How mature is your supply chain risk management? A self assessment model for supply chain risk management maturity

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ABSTRACT

Purpose

The aim of this paper is to develop a maturity model to quickly assess and to steadily improve a company's SCRM.

Design/methodology/approach

A literature review about existing SCRM maturity models indicates a research gap in this specific field. After identifying the current status of research the current status of practice has been analysed by conducting a survey as well as 33 expert interviews. Based on the results a SCRM maturity model was developed.

Findings

The survey's results show that there is still great potential for companies when carrying out their SCRM. During the expert interviews, best practices were identified and prioritized how SCRM should be implemented and how it should be designed when identifying, analysing/assessing, handling and controlling supply chain risks.
The SCRM maturity model consists of four maturity levels for 7 SCRM dimensions and of a catalogue of more than 100 measures to improve the SCRM. By answering a catalogue of statements for each dimension, the SCRM can be assessed and improvement measures are proposed to achieve a higher maturity.

Research limitations/implications

One limitation can be seen in the small number of companies in which the practical evaluation of the SCRM maturity model was conducted.

Practical implications

Companies can increase their competitiveness by identifying weaknesses when applying the SCRM maturity model.

Original/value

The underlying managerial problem is a lack of maturity models in the field of SCRM, which can be applied by a self-assessment.

Keywords: supply chain risk management, supply chain management, maturity model, self-assessment, measures, improvement.

1. INTRODUCTION

The topic supply chain risk management (SCRM) has gained in importance in both research and practice during the last years. Reasons for this can be found e.g. in the rising number of natural disasters or in the increasing interdependency of supply chain partners, which makes the whole supply chain network more vulnerable.

The growing awareness of supply chain risks has prompted companies to implement an adequate risk management. However, the implementation of SCRM does not guarantee the measures' success and efficiency. On the one hand, a method is needed how companies can self-assess their status quo and therewith the maturity of their SCRM. On the other hand, companies need best practices of SCRM measures from whom they can gain guidance or they need detailed recommendations how to improve their SCRM systematically.

A maturity model fulfills these demands (deBruin et al., 2005). Maturity models have been used within several areas for a long time, but only very few are targeting SCRM. For this reason, the purpose of the paper is to develop a SCRM maturity model to quickly assess and to steadily improve a company's SCRM.

At first, the theoretical background is provided for SCRM and maturity models. Afterwards, the research methodology for the empirical part is described. Subsequently, the empirical results of a conducted survey and expert interviews are presented. The survey results show the status quo of SCRM. During the expert interviews, the authors investigated the dimensions of SCRM maturity. In addition, best practices have been identified and prioritized how SCRM should be designed. Based on the empirical results a SCRM maturity model is developed. Finally, the paper finishes with conclusions and implications.

2. THEORETICAL FOUNDATIONS

2.1. Supply chain risk management

During supply chain operations, companies are often exposed to a large variety of potential risks to different degrees. Tummala and Leung (1996) for example differentiate between catastrophic, critical, marginal and negligible risks on the level of hazard severity, while Narasimhan and Sahasranam (2007) distinguish between strategic, tactical and operational risks on the planning level. In order to cope with this large variety of potential supply chain risks while pursuing supply chain goals, it is necessary to implement a SCRM. SCRM can be understood as "*a part of Supply Chain Management which contains all strategies and measures, all knowledge, all institutions, all processes, and all technologies, which can be used on the technical, personal and organisational level to reduce supply chain risk."*(Kersten et al., 2011, p. 157). Therefore, its main objective is to increase the transparency and robustness of processes and as a consequence to avoid any kind of supply chain disruptions (Tang, 2006).

The typical risk management process is based on the generic management process (e.g. see Terry, 1972) and encompasses the following steps: risk identification, analysis and assessment, handling (also called mitigation) and control. In the first step (identification), potential risks within the company and its supply chain are identified and classified. Afterwards (analysis and assessment), the gathered risks are analysed and assessed by indicating the likelihood of occurrence and the possible damage, and the risks are prioritized in preparation for the risk handling step. In the third step (handling), suitable strategies are selected in order to handle risks target at avoiding, reducing, transferring, sharing or taking the risk (Norrman and Lindroth, 2004). In the last step (control), a successful mitigation is examined and potential risk

changes are monitored. Generally, the risk management process should be run through iteratively because single risks or the whole risk situation may change over time (Eberle, 2005).

