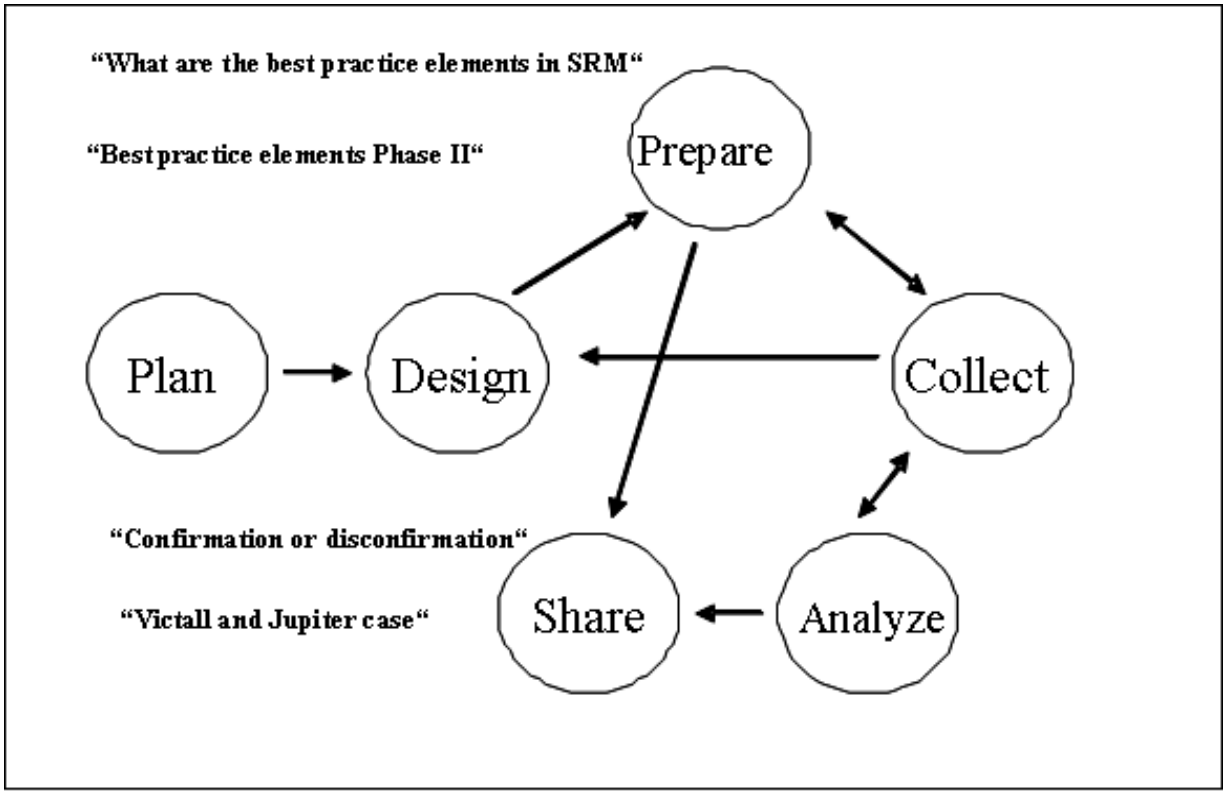
production of double-deck trains for markets in Germany and Switzerland (Doppelstock 2010). Figure 7-2 shows the case study sequence as recommended by Yin (2009), with the planning, design, preparation, collection, analysis and sharing phase. Even though some academics are against case studies in general (Remenyi et al., 2003), they are nevertheless valuable for research (Yin, 2009). Yin defines them as being an "empirical enquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used" (Yin, 2009; 1993). As previously outlined the case studies can be applied as a narrative or an evidence-collecting device. For the purpose of this paper, the latter form has been used. Case studies have been viewed by critics as a less desirable form of empirical research methodology (Yin, 2009; Remenyi et al., 2003). Accusations include bias and a tendency to use incomplete evidence.

Of course, case studies are not perfectly objective due to the opinions of both the transmitter and the recipient of the information. However, they represent an ideal approach for collecting evidence on social systems and question the "how" and "why" of phenomena in social behaviour more deeply. All in all, the methodology of case studies is considered to be a suitable tool for confirming and disconfirming best practices, especially as the depth of enquiry is significantly greater than with quantitative research methods. The summarized results have been attached in the appendices of the paper (Appendix 15 and Appendix 16). Figure 7-2 shows how the case study approach is used for confirming or disconfirming the best practices identified through the systematic literature review and the interviews in Phase II. It should be mentioned that interviews conducted as part of a case study are also subject to the guidelines of "The University of Gloucestershire's Handbook of Research Ethics (2008)". Adherence to the ethical rules ensures that the thesis reports all information and outcomes honestly and avoids bias in the interpretation of data analysis. Prior to every interview, the purpose of the research and the respective questions was explained to the potential candidates personally or via phone. Interview questions (see Appendix 4) were sent to the interviewees approximately three weeks in advance. No interviewee refused participation beforehand or withdrew afterwards, so it was not necessary to find alternative candidates. Confidentiality was guaranteed for all interviewees and participants in the research. The superiors of the operational members were informed prior to the interviews about the respective stage of progress. Participants were asked if their anticipated findings should be treated confidentially.

As the research itself and the findings add value to managerial practice within Bombardier and research, senior management supported the interviews in Phase III in order to improve the own performance by confirming or disconfirming best practices in SRM. The figure below displays the

major steps in case studies, plan, design, prepare, collect, analyze and share.

Figure 7-2: Case study approach for confirmation and disconfirmation of best practices

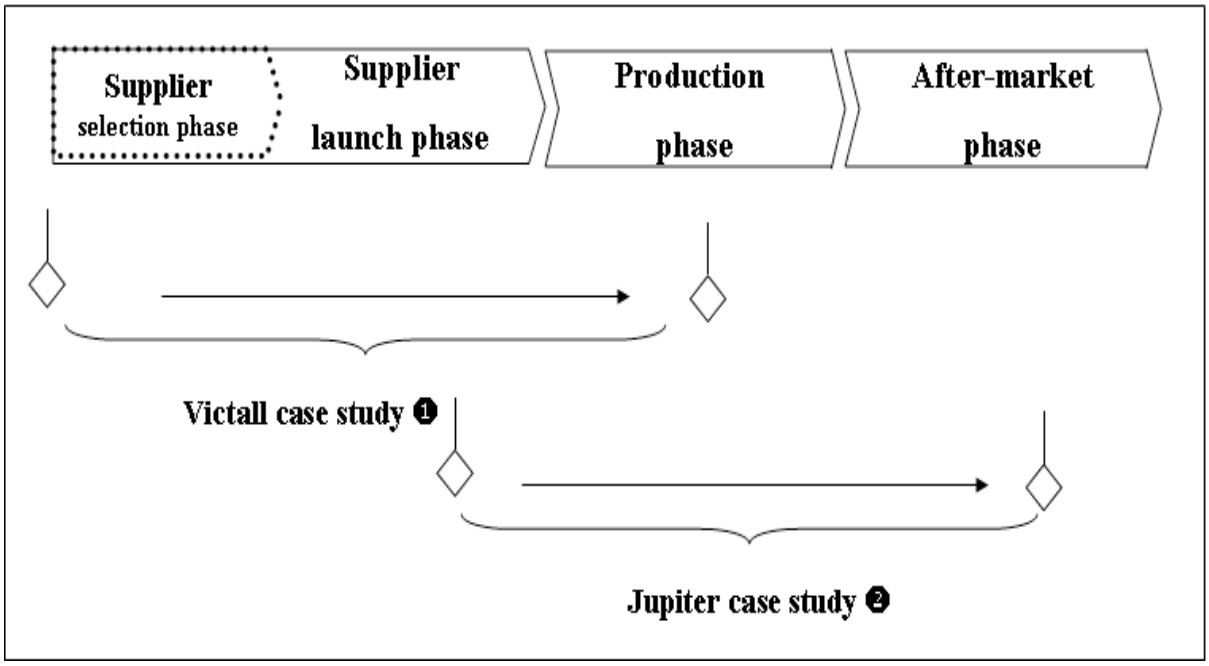


Source: adapted from Remenyi et al. ,2003.

Interviewees were informed that protocols and other data would be stored safely on the researcher's personal computer and would be destroyed after approval of the thesis by the University of Gloucestershire. Analyzing two cases with separate but similar environments served as replication, as recommended by Remenyi et al. (2003). The first case study focused on Victall (Chinese supplier) during the supplier selection, launch and production phase. The second case dealt with Jupiter (Scandinavian supplier), in the launch, production and after-market phase, as outlined in Figure 7-3. The two cases were chosen in order to cover the entire value stream. As the figure on the next page shows, the two cases overlap in this respect. Jupiter is now in the production phase after having been selected and launched successfully a few years ago. Victall was selected as a second source, since the parts of the incumbent supplier had a relatively high cost, quality issues and shortages in terms of OTD. Supply disruptions were common. As a result, Victall was selected and sourced with the support of IPO. Jupiter faced capacity and quality issues for an important customer in Scandinavia, which also resulted in supply disruptions. Whereas the Victall case has a focus on proactive SRM

activities, the Jupiter case deals more with reactive measures, as outlined by Gürtler & Spinler (2010).

Figure 7-3: Scope of Victall and Jupiter case studies



Source: own source, scope of case studies for research.

In the context of case studies, Yin (2009) gives examples where in-depth interviews supported by question lists were used to ascertain attitudes. Interviews were conducted at the relevant sites in 2012 and 2013 (see question list in Appendix 7 and the dates in the previous tables of participants). The results were often unsatisfactory, since one cannot do justice to the complexity of a standpoint simply by applying numerical and quantitative methodology. On the contrary, case studies with in-depth interviews are seen as an ideal evidence-collecting tool (Yin, 2003; 2009). Yin points out that case studies investigate behind the scenes and are intended to obtain more insight on what the SRM best practice elements look like (Yin, 2009). Even though Yin recommends case studies as an appropriate strategy, he underlines the fact that using case studies remains one of the most challenging of all social science endeavours (Yin, 2009).

For the analysis it was decided to use pattern-matching methodology, as recommended by several authors (Trochim, 1989; Yin, 2003; 2009; Remeny et al., 2009). Trochim describes this methodology as comparing the empirically based patterns of the case studies with the predicted patterns that were identified through the systematic literature review and semi-structured interviews in Phase II

(Trochim, 1989). The two cases were analyzed and compared with the best practice elements identified in Phase II (Yin, 2003). As previously outlined, there were limitations incorporated into the research and case studies in terms of the value chain, the value-adding activities and the industry itself. The two case studies in this paper included the evaluation of subsuppliers up to the tier-two and tier-three level at the manufacturing sites in Görlitz and Hennigsdorf. The value chain included supplier selection, supplier launch, serial production and after-market aspects, as outlined below. Other aspects such as tier four or the downstream supply chain were not taken into account, since they are not relevant for confirming or disconfirming the identified best practices in SRM in manufacturing sites of the European transportation industry. The purpose of the case studies was to validate or invalidate the 13 best practice categories. Confirmation or disconfirmation of best practices was limited to those categories which were identified in Phase II through the systematic literature review and semi-structured interviews. The respective interview protocols were transcribed, categorized and analyzed by the pattern-matching technique (Yin, 2009). As with the Phase II interviews, ethical considerations and principles were applied.

7.2 The Victall case: a Chinese supplier to Bombardier Hennigsdorf

The Qingdao Victall Railway group (Victall) is based in Qingdao, China. Victall is a group company which operates several production sites in the region of Xingdao (China). They supply interior and exterior parts of high quality to the European transportation industry. The corporate headquarters and major manufacturing site is only a few kilometres from Liuting Airport, about 12 kilometres from the nearest harbour, and 32 kilometres from the biggest railway station in the province.

Victall has its core competencies in the development, manufacture and delivery of systems and modules for car, train and truck producers and recently expanded its domestic market presence with its main customers (CNR, CSR, Siemens China, Alstom China and Bombardier China) to markets in Europe. The major customers in the European transportation sector include the market leaders like Siemens, Alstom, Bombardier or BMW. The company group has approximately 3,000 employees, 200 of these employees are technicians or engineers. Vertical integration has been extensive, and the production of major components and systems is now in the hands of four subsidiaries: Qingdao Victall Railway Decoration Materials Manufacturing, Qingdao Siji Die and Moulds, Qingdao Victall Painting, and Qingdao Victall New Materials Manufacturing. In addition, a venture company with a domestic partner and two sino-foreign joint venture companies for brake systems and doors ensure the expansion to major technologies in these areas. The main part of the business comprises transportation equipment and auxiliary components, consisting of moulded and cast interiors or

exterior modules. At the end of 2012, the turnover of the group exceeded RMB 2 billion. Victall possesses the international quality management system recognition of ISO 9000 (quality management system) and the International Railway Industry Standard (IRIS) or EN 15085 (welding system certification). ISO 9000 and IRIS are usually requirements by the OEM and customer to supply parts in this industry. The company has recently developed capabilities of designing and manufacturing modules for a global customer base in China, Europe and North America. With an office in Hamburg (Germany) and a warehouse near Duesseldorf (Germany), Victall targets the European markets in railway, truck and automotive segments.

Victall is a relatively new supplier to Bombardier and therefore serves as a good example for the confirmation or disconfirmation of best practices in SRM in manufacturing companies in the European transportation industry during the selection and launch phases. For the Victall case study, the interviewees were chosen by IPO, procurement, SPM, SQA and the suppliers themselves.

Table 7-4: Interview participants in Victall case study

No.	Department	Position	Date of interview
1.	IPO	Director	2012/12/17
2.	PROCURMENT	Manager	2012/12/17
3.	SPM	Head of SPM	2012/12/19
4.	SQA	Head of SQA	2012/12/19
5.	Victall	Managing Director and Owner	2012/12/20

Interview participants in the case study one with the managers of the following functions: IPO in China, procurement in Hennigsdorf, SPM in Hennigsdorf, SQA and Victall.

The operational project members were also questioned with the aim of increasing the validity of the results, as recommended by Yin (2009). The protocol was transcribed and the data analysed according to the pattern-matching technique (Yin, 2009). The following categories and patterns in SRM were analyzed and compared with the findings:

corporate strategy, organization, supplier selection, supplier co-operation, supply chain visibility, B2B collaboration, cost transparency, risk management, demand scheduling and production systems, supplier quality performance, Supplier academy, global sourcing set-up, and claims management.

The semi-structured interviews in the case studies helped to analyze to which extent the best practice criteria had been fulfilled.

Table 7-5: Iinterview participants including operational members in Victall case study

No.	Department	Position	Date of interview
1.	Projet Management	Manager	2013/01/08
2.	PROCURMENT	Commodity Buyer	2013/01/08
3.	SPM	SPM Engineer	2013/01/08
4.	SQA	SQA Engineer	2013/01/11
5.	Victall	Key Account Manager	2013/01/11

Operational project and team members of the Victall case study.

Figure 7-6 summarizes the results of the Victall case study interviews and how far these findings match the identified best practices from the literature and the feedback of senior managers in Phase II. A circle (●) shows where patterns match, a triangle where they partially match (▲), and a cross (✖) where there is no verification of best practice.

The interview with the IPO director and procurement manager revealed that SRM and purchasing objectives are part of the corporate strategy and management of Bombardier. He explained the organisation and linkage to the procurement organisation. China sourcing is part of the seven major strategies of Bombardier with the slogan “road to Asia”. The road to Asia includes transfer of knowledge, human resources, technology and people.

There are objectives regarding the extent of global sourcing. Bombardier has established the position of Chief Procurement Officer (CPO) as a member of the executive board of the worldwide transportation division. As the overall value-adding activities have been drastically reduced and now amount to less than 30 per cent with average projects, the incorporation of procurement and SRM aspects has become an integral part of Bombardier’s future set-up. Bombardier’s procurement strategy shows that there is a focus on optimizing the upstream supply chain and collaborating with suppliers (Bombardier Transportation, 2010). The heads of SPM and SQA confirmed the statements and referred to the procurement handbook. The handbook clearly states a link to SRM and

emphasizes the collaboration and co-operation with suppliers. Indeed, the Victall case study revealed that supplier relationships are best managed through the procurement function.

Figure 7-6: Confirmation and disconfirmation of best practices through Victall case study

Victall case study SRM best practies and patterns	Description of best practices and patterns	Level of matching
Corporate strategy	Integration of SRM into corporate strategy and corporate management. Corporate objectives including hard and soft factors exist and are continually measured.	●
Organization	SRM is integrated into core procurement and logistics function. There are only few interfaces to the suppliers.	●
Supplier selection	Supplier selection is executed systematically through commodity strategies on the basis of audits and qualification. Case-by-case early supplier involvement and long-term strategies.	●
Supplier co-operation	Collaboration throughout the supply chains. Partial implementation of lean principles at suppliers for key commodities.	▲
Supply chain visibility	Usage of web-based and customized systems to monitor shipments and inventories in supply chain.	●
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	X→▲
Cost transparency	Detailed open-books policy on main category level. Joint cost optimization workshops.	●
Risk management	Managing supply chain resilience to risk-related events on tier 1-3 level.	▲
Demand scheduling and production system	Application of lean principles. Pull system in place, but autonomous and separate production systems. Inventories covered through VMI or smart logistics concepts.	▲→●
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions and follow up activities.	●
Supplier academy	Needs and training internally available. Supplier development and coaching on a case-by-case basis.	▲→●
Global sourcing	SRM pursued by SRM managers. Case-by-case involvement of other functions. LCCS offices support home base organization.	●
Claims management	Suppliers are claimed in a systematic way. Performance is measured based on specific and neutral criteria, e.g. incoming quality or on-time delivery; contractual governance is available.	●

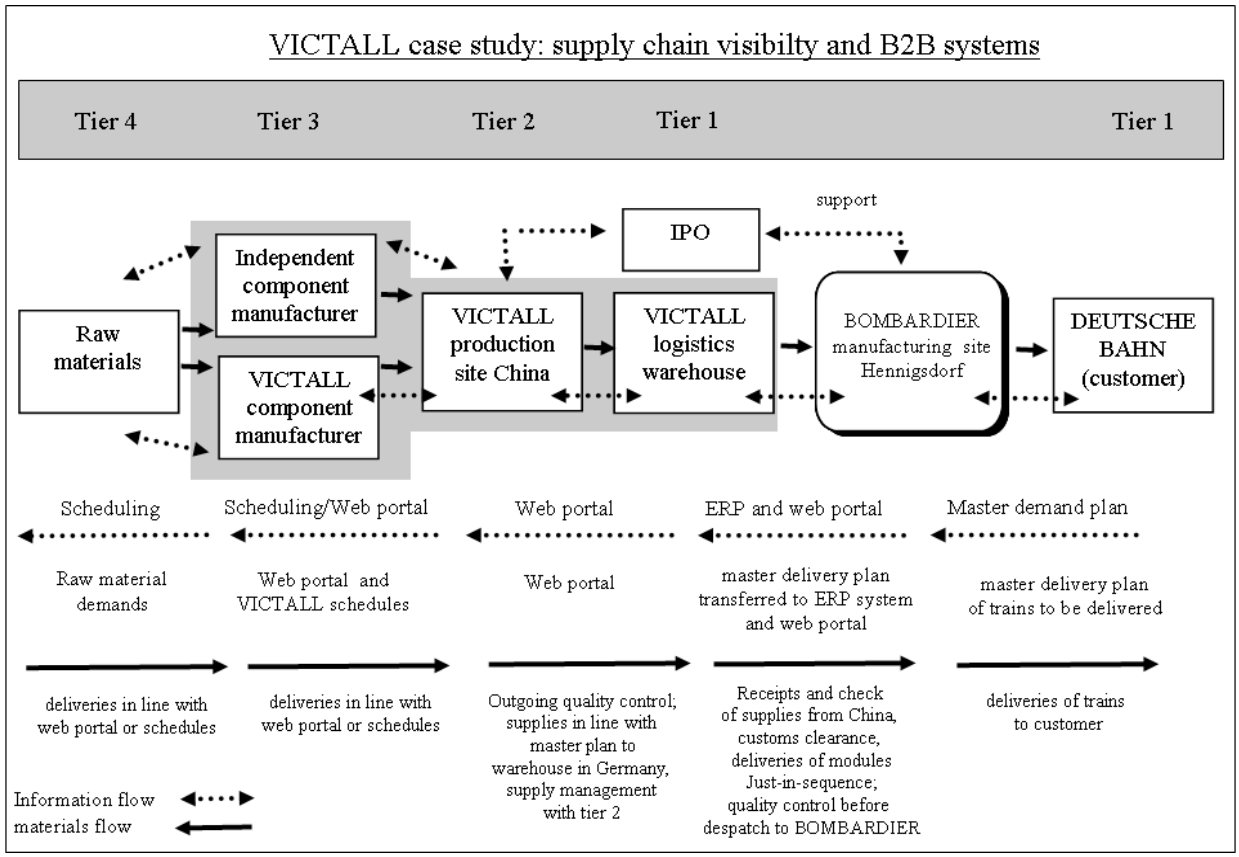
Source: Results of Victall case study interviews and pattern matching.

Even though competition is fierce in the market for interior parts, Bombardier is regarded as a fair customer who keeps promises and pursues a collaborative approach in terms of establishing a supplier connection with the help of IPO. Both Bombardier and Victall have established a common strategy on projects, modules and systems on a five-year basis. Moreover, it was agreed to establish a logistics concept (including a warehouse) for additional value-adding services near Hennigsdorf. The logistics concept is intended to offer overall support and create supply chain resilience. Regarding the organization of SRM, the candidates at Bombardier pointed out that procurement activities were handled globally by a group function on a site basis for day-to-day business. The candidates at

Victall explained that SRM activities were handled by the procurement function at the Hennigsdorf site, whereby IPO acted as an interface. Support for launching products and supplying to the site in Hennigsdorf is given in such form, that Bombardier utilizes own resources and staff to set up the quality and logistics chain. Specialists (buyers, quality engineers or IPO managers) from procurement, quality or the IPO are involved in setting up this system. Even though Bombardier has visited the manufacturing site and certain subsuppliers in China a couple of times between the years 2010 and 2013, there is still no synchronization of production systems at this point in time. Especially the keiretsu supply network concept requires a synchronization of production systems of customers and the supply network (Liker & Choi, 2005). The next category of best practice in SRM is supplier selection. In this respect, the case study interviews revealed that Victall was targeted not only for cost advantages, but also technology, quality and delivery issues. After Victall had been successfully evaluated, a pilot project was sourced to the company. For this purpose, an expert recommended by Bombardier was hired and asked for conceptual support. After the establishment of all relevant processes and the flawless launch of the project, Victall was gradually given more contracts. Figure 7-7 shows the logistics concept and the methods which were applied for anticipating disturbances and reacting rapidly to such incidents. Regarding raw materials and major subcomponents, supply chain visibility is guaranteed through a web portal provided for the suppliers. The portal shows demand on a daily basis. It is directly linked with the ERP system of the manufacturing plant of Bombardier and offers transparency of current demand and future projects. There is an agreed freezing period with all suppliers, in which demands are “frozen”. Demand and schedules can only be amended during this period with the consent of both parties. The major components supplies for the systems and modules delivered to Bombardier in Hennigsdorf by Victall come from internal companies of Victall. These internal companies have access to the overall demand of the end-customer Bombardier via the web portal, so that the entire supply chain is visible to Victall. Within the supply chain, Victall has installed specific quality gates, such as quality checks of raw material supplies, quality checks after component manufacture, and final checks before the goods are shipped to Europe. After receiving goods from China, the Victall warehouse randomly checks critical and significant characteristics which are crucial for the manufacturing process of Bombardier in Hennigsdorf. Supply chain visibility is closely linked to B2B systems. The Victall case study shows that the customer schedules of the Deutsche Bahn (DB) regarding finished trains are entered in the ERP system of Bombardier, who in turn transfers these to a web portal. The web portal is actually operated by Bombardier and accessible via the warehouse (tier one), the Victall site in China (tier two), and its subsidiaries (tier three). As the B2B element is not yet fully implemented, a triangle was assigned to this category (partial confirmation). Alongside the web portal, there is a logistics agreement in place which covers aspects like demand, use of web portal, freezing periods

and collaboration between the two parties. Based on existing demand and contracts, Victall gives Bombardier confirmation of the deliveries and schedules three months in advance. If confirmation is missing, the Bombardier logistician is alerted and investigates why this is the case. Victall also plans to give data access to its internal subsidiaries and components suppliers to provide better supply chain visibility. Since it is the tier-one contact to the manufacturing site at Hennigsdorf, the warehouse plays a crucial role in avoiding supply disruptions by acting as quality gate, alert system and risk prevention method. The web portal is used for all phases from supplier launch to production and after-market. It can show statistics concerning performance indicators such as non-conformity of goods (NCG) or on-time delivery (OTD).

Figure 7-7: Supply chain visibility and B2B systems in Victall case



Source: own source in line with interviewees in case study interview, drafted in December 2012.

Cost transparency is a methodology that was recently introduced by Bombardier in Hennigsdorf. The minimum cost elements which are made transparent include raw materials, materials, labour hours, production hours, logistics, packaging, transport and overheads. An open-book policy is something which has to be agreed upon by both parties contractually. As both partners are aiming at achieving optimal cost levels in all areas, benchmarking activities and material enhancement plans (MEP) may

be implemented. Liker and Choi (2005) state that special activities for reducing cost throughout upstream supply chain management should focus on the elimination of waste and the concentration of lean processes. Thus it would be possible to prevent or manage supply disruptions more efficiently, which would automatically result in positive results with regard to one's own financial performance (Hendricks and Singhal, 2005). For this purpose, a risk management strategy has been developed by project management teams at both Bombardier and Victall. Setting up a warehouse near the manufacturing site (including a logistical supermarket concept and the ability to conduct retrofit and warranty activities) is one of the crucial pillars of the risk contingency plan. The warehouse holds a buffer (supermarket) of parts and represents value-adding activities for Victall and other suppliers. Moreover, it is possible to carry out quality inspection or reworking. The warehouse is located near the site in Hennigsdorf and with its Chinese-, English- and German-speaking staff acts as an interface. Bombardier also has a dual sourcing strategy, including LCCS and European suppliers, so potential capacity shortages, fluctuations or outages can immediately be mitigated. Even though a risk management plan is already in place, the emphasis still lies on preventing supply disruptions. As far as the categories of "scheduling and production system synchronization" are concerned, the case study showed that both systems have not yet been integrated. Nevertheless, Victall is striving to become a strategic supplier to Bombardier and their top management is very keen on understanding the Bombardier Operations System (BOS), which is based on the Toyota Production System (TPS) and the fact that Bombardier's operations are now globally based. Even though Bombardier supports a collaborative approach, it has not yet adopted the school of keiretsu supply networks. However, a joint workshop for the implementation of BOS principles within Victall has been scheduled for the end of 2013. It was possible to verify "supplier quality performance" as a best practice element during the case study interviews. Several statistics and plans (e.g. internal Victall defect ratios, quality improvement measures, quality workshops) have been disclosed by Victall as deliverables in this context. Besides quality indicators, many hard factors (e.g. percentage of defects) and soft factors (e.g. co-operation, response time for issues, quality improvements) also depend on the relationship between the two parties. The most important hard and soft factors relating to quality performance are:

- number of internal defects at Victall
- number of defects delivered to Bombardier (NCG)
- number of defects and issues raised by the end-customer
- number of quality workshops carried out jointly
- response time to quality questions
- number of quality people involved

The category “supplier academy” contained the information that Bombardier recently established a supplier performance group and knowledge database. However, principles, processes and knowledge are not yet being transferred systematically to the suppliers. Therefore, the pattern-matching result is indicated by a triangle (▲) and it will only become a circle (●) when the supplier academy (including knowledge transfer to the suppliers) has been fully implemented. This special category was considered to be a significant aspect during the identification of best practices in the interviews of senior managers in Phase II. The last categories to be checked in connection with the pattern-matching technique were “global sourcing” and “claims management”. Both these categories were validated as best practices in the case study interviews, as recommended by Yin (2009). A long-term strategy over several years was drafted jointly by the manufacturing site procurement organization, IPO and Victall. This strategy does not only comprise project and material spending, but also the value of collaboration and importance of knowledge transfer in both directions. Due to his experience as a lecturer at the FOM University, the author was able to bring potential candidates from the Chinese MBA course to Victall (Germany) as graduates and newcomers. In other areas, specialists and consultants helped to build up the logistics concept, web portal and warehouse. Claims management and chargeback fees in the event of non-conformities (NCG) were agreed upon contractually with the involvement of a claims manager at the Bombardier manufacturing site. Even though claims must never be a reason for supply discrepancies and disturbances, the introduction of a professional contract and claims management was a significant recommendation during the Phase II interviews. Up to now, no chargeback fees or claims have been drawn on Victall. The results for the interviews of the Victall case confirm the majority of best practice elements and categories. In a few areas “supplier co-operation”, “B2B systems” or “Supplier academy” the patterns matching technique has revealed partial confirmation or disconfirmation only for various reasons. If partial confirmation has been due to the fact that the best practice category is work in progress and in the process of being implemented, the category has been considered a best practice with some adjustment and consideration. Where categories or elements of categories were disconfirmed, these aspects were not considered for this thesis, and will have to be subjected to further scrutiny. In some areas, supplier co-operation is continually improving, combined with knowledge exchange. Phase II identified that this best practice is closely related to synchronized supply chains and the implementation of lean principles. The Victall case highlighted that the supply chain layout is currently work-in-progress with the aim of securing a resilient supply chain for the interior modules which are to be delivered. Synchronization has not yet been finalized, and the supply concept is still being implemented, including staff recruitment within Victall. Nevertheless, there is a clear vision and plan on the part of both parties to establish supplier collaboration (including tier-two and tier-three suppliers), integration of scheduling systems, application of lean principles and synchronization

of production systems to the extent that waste is eliminated. As the identified B2B best practice element suggests monitoring the upstream supply chain beyond tiers one, two and three, this category requires more detailed analysis. The Victall case shows that the web portal, which was recently rolled out by Bombardier in Hennigsdorf, emphasizes the direct supply layer (tier one), but can also be extended to tier-two and tier-three suppliers. The last category which requires some adjustment is the category "Supplier academy". A Supplier academy in terms of SRM is characterized by an enterprise that facilitates the learning opportunities of its employees and suppliers and continuously transforms and improves itself together with its partners throughout the supply chain (Emmett & Crocker, 2009). Such Supplier academys are necessary due to the pressures facing modern companies and they enable them to remain competitive in the business environment. The Victall case study showed that common objectives have to be mutually agreed upon. This may entail spreading and transferring knowledge by workshops in BOS techniques, joint recruitment, exchange of expertise in warehousing and the joint set-up of logistics providers and warehouses throughout the supply chain. Especially in the area of collaborating with the FOM University, both parties see a great potential for building up a mutually beneficial human resource base. Exchange of staff, including IPO, has been considered as one possibility, which could then be developed further in different directions.

7.3 The Jupiter case: a Scandinavian supplier to Bombardier Görlitz

The second case study selected for confirming and disconfirming best practices deals with Jupiter (Denmark), a Scandinavian supplier to the Bombardier manufacturing site in Görlitz (Germany). Jupiter is a global market leader in the production of high-end composite components for the transportation industry and wind turbine industry. Figure 7-8 shows the participants who responded to the questions referring to SRM best practices in the case study.

Table 7-8: Interviewees in Jupiter case study

No.	Department	Position	Date of interview
1.	Production Control	Manager	2013/01/14
2.	PROCURMENT	Manager	2013/01/14
3.	SPM	Head of SPM	2013/01/15
4.	SQA	Head of SQA	2013/01/16
5.	Jupiter	Managing Director	2013/01/16

With regional facilities in Denmark, Germany, the USA and China, Jupiter has created a global presence, duplicating a successful manufacturing and assembling set-up at various locations around the world. The Jupiter group is specialized in producing interior systems and modules for the European transportation industry. They are headquartered in Denmark and dispose of an international and complex supply base for mechanical and electrical systems. Jupiter also supplies parts to Bombardier in Hennigsdorf (Germany) and to other OEMS in the railway industry, e.g. Siemens, Alstom. The turnover of the Jupiter group exceeds a high two-digit million EUR figure. Jupiter supplies a huge range of interior sidewall systems and interior modules, in particular for Scandinavian end-customers of Bombardier. Currently, Jupiter supplies parts to Regina (Sweden) for the Västraffic system. The focus within the value stream is on the serial production and after-market phases, as previously described. However, due to falling demand in Scandinavia, the sales turnover with Bombardier has decreased significantly. Interviewees included management members from major functions (e.g. production control, procurement, supplier performance, SPM, SQA) and from Jupiter itself. Additionally, in order to increase the validity of the results, project members of the executional project team were also questioned, like in the first case study, as recommended by Yin (2009).

Table 7-9: Operational members in Jupiter case study

No.	Department	Position	Date of interview
1.	Production Control	Expeditor	2013/01/17
2.	PROCURMENT	Commodity Buyer	2013/01/17
3.	SPM	SPM Engineer	2013/01/17
4.	SQA	SQA Engineer	2013//01/17
5.	Jupiter	Sales Executive	2013//01/17

Concerns about the validity of the results were taken into account, as highlighted by Yin (2009). In this context, Yin recommends the pattern-matching technique in order to have an analytical method for analyzing the data (Yin, 2003; p. 43). Figure 7-10 summarizes the results of the Jupiter case study interviews (patterns) and how far these findings match the best practices identified in Phase II. The same symbols as in the previous case have been used. A circle (●) shows where the patterns match, a triangle where they partially match (▲), and a cross (✖) where there is no verification of best practice. The interviews with the operational members are summarized in Table 7-9. Each interview lasted between 60 and 90 minutes and took place at the site in Görlitz. Ethical aspects were

considered, as described above. By questioning staff at working level, the validity of the results was increased, as recommended by Yin (2003). As in the first case study, the interview protocols were transcribed and the data analyzed (Yin, 2009). The same categories as in the Victall case were examined and compared with the following best practices from Phase II: corporate strategy, organization, supplier selection, supplier co-operation, supply chain visibility, B2B collaboration, cost transparency, risk management, demand scheduling and production systems, supplier quality performance, Supplier academy, global sourcing set-up and claims management. Once again, the aim was to scrutinize the extent to which the best practice criteria had been fulfilled, and if this was not the case, to find out which stage they were at: industry laggards, industry standard or industry best practice (Yin, 2009).

Figure 7-10: Confirmation and disconfirmation of best practices through Jupiter case study

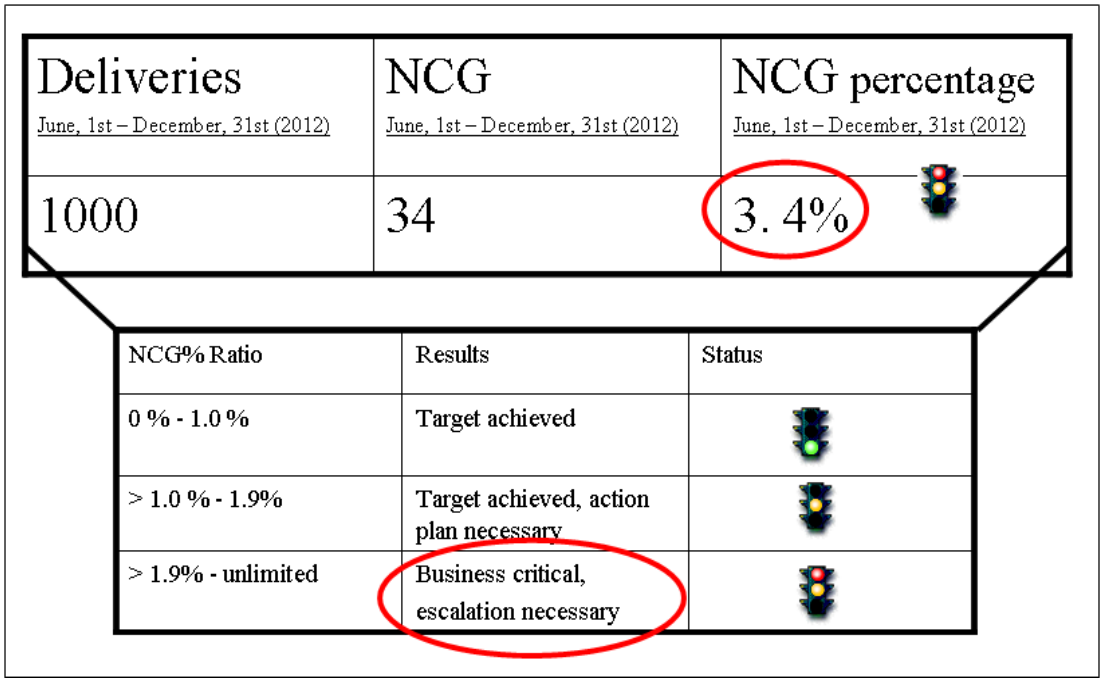
Jupiter case study **SRM** **best practies and patterns**	**Description of** **best practices and patterns**	**Level** **of matching**
Corporate strategy	Integration of SRM into corporate startegy and corporate management. Corporate objectives including hard and soft factors exist and are continually measured.	●
Organization	SRM is integrated into core procurement and logistics function. There are only few interfaces to the suppliers.	●
Supplier selection	Supplier selection is executed systematically through commodity strategies on the basis of audits and qualification. Case-by-case early supplier involvement and long-term strategies.	●
Supplier co-operation	Collaboration throughout the supply chains. Partial implementation of lean principles at suppliers for key commodities.	●
Supply chain visibility	Usage of web-based and customized systems to monitor shipments and inventories in supply chain.	▲→●
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	▲
Cost transparency	Detailed open-books policy on main category level. Joint cost optimization workshops.	●
Risk management	Managing supply chain resilience to risk-related events on tier 1-3 level.	●
Demand scheduling and production system	Application of lean principles. Pull system applied, but autonomous production systems. Inventories covered through VMI or smart logistics concepts etc.	▲
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions and follow up activities.	▲→●
Supplier academy	Needs and training internally available. Supplier development and coaching case-by-case.	▲
Global sourcing	SRM pursued by SRM managers. Case-by-case involvement of other functions. LCCS offices support home base organization.	n.a.
Claims management	Suppliers are claimed in a systematic way. Performance is measured based on specific and neutral criteria, e.g. incoming quality or on-time delivery; contractual governance is available.	●

Source: own source, showing the summary of the JUPITER case study.

The analysis shows that categories like “corporate strategy”, “organizational set-up in SRM”, “supplier selection process”, “supplier co-operation”, “supply chain visibility”, “cost transparency”, “risk management”, and “claims management” could be validated as best practice through the

pattern-matching technique. In the areas of "B2B collaboration", "demand scheduling and production systems" and "Supplier academy", refinement was necessary, since only partial matching could be verified. The category "supplier quality performance" was in special focus, since the interviews revealed that finished trains could not be delivered to the end-customer in Scandinavia allegedly due to defective Jupiter parts. The managers and operational members of the project who were responsible for profit and loss were extremely worried about possible penalties from the end-customer. For projects of this scope, delays in delivery may cause penalties to the extent of several million EUR. During the interviews it became evident that a purely quantitative and numerical approach may not fully reveal the truth of the phenomena, as outlined by Remenyi et al. (2003) or Yin (2009). Thus the qualitative approach is more suitable for this kind of research. Quantitative performance indicators are not only used by Bombardier, but also by other companies to measure supplier quality and delivery performance**.** These supplier performance data hypothetically contribute to good or bad supplier relationships between the customer and the supplier; however, without appropriate interpretation and harmonization, such data may not indicate the phenomena properly (Yin, 2009). The Jupiter case is representative of the weaknesses of such system, since all companies evaluate the quality performance of suppliers in a standardized way on a monthly basis. All Bombardier suppliers are evaluated in terms of delivery to the site and rate of NCGs in relation to the total quantity of goods supplied, as shown in Figure 7-11 (Bombardier, January to June 2012 NCG).

Figure 7-11: Business critical supplier evaluation

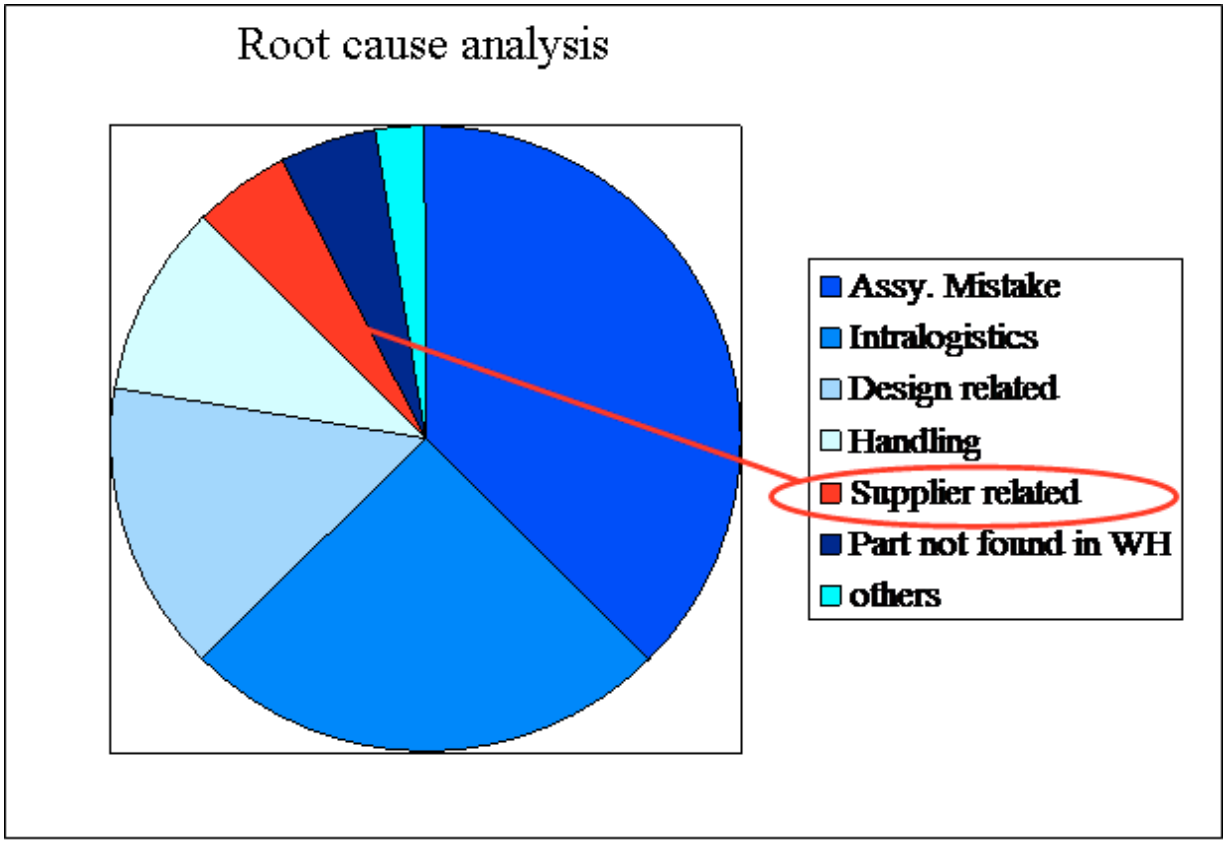


Source: NCG ratio of Jupiter, Bombardier Transportation , 2012. The NCG shows business critical, escalation necessary with a NCG value > 1.9 percent.

Every six months, management is informed about the performance of each individual supplier. For example, if a supplier delivered 1,000 goods within 6 months without any non-conformities, his NCG percentage is zero. If he delivers 100 non-conforming parts, his NCG percentage is 10. There are standard ways to determine whether a part is non-conforming or faulty. Quantitative evaluation is used to highlight whether a supplier is business-critical to Bombardier following actions such as escalation, re-sourcing or outphasing. These actions directly impact the supplier, since all deliveries have to be stopped and future orders are terminated. A report published in December 2012 urged Bombardier's top management to carry out immediate action regarding Jupiter due to bad quality performance and the presence of non-conforming parts in the production process in Görlitz. Jupiter's NCG ratio exceeded the 2.0 per cent limit (3.4 per cent between June and December 2012). According to the report (including statistics), 34 out of 1,000 delivered parts were non-conforming (i.e. NCG percentage ratio of 3.4). The data triggered an immediate escalation process within Bombardier, involving order suspension by other sites, such as Hennigsdorf. These actions affected Jupiter as a supplier. Management was informed and asked to develop an action plan and countermeasures. After reviewing the NCG percentage and data in more depth, it became clear that there were certain discrepancies which had to be looked at in more detail. Bombardier and Jupiter put a joint task force in place to analyze the data. The task force found out that the data were based on the subjective judgement of only a few functions. Moreover, there were no criticality levels (one bad screw may cause a standstill). It revealed the weakness of using only one criterion (NCG percentage) to define business-critical aspects. Criteria such as delivery performance or lot compliance were not included. Additionally, soft factors (co-operation, innovation, willingness to mitigate, setting up a task force, etc.) were missing. In conclusion, one can say that in the case of Jupiter, evaluation and determination of NCGs were not objective. The task force found evidence that certain factors had distorted Jupiter's performance data. Furthermore, the data neglected factors such as having a service team on site or being an innovation leader in the railway industry. NCG determination was based on positivistic methodology and judged by specific departments like "Incoming Quality", "Warehouse", "Shop Order Control", "Production", and "Testing". Positivist research only uses quantitative data (Yin, 2009). The relevant skill set comprises extensive knowledge of mathematics and statistics, and sometimes finance. Members with the ability to develop mathematical models and proficiency in statistical analysis were selected for working on the data. In many cases, the above mentioned departments were not able to understand the real cause of non-conformity, but attributed the problem to the supplier. Ultimately, it became clear to both Bombardier management and Jupiter that with such a quantitative analysis as done by Bombardier, it was not possible to measure quality performance accurately and that another approach was needed. The next chapter will apply qualitative research to Jupiter, showing more accurate results regarding quality performance. Jupiter

and Bombardier revealed that most of the non-conformities were not caused by the supplier, but by Bombardier internally. After looking into the matter more closely and carrying out a root cause analysis (RCA) through interviews, the outcomes were defined. The RCA (see pie chart in Figure 7-12) shows that the majority of NCG were caused by Bombardier members themselves, with only a small percentage caused by Jupiter. The interviews revealed the same thing. Indeed, there were weaknesses inherent in the entire supply chain. Nevertheless, there was no intervention at this stage. First of all, certain implications and limitations of the qualitative approach had to be considered. Although the qualitative methodology went further than the quantitative approach, no interaction ensued (Yin, 2009).

Figure 7-12: Jupiter NCG ratio

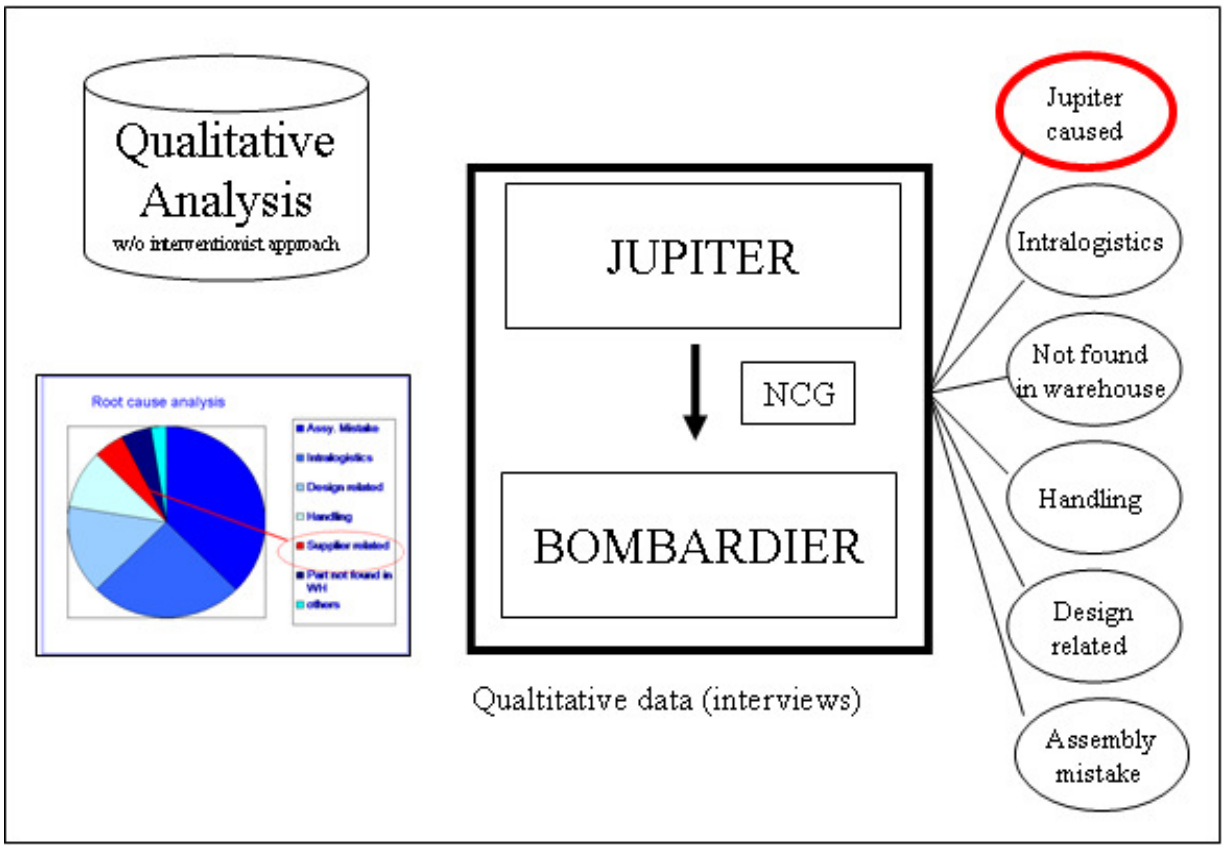


Source: Jupiter root cause analysis (NCG):

There were ideas for improvement based on qualitatively determined realities and evidence, but the system and the phenomena kept the “status quo”, since there had been no intervention. In conclusion, it can be said that the system has shown the advantages of the qualitative approach. The data material is more accurate and more objective now that the root cause of NCG has been analysed. The

interview approach provided more realistic results than the quantitative method based on NCG percentage. In conclusion, the quantitative data has shown not only one root cause, but several/more than one root causes (see RCA below), as displayed in the Figure 7-13. Qualitative and narrative systems are more accurate and reflect actual supplier performance (including soft factors) in a better way.