In scientific literature, there exist different theories and approaches having a diverse origin, and trying to explain the existence and design of SCRM. E.g. the new institutional economics (including agency theory, transaction cost theory, and property rights) as well as the systems theory provide single indicators how SCRM should be implemented and carried out (Coase, 1937; Williamson, 1985; Goebel, 2002; Picot et al., 2001; Kieser, 1995). From agency theory it can e.g. be derived that information asymmetries between the focal company and its supply chain partners should be reduced or from transaction cost theory it can be derived that a common understanding of values and awareness for SCRM should be created in order to prevent opportunistic behavior (Karrer, 2006; Picot et al., 2001; Stölzle, 1999).

In addition to the theories, some research papers focus on developing frameworks about how to implement SCRM (Chopra & Sodhi, 2004; Giunipero & Eltantawy, 2004; Manuj & Mentzer, 2008; Kersten et al., 2013). Most of them focus either on certain aspects of SCRM (e.g. on single process steps) or on SCRM in general but they do not contain recommendations for companies on a detailed level about how they can improve their SCRM systematically.

In preparation for developing the SCRM maturity model, the authors analyzed the existing theoretical approaches and SCRM frameworks to find several indications of determinants that make SCRM successful. Due to the limited number of pages, the focus of the paper is placed on the empirical results. Therefore, the results of the theoretical analysis cannot be described in detail. Nevertheless, it should be noted that, although the theories and existing frameworks provide important input, the question how SCRM should be designed and carried out to be most efficient is not satisfactory solved.

2.2. Maturity models

Maturity models are a class of reference models, which describe typical development stages and development processes in a specific field (Mettler, 2010). They are built on a number of dimensions and categories and of different development stages, the latter called maturity stages. Maturity itself can be described as the *„fully grown or developed mentally or physically; having achieved one's full potential"*(Hornby, 1989, p. 769) and is often used synonymously with capabilities (Wendler, 2014; Bensiek, 2013). The different maturity stages describe the complete range of possible development from none beginner status to best practice.

Regarding Fraser et al. (2002, p. 224), the main idea of a maturity model is *„that it describes in a few phrases, the typical behaviour exhibited by a firm at a number of levels of ‚maturity', for each of several aspects of the area under study"*. Maturity models further sketch typical development paths in the model and therefore ease the way to higher maturity. It is a useful instrument to identify the current status of an organisation or of a process and to reveal the potential for improvement (Kamprath, 2011; Wendler, 2014). The progress on achieving a higher maturity is related to a performance increase of the considered object (Bensiek, 2013). For the maturity of each stage, there should be a clear definition, which requirements are to be expected.

In literature maturity models are often criticized for obscurity in the model development procedure, for the lack of empirical tests and especially for the lack of sufficient depth in the assessment levels (deBruin et al., 2005; McCormack et al. 2008; Judgev and Thomas, 2002; Kamprath, 2011). Moreover, they often do not provide any recommendations for improvements. On the other hand, maturity models can help to find weaknesses in an

organization's abilities or in its processes. They are also easy to understand and to communicate (Klimko, 2001).

In scientific literature there exist different maturity models, having their origin in quality management (Crosbys, 1979). The maturity can be determined using different approaches reaching from self-assessment to audits by independent consultants (Hayes et al. 2005). They can be also be used as a quick test or as an extended process modelling.

During the last years numerous maturity models have been adopted by industry and developed for various disciplines, e.g. in the area of business process management, information technology, software development, product development or supply chain management (Röglinger et al., 2012; Hynds et al., 2014; Lockamy and McCormack, 2004; Reyes and Giachetti, 2010, Foggin et al., 2007, Srai and Gregory, 2005). Wendler (2012) shows in his systematic literature review that from 1993 to 2012 237 scientific articles in business management dealt with maturity models.