Figure 7-13: Root cause analysis Jupiter NCG



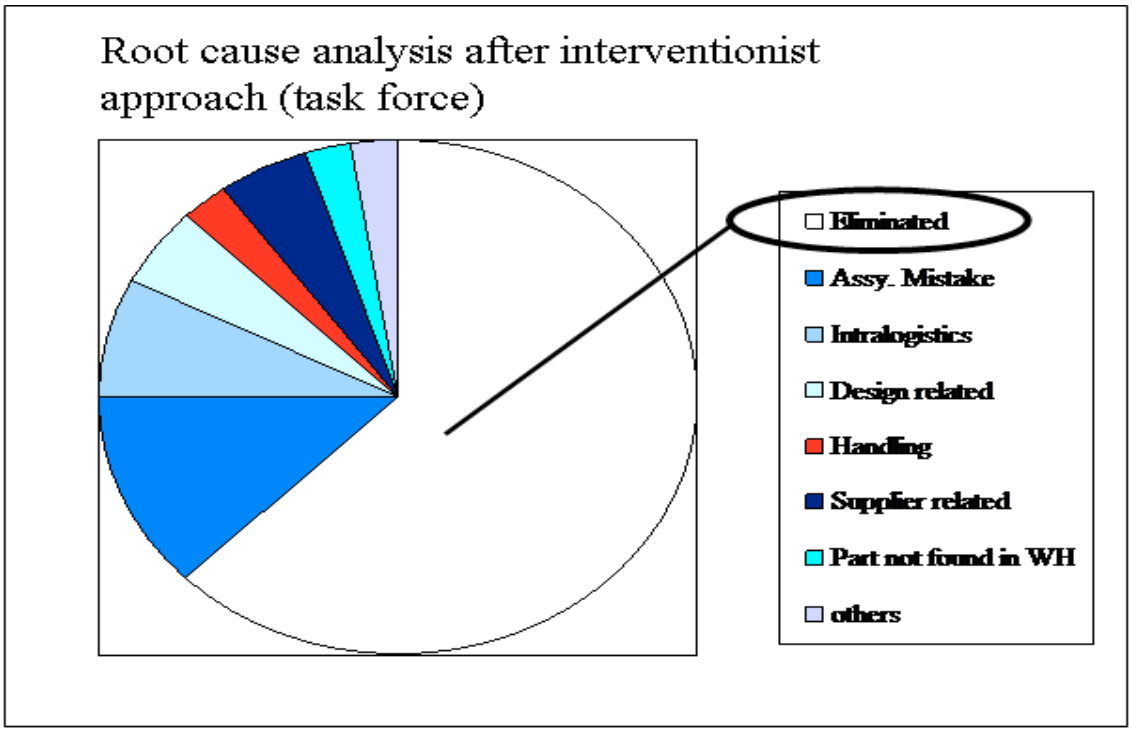
Source: own source, RCA for defects on Jupiter parts.

As there were several causal factors (not only Jupiter) within Bombardier which generated NCG (e.g. intralogistics, warehousing, handling, design section, assembly), it became necessary to develop question techniques to acquire more information. In complex situations and research projects, a qualitative research approach without intervention is considered to be effective, as recommended by Remenyi et al. (2003). Compared to quantitative methodologies, qualitative methodologies have certain advantages, as was illustrated in the Jupiter case. Non-positivists argue that purely positivistic approaches frequently fail, as several examples have shown (Yin, 2009). This school of thought assumes that objects of investigation in social sciences are social issues – a key concern is that

research should acknowledge and treat people (groups or functions like in the Jupiter case) as essentially human in nature rather than as mere objects. Central to the above mentioned argument is the fact that human beings have the ability to think, act and influence the world. Positivist research strategies are unable to provide an understanding of such human dimensions. In the UK general election in 1992, when the opinion polls (including the exit polls) predicted a Labour Party victory, the Conservative Party won instead (Remenyi et al., 2003; p. 92). It almost seems that voters were simply not willing to tell the truth about how they actually intended to vote. Certain scientists claim that qualitative research meanwhile represents a more suitable strategy. Nevertheless, it also has some disadvantages compared with quantitative methodologies. Remenyi et al. (2003) state that subjectivity may possibly lead to procedural problems and that replicability is difficult to achieve. Moreover, the bias of researchers is inherent and unavoidable. Another criticism is that qualitative research is labour-intensive and expensive compared to quantitative research. Even though it aims to be in-depth, a comprehensive approach to data-gathering limits scope. Finally, qualitative research is not always well understood by "classical" researchers, as indicated by Remenyi et al. (2003). There is an ongoing debate among researchers about the suitability and validity of quantitative and qualitative methods in research (Remenyi, 2003; Denzin & Lincoln, 2000; Popper, 1934). Remenyi et al. (2003; p. 104) outline characteristics of the quantitative (positivist) and qualitative (non-positivist) approach. According to Denzin and Lincoln (2000), the key difference between quantitative and qualitative methodology is flexibility. They state that quantitative methods are less flexible than qualitative methods. A cross-functional task force, which is supported by skilled process consultants, has been set up. The task force has been given three main objectives: 1) to identify the root causes of each individual NCG regardless of whose fault it was; 2) to describe the NCGs and allocate them to the causal function; 3) to establish sustainable countermeasures by changing, adjusting or adopting processes and systems. Even though Action Research (AR) was not seriously considered for this study, the Jupiter case shows the potential of AR in research and managerial practice in SRM. AR is a form of research in which practitioners reflect systematically on their practice, implementing informed action to bring about improvement (Carr & Kemmis, 1986). One widely accepted definition describes it in the following way: "AR is a form of self-reflective enquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, their understanding of these practices, and the situations in which the practices are carried out" (Carr & Kemmis 1986). In the Jupiter case, a cross-functional task force was set up. At a relatively early stage, certain characteristics relating to the interplay of the task force members became obvious. All task force members were directly responsible for making decisions. First of all, the issues to be researched were determined. Then the enquiry was developed and implemented. The co-operation and grouping of the individual participants significantly

increased collaboration and enriched working relationships and liaison within the task force. AR and the scope of the project gave stakeholders the possibility to look beyond the root causes, and thus they gained a greater understanding of their own practices in handling Jupiter material. In Figure 7-14 one can see that the majority of defects could be eliminated.

Figure 7-14: Root cause analysis Jupiter after interventionist approach

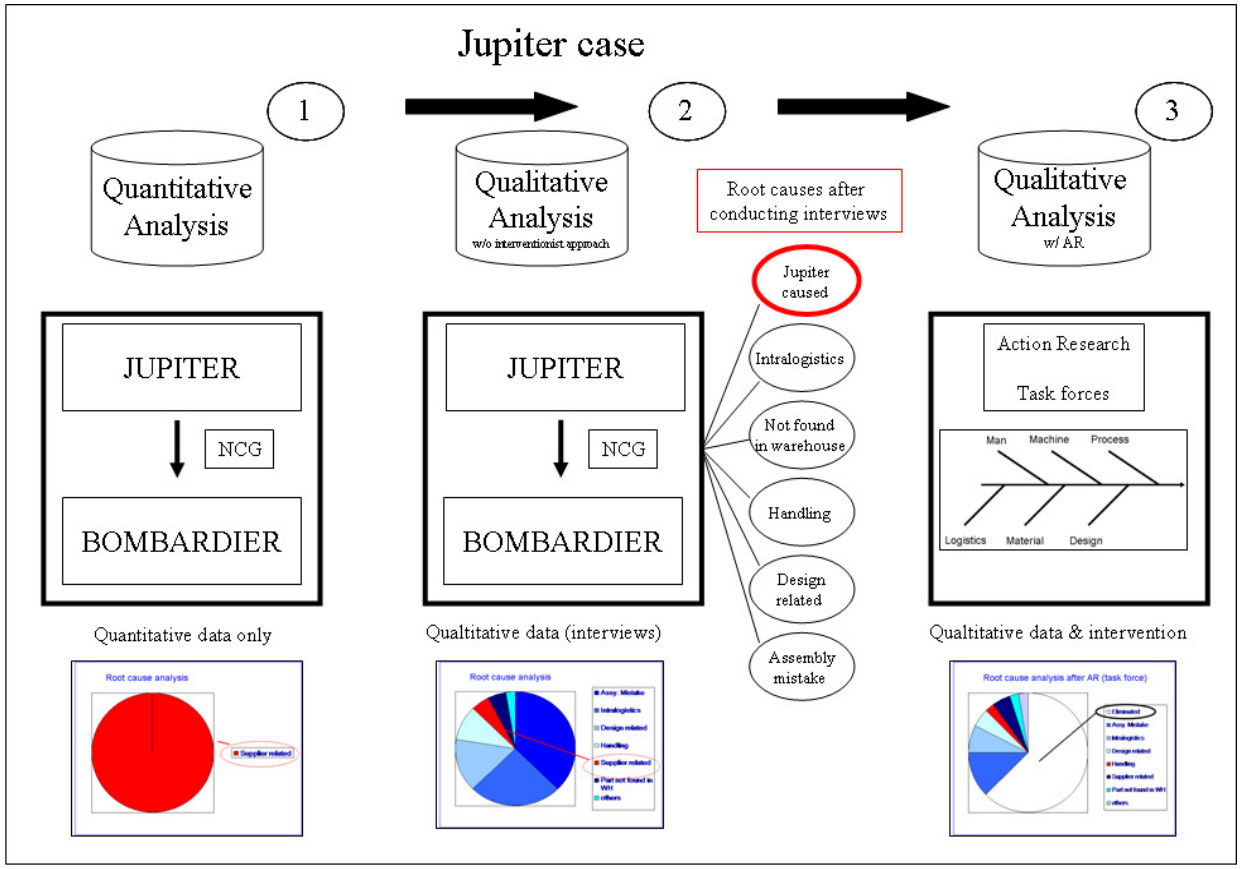


Source: Results of the task force after the root cause analysis.

The members of the task force were empowered to make informed decisions about what to change and what not to change. They linked prior knowledge to new information, learned from experience (even failures), asked questions and systematically found answers on the topic. With AR it would also be possible for management and stakeholders of Jupiter to integrate theory (findings) and practice, increase teamwork, steer more effectively towards a zero-defect philosophy and improve discipline among task force members. It was the wish of each member to increase the predictability of what happened in their functions. The task force acquired knowledge in qualitative research methods beyond a numerical system. The white area in the pie chart in Figure 7-15 shows the results after intervention into the processes and systems. About two-thirds of the NCG could be erased within a short period of time. By taking immediate action, it was possible to bring about improvements quickly. The Jupiter task force has had fundamental implications both for the

individual project and for the general system of supplier performance within Bombardier. Figure 7-16 shows the three approaches and their respective outcome in the pie charts. The Jupiter quality performance was judged to be extremely bad using quantitative methodology ❶ however, the qualitative approach without intervention ❷ (including interviews and qualitative root causes) still revealed weaknesses in the quantitative methodology itself. Through potential AR ❸ and a task force which including external specialists in processes, it was possible to intervene in and improve the system. In conclusion, one can say that AR offers suitable features for making improvements with intervention (Remenyi et al., 2003), as the Jupiter case has shown.

Figure 7-15: Jupiter case in the context of qualitative and quantitative research

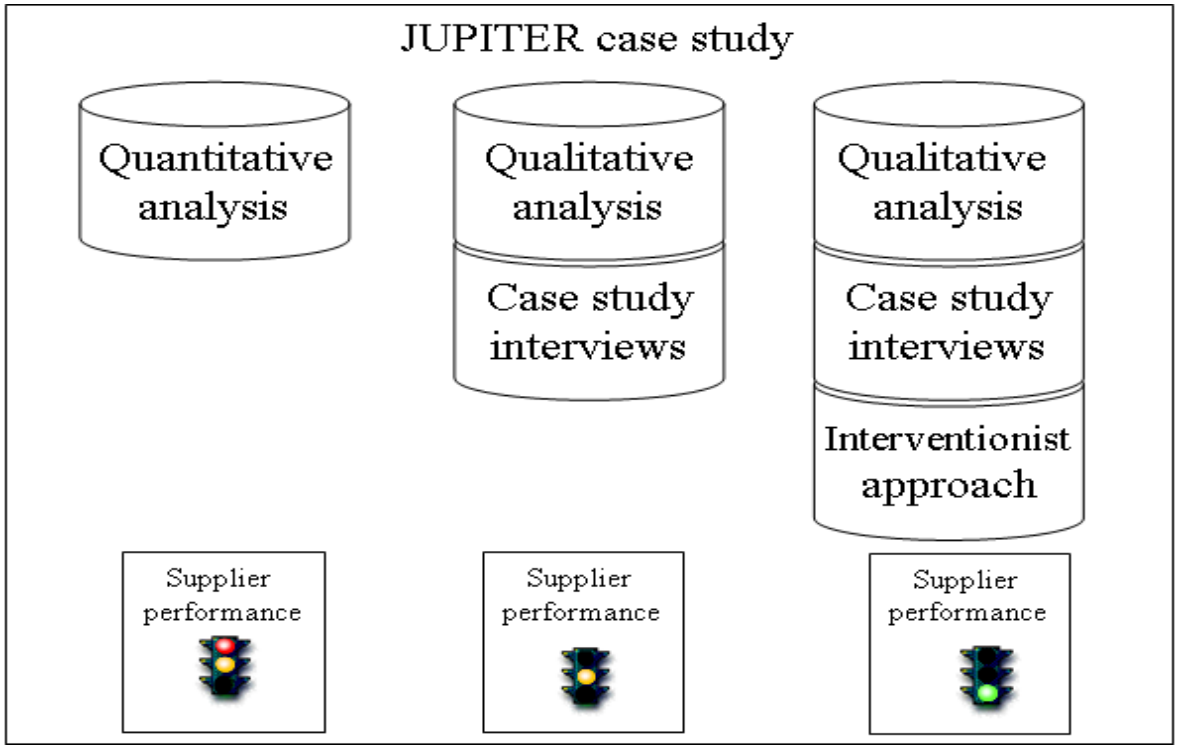


Source: own source. NCG after quantitative, qualitative and interventionist approach.

These principles are the subject of discussion in the next chapter. Reason and Bradbury (2001) emphasise that AR is a participative process in which experience and reflection are the essential criteria for intervening in a system. Figure 7-16 shows the different results from "red" to "green" (cf. traffic lights) relating to the three approaches. AR has shown that an interventionist approach in a transformative and improvement cycle significantly has changed the overall performance of Jupiter. One important principle has been the continuous reflection by all task force members and the

triggering of improvements through the pluralist structure. The Jupiter case and respective supplier quality performance helped also to confirm or disconfirm other categories and best practices. The Jupiter case showed that SRM has been closely linked to the corporate management and strategy. Due to the alert system in terms of quality performance, the issue was escalated and top management put immediately an action plan and team in place for root cause analysis and mitigation. This team incorporated the supplier in a collaborative way.

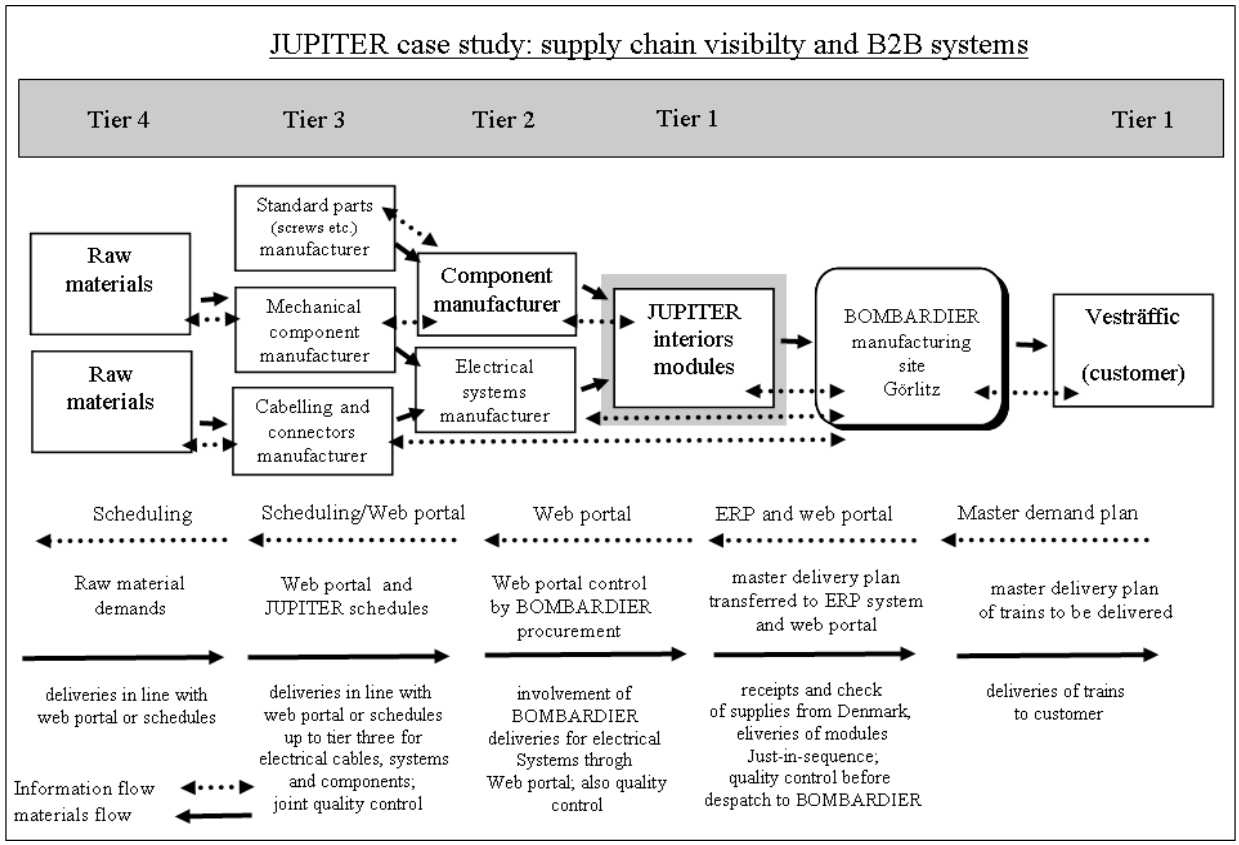
Figure 7-16: Root cause analysis Jupiter NCG



Source: own source. Supplier performance results based on quantitative and qualitative approaches.

Critical supplies (e.g. electrical components, cabling, connectors) which are an essential part of interiors, sidewalls or door pillar modules in trains or trucks, are incorporated into the supply chain of Bombardier through the web portal and scheduling agreements. Departments like production control and expediting and procurement monitor the supplies from the tier-three and tier-two suppliers in terms of OTD and quality governance. Nevertheless, suppliers for other commodities, like standard parts, are managed solely by Jupiter without involvement of Bombardier. Only B2B systems are linked, as we can see in the dotted lines leading to cabling (tier three) and electrical systems (tier two) manufacturers. Regarding cost transparency and risk management, the Jupiter case showed a collaborative approach, reflecting an open-book policy, a long-term strategy and common initiatives for establishing contingency plans and risk mitigation.

Figure 7-17: Supply chain visibility and B2B systems in Jupiter case



Source: own source in line with interviewees in case study interview, drafted in December 2012.

The establishment of the task force was one of the best practices agreed upon by both companies. As Bombardier has not yet established a lean supplier team, workshops and SEAP, PAP and FAI assessments have been limited to the implementation of a minor set of lean principles. However, the web portal and scheduling agreements will help Jupiter and its supply base to synchronize with the Bombardier production and scheduling system more effectively. Such a roll-out is also part of Bombardier's development towards a Supplier academy (which includes the supply networks). Global sourcing did not apply in this case, and claims management is part of the contractually agreed terms and conditions of both companies. The Jupiter case study confirmed most of the best practices identified in Phase II. Certain areas like quality performance, production and scheduling and the Supplier academy require adjustment, as these could only be partially confirmed.

7.4 Summary of case studies and refining best practice elements

The previous section dealt with the confirmation, disconfirmation and amendment of best practice categories through two case studies within the transportation industry. Two supplier projects during selection/launch and production/after-market at the Bombardier sites in Hennigsdorf and Görlitz

have been selected to carry out a comparison of activities in SRM with the identified best practice elements in the systematic literature review and the semi-structured interviews in Phase II (Yin, 2009; Fink, 2010; Remenyi et al., 2003). Analytical generalization and pattern-matching techniques regarding the best practice categories have been applied as analysis tools (Yin, 2009; p. 38). Identified best practice elements, risk factors and mitigation aspects (Phase II) have been used as a template with which to compare, confirm or disconfirm the empirical results of the case studies in Phase III. The analysis confirmed the majority of the best practice elements. Figure 7-18 shows the results of the case studies in each of the 13 best practice category. The column "confirmation, disconfirmation and refinement" describes where refinement has been necessary. Appendix 17 summarizes the sequence of the case study approach. The categories Supplier co-operation, B2B collaboration, risk management, demand scheduling production system, supplier quality performance and Supplier academy require slight refinement or refinement. The next chapter focuses on the results of Phase III and shows how the categories have been refined and amended according to the case study results. The next chapter (Phase IV) and outlines the refining of best practices and the establishment of the best practice model of SRM.

Figure 7-18: Summary of case studies

Summary of case studies SRM best practies and patterns	Description of best practices and patterns	Victall Level of matching	Jupiter Level of matching	Confirmation, disconfirmation and refinement
Corporate strategy	Integration of SRM into corporate strategy and corporate management. Corporate objectives including hard and soft factors exist and are continually measured.	●	●	Confirmation
Organization	SRM is integrated into core procurement and logistics function . There exist only few interfaces to the suppliers.	●	●	Confirmation
Supplier selection	Supplier selection is executed systematically through commodity strategies on the basis of audits and qualification. Case-by-case early supplier involvement and long-term strategies.	●	●	Confirmation
Supplier co-operation	Collaboration throughout the supply chains. Partial implementation of lean principles at suppliers for key commodities.	▲	●	Slight refinement necessary
Supply chain visibility	Usage of web based and customized systems to monitor shipments and inventories in supply chain.	●	▲→●	Confirmation
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	X→▲	▲	Disconfirmation, partial confirmtion refinement necessary
Cost transparency	Detailed open books policy on main category level. Joint cost optimization workshops.	●	●	Confirmation
Risk management	Managing supply chain resiliency to risk-related events on tier 1-3 levels.	▲	●	Slight refinement necessary
Demand scheduling and production system	Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI or smart logistics concepts etc.	▲→●	▲	Slight refinement necessary
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions and follow up activities.	●	▲→●	Slight refinement necessary
Supplier academy	Needs and training internally available. Supplier development and coaching case-by-case.	▲	▲	Refinement necessary
Global sourcing	SRM pursued by SRM managers. Case-by-case involvement of other functions. LCCS offices support home base organization.	●	n.a.	Confirmation
Claims Management	Suppliers are claimed in a systematic way. Performance is measured based on specific and neutral criteria, e.g. incoming quality or on-time delivery; contractual governance is available.	●	●	Confirmation

Case study analysis (adapted from Yin, 2009); see Appendix10.

8. Phase IV: Refining best practices in SRM

8.1 Best practice elements and establishment of a best practice model of SRM

Phase IV is the last of four phases and tackles the confirmation and refining of best practices in SRM in manufacturing companies in the European transportation industry. In addition, this phase has been used to develop a best practice model for the different categories, the maturity levels for each category, and a logical plan as to how to achieve the best practice levels. After the validation and amendment of the research questions in Phase I, 13 categories of best practices were identified in Phase II, which were clustered and compared with the findings of the two case studies in Phase III. Moreover, the case studies revealed two additional best practice elements in terms of dual sourcing and qualitative investigation of supply chain discrepancies. Thus the research so far has identified the following 15 best practice elements and aspects of SRM in the respective industry:

1. Corporate strategy
2. Organization
3. Supplier selection
4. Supplier co-operation
5. Supply chain visibility
6. B2B collaboration
7. Risk management
8. Demand scheduling and production system
9. Supplier quality
10. Supplier quality performance
11. Supplier academy
12. Global sourcing
13. Claims management
14. Dual source paradox
15. Qualitative investigation of supply chain discrepancies

The best practices were classified into 13 categories from corporate management to claims management with the help of the previous phases. The table on the next page shows where the best practices could be fully or partially validated through the case study results. With the exception of six categories (i.e. (4) supplier co-operation, (5) supply chain visibility, (6) B2B collaboration, (7) risk management, (8) demand scheduling and production system, (11) Supplier academy), all categories

could be validated as best practices by means of the pattern-matching technique, as recommended by Yin (2009). The columns in Figure 8-1 show whether the degree of pattern-matching for the Victall and Jupiter case studies was high, medium or low. Based on this analysis, the best practice categories were either confirmed or refined in their descriptions, patterns and characteristics.