Nevertheless, a literature analysis conducted by the authors focusing maturity models in the area of SCRM has clearly revealed that this concept is still in its incipient state. Of course, there exist several models focusing risk management in general (enterprise risk management) and supply chain management maturity models considering single aspects of SCRM (e.g. Mendes et al., 2016 or Olivia, 2016), but there exist only very few models targeting SCRM as a whole concept. A systematic in-depth analysis regarding their content and structure is lacking. For this reason, the authors started a deeper literature analysis. Table 2.1 shows a list of maturity models focusing SCRM to a comprehensive extent.

Table 2.1 Maturity models focusing SCRM

Author	Year	Title	Origin
Aberdeen Group	2006	Global Supply Chain Benchmark Report	practice
Bearing Point	2008	Achieving organisational resilience through SCRM	practice
Böger	2010	Gestaltungsansätze und Determinanten des SCRM	research
Gupta et al.	2014	SCRM: A Conceptual Framework and Empirical Validation	research
IBM	2003	Supply Chain Risk Management	practice
Rice et al.	2007	How Risk Management Can Secure Your Business Future	research
Schlegel et al.	2015	Supply Chain Risk Management. An Emerging Discipline	research
SCRLC	2013	Supply Chain risk Management Maturity Model	practice

While the maturity models from Aberdeen Group (2006), Bearing Point (2008), IBM (2003) and Supply Chain Risk Leadership Council (SCRLC) (2013) were developed by practitioners

the models from Böger (2010), Gupta et al. (2014), Rice et al. (2007) and Schlegel et al. (2015) are rooted in research.

Because consulting companies sell their assessment services to organisations a detailed information about the content and the basis for assessment and calculation is not publicly accessible in the above-mentioned cases. E.g., the theory behind the construction of the SCRM model developed by the SCRLC as well as its documentation is limited to members of the SCRLC. Therefore, SCRM maturity models have only been considered for analysis which provide a reasonable documentation.

The evaluated SCRM maturity models differ regarding their scope, their applicability, and their development background, regarding their number of maturity levels (from 2 to 5) as well as regarding their assessment and their graphic illustrations. The number and content of dimensions (from 2 to 9) vary, just as do the categories. Nevertheless, the analysis has shown that all models have notable limitations regarding their empirical foundations and their assessment process as well as regarding their implementation of recommendations or best practices.

Gupta et al. (2014) bring out a schema for analysing supply chain risks. They develop a risk management action framework that helps to identify the level at which the firms are operating and the strategies they need. However, in their work, they are focusing on different risk categories and no guideline was developed how companies – in their research only Singaporean firms – can improve their SCRM in different thematic areas.

Rice et al. (2007) mostly concentrate in their work on supply chain security rather than SCRM on a whole and the description of maturity level is limited to maturity of a firm in C-TPAT and other compliance criteria.

The maturity model developed by Schlegel and Trent (2014) is failing to define factors and determinants for the successful development alongside the model. Beyond that, it is overlapping with controlling and operations research.

Böger (2010) is the only author who concentrates on providing insight into the method how her maturity model has been developed. She conducted 9 interviews in Germany, 1 in Switzerland and 15 in the United States to identify determinants for SCRM. As an output, she designs a simple maturity model using a Boston Consulting Group Matrix. In the matrix the different maturities are only defined as high and low, therefore the classical stage approach of a maturity model is missing. She also does not include a calculation to determine the maturity level and she renounced best practices.

To briefly conclude, all models providing insides into general SCRM maturities and first approaches for improvement, but they do not cover the requirements of theoretical foundation, detailed descriptions of assessment, calculation, and validation of the model as well as a catalogue of measures, including best practices. Therefore, a SCRM maturity model was developed, which meets these requirements.

3. RESEARCH METHODOLOGY

3.1. Research Questions and design

When developing the SCRM maturity model the following research questions (RQ) determined the procedure.

RQ 1: What are dimensions and categories of SCRM maturity?

RQ 2: How can SCRM maturity be determined?

RQ 3: Which measures can a company take in order to improve its SCRM maturity step by step?