Figure 8-1: Summary of pattern matching analysis

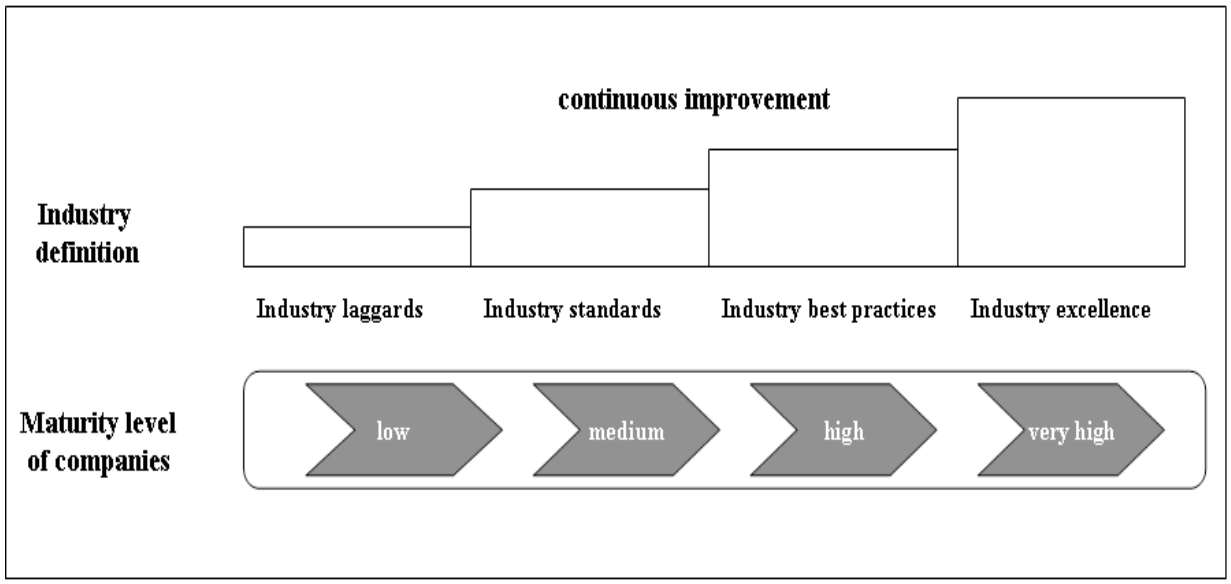
Best practice category	Industry best practice	Victall case Degree of patterns matching	Jupiter case Degree of patterns matching
Corporate strategy	Integration into corporate objectives including hard and soft factors.	High	High
Organization	Partially integrated in parallel to core procurement and logistics function . Few interfaces.	High	High
Supplier selection	Case-by-case early supplier involvement and long-term strategies.	High	High
Supplier co-operation	Collaborative supply chains. Partial implementation of lean principles at suppliers.	Medium	Medium
Supply chain visibility	Usage of customized systems to monitor shipments and inventories in supply chain.	High	Medium
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	Medium/low	Medium
Cost transparency	Detailed open books policy on main category level. Joint cost optimization workshops.	High	High
Risk management	Managing supply chain resiliency to risk-related events on tier 1-3 level.	Medium	High
Demand scheduling and production system	Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI etc.	Medium	Medium
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions.	High	High/medium
Supplier academy	Needs and training internally available. Supplier development and coaching case-by-case.	Medium	Medium
Global sourcing, e.g. Asia, Eastern Europe	SRM pursued by SRM managers. Case-by-case involvement of other functions.	High	High
Claims Management	Claim suppliers in a systematic way. Performance measured, contractual governance available.	High	High
Dual source paradox	Systematic sourcing strategies. Dual sourcing strategies for selected components in place. Risk assessment case by case.	High	High
Qualitative investigation of supply chain discrepancies	Root cause analysis of supply chain disruptions systematically and proactively measured after supplier selection. Cross-functional team in place.	High	High

Source: own source, results of patterns matching analysis.

Each best practice category was described in terms of behaviour and characteristics in a specific area (Yin, 2009). Furthermore, the multiple qualitative approach revealed the maturity levels and development steps in SRM, which ranged from basic performance to excellent performance (Aberdeen group, 2006; Bombardier Transportation, 2010). The six categories which could be partially confirmed needed reassessment, as the case studies show. The various elements showed a

medium degree of pattern matching in four categories, one was of a low degree. Yin (2009) and Remenyi et al. (2003) suggest further scrutiny and refinement of the best practices accordingly. Subsequently, after confirming or refining, the categories were integrated into a best practice model, including the maturity levels for each category, as recommended by Yin (2009). The Aberdeen group and other authors propose a framework comprising four levels: industry laggards, industry standards, industry best practice, and industry excellence (Aberdeen group, 2006). These levels were refined in line with the needs of the research. Other companies have developed a similar model going from level one (= basic performance) up to level four (= industry excellence) (Bombardier Transportation, 2010).

Figure 8-2: Maturity levels from industry laggards to industry excellence in SRM



Source: adapted from Aberdeen group and other authors.

Remenyi et al. (2003; p. 177) explain principles of good practice in terms of how to collect evidence, how to refine the levels, and how to construct validity. They also stress certain conditions needed to "meet the test of construct validity" in two steps.

The first step is to "carefully identify ideas, concepts, relationships and issues which are to be studied". The second step is described as a "demonstration that the selected measures to be used in the research actually address the ideas, concepts, relationships and issues being studied. As one of the recommended tactics by Yin (2009) or Remenyi et al. (2003), operational "key informants" and experts, who have detailed knowledge about the relevant projects, can contribute to the findings in

the case studies. Internal and external construct validity and construct refinement are crucial parts of the research, as pointed out by Remenyi et al. (2003). Internal validity of the best practice elements is important in all causal and explanatory studies of the relationship between different events. Rosenthal and Rosnow (1991) emphasize that internal validity may be defined as the degree of validity of statements made about whether x causes y. In demonstrating validity, it is necessary to consider other plausible explanations of the relationship between x and y. Internal validation may be asserted (if not, in fact, proved) by examining possible alternative explanations (Remenyi et al. 2003). External validity is concerned with knowing whether the researcher's best practice elements are generalizable (Remenyi et al., 2003). For positivists, this represents a central issue, whereas phenomenologists are less concerned with external validity (Remenyi et al., 2003). The case study approach promotes a generalization form by testing conclusions and replicating the studies in other organizations. The refinement of three categories (i.e. supply chain visibility, risk management, and Supplier academy) was carried out in line with the recommendations of Remenyi et al. (2003). They are made visible in red in Figure 8-3. The summary in Phase II outlined the necessary amendments and refinements for the identified best practice categories and elements. Whereas the majority of best practice categories could be confirmed, six categories had to be once more scrutinized and refined, as recommended by Yin (2009) and Remenyi et al. (2003).

Especially the categories (4) supplier co-operation, (5) supply chain visibility and (6) B2B collaboration needed to be examined on the question of how many tiers in the supply chain are involved in SRM best practice activities (Yin, 2009); the interviews and case studies show that the majority of companies manage tier one and two supply networks rather than incorporating tier two and tier three suppliers. Where companies manage only tier one suppliers, supply chain resilience is limited to a direct supply base (tier one module and systems suppliers), whereas monitoring and management is left to the module and systems suppliers. For these organizations it is important that an SRM function is also established at the module and systems suppliers. However, the second and deeper look to the literature review and interviews in Phase II revealed that best practice companies co-operate on a tier one and tier two suppliers. Industry excellence displayed, that suppliers are managed up to tiers one, two and three. As a consequence, the best practice companies monitor their direct tier one and tier two module and systems suppliers and ensure in parallel that their direct suppliers implement these SRM elements, too. This goes in hand with the elements supply chain visibility, B2B collaboration. Figure 8-3 gives the 13 best practice elements (criteria and dimensions). It also defines the respective maturity level (from industry laggards to industry excellence) and includes the patterns and behaviour of each element. The three fields in red have been amended and refined in terms of industry best practices. The reassessment shows that best

practice enterprises involve tier one and tier two levels systematically, whereas tier three levels are included only selectively.

Figure 8-3: Refining best practice categories and elements

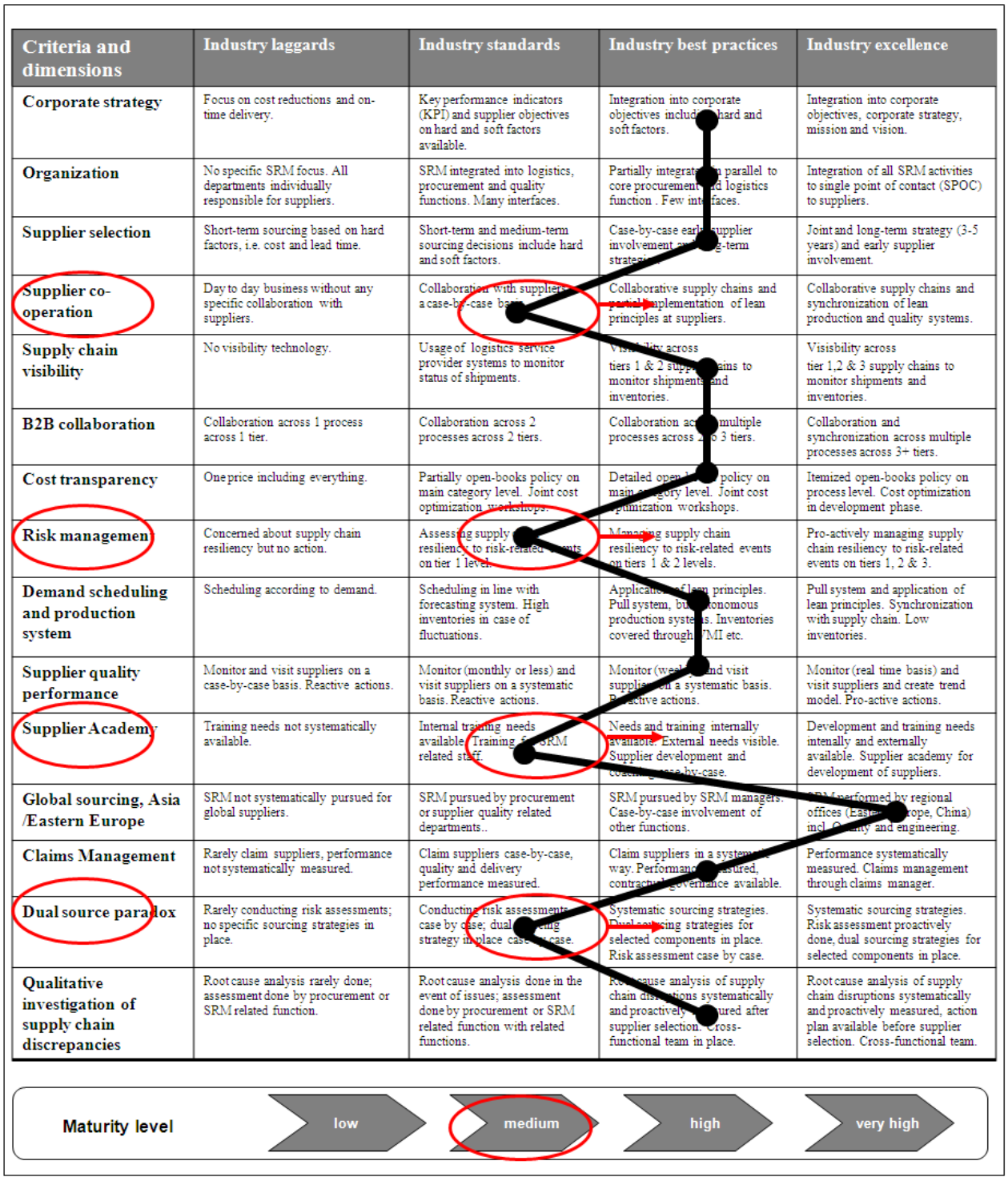
Criteria and dimensions	Industry laggards	Industry standards	Industry best practices	Industry excellence
Corporate strategy	Focus on cost reductions and on-time delivery.	Key performance indicators (KPI) and supplier objectives on hard and soft factors available.	Integration into corporate objectives including hard and soft factors.	Integration into corporate objectives, corporate strategy, mission and vision.
Organization	No specific SRM focus. All departments individually responsible for suppliers.	SRM integrated into logistics, procurement and quality functions. Many interfaces.	Partially integrated in parallel to core procurement and logistics function . Few interfaces.	Integration of all SRM activities to single point of contact (SPOC) to suppliers.
Supplier selection	Short-term sourcing based on hard factors, i.e. cost and lead time.	Short-term and medium-term sourcing decisions include hard and soft factors.	Case-by-case early supplier involvement and long-term strategies.	Joint and long-term strategy (3-5 years) and early supplier involvement.
Supplier co-operation	Day to day business without any specific collaboration with suppliers.	Collaboration with suppliers on a case-by-case basis.	*Collaborative supply chains and partial implementation of lean principles at suppliers.*	Collaborative supply chains and synchronization of lean production and quality systems.
Supply chain visibility	No visibility technology.	Usage of logistics service provider systems to monitor status of shipments.	*Visibility across tiers 1 & 2 supply chains to monitor shipments and inventories.*	*Visibility across tier 1,2 & 3 supply chains to monitor shipments and inventories.*
B2B collaboration	Collaboration across 1 process across 1 tier.	Collaboration across 2 processes across 2 tiers.	*Collaboration across multiple processes across 2 to 3 tiers.*	Collaboration and synchronization across multiple processes across 3+ tiers.
Cost transparency	One price including everything.	Partially open-books policy on main category level. Joint cost optimization workshops.	Detailed open-books policy on main category level. Joint cost optimization workshops.	Itemized open-books policy on process level. Cost optimization in development phase.
Risk management	Concerned about supply chain resiliency but no action.	Assessing supply chain resiliency to risk-related events on tier 1 level.	*Managing supply chain resiliency to risk-related events on tiers 1 & 2 levels.*	*Pro-actively managing supply chain resiliency to risk-related events on tiers 1, 2 & 3.*
Demand scheduling and production system	Scheduling according to demand.	Scheduling in line with forecasting system. High inventories in case of fluctuations.	*Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI etc.*	Pull system and application of lean principles. Synchronization with supply chain. Low inventories.
Supplier quality performance	Monitor and visit suppliers on a case-by-case basis. Reactive actions.	Monitor (monthly or less) and visit suppliers on a systematic basis. Reactive actions.	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions.	Monitor (real time basis) and visit suppliers and create trend model. Pro-active actions.
Supplier Academy	Training needs not systematically available.	Internal training needs available. Training for SRM related staff.	*Needs and training internally available. External needs visible. Supplier development and coaching case-by-case.*	*Development and training needs internally and externally available. Supplier academy for development of suppliers.*
Global sourcing, Asia /Eastern Europe	SRM not systematically pursued for global suppliers.	SRM pursued by procurement or supplier quality related departments..	SRM pursued by SRM managers. Case-by-case involvement of other functions.	SRM performed by regional offices (Eastern Europe, China) incl. Quality and engineering.
Claims Management	Rarely claim suppliers, performance not systematically measured.	Claim suppliers case-by-case, quality and delivery performance measured.	Claim suppliers in a systematic way. Performance measured, contractual governance available.	Performance systematically measured. Claims management through claims manager.
Dual source paradox	*Rarely conducting risk assessments; no specific sourcing strategies in place.*	*Conducting risk assessments case by case; dual sourcing strategy in place case by case.*	*Systematic sourcing strategies. Dual sourcing strategies for selected components in place. Risk assessment case by case.*	*Systematic sourcing strategies. Risk assessment proactively done, dual sourcing strategies for selected components in place.*
Qualitative investigation of supply chain discrepancies	*Root cause analysis rarely done; assessment done by procurement or SRM related function.*	*Root cause analysis done in the event of issues; assessment done by procurement or SRM related function with related functions.*	*Root cause analysis of supply chain disruptions systematically and proactively measured after supplier selection. Cross-functional team in place.*	*Root cause analysis of supply chain disruptions systematically and proactively measured, action plan available before supplier selection. Cross-functional team.*

Source: own source, best practice categories – refinements are in red.

Two other categories, which need refinement were the categories (7) risk management, (8) demand scheduling and production system and (11) Supplier academy. Risk management plans and prevention are measures for supply chain resilience. Risk management plans of best practice companies include norrmally also tier one and tier two levels of the supply networks. This goes in hand with logistics concepts, dual sourcing and dedicated risk mitigation teams for functions like quality, procurement and logistics serve as potential troubleshooters at the suppliers. The category has therefore also been refined after having revisited the findings from Phase II. Demand and scheduling systems apply the introduction of lean principles to the supply base as best practice element (8). This category could also be validated after having revisited the Phase II findings. Best practice companies in the European transportation system consider production synchronization, lean principles, logistical supermarket or VMI concepts. The next category, which had to be examined and refined is the (11) Supplier academy. The findings in Phase II have shown that the trainings and coaching needs have to be identified by the SRM function. The needs have to be identified for external suppliers and for internal functions, which have interactions with suppliers. Managerial practice has shows that SRM also needs development internally as highlighted by Dust et al. (2009) or Helmold (2010). In their articles both authors highlight the need for training and competencies for conducting projects, launches or other activities with suppliers. Industry excellence companies also identify and training needs intenally and externally; These companies possess a supplier academy for development of suppliers and internal stakeholders. Freitag (2004) outlines that Porsche start with extensive training of basic aspects in lean production methods or quality tools before initiating a supplier project. In addition, two elements had to be added as categories “(14) dual source paradox” and (15) “qualitative investigation of supply chain discrepancies”. In demonstrating internal and external validity as proposed by Rosenthal and Rosnow (1991), the categories have been applied to the manufacturing site in Bombardier Hennigsdorf. The following summary 8-4 on the next page shows the maturity levels and achievements of Bombardier in Hennigsdorf in the identified categories. The black line (**—**) depicts the maturity levels of Bombardier for the identified best practice categories (i.e. industry laggards, industry standards, industrial best practices, industry excellence. The red circles show the biggest gaps where best practice elements only have an industry standard (gap analysis). These elements are supplier co-operation, risk management and the Supplier academy. These categories show the biggest gap and discrepancy in terms of SRM maturity and must be tackled through the framework. The red arrows show in which categories (e.g. supplier co-operation, risk management or Supplier academy) improvement is required to achieve a best practice or industry excellence maturity level. In particular, the framework what the company has to do in each category in order to reach the next level. Later on in this chapter, the best practice framework, a

proposed sequence and a logical plan will be described in more detail, explaining how such models can be applied.

Figure 8-4: Best practice elements and maturity levels of Bombardier



Criteria and dimensions	Industry laggards	Industry standards	Industry best practices	Industry excellence
Corporate strategy	Focus on cost reductions and on-time delivery.	Key performance indicators (KPI) and supplier objectives on hard and soft factors available.	Integration into corporate objectives includ hard and soft factors.	Integration into corporate objectives, corporate strategy, mission and vision.
Organization	No specific SRM focus. All departments individually responsible for suppliers.	SRM integrated into logistics, procurement and quality functions. Many interfaces.	Partially integrat n parallel to core procurement d logistics function . Few int faces.	Integration of all SRM activities to single point of contact (SPOC) to suppliers.
Supplier selection	Short-term sourcing based on hard factors, i.e. cost and lead time.	Short-term and medium-term sourcing decisions include hard and soft factors.	Case-by-case earl supplier involvement g-term strate	Joint and long-term strategy (3-5 years) and early supplier involvement.
Supplier co-operation	Day to day business without any specific collaboration with suppliers.	Collaboration with supplier a case-by-case ba	Collaborative supply chains and partial implementation of lean principles at suppliers.	Collaborative supply chains and synchronization of lean production and quality systems.
Supply chain visibility	No visibility technology.	Usage of logistics service provider systems to monitor status of shipments.	Visibility across tiers 1 & 2 supp ains to monitor shipments nd inventories.	Visisbility across tier 1,2 & 3 supply chains to monitor shipments and inventories.
B2B collaboration	Collaboration across 1 process across 1 tier.	Collaboration across 2 processes across 2 tiers.	Collaboration ac multiple processes across 2 3 tiers.	Collaboration and synchronization across multiple processes across 3+ tiers.
Cost transparency	One price including everything.	Partially open-books policy on main category level. Joint cost optimization workshops.	Detailed open policy on main ategory level. Joint cost timization workshops.	Itemized open-books policy on process level. Cost optimization in development phase.
Risk management	Concerned about supply chain resiliency but no action.	Assessing supply resiliency to risk-relate nts on tier 1 level.	Managing supply chain resiliency to risk-related events on tiers 1 & 2 levels.	Pro-actively managing supply chain resiliency to risk-related events on tiers 1, 2 & 3.
Demand scheduling and production system	Scheduling according to demand.	Scheduling in line with forecasting system. High inventories in case of fluctuations.	Applicat f lean principles. Pull system, bu onomous production syste s. Inventories covered through MI etc.	Pull system and application of lean principles. Synchronization with supply chain. Low inventories.
Supplier quality performance	Monitor and visit suppliers on a case-by-case basis. Reactive actions.	Monitor (monthly or less) and visit suppliers on a systematic basis. Reactive actions.	Monitor (wee nd visit supplie on a systematic basis. R active actions.	Monitor (real time basis) and visit suppliers and create trend model. Pro-active actions.
Supplier Academy	Training needs not systematically available.	Internal training needs available. Training f SRM related staff.	Needs and training internally available. External needs visible. Supplier development and ase-by-case.	Development and training needs intenally and externally available. Supplier academy for development of suppliers.
Global sourcing, Asia /Eastern Europe	SRM not systematically pursued for global suppliers.	SRM pursued by procurement or supplier quality related departments..	SRM pursued by SRM managers. Case-by-case involvement of other functions.	SRM performed by regional offices (East rope, China) incl. Quality and engineering.
Claims Management	Rarely claim suppliers, performance not systematically measured.	Claim suppliers case-by-case, quality and delivery performance measured.	Claim suppliers in a system way. Performan stured, contractu governance available.	Performance systematically measured. Claims management through claims manager.
Dual source paradox	Rarely conducting risk assessments; no specific sourcing strategies in place.	Conducting risk assessments case by case; dual ing strategy in place case case.	Systematic sourcing strategies. Dual sourcing strategies for selected components in place. Risk assessment case by case.	Systematic sourcing strategies. Risk assessment proactively done, dual sourcing strategies for selected components in place.
Qualitative investigation of supply chain discrepancies	Root cause analysis rarely done; assessment done by procurement or SRM related function.	Root cause analysis done in the event of issues; assessment done by procurement or SRM related function with related functions.	Root cause analysis of supply chain dis tions systematically and proactively ured after supplier selection. Cross-functional team in place.	Root cause analysis of supply chain disruptions systematically and proactively measured, action plan available before supplier selection. Cross-functional team.

Source: gap analysis and assessment of each best practice element. Biggest gaps are shown in three categories supplier co-operation, risk management and Supplier academy.

Corporate strategy

The case studies disclosed that SRM in Bombardier is fully integrated into corporate strategy and corporate management. SRM objectives, including organizational and process development, have been implemented into P2E activity. Both P2E activity and the specific SRM objectives are monitored on a continual basis and integrated into BSC and SCIP. Thus improvement or decline can be controlled by corporate management. However, supply-related values, beliefs and objectives are not yet part of the organization's vision and mission. The maturity level of this category is significantly high. Nevertheless, recognition of this important function inside the vision and mission represents a potential for further improvement towards industry excellence.

Organization

Regarding the organizational structure, SRM has been integrated into procurement, which is an important function and, as such, represented in the executive board of the enterprise. This category implies that there is only one single point to the supplier in upstream supply chain management, equivalent to a key account manager as a single point of contact to the supplier in downstream supply chain management. Although there is a supplier manager established as one single point of contact, the systems buyer has full responsibility of supplier-related issues in terms of quality, cost, delivery and other aspects.

Supplier selection

The two case studies validated best practices in terms of supplier selection. There is a high maturity level for this category. Bombardier selects its suppliers by applying commodity policy and other long-term strategies. These strategies normally have a scope of five to ten years. Before the suppliers in the two case studies were selected, the assessment and approval process had taken place by applying SEAP, PAP and FAI. In the case of Victall, IPO supported the manufacturing site in Hennigsdorf with assessment and communication. Before the suppliers were selected, certain measures had to be carried out. These activities involved departments like technology, quality and logistics. Before parts were delivered to Bombardier for the mass production process, prototypes were sent by the supplier to validate the design and logistics supply chain. Thus validation of the supply chain included the warehouse in Germany (tier one to Bombardier in Hennigsdorf), the assembly site of Victall (tier two) in China and the subsuppliers (tier three). VMI combined with double sourcing was used as an instrumental emergency plan to avoid supply disruption and secure supply chain resilience. Such a strategy is based on holding sufficient inventory to compensate any disturbance in the supply chain. This category could also be confirmed.

Supplier co-operation

The case studies showed that on the one hand, supplier relationships already existed (Jupiter), whereas on the other hand, the relationship was new (Victall). In the Jupiter case, lean principles were rolled out by the SPM department through a workshop in Denmark, concentrating on subsupplier management and the elimination of waste on tier one and tier two levels. As Jupiter represents an important commodity for Bombardier's railway business, management meetings take place regularly. Discrepancies and long-term strategies are openly discussed in an intensively collaborative way. Regarding Victall, the ties have not yet become so close, since the supply relationship was established only recently. Although SEAP, PAP and FAI have already taken place, there have so far been no workshops focusing on lean principles.