Based on the literature review and the identified research gap, this study targets at developing a SCRM maturity model, which can be used for a self-assessment. For this purpose, the research design constitutes as follows:

To answer the research questions a mixed method approach was chosen. The empirical evidence in this paper is based on the quantitative as well as on the qualitative research style (Blaxter et al., 2006). The survey method – as quantitative research – was used to gather facts regarding the status quo of implemented SCRM measures and to assess the need for a SCRM maturity model. Afterwards, expert interviews were conducted (qualitative research) to deeper analyze the determination of SCRM maturity. Based on the results the SCRM maturity model was developed. Last, the authors conducted a case study to validate the developed SCRM maturity model in a company.

3.2. Empirical survey and expert interviews

Based on a literature review and the identified research gap, an abbreviated survey was conducted between July and September 2015 using a diversified sample composed of companies of different size and from different industry sectors. The online survey was sent to 698 recipients, of which 82 took part. After a review of the answers, 64 questionnaires could have been evaluated. The respondents had positions in management board, Logistics/ SCM, purchasing or risk management, worked in machinery and plant manufacturing (20%), automotive (12%), electronics (10%), service sector (10%), metal (8%), aviation (6%), energy industry (4%) and other sectors (29%). The company sizes were represented as following: less than 100 employees (5%), from 101-1.000 employees (30%), from 1.001-10.000 (11%), 10.001-100.000 (31%) and more than 100.000 (23%).

The survey contains questions about the extent and frequency of implemented SCRM instruments. Furthermore, the respondents were requested to express their opinion about what constitutes SCRM maturity (the results will be presented in chapter 4.1).

The next step required a detailed analysis to determine the dimensions of SCRM maturity. Here, the complexity of the research questions requires personal interviews. The willingness to answer questions in a greater depth and in an open discussion can only be achieved by personal and individual conversations with selected interview partners. Furthermore, SCRM addresses a sensitive issue. Hence, it is of great importance building trust with the company representatives (Schröder and Prause 2015).

To deepen the analysis 33 expert interviews have been conducted. The main target was to determine the dimensions and categories of SCRM maturity, to assign their assorted characteristics to each stage of maturation and to collect best practices for each category. The authors conducted the expert interviews in the core time from August 2015 until January 2016. For this, interviewees from different industries were selected, because SCRM is e.g. more established in pharmaceutical industry than in wind energy, which results from high legal requirements related to full traceability of pharmaceutical.

Table 3.1 shows an extract of the interviewed experts. They were all working in leading positions and had several years of experience in SCRM.

All interviews were carried out in person in the native language of the interviewee. If possible, the expert's company was visited. Only in some cases, it was switched to a telephone interview.

A guideline was used to structure the discussion. During the interviews, the SCRM design and best practices were discussed in detail. The time required for each conversation varied from 60 and 135 minutes. All interviews were recorded and then transcribed.

Table 3.1 List of experts (extract)

Number	Industry sector	Position
1	Pharmaceutical	Risk Manager Operations
2	Pharmaceutical	Head of Strategic Purchasing
3	Pharmaceutical consulting	Supply Chain Management Consultant
4	Pharmaceutical	Head of Supply Chain Management
5	Medical technology	Operations Manager
6	Shipbuilding	1. Head of Logistics 2. Supply Chain Controlling
7	Food	Logistics Manager
8	Manufacturing	Senior Director Supply Chain Management
9	Communication technology	Purchasing manager
10	Consulting	Business Manager
11	Logistics service provider	Director Risk Management
12	Logistics consultancy	Consultant
13	Consumer goods	Director Supply Chain Management
14	Medical technology	Head of Strategy & Projects Global Order Fulfillment
15	Chemistry	Chief Executive Officer
16	Logistics service provider	Business Development Manager
17	Automotive	Project Manager
18	Trade	Supply Chain Management
19	Pharmaceutical	Corporate Risk Manager
20	Aviation	Supply Chain & Operation Manager
21	Aviation	Risk Manager
22	Wind energy	Head of Risk Management
23	Chemical	Risk Manager
24	Food and trade	Chief Executive Officer
25	Aviation	Head of Additive Manufacturing Solutions
26	Manufacturing	Manager Strategic Purchase
27	Aerospace	Supply Chain Manager
…	…	…

33	Manufacturing	Internal Audit Manager

Parallel to data collection, data have been analyzed through coding activities. For this purpose, the qualitative research program MAXQDA was used that allows joint data analysis. The evaluation of the interviews was based on the qualitative content analysis by Maring (2002) and on the methodological principles of Grounded Theory approach (Glaser and Strauss, 1967; Fendt and Sachs, 2008; Corbin and Strauss, 1990, Strauss and Corbin, 1998).

To ensure high research quality the search process was verified employing Mayring's criteria for qualitative research (Mayring, 2002) which include documentation, using conclusive arguments to validate interpretations, methodological rigor and systematic approach, collecting data from real-life-solutions as well as evaluation of results from participants and triangulation.

In the following chapter, the results of the survey and expert interviews will be described which build the fundament of the SCRM maturity model.

4. DEVELOPMENT OF THE SCRM MATURITY MODEL

4.1. Key results of the survey and expert interviews

At first, the company representatives were asked to name the department in their organization that is involved in SCRM activities. At the majority, SCRM is coordinated either by the logistics/ SCM department or by purchasing department, but other departments like quality management, controlling or production have interfaces with them. The representatives were also asked to estimate how many employees are involved in SCRM in their company full time. Only in companies with more than 100.000 employees, people are working full time in the field of SCRM. In all other companies, the employees only deal for some hours per month with the topic.

In addition, the experts indicated how intensified the SCRM process steps are implemented in their organization (s. figure 4.1).

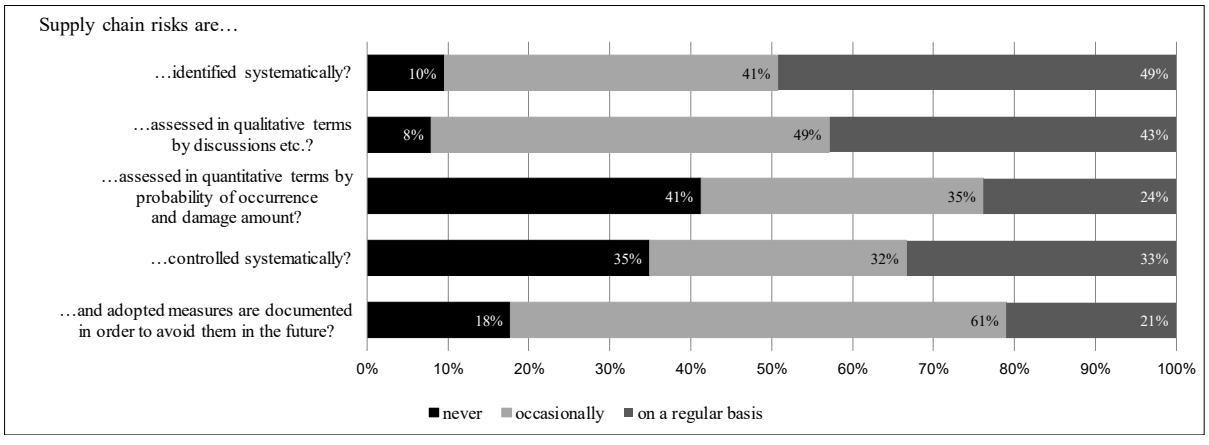

Figure 4.1 Implemented SCRM process steps

The survey results show that the majority of the respondents identify their supply chain risks systematically on a regular basis (49%) or occasionally (41%). They qualitatively assess the risks during discussions with their colleagues (43% on a regular basis, 49% occasionally), but 41% never assess their supply chain risks by indicating the likelihood of occurrence and the possible damage. Regarding the controlling process, 33% mentioned to monitor their risks on

a regular basis (33%) or occasionally (32%), while 35% renounce control. A documentation occasionally takes place in 61%, in 21% on a regular basis and by 18% at no time.

By reflecting the SCRM in their own company 35% of the respondents were the opinion that their SCRM matures, 27% think that is it sophisticated, and 30% even estimated it to be immature. Only 5% deem their SCRM as optimized.

The company representatives were also asked to name their potentials for improvement regarding several SCRM activities. The biggest need for improvement was seen in the transparency of supply chains (49%), the integration of SCRM into existing management systems (42%) as well as methods for quantitative risk assessment (36%). However, in the field of supply chain risk identification, 22% of the companies did not see any room for improvement.