Supply chain visibility

After supplier selection, Bombardier introduced a web-based logistics tool (called the web portal), which had to be integrated into the supplier's own organization. Supply chain visibility incorporates the tier one and tier two relationships through information tools like ERP. The web-tool is to be transferred to all sites within Bombardier. After Hennigsdorf, other sites will take advantage of such system within the year 2103. Such a tool is linked to the ERP system of the manufacturing sites in Hennigsdorf and Görlitz. Whereas the system in Hennigsdorf was implemented successfully in 2012, Görlitz plans to roll out this system in 2013. The system has to be checked by the Bombardier expeditor and the supplier on a minimum basis weekly and involves contractually agreed terms like delivery schedules, freezing periods, packaging issues and lot sizes. The web portal can be shared easily with suppliers and subsuppliers. Even though the category only showed medium confirmation, this element nevertheless represents best practice.

B2B collaboration

B2B collaboration was established through a web-based scheduling system, which contains ERP data from Bombardier and is visible to the supply base on tier one and tier two levels. The system is focused on logistical aspects like scheduling, OTD and shipments. In addition to this, it is designed to focus on quality issues. Deliveries and quality indicators (e.g. NCG, response time to defects, co-operation) will be integrated into the system.

Risk management

Supply chain resilience is closely linked to risk management and how early supply chain risks or disruptions are detected. Risk management in the two case studies showed that Bombardier monitors the direct suppliers Victall and Jupiter in terms of quality, cost and delivery. In addition, the system

has been extended to subsuppliers (tier two levels), but not beyond. However, Bombardier expects its direct supply networks to establish SRM principles and structures of their own which, in turn, can monitor the corresponding suppliers and supply chains. The aim is to create a resilient supply chain. This requires a close connection between the SRM departments of Bombardier's suppliers and Bombardier itself. Moreover, VMI and local warehouses are part of the supply chain concept. At the same time, a double sourcing strategy has to be implemented, enabling Bombardier to resource the suppliers in the event of significant supply disruptions which cannot be remedied immediately. Finally, dedicated risk mitigation teams for functions like quality, procurement and logistics serve as potential troubleshooters at the suppliers.

Demand scheduling and production system

Demand scheduling systems were assessed during SEAP and PAP of Victall and Jupiter. Bombardier uses a model which is based on the Toyota production system, focusing on elimination of waste and concentrating on value-adding activities (Ohno, 1988). This model is called the Bombardier operating system (BOS). BOS is currently being renewed within Bombardier to include external experts. However, it has not yet been introduced to its supply base. The scheduling and production systems of the suppliers are still not compatible or interconnected with the systems in Hennigsdorf and Görlitz. A best practice identified during the interviews shows that industry benchmarks carry out lean workshops with the supply base. As part of a Supplier academy, special teams teach suppliers theoretical and practical knowledge and conduct workshops with suppliers to make the systems compatible. At BOMBARDIER such a team is in the process of being established. The first workshops for optimizing the supply network are targeted for the third quarter of 2013. Meanwhile, external consultants are used for interconnections and synchronization. Nevertheless, it should be mentioned that such competency still needs to be developed internally at Bombardier.

Supplier quality performance

Supplier quality performance is an essential aspect of SRM and the relevant best practices. There are certain aspects which have to be taken into account during the value stream phases from the point of supplier selection up to after-market. Supplier quality data in terms of NCG were tracked from the first up to the last delivery of goods. However, a purely quantitative approach is too narrow, as seen in the case study of Jupiter (Yin, 2009). Best practice patterns for quality performance measurement comprise proactive methods relating to soft factors (e.g. reaction time to send reports and to mitigate of quality issues, execution of quality-securing measures) and hard factors (ppm, field returns, number of defects, NCG). From the data, a trend analysis can be developed on each sub-criterion as a

proactive warning system. Modern ERP software is capable of generating these trends as outlined before.

Supplier academy

The best practice element of a supplier academy emphasizes the evaluation of needs and competencies of one's own employees as well as those of the supplier. For this reason, there must be an analysis of which skills are available and which competencies have to be acquired. The skills may comprise quality management systems, certification issues, lean principles, cost analysis techniques, or even project management. Best practice companies have a supplier academy, including standard coaching modules and classes for internal and external needs. During the interviews it was mentioned by interviewees from ZF or BMW, "that companies like ZF or Porsche have a supplier academy, through which suppliers or internal employees can be trained or coached."

Global sourcing (e.g. Asia, Eastern Europe, India)

Global sourcing offices in Asia, Eastern Europe or India involve financial investment for each organization. However, differences in culture, time and language can be resolved by making use of local experts. The respective offices can consist of one single representative or they may be fully functional with quality, procurement and technical competencies. In the second case study, IPO was of great help in dealing with various difficulties. Especially the interviews revealed that multinational companies in the European transportation industry establish sourcing offices, predominantly in Eastern Europe, China or India. Thales, the Train Manufacturer, Alstom, BMW and the other companies have set up offices in these countries in order to take advantage of the labour cost advantage (Bombardier, 2010). Interviews displayed that the maturity of competencies and components is growing quickly in regions like Poland, China or India. Whereas components were sourced out of these countries years ago, suppliers from these countries have started creating joint ventures or strategic alliances through which knowledge could be transferred intensively. As a result, more advanced systems and modules can nowadays also be supplied from these regions at a a low cost level.

Claims management

Contractual issues including general terms and so-called chargeback fee agreements help to clarify monetary claims. If suppliers deliver parts with non-conformities or do not deliver punctually, a claims management process is executed through the SRM function. If there are unclear issues, a claims manager within procurement proceeds with legal steps. The claim manager also acts as internal coach and trainer with respect to legal issues. The majority of procurement or SRM

connected people does not have a law background, therefore the claim managers can close this gap ideally. Nevertheless, it should not be forgotten, that potential claims and penalties should serve as a mechanism to prevent claims and supply disruptions, based on legal and objective grounds of malfunctions of suppliers.

Dual source paradox

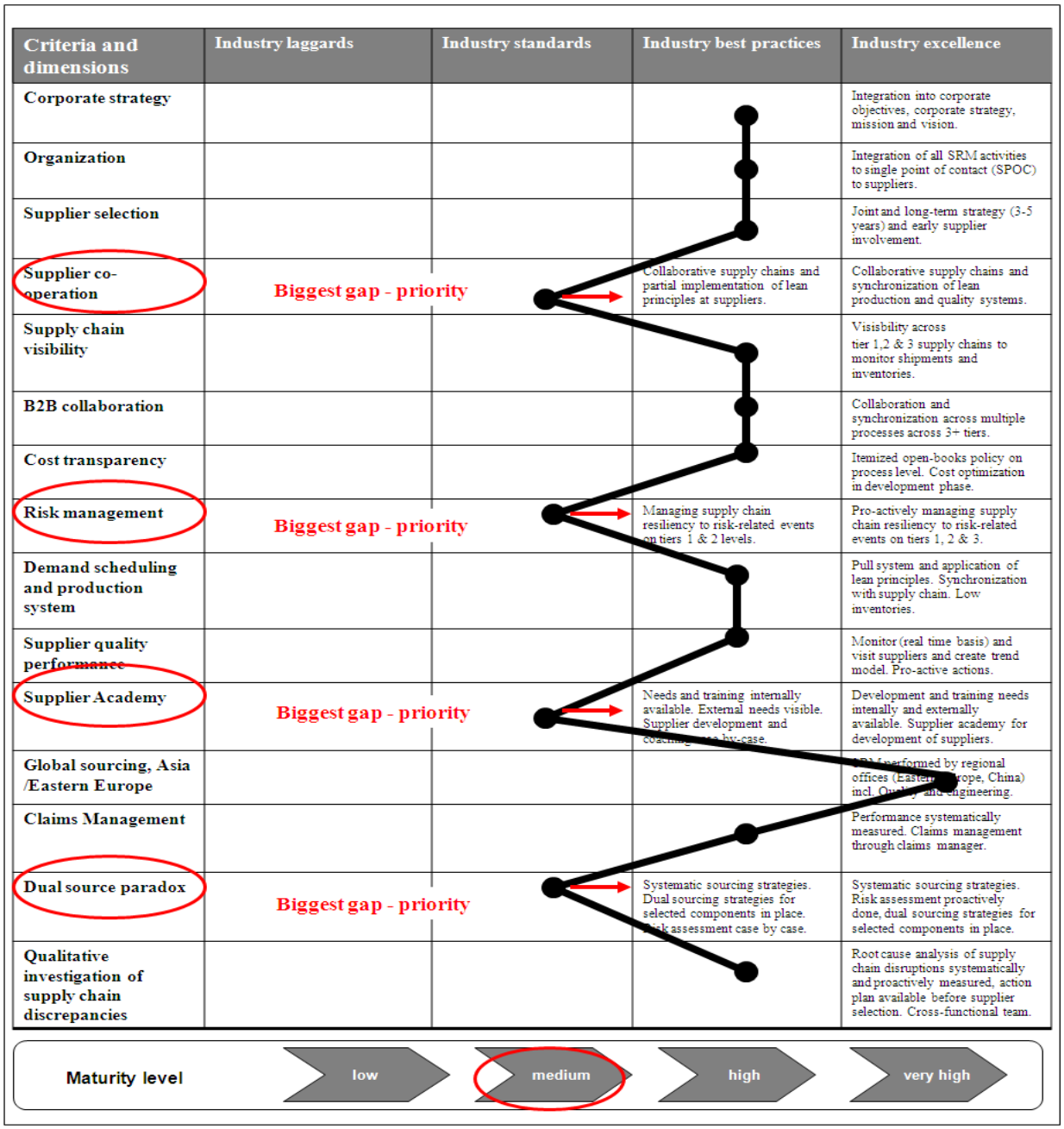
After having completed Phase III, two additional best practice elements could be identified. These are the dual source paradox and the qualitative investigation of supply chain discrepancies. Even though lean principles suggest a single source strategy, it was visible that best practice companies like BMW apply a dual source strategy including a triangular relationship with both suppliers. This paradox is planned carefully throughout the value stream phases from supplier selection to after-market and necessitates structured and systematic sourcing strategies. There are dual sourcing strategies for selected components in place in order to minimize risks of disruptions. There are also scenarios in this triangular relationship, in which a mature supplier takes responsibility of the development and the launch. This is done in order to then roll out a mature product to a low cost country after the launch phase of this product. Thus it possible to ensure timely development, a safe launch and flawless execution, but also enables the parties to benefit from the cost benefits after having confirmed maturity of the system or module. “Even though the suppliers are in competition, there are mutual benefits to both to learn from each other and to further improve”, as mentioned by the BMW interviewee.

Qualitative investigation of supply chain discrepancies

The Jupiter case has shown that purely quantitative evaluation for supplier relationship management is weak and inflexible. Therefore, the case studies revealed, that companies should foster a cross-functional and qualitative approach in analysing supplier relationships, defects and supply disruptions. Such qualitative approach could involve an interventionist approach, e.g. action research, in a task force to analyse and mitigate discrepancies. Best practice companies like BMW or ZF have a dedicated SRM project leader, who starts from supplier selection with preventive measures for creating the resilient supply chain. In the event of supply disruptions or relationship discrepancies, he acts as a SRM liaision manager including the supplier and the necessary departments, e.g. logistics, development, quality or production. A qualitative tool box enables the team to carefully evaluate the individual root causes for each aspect of discrepancy. Throughout the interviews in Phase II and the case studies (Phase II), it was commented by interviewees, “that SRM necessitates such approach in order to have clear understanding of root cause and issues”. It was also pointed out that such supqualitative approach should be introduced at the very early beginning of

supplier selection as part of a proactive concept. The best practice elements help companies to establish resilient supply chains and proactively prevent, anticipate and manage supply disruptions or disturbances within supply networks, as recommended by several authors. Combined with best practice elements, the application of the following framework enables manufacturing companies in the European transportation industry to establish a best practice model in SRM (see Figure 8-6). Step 1 focuses on the assessment of the baseline for each category.

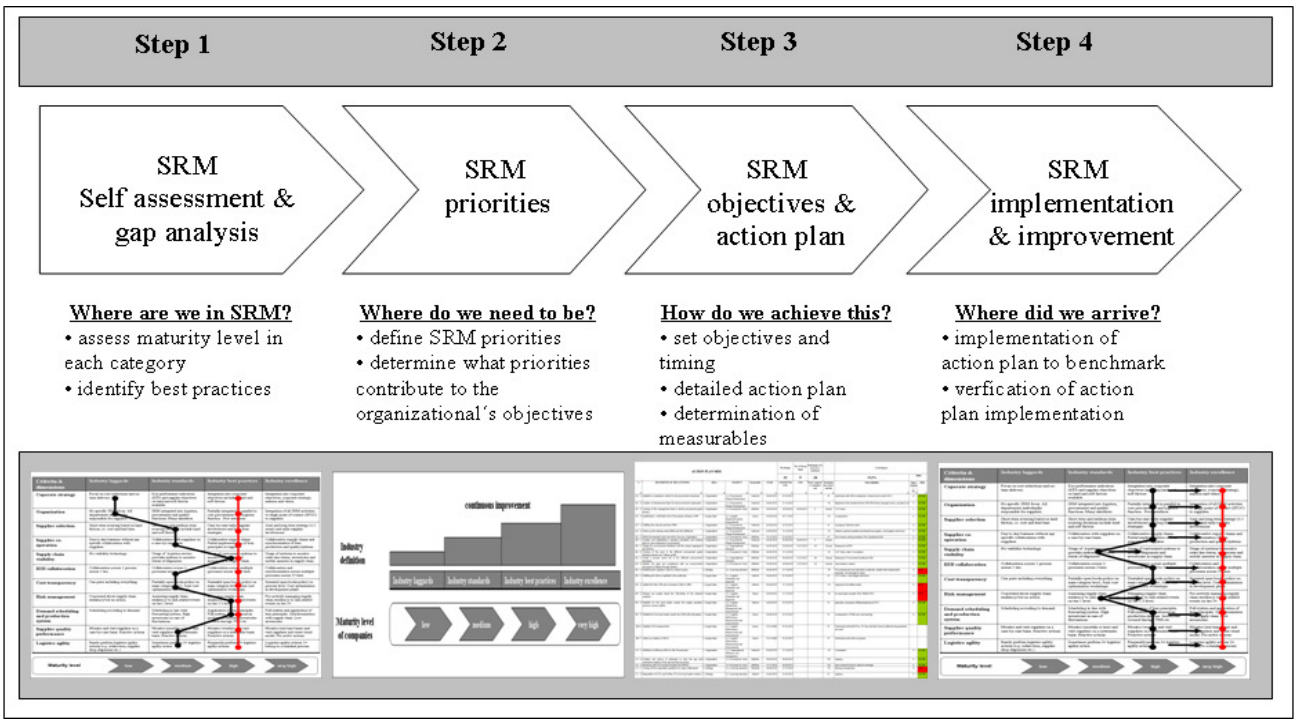
Figure 8-5: SRM assessment (example of Bombardier Hennigsdorf)



Source: best practice elements assessment (black).

Chapter eigth has been used to refine the above mentioned best practice elements and to establish a best practice model referring back to the original research questions and objectives of the study. With minor deviations, the best practices were confirmed. In addition to this, maturity levels could be defined from the research, taking literature and managerial practice into account. The thirteen best practices were integrated into the maturity matrix and described in accordance with the respective patterns, behaviour and characteristics. The outline of best practices and maturity levels was used for developing a framework and best practice model, including initial assessment, setting of priorities, defining objectives and action plan, and implementation and improvement to the next level.

Figure 8-6: Best practice model of SRM: a framework for manufacturing companies



Source: outcome of the research: best practice model in SRM including four steps.

8.2 Limitations to the best practice model and framework

This section has been used to discuss limitations to the work and how these limitations have influenced the scope of objectives, methods employed and extent of primary research. The most important limitations are the industry itself and the number of interviews and sample sizes involved. Qualitative research methods, including a systematic literature review, interviews and case studies, were selected as suitable methods for this study. Quantitative methodologies were not used, since they were considered less suitable for the research in SRM. Nevertheless, quantitative measures revealed additional best practice elements and made contributions to the developed model. The scope

of the research is limited to certain phases of the value stream, tiers and supplier networks. In an ideal world, the work might have been improved by involving more interviewees than only ten. Even though Yin and other authors recommend small samples in terms of case studies and interviews, a larger scope would undoubtedly have added more data (Yin, 2009; Remenyi et al., 2003). The research was limited to manufacturing companies and the transportation industry, which in itself was a further restriction. Although the empirical part of this research included a multiple and qualitative approach, the established best practice model in SRM was not implemented in managerial practice. A recommendation for further research would therefore be the implementation of the model at a manufacturing company in the selected industry. This might be within Bombardier or another company. The following chapter will present a clear and logical proposal for a plan which takes the above mentioned aspects and thoughts into account.

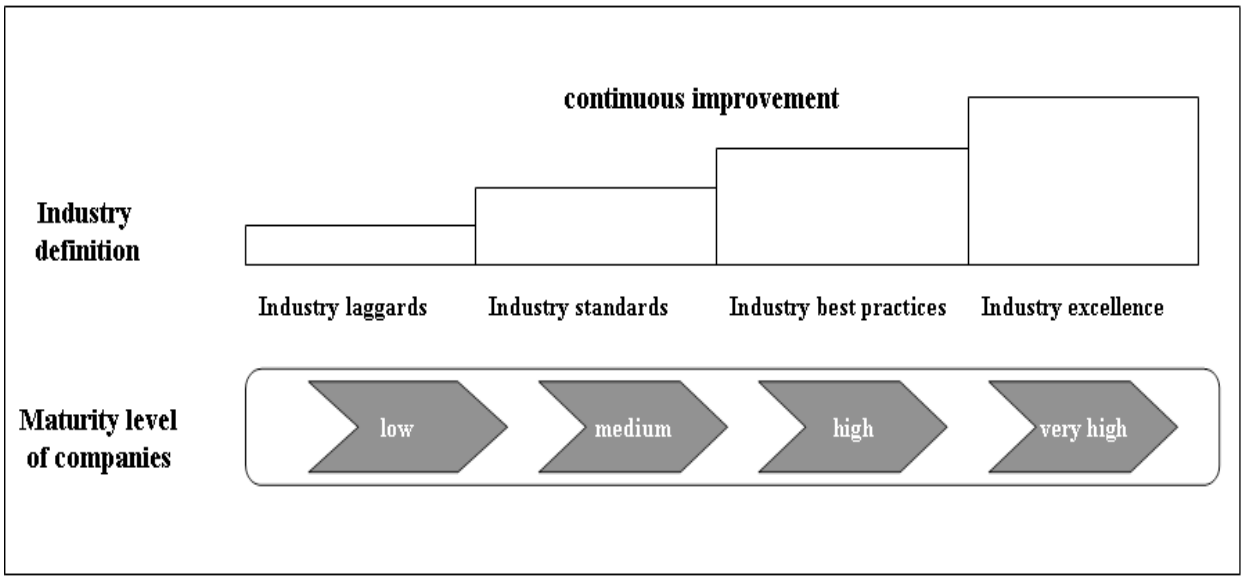
9. Conclusion and recommendations

9.1 Closing the gap in research and developing a best practice model of SRM

The research has contributed to identifying schools of thought, defining and classifying causal factors for supply chain disruptions and examining how supply chain disruptions can be anticipated, managed and prevented. As a result, it became possible to develop best practice elements of SRM. The systematic literature review identified three schools in SRM: (1) collaborative supply networks, (2) keiretsu supply networks, (3) complex adaptive supply networks. Whereas traditional paradigms consider the SRM function only as a peripheral function to ensure timely deliveries and lowest possible cost (Bennet & O'Kane, 2006; Behrendt, 1995), the three identified schools consider SRM as a strategic tool for avoiding supply disruptions (Gürtler & Spinler, 2010). The relationships are based on trust and partnerships and include a set of proactive principles in SRM (Bozhard et al., 2003). Even though the literature review identified three schools of thought in SRM, the majority of companies involved in the research mainly aimed for a collaborative approach. In just a few cases, companies had a keiretsu-focused approach with their supply network. The classification of risk factors and causes for supply disruptions into external (macro risks like natural disasters) or internal (micro risks like internal supply chain vulnerability) raised the question of how to anticipate these incidents and what an early warning system would look like (Aberdeen group, 2006; Gürtler & Spinler, 2010). In the literature one finds numerous classifications of supply disruptions, as highlighted in the previous sections by the Aberdeen group (2006) and other authors. The research also showed how mature organizations are and how these manufacturing enterprises manage their supplier relationships in order to anticipate and avoid supply disruptions. By addressing the three research questions from I to III, best practice elements in SRM were identified, categorized and finally refined (as part of question IV). Most of the elements emphasized proactive measures, tools and processes, but some also highlighted a reactive approach. The identified SRM best practices could be linked to certain patterns and behaviour forms found in manufacturing companies in the European transportation sector. These elements included: corporate strategy, organization, supplier selection, supplier co-operation, supply chain visibility, B2B collaboration, cost transparency, risk management, demand scheduling and production system, supplier quality performance, Supplier academy, global sourcing, and claims management. The research has made a significant contribution by defining best practice elements and establishing a best practice model, including the maturity levels and development steps from baseline to industry excellence for the identified elements and categories. Each best practice category was assigned to a certain maturity level: low (industry laggard), medium (industry standard), high (industry best practice), and highest (industry

excellence). This model will explicitly help manufacturing companies to determine where their own organization stands and what measures it takes to achieve a best practice or industry excellence level, as shown below. The model can be applied to manufacturing organizations in the relevant industry. Application and implementation will be explained later in this section (see figure 9-1).

Figure 9-1: Maturity levels of SRM best practices

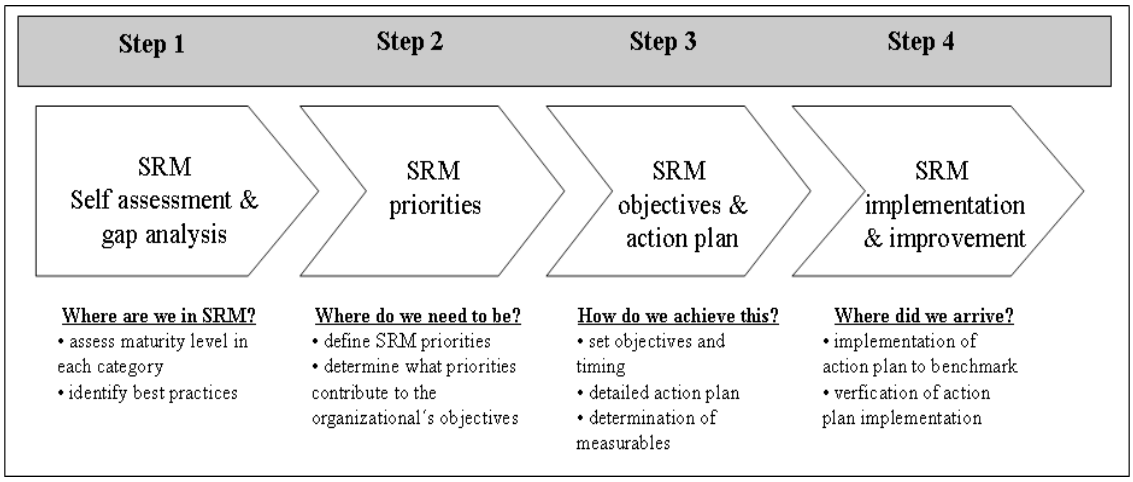


Source: own source: Maturity levels for SRM best practice.

With regard to the research and the developed best practice model there are certain limitations. Limitations include the industry itself as well as the fact that the interviews were only conducted in multinational manufacturing companies in the European transportation industry. The best practice elements and established model have not yet been implemented in managerial practice, so this has to be proved via separate research. Based on a request by managerial practice and science to develop such a model, the proposed framework is meant to be a guideline in SRM with a focus on proactive measures. In this context, action research (AR) has not been considered, but it may be a suitable qualitative and interventionist approach for further research in this area. AR was developed during the 1960's and is considered to be a powerful tool in today's academic and business environments, as stated by several authors (Reason & Bradbury, 2001). French and Bell (1978) defined it as: "… the process of systematically collecting research data about an ongoing system relative to some objective, goal or need of that system, feeding these data back into a system, taking action by altering selected variables within the system based on the data and on hypotheses, and evaluating the results of the actions by collecting more data." AR is an interventionist approach involving small-, medium-

or large-scale intervention on the part of the researcher into the phenomenon under study (Remenyi et al., 2003). AR could be suitable for further research in SRM. AR has the advantage that it contributes to knowledge which can be applied and validated in action (Gummesson, 1991). The present doctoral thesis considers a number of areas for further research in SRM and supply networks. The best practice model needs empirical confirmation and validation. In this context, a logical plan for further scrutiny would be to implement the best practice elements and the model in a manufacturing company of the respective industry in order to prove their relevance for managerial practice. A manufacturing site would have to be selected, either within Bombardier Transportation or the industry, in order to apply the following steps: "Where are we in terms of SRM?", "Where do we need to be?", "How do we achieve this?" Figure 9-2 shows Steps 1-4 of the best practice model.