These results show that there is a need for measures how to improve the SCRM in the different companies. Due to the fact that most of the employees deal only for some hours per month with the topic, the SCRM maturity model should be easy to apply and it should also include concrete measures how to improve the SCRM.

The preliminary findings from the survey were deeper analyzed in the expert interviews, afterwards. During the interviews, the experts spoke about their experience with SCRM. The SCRM process was explored and the interviewees were asked to further elaborate on the specific steps of the SCRM process and tools used within the organisation. Afterwards, determinants of successful SCRM were explored. A special emphasis was put on factors making SCRM mature, how to determine the optimal maturity for an institution and which obstacles need to be overcome to reach the aspired SCRM maturity level. Lastly, best practices were discussed.

During the interviews different SCRM-related topics were discussed with the experts and as mentioned before coded and analyzed with MAXQDA. As an output of the analysis 16 categories were investigated by the authors supporting SCRM to become mature. In preparation for the SCRM maturity model, these categories were structured and aggregated to 7 dimensions (s. figure 4.2).

The dimension “organizational involvement” comprises “responsibilities for SCRM activities and the range of employees handling with the topic”. Also, the “integrated hierarchy level” was seen by the experts as important for a successful SCRM as well as the “integration of SCRM into the existing management and planning systems”.

The dimension “mental fixing” contains the category “employees skill, training” that deals with the skills of employees to handle with SCRM instruments and with the company’s offer of training and further education” as well as the category “SCRM awareness and culture”.

The dimension “transparency” covers the “transparency in value adding processes”, the existing “information about suppliers” and the “visualization of the supply chain”.

The dimension “identification and evaluation” represents the first two steps of the SCRM process (s. chapter 2.1) and therefore deals with the “supply chain risk identification” and with the “supply chain risk evaluation” and “prioritization”.

The dimension “control of measures” (related to the third step of the SCRM process) focuses on “triggering on SCRM measures” as well as on” handling of emergencies (business continuity management)”.

While topics like “measures of control” and the “documentation of supply chain risks and taken SCRM measures” (related to the last step of the SCRM process) are consolidated to the

dimension “controlling and documentation” the categories “communication”, as well as risk “report and general report” are grouped under the dimension “communication and reporting”.