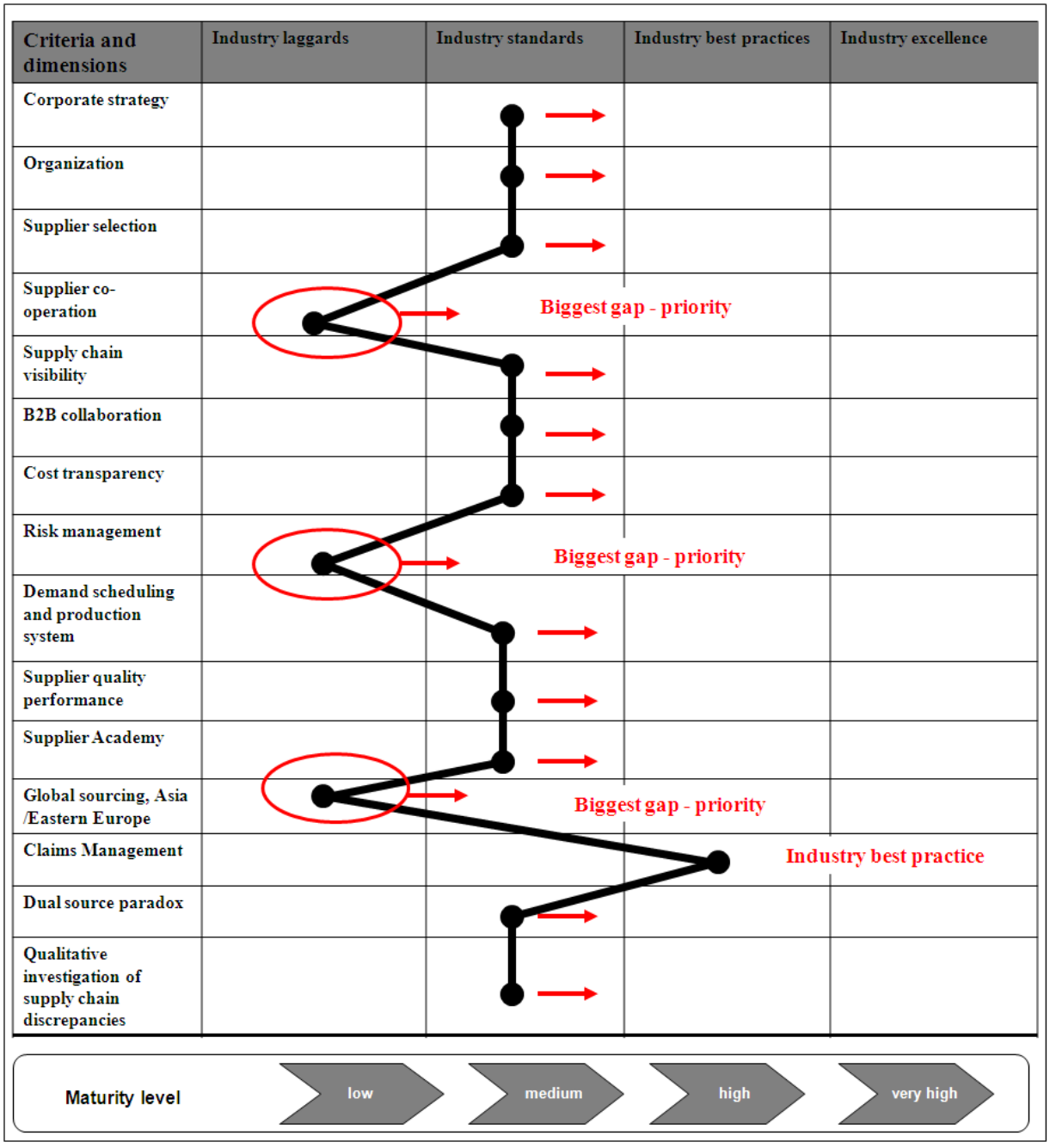
Figure 9-2: Sequence for SRM assessment and logical action plan



A manufacturing site, e.g. Siegen (Germany), Crespin (France), Derby (UK), could be assessed to ascertain the extent to which best practice elements are installed (Step 1). Self-assessment or assessment by auditors would result in a gap analysis of SRM best practices. The assessment could be carried out via an audit by senior experts in SRM and would last for a period of three to four months. Based on the assessment of each category, a plan would be made, including actions and implementation timing. The implementation could be realized with an interventionist approach and would probably take six to twelve months. The assessment would comprise priorities and development areas (step 2), as shown in the figure on the next page. A crucial part of the assessment would be to evaluate each best practice element in relation to its maturity level (i.e. industry laggards to industry best practice) with the ultimate aim of achieving the highest maturity level of industry excellence (step 3). The assessment has to incorporate the 13 identified best practice elements, as shown in Figure 9-3. The black line (-) shows the assessment as part of the developed best practice

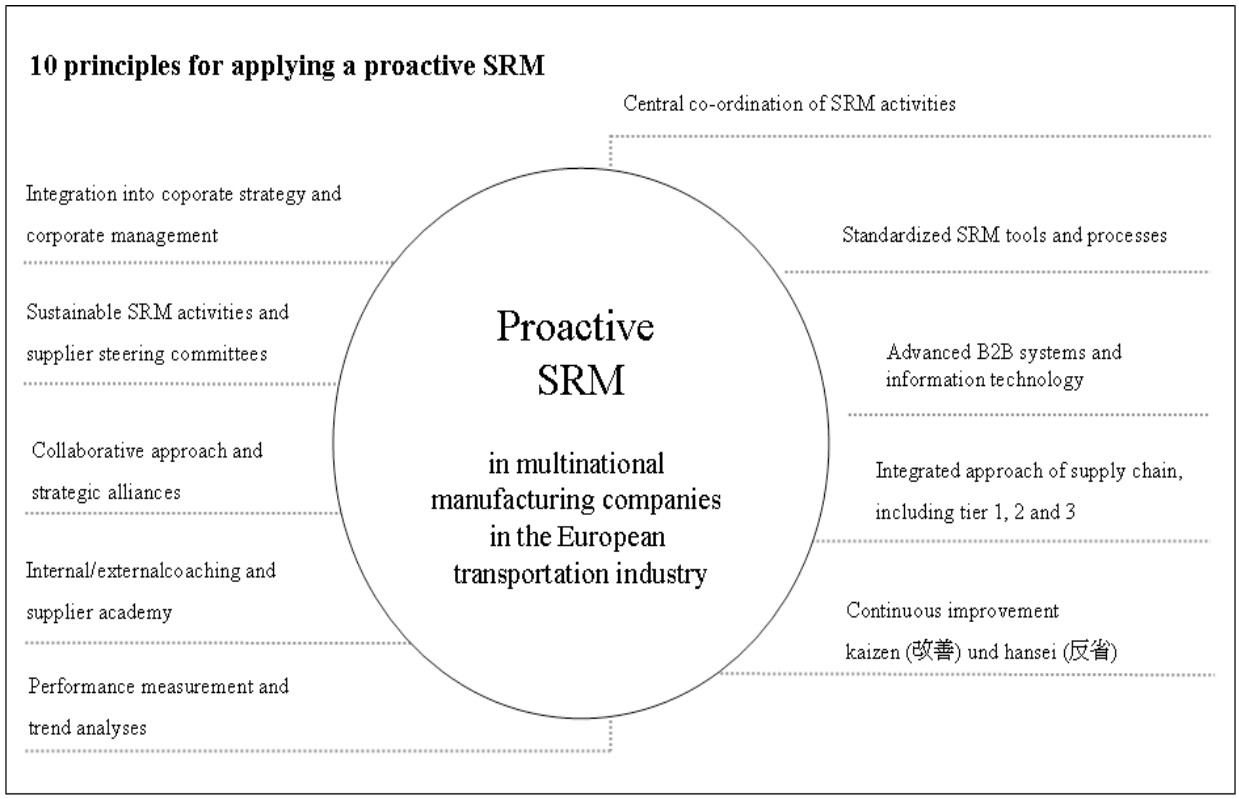
framework. After assessment of each category in terms of maturity level, a clear and logical plan should be made to implement the best practices in the companies, as shown by the red line (-) in the same figure. Priorities should be assigned to the lowest maturity levels as shown in the figure. The figure shows in three categories there is is a low maturity and gap towards best practice and industry excellence. The implementation of actions needs monitoring, adjustment or improvement of the plan if necessary (step 4). Best practice elements with a high maturity must also be considered in an action plan, but not as priority.

Figure 9-3: Striving for excellence in SRM: maturity levels



Whereas certain practices like the introduction of SRM principles into corporate strategy might last longer and trigger resistance within corporate management, other principles could be executed in a shorter time frame. Resistance may also arise due to the fact that the collaborative and the keiretsu models consider suppliers as equal partners with the same rights (Bozhard et al., 2003). Traditionalists are not yet treating suppliers as equal partners at this stage (Behrendt, 1995). Moreover, resources would be required to establish SRM functions, which could be rejected due to budgetary constraints and restrictions. The interviews in Phase II revealed that best practice companies assign former line functions to the role of an SRM manager, since these persons have the necessary experience for dealing with the supply network on a tier one, tier two and tier three basis. After a final review, the results of the action research could be used for further refinement of the best practice model in SRM. Another area of research might be to evaluate the application of the best practice model in other industries, e.g. manufacturing companies in the electronics or machinery industry. Perhaps the service industry would also be of interest for confirming or disconfirming the best practice model in SRM. Especially industries or companies which have outsourced a large scope of their products to global supply networks would benefit from such research in SRM and supply networks. In conclusion, it is evident that proactive SRM requires a subset of principles:

Figure 9-4: Best practices in SRM including maturity levels



Source: own source, adapted from several sources.

The principles can be described as follows: 1) SRM best practices are focused on a multilayer approach, involving not only tier one, but also tier two and three levels; 2) SRM has to be integrated into the management and strategy of the company. Proactive SRM can only be introduced and executed if the corporate objectives are communicated and cascaded throughout the organization; 3) advanced and innovative SRM has standardized tools and processes; 4) SRM best practice companies have sophisticated B2B platforms in terms of quality, cost and delivery; 5) SRM activities have to be sustainable and oriented long-term; 6) SRM requires a collaborative approach, including strategic alliances with suppliers. Such activities should be organized centrally; 7) proactive SRM can be compared with a key account manager in terms of being a single point of contact for the supplier (customer); 8) performance indicators have to be mutually agreed upon and may comprise both hard and soft factors. The assessment process should consist of quality, cost, delivery and technological criteria; 9) the Supplier academy should, among other things, be characterized by the capability and competencies of coaching suppliers; 10) all the above mentioned principles should be combined with a philosophy of continuous improvement to achieve a best practice model in SRM. Companies that want to distance themselves from their competitors through best-in-class SRM must implement the ten principles and adopt a collaborative approach in dealing with their supply base. Appropriate management of one's supply base can lead to competitive advantage.

9.2 Personal professional reflection and future research

In summary, one can say that the research journey so far has been very exciting, especially if one adopts a metacognitive approach, as recommended by Moon (2004). According to Bolton, reflection is only effectively undertaken and grasped by becoming immersed in doing it rather than reading about it or following instructions (Bolton, 2004; p. 4). He adds that "reflective practice is a process of learning and developing". Looking back at three to four years of research, the author sometimes wonders how he managed to combine doctorate, work and family during this time. Moreover, a crucial change from being a positivist to becoming a pragmatic interpretivist and the understanding that quantitative methods in research are less flexible have influenced this study journey significantly. Authors like Pawson (2006), Yin (2009) and Remenyi et al. (2003) point out that quantitative methods are less suitable and less accurate than qualitative methods. Quantitative methods are based on different assumptions about the nature of truth (epistemology) and reality (ontology). Whereas the author started as a positivist with a tendency towards quantitative research, he came to realize during the first months of the doctorate that objectivity in SRM and supply networks is hard to achieve and that selected variables are subjective, too (Pawson, 2006). The world can be seen as a social and human construct. Consequently, supply networks are subjective as well.

Nevertheless, it should not be forgotten that a large number of practitioners still base their SRM performance on quantitative factors, e.g. quality, delivery. Nevertheless, inflexibility of quantitative methods had a strong influence on methodology and ontology. Keeping a diary has been a useful tool so far for recording experience during the study journey. It enhances critical thinking and thus questions beliefs, attitudes and patterns relating to the research topic. A diary also helps one to reflect on and select appropriate methodologies and methods (e.g. case study approach, interviews). It documents the learning process and evolution of research by establishing a role model for SRM and is an ideal tool for reflecting on the past, present and future (Fink, 2010). Nevertheless, the author also incorporated other issues that supported the research, like discussions with family members, colleagues, experts and other people. Finally, a diary enhances problem-solving skills and enables people to explore themselves. Reflecting on the past 36 to 48 months, it is apparent that time and one's perception of it have taken on a different meaning. Time is probably the most important resource with regard to combining a doctorate with work and family. Another essential part of the achievement has been the ALS and the exchange within the group. A core team of members of the ALS have continuously exchanged views, ideas and beliefs concerning the research. This has helped to complete the requisite milestones on time. Moreover, the journey encouraged the author to undertake further reading and research in SRM and supply network management. Indeed, the reserarcher was induced to publish articles and books on the relevant topics and findings. Meanwhile, three books on the research topic are available in the bookshops and online libraries. Up to now, he has published about 15 articles in various magazines and procurement journals in three languages:

- Supply Chain Management - Institute for Production Management
- Supply Chain Management Europe
- Journal of Lean Thinking
- Inside Supply Management (ISM)
- Technik und Einkauf
- Procure.ch (Swiss Procurement Association)
- Beschaffung aktuell (German Procurement Association)
- Industrieportal
- FM Logistik
- Institut for Logistik and Dienstleistungen (ILD)

In addition, the author has become a part-time lecturer at two universities (THM and FOM), where he teaches principles of supply management, SRM and logistics. Even though, financially speaking, teaching is not as beneficial as working in industry, he may continue this after acquisition of the doctoral degree (DBA). The future outlook is not yet clear in terms of professional and academic objectives. As the author sees potential benefits from doing further research in SRM and supply networks, he is considering applying for a professorship after graduation. On the other hand, consultancy and AR might also be of interest in professional life. Recently, a question has arisen concerning the most important contributions of this field to life, research and society. This question will also influence the future. In conclusion, one can say that change was and is part of the research and the author's life, including patterns, beliefs and philosophical standpoints. The main question within this research focuses on "What should a best practice model in SRM look like?" and "Why do certain criteria contribute to such a system?". These are areas for additional research. Further examination could be in connection with SME in the respective industry, other regions (China, India) or other sectors. Research could possibly be extended to other industries other than manufacturing companies in the European transportation industry. The future will show when and where the research journey continues.

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Appendix 1: Supply disruptions from 2000-2012

Year	Description	Source
2012	Delays of deliveries from 133 Stadler KISS trains due to missing homologation of certain modules and parts.	Becker, 2012
2012	SBB delay caused by late design completion and supply delays by Bombardier in 2013.	Witwer, 2012
2012	Supply disruptions from sub suppliers to Hitachi cause a significant delay in train-building project in England for the first highspeed trains.	Odell & Pickard, 2012
2012	Highspeed trains to the Deutsche Bahn are delayed by Siemens and Bombardier due to software issues.	Böhler, 2012
2011	Thailand´s 2011 flooding caused production standstills in several Honda factories including the Honda UK SWINDON manufacturing site.	Chongvilaivan, 2011
2011	Deficient electrical parts caused passengers to stay in Alstom Eurostar train overnight.	Haslett, 2011
2011	China's new high-speed rail plagued by power outages caused by malfunctioning electrical appliances and overvoltage.	Jing, 2011
2010	Honda recalls 437,000 cars due to potential faults in airbags. Airbag supplier faced quality problems.	Grant, 2010
2009/2010	World-wide recalls for major car lines by Toyota due to defective component and systems supplier (floor mats).	Connor, 2010
2008	Module and component supplier Plastech went into receivership (Chrysler). This led to temporary shutdown of Chrysler factories.	Trkman & McCormack, 2009
2007	Toyota Motor Corporation halted production in all Japanese factories due to an earthquake that severely damaged Riken as the major parts supplier.	Blackhurst, 2008
2005	EADS faces a huge drop in the stock value and cost exceeding million 500 US$ as the supply of harnesses is disrupted by a supplier.	Schmidt & Ranman, 2012
2001	Ford Motor Company spent 2.1 million USD to replace defective tires from Firestone. 14.4 million tires were recalled.	Kumar, 2001
2000	Lightning caused a fire that shut down the Philips semiconductor factory in Albuquerque, thus causing shortages of components for several industries.	Tomlin, 2006

Supply disruptions in manufacturing companies from 2000 until 2012

Appendix 2: List of articles published in magazines and journals

Date	Title	Language	Magazine
2013/02	Management. Lieferantenregression. Leistungsstörungen in der Lieferkette.	German	Beschaffung aktuell
2012/09	Claim-Management in der Praxis. Leistungsstörungen in der Lieferkette.	German	Procure
2012/06	Leistungsstörungen frühzeitig beheben.	German	Logistik heute
2012/02	Praxis: Leistungsstörungen im Lieferantenmanagement.	German	All about sourcing
2011/12	Schlanke Lieferketten.	German	All about sourcing
2011/11	Schriftenreihe Logistikforschung. Schlanke Prinzipien im Lieferantenmanagement.	German	Instute for Logistics and Services (ild)
2011/11	Suppliers and Demand. Claims management.	English	SCM Europe
2011/11	Launch Management. Lean Principles in the Strategic Supplier Management.	English	SCM-IPM
2011/09	Transposition durables des principles des la production allegee de la chaine du livraison..	French	Procure
2011/08	Lean Principles in the Upstream Supply Chain Management.	English	SCM Europe
2011/08	Wettbewerbsvorteile im Upstream Supply Chain Management durch die nachhaltige Übertragung von schlanken Prinzipien.	German	Procure
2011/07	Upstream Supply Chain Management. Schlanke Lieferketten.	German	M + Q
2011/05	Driving value in the upstream supply chain management through applying lean principles.	English	Journal of lean thinking
2010/10	Supply Chain Management. Integratives Lieferantenmanagement in der Automobilindustrie.	German	SCM-IPM
2010/10	Erschließung von Kostenpotenzialen durch ein voraus-schauendes und integratives Lieferantenmanagement.	German	Technik u Einkauf
2010/08	Lieferantenmanagement, Automobilindustrie. An den Kunden denken.	German	Beschaffung aktuell
2010/08	Supply Chain Management. Erschließung von Kostenpotenzia-len im Einkauf in der Automobilindustrie.	German	Procure
2010/06	Supply Chain Management. Erschließung von Kostenpotenzia-len im Einkauf durch ein.	German	Procure
2010/06	Supply Chain Management. Driving Maximum Value through Supply Relationships.	English	ISM
2010/06	Strategisches Lieferantenmanagement. Potenziale im Auge.	German	M u Q
2010/03	Supply Chain Management. Supply Relationships.	English	SupplyManagement

Appendix 3: Results of Phase I interviews

	Function	Senior Director of Global Supplier Quality Assurance	Head of Logistics and Production Control	Director of Supplier Relationship Management	Head of Supplier Performance Management	Director of Supplier Quality Assurance and Quality
1.	What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks? This question was added after the second interview	Collaborative	Collaboration	Partnership oreinted	Based on trust and partnership	Collabroative
2.	What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe?	- Non-compliance of processes and tools in supplier development - Missing resources	- Disrupted supply chain - Capacity issues - Waste in chain	- Non compliance of tools in terms of supplier approval and readiness	- Reactive measures - Fire fighting - Missing roles and responsibilities	- Inmature design, therefore FAI´s that are not meeting final requirements - Inexperience of BT quality people
3.	How can supply disruptions be anticipated, managed and prevented?	- Pro-active measures - SEAP, PAP and QBRs process within procurement as part of supplier selection	- Joint logistics concept - Early supplier selection - Clear logistics protocol - Lean production system	- Pro-active measures - Tool and process compliance - Resources (1 supplier manager for 3 - 5 suppliers)	- Warning system - Proactive masures - Clear responsibilities with SPM as lead and single contact	- Pro-active measures - Tool and process compliance
4.	What are the best-practice elements of SRM in manufacturing companies in the European tranpsortation industry?	- Pro-active approach in terms of monitoring quality, delivery and financial health - supplier quality assurance through supplier evaluation and approval process (SEAP), first article inspection (FA) and parts approval process (PAP) in procurement - hierarchy incl. QBRs.	- SPM team created - Monitoring of suppliers - WEB based tools for quality/deliveries	- Best-practice elements within BT sites - Level 1 to 4 to achieve excellence - Pro-active approach in procurement	- Monitoring quality performance, logistics and financial health (SFA) - Low performance measurement (LPSM) - Business critical (BCL) - Qualification tools like supplier evaluation and assessemnt process (SEAP)	- Combination of supplier quality and supplier development - Supplier development within procurement contractually and pro-active - supplier quality assurance through first article inspection (FA) abd production approval process
1.	How to avoid supply disruptions through SRM?	- Usage of production part apporval process (PAP) including required tools	- IT systems synchronized - Flexible delivery schedules - Standard logistics protocol - Elimination of waste	- Low performance supplier monitoring (LPSM) for local and global suppliers - Measurement through sites	- Low performance supplier monitoring (LPSM) - Early supplier involvement during selection and production approval process	- Co-operation of supplier quality, procurement and incoming goods - Launch activities deeper focusing on quality
2.	How to recognize supply disruptions at an early stage?	- LPSM - Early warning system - cross functional teams	- Early warning system - Back order meeting - Advanced quality planning and excecution	- PAP/FAI - Early warning system - cross functional teams	- Early warning system - Back order meeting - Advanced quality planning and excecution	- PAP/FAI - Early warning system - cross functional teams
3.	How is SRM linked to the corporate strategy?	- Group, division and part of site management - In Site Continous Improvement Plan (SCIP) - Top Management attention necessary	- SPM in PROC as part of the site general management team or in logistics - Escalation = quick actions - Part of the Balanced Score Card (BSC) of site	- Part of site management - In Site Continous Improvement Plan (SCIP)	- SPM in PROC as part of the site general management team or in logistics - Escalation = quick actions - Part of the Balanced Score Card (BSC) of site	- Part of site management - In Site Continous Improvement Plan (SCIP) - Depending on outsourcing activities
4.	What are the values and policies on SRM?	- Detailed in terms of measuring performance - Fair - Preventive - Logical - Improvement focused	- Facts based - Fair internally and externally - Partnership and long-term supplier oriented - In the event of contineous malfunction change of suppliers - Corporate social responsibility	- Openess - Fair - Pro-active - Logical - Improvement focused	- Transparent - Fair - Preventive - Logical - Improvement focused	- Transparent - Fair - Preventive
5.	How is SRM organized?	- Part of the site management team - Reporting to CEO via division and group	- Within procurement as separate function or by the line buyers - Ideal world: single point of contact	- Procurement Director - Commodity specialized SPM employees - technical/commercial focus	- Own head in proc. - Commodity specialized SPM employees - technical/commercial focus	- Part of the site management team
6.	Who is responsible for SRM?	- Supplier performance within Procurement	- Within procurement as separate function or by the line buyers - Ideal world: single point of contact	- Supplier performance within Procurement	- Supplier performance within Procurement	- Supplier performance within Procurement
7.	How are information systems used for SRM?	- WEB tool like in other sites - Suppliers can see their own values and have to confirm quality actions or on-time-delivery	- Central tool - Forecast models and trend analyses are crucial - Focus on quality and delivery - minimum NCGs & OTD - Ideally WEB based	- WEB tool - Suppliers can see their own values and have to confirm quality actions or on-time-delivery	- WEB tool - Suppliers can see their own values and have to confirm quality actions or on-time-delivery	- SAP and Web based methodologies -Suppliers can see their own values and have to confirm quality actions or on-time-delivery
8.	How is SRM performance measured?	- Soft and hard factors incl. Innovativeness, willingness to introduce lean methods etc.	- Soft and hard factors incl. Innovativeness, willingness to introduce lean methods etc.	- Soft and hard factors incl. Innovativeness, willingness to introduce lean methods etc.	- Soft and hard factors incl. Innovativeness, willingness to introduce lean methods etc.	- Soft and hard factors incl. Innovativeness, willingness to introduce lean methods etc.
9.	What are the key performance indicators (KPI) for SRM?	1. NCGs/Fied errors 2. OTD 3. Financial analysis 4. Reaction time (8D reports) 5. Other factors	1. NCGs 2. OTD 3. Field performance 4. Reaction time and flexibility	1. NCGs/Fied errors 2. OTD 3. Financial analysis 4. Reaction time (8D reports) 5. Other factors	1. NCGs/Fied errors 2. OTD 3. Financial analysis 4. Reaction time (8D reports) 5. Other factors	1. Quality, serial und field quality 2. OTD 3. Financial analysis 4. Reaction time (8D reports)
10.	How are SRM activities adding value?	- Qualified people help to add value through preventive measures and activities - Contact to suppliers	- Focus on value added processes - Elimination of waste - Lean processes - Qualified people	- Qualified people help to add value through preventive measures and activities - Contact to suppliers	- Qualified people help to add value through preventive measures and activities - Contact to suppliers	- Qualified people help to add value through preventive measures and activities - Contact to suppliers

Appendix 4: Phase I question list for research questions validation

University of Gloucestershire
Marc Helmold

Doctorate of Business Administration (DBA)

Interview Questions:

Name:

Function:

Date:

1 What are the best-practice elements and development steps of SRM in manufacturing companies in the European transportation industry?
2 What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe?
3 How can supply chain disruptions be anticipated, managed and prevented?

---

1. How can supply disturbances and disruptions by avoided at an early stage by means of SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to the corporate strategy and integrated in corporate management??
4. What are the values and policies on SRM?
5. How is SRM organised?
6. Who is responsible for SRM?
7. How are information systems used for SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How are SRM activities adding value

Additional aspects which have to be taken into account

Appendix 5: Phase II question list after adjustment of research questions

University of Gloucestershire — Doctorate of Business Administration (DBA)

Marc Helmold

Interview Questions: Name:

Function:

Date:

I. What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint?

II. What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe? Can you give examples?

III. How can supply chain disruptions be anticipated, managed and prevented? Can you give examples?

IV. What are the best-practice elements and development steps of SRM in manufacturing companies in the European transportation industry? Can you give examples?

---

1. How can supply disturbances and disruptions by avoided at an early stage by means of SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to the corporate strategy and integrated in corporate management?
4. What are the values and policies on SRM?
5. How is SRM organised?
6. Who is responsible for SRM?
7. How are information systems used for SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How are SRM activities adding value?

If I could get you to think about what we've discussed, what would you think is the most important aspect?

Additional aspects which have to be taken into account

University of Gloucestershire — Doctorate of Business Administration (DBA)

Appendix 6: Bombardier Procurement guide 2011

BT Procurement Guide 2011

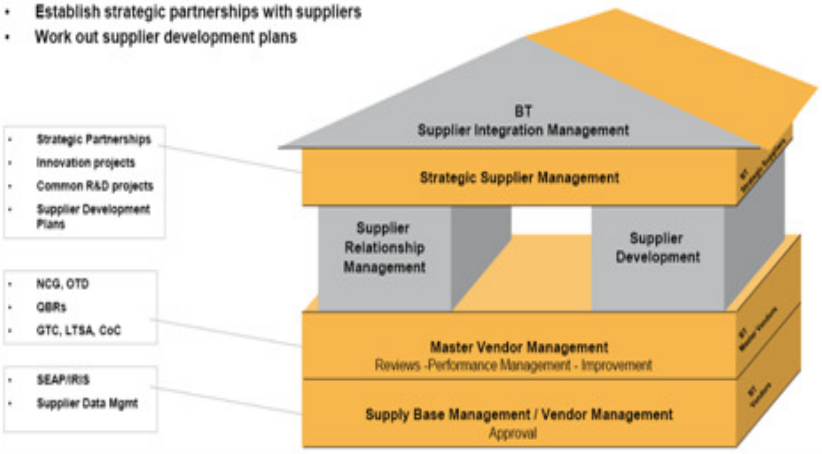
GRP-20-25-00-005250 rev01
Berlin, April 2011

BOMBARDIER

Optimise our supply chain and actively manage our risks

Supplier Integration Management

- Improve flawless execution by
  - Segmentation of Supply Base and focus on key suppliers
  - Management of supply chain risks and performance
  - Implementation of standard approval processes
  - Refreshed commodity strategies
- Support development of innovative, environmentally conscious products by
  - Expand BT's CSR standards on main suppliers
  - Establish strategic partnerships with suppliers
  - Work out supplier development plans



BOMBARDIER

Appendix 7: Case study questions in Phase III

Interview Questions: Name:

(anonymous)

CASE: Function:

Date:

CASE STUDY APPROACH (PATTERNS MATCHING)

---

1. How is SRM integrated into the corporate strategy? Why?
2. How is SRM organized? Why? Based on what criteria was the supplier selected?
   Why did you apply these criteria?
3. Who has been involved in the selection process? Why was the supplier
4. How is the co-operation with the supplier?
5. What is the level of supply chain (tier 1, 2 and 3) visibility?
6. What is the level of B2B collaboration? What systems are used in which way? Why?
7. What is the level of cost transparency?
8. How do you proceed risk management? Are there contingency plans available?
9. How are demands scheduled and how is production levelled out to the supplier?
10. What quality performance indications are measured on quality? Why?
11. What is the extent of logistics agility? How many changes do you have? Why?
12. How is the supplier trained to understand the customer specifics in terms of SRM.
    Who is doing the training? What areas? Do you know the expression learning organization?
11. Do you have global sourcing activities? n In what areas? What regions?
13. Do you have a claims management? Why? How does it look like?

Any additional aspects of importance for this research?

Appendix 8: Patterns matching results from Victall case in Phase III

Victall case study SRM best practies and patterns	Description of best practices and patterns	Level of matching
Corporate strategy	Integration of SRM into corporate strategy and corporate management. Corporate objectives including hard and soft factors exist and are continually measured.	●
Organization	SRM is integrated into core procurement and logistics function. There are only few interfaces to the suppliers.	●
Supplier selection	Supplier selection is executed systematically through commodity strategies on the basis of audits and qualification. Case-by-case early supplier involvement and long-term strategies.	●
Supplier co-operation	Collaboration throughout the supply chains. Partial implementation of lean principles at suppliers for key commodities.	▲
Supply chain visibility	Usage of web-based and customized systems to monitor shipments and inventories in supply chain.	●
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	X→▲
Cost transparency	Detailed open-books policy on main category level. Joint cost optimization workshops.	●
Risk management	Managing supply chain resilience to risk-related events on tier 1-3 level.	▲
Demand scheduling and production system	Application of lean principles. Pull system in place, but autonomous and separate production systems. Inventories covered through VMI or smart logistics concepts.	▲→●
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions and follow up activities.	●
Supplier academy	Needs and training internally available. Supplier development and coaching on a case-by-case basis.	▲→●
Global sourcing	SRM pursued by SRM managers. Case-by-case involvement of other functions. LCCS offices support home base organization.	●
Claims management	Suppliers are claimed in a systematic way. Performance is measured based on specific and neutral criteria, e.g. incoming quality or on-time delivery; contractual governance is available.	●
Level of confirmation or disconfirmation of SRM best practices through case study anaylsis		
Full confirmation:	Pattern matching technique shows full confirmation	●
Partial confirmation:(additional comments)	Pattern matching technique shows partial confirmation	▲
Disconfirmation:	Pattern matching technique shows no or only partial confirmation	X

Appendix 9: Patterns matching results from Jupiter case in Phase III

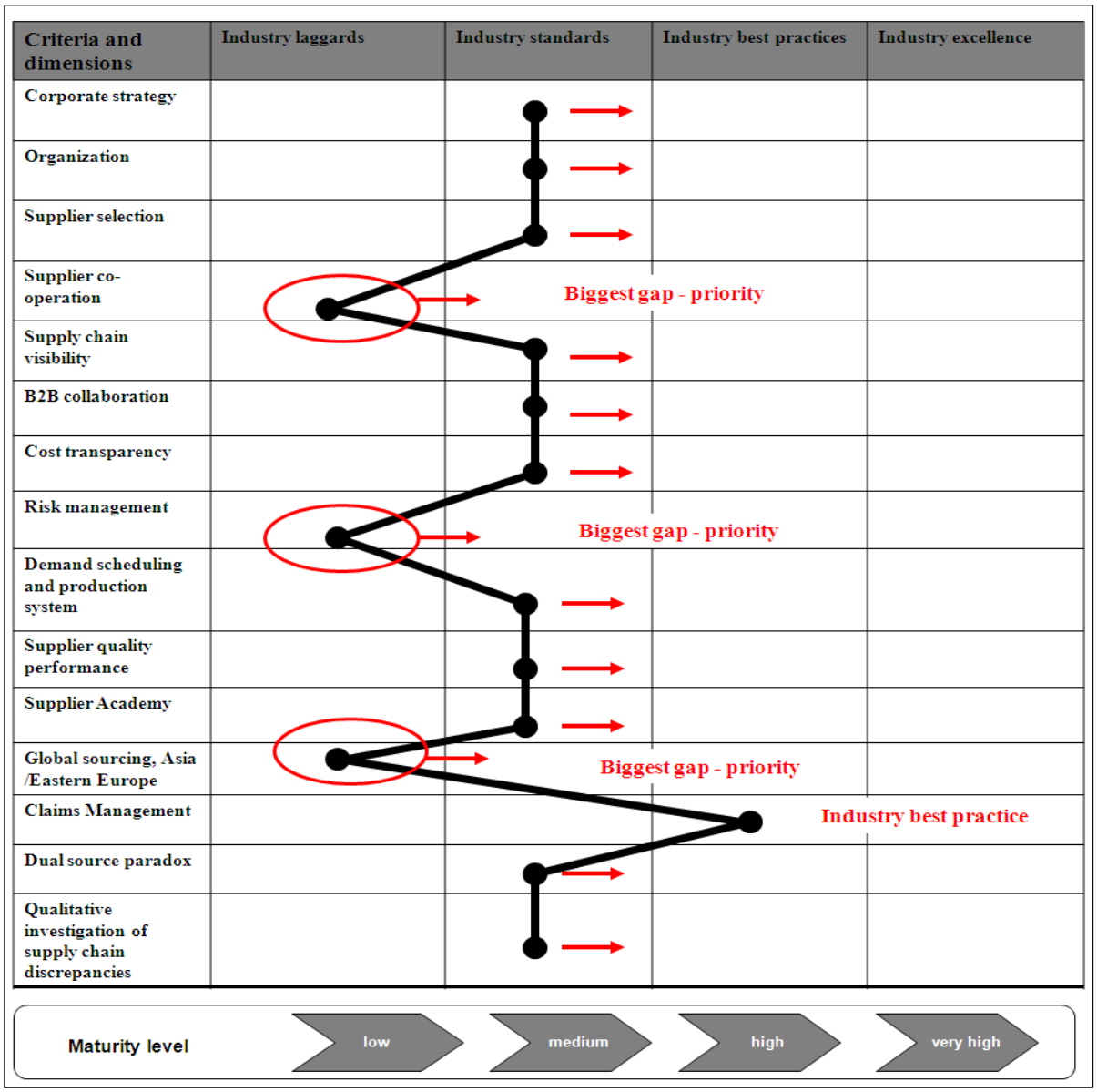
Jupiter case study SRM best practies and patterns	Description of best practices and patterns	Level of matching
Corporate strategy	Integration of SRM into corporate startegy and corporate management. Corporate objectives including hard and soft factors exist and are continually measured.	●
Organization	SRM is integrated into core procurement and logistics function. There are only few interfaces to the suppliers.	●
Supplier selection	Supplier selection is executed systematically through commodity strategies on the basis of audits and qualification. Case-by-case early supplier involvement and long-term strategies.	●
Supplier co-operation	Collaboration throughout the supply chains. Partial implementation of lean principles at suppliers for key commodities.	●
Supply chain visibility	Usage of web-based and customized systems to monitor shipments and inventories in supply chain.	▲→●
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	▲
Cost transparency	Detailed open-books policy on main category level. Joint cost optimization workshops.	●
Risk management	Managing supply chain resilience to risk-related events on tier 1-3 level.	●
Demand scheduling and production system	Application of lean principles. Pull system applied, but autonomous production systems. Inventories covered through VMI or smart logistics concepts etc.	▲
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions and follow up activities.	▲→●
Supplier academy	Needs and training internally available. Supplier development and coaching case-by-case.	▲
Global sourcing	SRM pursued by SRM managers. Case-by-case involvement of other functions. LCCS offices support home base organization.	n.a.
Claims management	Suppliers are claimed in a systematic way. Performance is measured based on specific and neutral criteria, e.g. incoming quality or on-time delivery; contractual governance is available.	●
Level of confirmation or disconfirmation of SRM best practices through case study anaylsis		
Full confirmation:	Pattern matching technique shows full confirmation	●
Partial confirmation:(additional comments)	Pattern matching technique shows partial confirmation	▲
Disconfirmation:	Pattern matching technique shows no or only partial confirmation	X

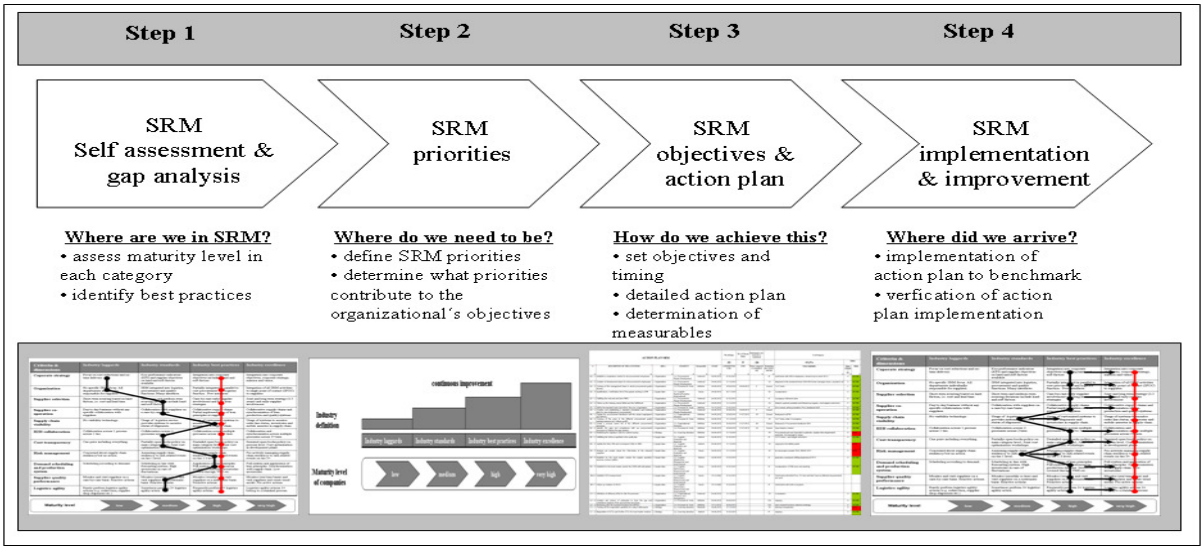
Appendix 10: Patterns matching summary

Summary of case studies SRM best practies and patterns	Description of best practices and patterns	Victall Level of matching	Jupiter Level of matching	Confirmation, disconfirmation and refinement
Corporate strategy	Integration of SRM into corporate strategy and corporate management. Corporate objectives including hard and soft factors exist and are continually measured.	●	●	Confirmation
Organization	SRM is integrated into core procurement and logistics function . There exist only few interfaces to the suppliers.	●	●	Confirmation
Supplier selection	Supplier selection is executed systematically through commodity strategies on the basis of audits and qualification. Case-by-case early supplier involvement and long-term strategies.	●	●	Confirmation
Supplier co-operation	Collaboration throughout the supply chains. Partial implementation of lean principles at suppliers for key commodities.	▲	●	Slight refinement necessary
Supply chain visibility	Usage of web based and customized systems to monitor shipments and inventories in supply chain.	●	▲→●	Confirmation
B2B collaboration	Collaboration across multiple processes across 2 to 3 tiers.	X →▲	▲	Disconfirmation, partial confirmtion refinement necessary
Cost transparency	Detailed open books policy on main category level. Joint cost optimization workshops.	●	●	Confirmation
Risk management	Managing supply chain resiliency to risk-related events on tier 1-3 levels.	▲	●	Slight refinement necessary
Demand scheduling and production system	Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI or smart logistics concepts etc.	▲→●	▲	Slight refinement necessary
Supplier quality performance	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions and follow up activities.	●	▲→●	Slight refinement necessary
Supplier academy	Needs and training internally available. Supplier development and coaching case-by-case.	▲	▲	Refinement necessary
Global sourcing	SRM pursued by SRM managers. Case-by-case involvement of other functions. LCCS offices support home base organization.	●	n.a.	Confirmation
Claims Management	Suppliers are claimed in a systematic way. Performance is measured based on specific and neutral criteria, e.g. incoming quality or on-time delivery; contractual governance is available.	●	●	Confirmation

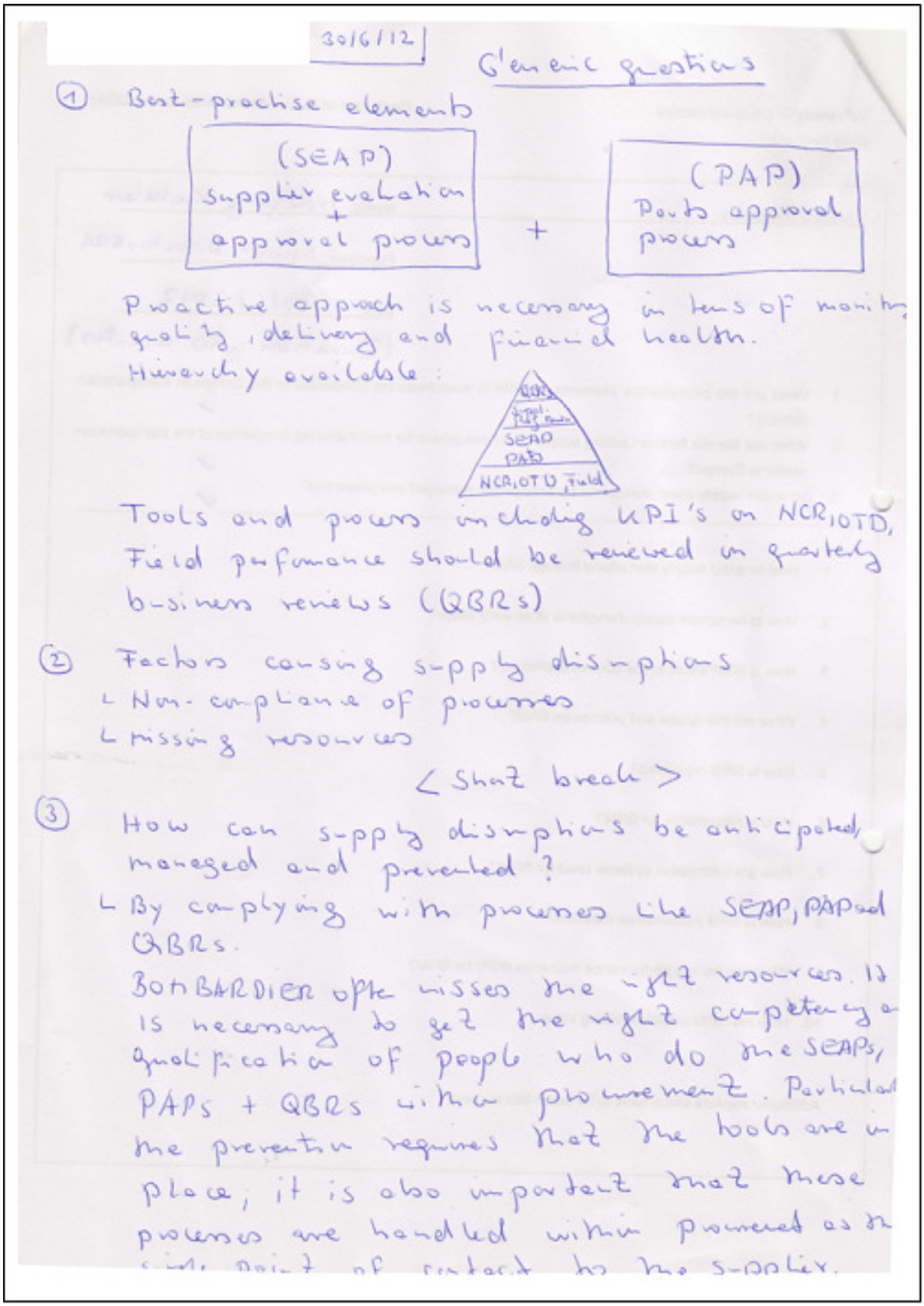
Level of confirmation or disconfirmation of SRM best practices through case study anaylsis		
Full confirmation:	Pattern matching technique shows full confirmation	●
Partial confirmation:(additional comme	Pattern matching technique shows partial confirmation	▲
Disconfirmation:	Pattern matching technique shows no or only partial confirmation	X

Appendix 11: Best practice model in SRM





Appendix 12: Phase I: Extract from question list from candidate 1



30/6/12

Generic questions

① Best-practise elements

(SEAP) supplier evaluation + approval process + (PAP) Parts approval process

Proactive approach is necessary in terms of monitoring quality, delivery and financial health.

Hierarchy available:

Tools and process including KPI's on NCR, OTD, Field performance should be reviewed in quarterly business reviews (QBRs)

② Factors causing supply disruptions
- Non-compliance of processes
- missing resources

< Short break >

③ How can supply disruptions be anticipated, managed and prevented?
- By complying with processes like SEAP, PAP and QBRs.

Both BARDIEN opte misses the right resources. It is necessary to get the right competency & qualification of people who do the SEAPs, PAPs + QBRs within procurement. Particular the prevention requires that the tools are in place, it is also important that these processes are handled within procurement as the single point of contact to the supplier.

Appendix 13: Article extract from SCM Magazine

Launch Management – Lean Principles in the Strategic Supplier Management

Marc Helmold, Bombardier Transportation

Summary

The purpose of this paper is to outline the needs to apply and transfer lean principles for developing ideal supply networks. It was believed by various experts from industry and academia that current supply network were possibly showing waste and non adding value activities in certain process steps due to severe and costly supply disruptions in recent years. This paper will be helpful to academics and practitioners who work both with supply networks and supplier relationship management (SRM) and with current purchasing and SRM practices. Reduced manufacturing depths lead automatically to higher dependencies on suppliers and supply networks. Although numerous companies already introduced lean principles, these techniques have not yet been rolled out to the upstream supply chain. Lean principles must be a integral part of the strategic supplier management. Companies can thus differentiate and gain the egde over their competitors. Studies and empirical data show that the transfer of lean processes to the supply network lead to significant advantages in terms of quality, cost and delivery performance.

Upstream Supply Chain Management

Recent trends like the increasing outsourcing activities, the ongoing globalization and the increased activities towards the concentration on core competencies have led to more and more complex supply interdependencies. The activities carried out by the organisation itself regularly account for only 20 percent to 30 percent of its total performance. As a result, supplier relationship management (SRM) and supplier network management have become more important in peripheral business areas. With the increased dependency on supplier networks as shown in Figure 1, companies have also aggravated a huge amount of risk considerably towards the upstream supply chain. The picture shows the supply chain in the area of suppliers and customers.

This fact is also emphasized by Hendricks & Singhal (2008), who identified that enterprises without operational slack and redundancies in their supply chains experience negative stock effects. They showed in the quoted articles the tremendous impacts of supply chain risk disruptions on stock price performance and shareholder value. Their studies show that such disruptions can lead to an abnormal stock price return of minus 40 percent. The typical challenges and issues raised in the existing literature are very similar and raise amongst others the following important questions:

- How to avoid supply disruptions through supplier management?
- How are supplier network activities adding value?
- What are critical success factors of keiretsu supply networks?

Surveys and empirical data point out that there is still a gap in practice, the role of SRM and the application of lean and other principles to multi-layer supply network [Dust/Helmold 2009].