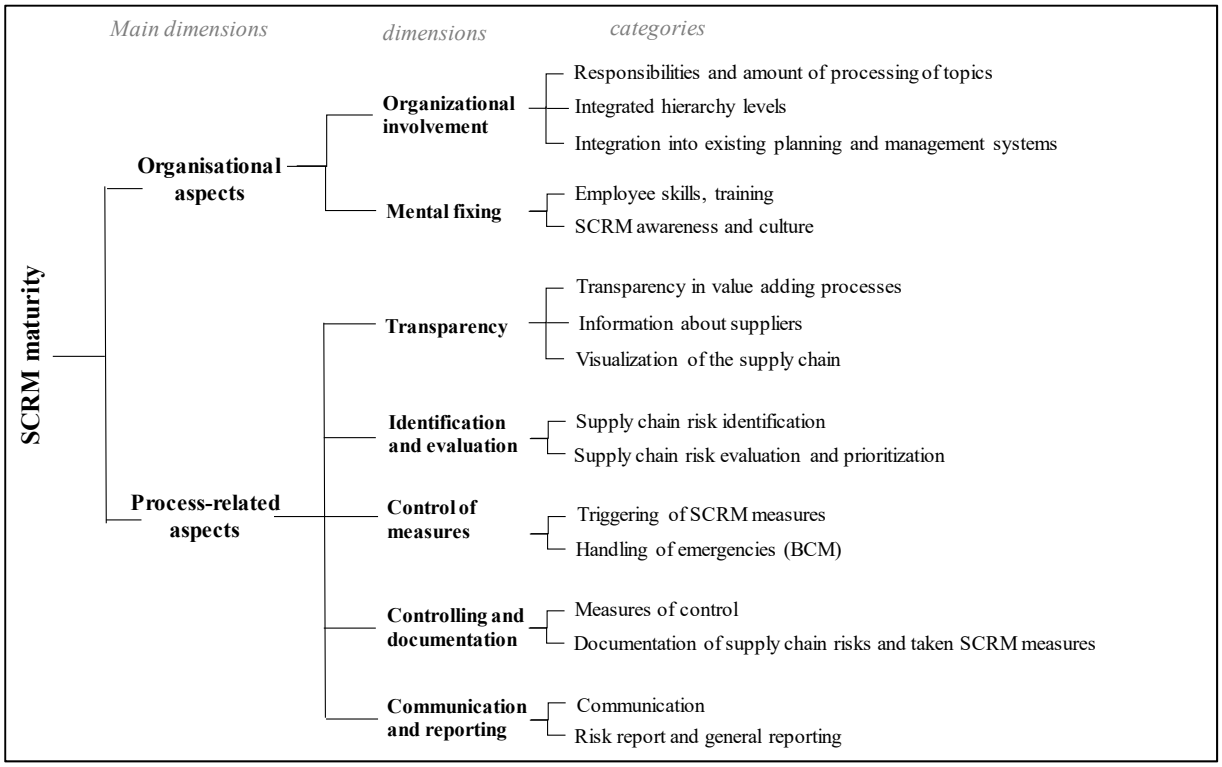

Figure 4.2 Main dimensions, dimensions, and categories of SCRM maturity

It turned out that part of the dimensions refer to “*organizational aspects*” while others encompass “*process-related aspects*”. Therefore, both are hereafter referred to as *main dimensions*. In total, seven dimensions were built, two of which allocated to the main dimension *“organizational aspects”* and five of which to the main dimension *“process-related aspects”*.

While all above-mentioned dimensions and categories were discussed with the experts, they were also asked to state their experience and opinion about their assorted characteristics. They run possible scenarios for each category through their mind, how e.g. supply chain risk assessment could be improved: starting from an individual assessment on an irregular basis to satisfy the requirements from executive management; continuing implementing a standardized process with fixed criteria and threshold values; adding quantitative methods; involving other experts/ departments or supply chain partners into the assessment process; extending the assessment from operative to strategic supply chain risks; or working with algorithms to use big data and to make predictive analysis possible; just to name a view.

Finally, the authors compiled a catalogue of measures, containing recommendations how to achieve a higher maturation in each category. (An extract of the catalogue will be presented in chapter 4.4).

4.2. Structure and application of the SCRM maturity model

The literature analysis has shown that the maturity models mostly have a 5-level or a 4-level system. According to Wendler (2009, S. 294), the maturity model consists of five levels of development, in which the applicant can achieve four maturity stages. At the beginning of the levels of development, there does not exist any SCRM activity. Organizations at this level are unaware of their need for SCRM as it is not considered essential to achieving business objectives. In the first level (maturity stage 1) first SCRM activities can be noticed. Although

they are still mostly reactive and not regularly updated. While maturity stage 1 has a strong focus on the individual workstation, stages 2 and 3 pursue an inter-divisional respectively supply-chain wide approach. In maturity stage 2 first SCRM standards are implemented and single SCRM processes steps are defined, which is even more extended at maturity stage 3. The final level of development (maturity stage 4) is characterized by optimized and well-established supply chain-wide SCRM activities, comprising the entire SCRM process.

The SCRM maturity model was implemented in MS Excel and consists of two main dimensions, seven dimensions, and 16 categories (s. figure 4.2).

In addition, a catalogue of statements was developed to make the self-assessment possible. For each of the 16 categories, 6-9 statements were formulated. In total, the catalogue comprises 104 statements. Some of them can be answered with “yes” or “no” (e.g. “In each relevant department at least one employee is responsible for the topic SCRM.”) and others include an estimation of the degree of fulfilment (e.g. no (0%), some (up to 33%), predominant (up to 66%) and nearly completely (100%) (e.g. “Detailed information about geographical location of the production plants of the direct suppliers is available.”).

After the operator has answered all statements the maturity levels can be calculated for each category, for each dimension as well as for both main dimensions. The calculation rules consider the degree of fulfilment and also enable a weighting of the single dimensions. For clarity, the results are presented in a spider diagram, which makes the maturity stages of the different dimensions comparable (see figure 4.4).