Value adding activities consist in many companies of about 20-30 percent. Original equipment manufacturers

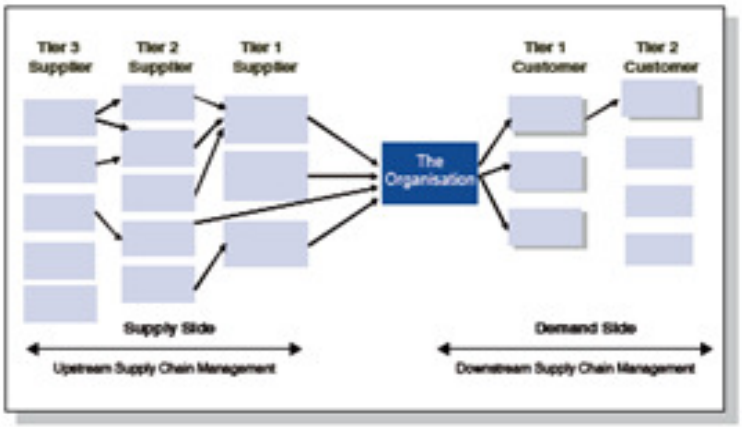


Figure 1: Upstream Supply Chain Management

Appendix 14: Supplier evaluation (PASE)

Panasonic	Supplier Evaluation Criteria's					Date:	151.2009
	PAS Europe					Page:	1 of 1
Main Criteria	Sub Criteria		Rating	Points (max)		Remark (tim. / respons.)	
QUALITY	IQC Lot out ratio		5 = 0 Lot out	5	40	Monthly evaluation	PASCZ IQA
			0 = 1 and more				
	0km rejects		5 = 0 rejects	5			
			0 = 1 and more rejects				
	Actual PPM vs. QTA		10 = in QTA target	10			
			9 = by 10% out of target				
			8 = by 20% out of target				
			7 = by 30% out of target				
			6 = by 40% out of target				
			5 = by 50% out of target				
			4 = by 60% out of target				
			3 = by 70% out of target				
			2 = by 80% out of target				
			1 = by 90% out of target				
			0 = by 100% out of target				
	Initial Response		3 = within 1 working day	3			
			2 = within 2 working days				
			1 = within 3 working days				
			0 = up to 3 working days				
	8D completion		3 = in time	3			
			2 = 1 working day delay				
			1 = 2 working days delay				
			0 = up to 2 working days delay				
	Repetion of failures		5 = No	5			
			0 = Yes				
	R/E, A/I (C suppliers); Weekly con-call (B suppliers); Stable or decreasing monthly PPM trend (A,AB suppliers)		1 = Yes	1			
			0 = No				
	Certificate of conformity (A,AB,B,C suppliers)		1 = Yes	1			
			0 = No				
	In-process and OQA data (A,AB,B,C suppliers)		1 = Yes	1			
			0 = No				
	Improvement plan (A,AB,B,C suppliers)		1 = Yes	1			
			0 = No				
	Quantity 8D reports per month (Field rejects)		5 = 0 field rejects	5			PASE SQA
			3 = 1 field reject				
			0 = more than 1 field reject				
COST	Cost Discipline	Price stability -keeping stable prices during FY -compliance with CD Agreements -proactive development of CD Roadmap	4 = outstanding	10	25	Evaluation every 6 months	PASE Advanced Purchasing
			3 = very good				
			2 = good				
			1 = acceptable				
			0 = bad				
		Technical changes -Suitability of Cost up/down for changes -Tech. Changes plausible & acceptable	2 = good				
			1 = acceptable				
			0 = bad				
		Price transparency -Transparency of calculation -Supplier willing to do "open book" policy - Cost Increments detailed and plausible	4 = outstanding				
			3 = very good				
			2 = good				
			1 = acceptable				
			0 = bad				
	VE activities	Pro-activity with regard to CD ideas, - Generation of ITA KONA ideas - Optimization of Product Development - Production Transfer - Tool Optimization - Red. of Logistics Cost .	5 = outstanding	10			
			4 = very good				
			3 = good				
			2 = acceptable				
			1 = bad				
			0 = very bad				
		Contribution to PASE cost down activity - Results of Cost Down Activities - Proportion Expense - Result - Initiation of CD Ideas, Workshops etc. - Implementation of CD Activities	5 = outstanding				
			4 = very good				
			3 = good				
			2 = acceptable				
			1 = bad				
			0 = very bad				
	Communication and Co-operation	Communication and co-operation - Availability of contact persons - Adherence of dates/Reaction time - Openess and flow of information	3 = good	5			
			2 = acceptable				
			1 = bad				
			0 = very bad				
		Flexibility in negotiations - Willingnesses of making compromises - Speed of Negotiation and Decision	2 = good				
			1 = acceptable				
			0 = bad				
DELIVERY	On time delivery		20 = 0-1 day delay	20	35	Evaluation every 3 months	PASCZ Procurement
			10 = 2-3 days delay				
			0 = 4 and more days delay				
	Logistic nonconformities		5 = all required documents attached to shipment (correct PO #; P/N; all necesary data for customs formalities; bar code where is required; no +/- qty)	5			
			2 = missing correct documents for customs formalities and receiving activities				
			0 = QTY +/-; missing PO; P/N; country of origin; Terms of delivery				
	VMI (consignment stock; JIT deliveries) in case Panasonic requested		5 = yes	5			
			0 = no				
	Co-operation (on time response)		5 = within 2 days	5			
			0 = after 2 days				
TOTAL *					100		
Additional Adjustments *:	Missing ISO 9001				-5		PASCZ
	Missing ISO 14001				-5	Evaluation	Purchasing
	ISO/TS16949 certified				+5	every 6 months	Planning
	Critical customer quality problem				-40		QA

Appendix 15: Summary of interviews from Phase II (I-IV)

		1	2	3	4	5
Doctor in Business Administration (DBA) Phase II interviews summary		**Siemens**	**MELCO**	**MAN**	**BMW**	**PCS**
I.	What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex	- Collaborative and keiretsu supply networks	- Keiretsu supply networks for majority of systems	- Collaborative and keiretsu supply networks	- Collaborative and keiretsu supply networks	- Collaborative and keiretsu supply networks
II.	What are risks and causal factors for supply disruptions?	1. Global chains 2. Insolvencies 3. Disasters	1. subsupplier issues 2. Globalization 3. Disasters, floods or earthquakes (Fukushima)	1. Global supply chains 2. subsupplier issues 3. Quality issues	1. Natural disasters (earthquake Italy) 2. Insolvencies 3. Global suppliers	1. Globalization 2. Turmoil 3. Quality issues
III.	How can supply disruptions be anticipated, managed and prevented?	1. Global accessibale monitoring system 2. KPI (hard and soft) 3. Strategic focus	1. Close and permanent monitoring, based on suitable KPI	1. KPI 2. Stable design 3. Early involvement	1. Dual sourcing 2. Active launch management 3. SRM	1. Concurrent launch 2. Monitoring system 3. Close ties to suppliers
IV.	What are the best-practice elements of SRM in manufacturing companies in the European tranpsortation industry?	1. Partnerships and long-term focused 2. Global web-based tool for supplier performance 3. Exchange of personnel	1. Manage total business (360 degrees) 2. Measure and shape supplier performance 3. Keiretus relationships, in	1. Global network and global offices 2. Task forces (proactive and reactive)	1. Dual sourcing 2. Back office and front office 3. Global network and global offices	1. New SRM approach 2. Strong relationships with key suppliers

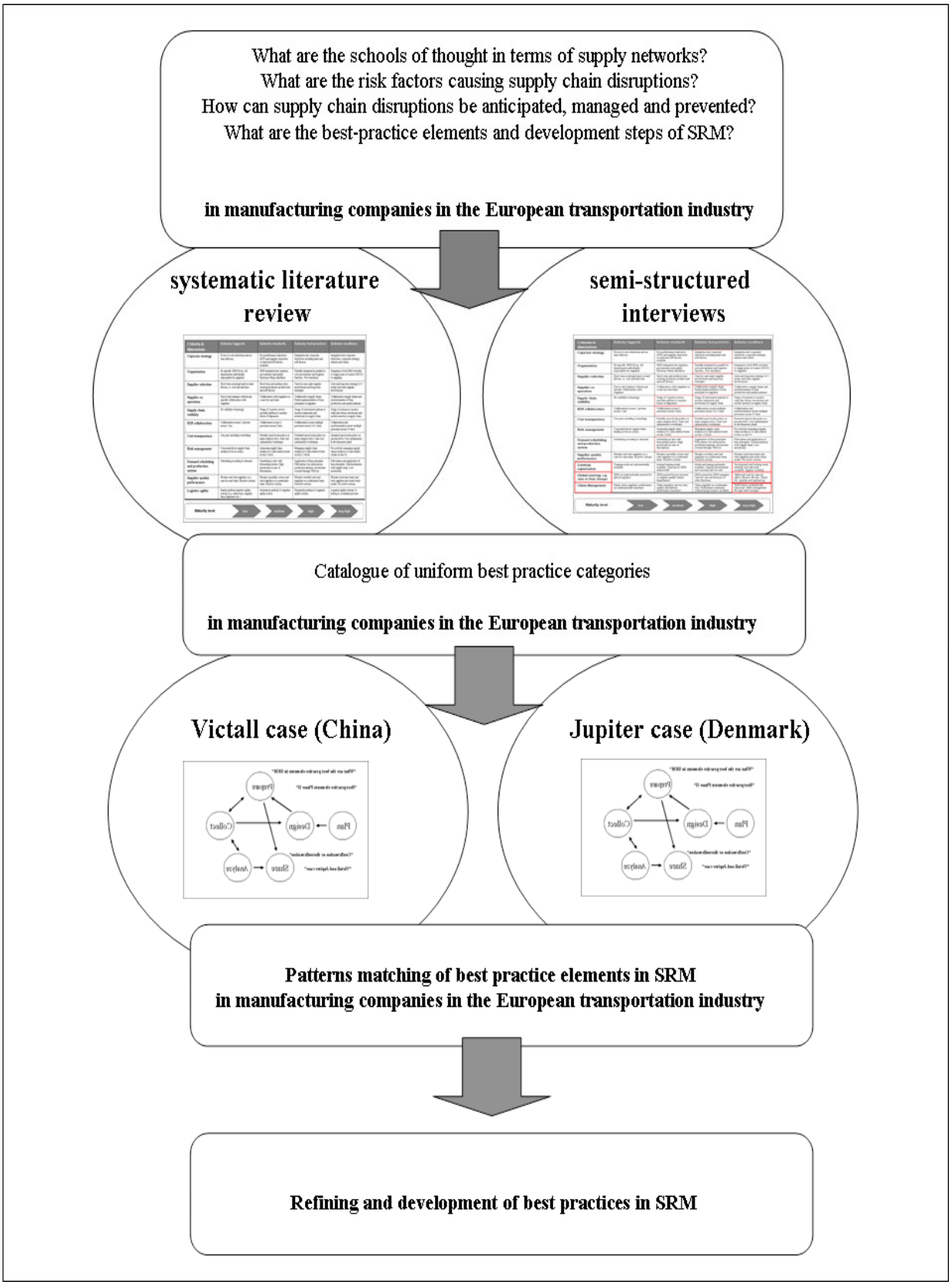
		6	7	8	9	10
Doctor in Business Administration (DBA) Phase II interviews summary		**ZF**	**Thales**	**Train Manufacturer**	**PASE**	**Alstom**
I.	What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as	- Collaborative supply networks	- Collaborative supply networks	- Collaborative supply networks	- Keiretsu supply networks	- Collaborative and keiretsu supply networks
II.	What are risks and causal factors for supply disruptions?	1. Globalization 2. Arab spring 3. Quality issues	1. Globalization 2. Political issues and conflicts in Africa 3. Quality issues	1. Globalization and intransparent supplychains 2. Disasters 3. Quality issues	1. Global & complex supply chains 2. subsupplier issues 3. Disasters (flood)	1. Global & complex supply chains 2. subsupplier issues 3. Disasters (flood) 4. Technical discrepancies
III.	How can supply disruptions be anticipated, managed and prevented?	1. X-functional supplier evaluation at sites 2. Monitoring system 3. Regurlar monitoring	1. SRM KPIs 2. Early launch management 3. SCM visibilit	1. Realiable KPI 2. SCM visibility	1. Strong ties (Keiretsu 2. Synchronized production systems 2. Global SCM visibility	1. Evaluation/trend analysis 2. Active launch management 3. Dual sourcing
IV.	What are the best-practice elements of SRM in manufacturing companies in the European tranpsortation industry?	1. New SRM academy and learning organization 2. Strong relationships with key suppliers 3. Global qualification	1. Supplier selection at early stage 2. Strong relationships with key suppliers 3. Global supply networks	1. Selection at early stage 2. Alliances with key technology 3. Global supply networks beyond tier 1, 2 & 3	1. Selection at early stage 2. Alliances with key technology 3. Global supply networks beyond tier 1, 2 & 3	1. Supplier evaluation system (Q-C-D-SF) 2. Strong relationships 3. Strategic alliances

Appendix 16: Summary of interviews from Phase II (1.-10.)

		1	2	3	4	5
	Specific questions	**Siemens**	**MELCO**	**MAN**	**BMW**	**PCS**
1.	How to avoid supply disruptions through SRM?	1. Evaluation system 2. Early involvement of suppliers 3. View beyond tier 1	1. 360 degrees from the beginning of projects 2. Clear assessments	1. Supplier assessments 2. Joined launch management including tier one workshops 3. Responsibility of tier ones for their supplier management	1. Dual sourcing 2. Task force with front office	1. Evaluation and performance system 2. Early involvement of suppliers 3. SCM visibility
2.	How to recognize supply disruptions at an early stage?	1. Evaluation system 2. Early involvement of suppliers 3. View beyond tier 1	1. 360 degrees from the beginning of projects 2. Clear assessments	1. Evaluation and performance system 2.Supplier visits	1. Evaluation and performance system 2.Supplier visits	1. Evaluation and performance system 2. Early involvement of suppliers 3. SCM visibility
3.	How is SRM linked to the corporate strategy?	1. Part of management	1. Closely linked to corporate board	1. Closely linked to corporate board 2. Objectives of SRM in BSC	1. CPO 2. Objectives in BSC 3. In mission, vision	1. Closely linked to corporate board and management 2. Objectives of SRM in BSC
4.	What are the values and policies on SRM?	1. Standardized systems 2. Part of corporate strategy 3. B2B systems must be sophisticated 4. learning organization 5. collaborative approach	1. Standardized processes 2. KPI 3. Early supplier involvement 4. KAIZEN attitude	1. Cooperative approach 2. KAIZEN 3. B2B systems must be sophisticated 4. learning organization 5. collaborative approach	1. Standardized processes 2. KPI 3. Early supplier involvement	1. Standardized processes 2. KPI 3. Early supplier involvement
5.	How is SRM organized?	1. Procurement	1. Procurement 2. Strong relationships through procurement	1. Procurement in manufacturing sites 2. Task force	1. Procurement 2. Front office	1. Procurement
6.	Who is responsible for SRM?	1. Procurement	1. Procurement (in Japanese: koubai-bu)	1. Procurement/Purchasing	1. Procurement	1. Procurement
7.	How are information systems used for SRM?	1. Web-based tool accesible from all functions	1. Web-based including tier 2,3	1. Web-based	1. Web-based	1. Excel-based
8.	How is SRM performance measured?	1. monthly via B2B web-based tool 2. Q-C-D-SF-Technology	1. Real-time basis 2. Q, C and D - also based on experience of suppliers	1. Real-time basis	1. Real-time basis	1. Paper-based; monthly or less for selected criteria
9.	What are the key performance indicators (KPI) for SRM?	1. Quality 2. Delivery/logistics 3. Technology 4. Cost	1. Quality 2. Delivery/logistics 3. Technology 4. Cost	1. Quality 2. Cost / financial performance 3. Logistics	1. Quality NCG/Field defects - also soft factors 2. On-time delivery 3. Innovatiness	1. Quality NCG 2. On-time delivery
10.	How are SRM activities adding value?	1. Customer satisfaction 2. Elimination of waste 3. Customer is willing to pay, or not willing to pay for supply	1. Customer satisfaction 2. Elimination of waste	1. Customer satisfaction 2. Elimination of waste 3. Customer is willing to pay, or not willing to pay for supply	1. Integral part within BMW, therefore adding value to key processes	1. Partially adding value

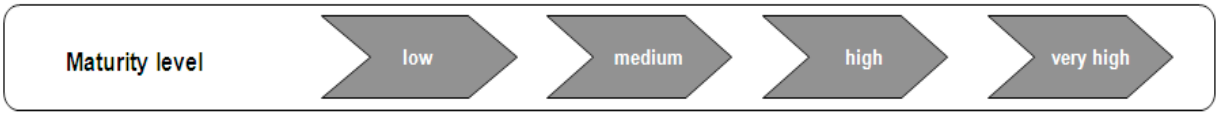
		6	7	8	9	10
	Specific questions		**Thales**	**Manufacturer**	**PASE**	**Alstom**
1.	How to avoid supply disruptions through SRM?	1. Evaluation and performance system 2. Early involvement of suppliers 3. SCM visibility 4. Strategic alliances	1. Evaluation system 2. Early supplier involvement 3. Concurrent engineering and milestones	1. Evaluation system 2. Early supplier involvement	1. Evaluation and performance system , based on hard KPI 2. Early supplier involvement 3. Keiretsu approach for key modules 4. VMI (European-based VMI	1. Evaluation system 2. Early supplier involvement
2.	How to recognize supply disruptions at an early stage?	1. Evaluation and performance system 2. Early involvement of suppliers 3. SCM visibility 4. Strategic alliances	1. Evaluation system 2. Contingency plans 3. Dual sources for "golden parts"	1. Evaluation and performance system 2. Early involvement of suppliers 3. SCM visibility	1. Evaluation system with trends	1. Evaluation and performance system 2. Early involvement of suppliers 3. SCM web-based prortal
3.	How is SRM linked to the corporate strategy?	1. Member of board including departments and objectives	1. Part of the strategy	2 Strategy in SRM 2. Top management support	1. Corporate focus of SRM	1. Closely linked to corporate board and management 2. Objectives of SRM in BSC
4.	What are the values and policies on SRM?	1. Standardized processes and tools 2. Part of corporate strategy 3. B2B systems must be sophisticated 4. learning organization	1. Standardized processes 2. KPI 3. Early supplier involvement	1. Standardized processes and tools 2. Part of corporate strategy 3. B2B systems must be sophisticated 4. learning organization	1. Standardized evaluation systems 2. KPI 3. Early supplier involvement 4. KAIZEN attitude 5. Contribution to customer	1. On all levels represented, group and sites
5.	How is SRM organized?	1. Purchasing 2. Strong relationships through procurement	1. Procurement	1. Procurement	1. Purchasing or logistics	1. Procurement
6.	Who is responsible for SRM?	1. Procurement	1. Procurement	1. Procurement	1. Procurement	1. Procurement
7.	How are information systems used for SRM?	1. Web-based 2. Portal for supplier academy	1. Web-based 2. Sophisticated B2B systems for tier one level	1. Web-based	1.Excel-based	1. Web-based
8.	How is SRM performance measured?	1. we+I8b-based protal: real-time basis	1. portal through internet	1. Excel based - only if business criticality is there, quarterly in QBR with	1. Excel-based, monthly basis	1. Excel based - only if business criticality is there, quarterly in QBR with
9.	What are the key performance indicators (KPI) for SRM?	1. Quality 2. Cost 3. Logistics	1. Q-C-D-SFH	1. Q-C-D-SF	1. Quality, hard and soft 2. Delivery/logistics 3. Cost 4. CSR	1. Quality, hard and soft 2. Delivery/logistics 3. Cost 4. CSR
10.	How are SRM activities adding value?	1. Customer satisfaction 2. Elimination of waste 3. Customer is willing to pay, or not willing to pay for supply disruptions	1. Driving suppliers to customer goals, therefore adding vallue	1. SRM to be set up	1. Customer satisfaction 2. Elimination of waste	1. Customer satisfaction 2. Elimination of waste

Appendix 17: Case study approach and sequence



Appendix 18: Best practice elements in SRM

Criteria and dimensions	Industry laggards	Industry standards	Industry best practices	Industry excellence
Corporate strategy	Focus on cost reductions and on-time delivery.	Key performance indicators (KPI) and supplier objectives on hard and soft factors available.	Integration into corporate objectives including hard and soft factors.	Integration into corporate objectives, corporate strategy, mission and vision.
Organization	No specific SRM focus. All departments individually responsible for suppliers.	SRM integrated into logistics, procurement and quality functions. Many interfaces.	Partially integrated in parallel to core procurement and logistics function . Few interfaces.	Integration of all SRM activities to single point of contact (SPOC) to suppliers.
Supplier selection	Short-term sourcing based on hard factors, i.e. cost and lead time.	Short-term and medium-term sourcing decisions include hard and soft factors.	Case-by-case early supplier involvement and long-term strategies.	Joint and long-term strategy (3-5 years) and early supplier involvement.
Supplier co-operation	Day to day business without any specific collaboration with suppliers.	Collaboration with suppliers on a case-by-case basis.	Collaborative supply chains and partial implementation of lean principles at suppliers.	Collaborative supply chains and synchronization of lean production and quality systems.
Supply chain visibility	No visibility technology.	Usage of logistics service provider systems to monitor status of shipments.	Visisbility across tiers 1 & 2 supply chains to monitor shipments and inventories.	Visisbility across tier 1,2 & 3 supply chains to monitor shipments and inventories.
B2B collaboration	Collaboration across 1 process across 1 tier.	Collaboration across 2 processes across 2 tiers.	Collaboration across multiple processes across 2 to 3 tiers.	Collaboration and synchronization across multiple processes across 3+ tiers.
Cost transparency	One price including everything.	Partially open-books policy on main category level. Joint cost optimization workshops.	Detailed open-books policy on main category level. Joint cost optimization workshops.	Itemized open-books policy on process level. Cost optimization in development phase.
Risk management	Concerned about supply chain resiliency but no action.	Assessing supply chain resiliency to risk-related events on tier 1 level.	Managing supply chain resiliency to risk-related events on tiers 1 & 2 levels.	Pro-actively managing supply chain resiliency to risk-related events on tiers 1, 2 & 3.
Demand scheduling and production system	Scheduling according to demand.	Scheduling in line with forecasting system. High inventories in case of fluctuations.	Application of lean principles. Pull system, but autonomous production systems. Inventories covered through VMI etc.	Pull system and application of lean principles. Synchronization with supply chain. Low inventories.
Supplier quality performance	Monitor and visit suppliers on a case-by-case basis. Reactive actions.	Monitor (monthly or less) and visit suppliers on a systematic basis. Reactive actions.	Monitor (weekly) and visit suppliers on a systematic basis. Proactive actions.	Monitor (real time basis) and visit suppliers and create trend model. Pro-active actions.
Supplier Academy	Training needs not systematically available.	Internal training needs available. Training for SRM related staff.	Needs and training internally available. External needs visible. Supplier development and coaching case-by-case.	Development and training needs intenally and externally available. Supplier academy for development of suppliers.
Global sourcing, Asia /Eastern Europe	SRM not systematically pursued for global suppliers.	SRM pursued by procurement or supplier quality related departments..	SRM pursued by SRM managers. Case-by-case involvement of other functions.	SRM performed by regional offices (Eastern Europe, China) incl. Quality and engineering.
Claims Management	Rarely claim suppliers, performance not systematically measured.	Claim suppliers case-by-case, quality and delivery performance measured.	Claim suppliers in a systematic way. Performance measured, contractual governance available.	Performance systematically measured. Claims management through claims manager.
Dual source paradox	Rarely conducting risk assessments; no specific sourcing strategies in place.	Conducting risk assessments case by case; dual sourcing strategy in place case by case.	Systematic sourcing strategies. Dual sourcing strategies for selected components in place. Risk assessment case by case.	Systematic sourcing strategies. Risk assessment proactively done, dual sourcing strategies for selected components in place.
Qualitative investigation of supply chain discrepancies	Root cause analysis rarely done; assessment done by procurement or SRM related function.	Root cause analysis done in the event of issues; assessment done by procurement or SRM related function with related functions.	Root cause analysis of supply chain disruptions systematically and proactively measured after supplier selection. Cross-functional team in place.	Root cause analysis of supply chain disruptions systematically and proactively measured, action plan available before supplier selection. Cross-functional team.



Appendix 19: Phase II: Extract from question list from candidate ZF

University of Gloucestershire — Doctorate of Business Administration (DBA)

University of Gloucestershire — Doctorate of Business Administration (DBA)

Marc Helmold

ZF

Head of s-pplier

on: Developmen~

17/11/12

≈ 60 minutes

I. What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint?

ZF shives for a collaborative approach with the s-pply base; it parly implements lean principles in- to the s-pply chain including s-pplier workshops and the concentration on value adding activities; this means that 'waste' must be eliminated; The 3 major aspects can be summarized as follows:

(1) co-operative relationships

(2) transparency + openness

(3) collaborative management

S-pplier workshops are conducted by small teams and include topics on quality, workshops, 5S activities, these workshops are constraint driven.

II. What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe? Can you give examples?

There is a bunch of causal factors for s-pply disruptions; the major 3 elements + factors for ZF are:

(1) quality + technical requirements that are not met or missing

(2) => s-pply chain design + tools

(2) Logistics + production capabilities that are missing

(3) disasters (e.g. earthquakes)

(4) tier 2,3 constraints and shaky sub suppliers

(5) financial risks, financial stability

ur school of thought in terms of supply
adaptive systems viewpoint?
for manufacturing companies of the
rented? Can you give examples?
nent etepe of SRM in manufacturing
xamples?
of SRM?
of SRM?
rate management?
value to the organisation?
nk is the most important aspect?

Appendix 20: Phase I question list refining

Questionnaire before validation & amendment

University of Gloucestershire — Doctorate of Business Administration (DBA)
Marc Helmold

Interview Questions: Name:

Function:

Date:

1 What are the best-practice elements and development steps of SRM in manufacturing companies in the European transportation industry?
2 What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe?
3 How can supply chain disruptions be anticipated, managed and prevented?

---

1. How can supply disturbances and disruptions by avoided at an early stage by means of SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to the corporate strategy and integrated in corporate management??
4. What are the values and policies on SRM?
5. How is SRM organised?
6. Who is responsible for SRM?
7. How are information systems used for SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How are SRM activities adding value

Additional aspects which have to be taken into account

Questionnaire after validation & amendment

University of Gloucestershire — Doctorate of Business Administration (DBA)
Marc Helmold

Interview Questions: Name:

Function:

Date:

I. What are the beliefs, policies and values of your SRM? What is your school of thought in terms of supply networks, i.e. collaborative, keiretsu or supply networks as complex adaptive systems viewpoint?
II. What are the risk factors causing supply chain disruptions for manufacturing companies of the transportation sector in Europe? Can you give examples?
III. How can supply chain disruptions be anticipated, managed and prevented? Can you give examples?
IV. What are the best-practice elements and development steps of SRM in manufacturing companies in the European transportation industry? Can you give examples?

---

1. How can supply disturbances and disruptions by avoided at an early stage by means of SRM?
2. How to recognize supply disruptions at an early stage?
3. How is SRM linked to the corporate strategy and integrated in corporate management?
4. What are the values and policies on SRM?
5. How is SRM organised?
6. Who is responsible for SRM?
7. How are information systems used for SRM?
8. How is SRM performance measured?
9. What are the key performance indicators (KPI) for SRM?
10. How are SRM activities adding value?

If I could get you to think about what we've discussed, what would you think is the most important aspect?

Additional aspects which have to be taken into account

University of Gloucestershire — Doctorate of Business Administration (DBA)

Appendix 21: Appropriateness of research questions