Based on the assessment results the operator gets different recommendations for each category to achieve the next higher maturity stage. E.g. if for the category communication and reporting a maturity stage of 2 was achieved, the operator gets recommendations how to improve the communication and reporting process to achieve the maturity stage of 3. In total 135 recommendations were formulated, which result from the expert interviews enriched by scientific literature. All recommendations were allocated to the four maturity stages. (The next chapter contains a graphical illustration of the results as well as an extract of recommendations conducted during validation, therefore it will not be discussed further here.)

After developing the SCRM maturity model with its proposed method, it was the aim to validate the method. In the following, the validation is described.

4.3. Validation

The investigation was carried out in an international producing company in the field of nutrition. In total, three meetings lasting for several hours were led with professionals in the middle of the year 2016 to test the SCRM maturity model.

During the first meeting, the company’s field of activity, its supply chain as well as its environment was discussed. In the second meeting in total five professionals took part, three experts from supply chain management, one from procurement and one from quality management. Initially, each of them filled in his own catalogue of statements to determine the SCRM maturity. In a next step, the results of each statement were compared. If a deviation occurred, the statements had been discussed until a joint response was found, because the method only accepts one single input. Respondents have answered differently, due to their different level of information or their seniority, but this only affected isolated statements in which the degree of fulfilment needed to be estimated. After each statement was jointly filled in, the maturity stages for the dimensions and categories were calculated. During the last meeting, the results of the maturity stages were presented (s. figure 4.4.).

Figure 4.3 shows the company's SCRM maturity stages of for both, the 16 categories and 7 dimensions.

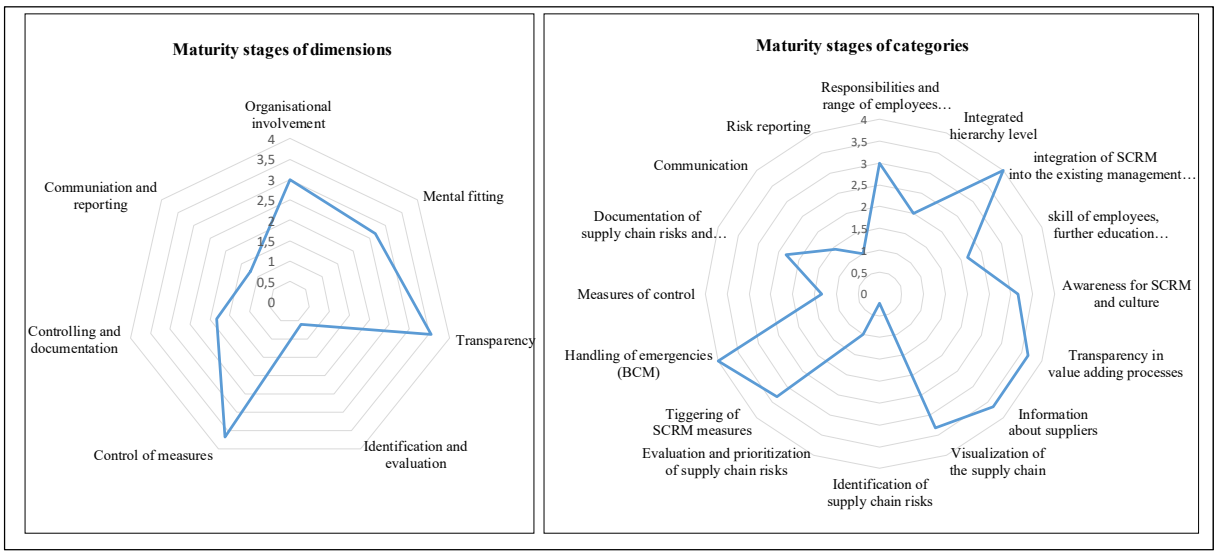

Figure 4.3 Results of the SCRM maturity assessment

By using the SCRM maturity model it was stated that the company gained a high maturation in the dimensions transparency and control of measures (both achieved a maturity stage of 4), resulting – as mentioned before – from the high legal requirements. On the other hand, strong weaknesses appeared in the dimensions identification and evaluation of supply chain risks (maturity stage 0) as well as in communication and reporting (maturity stage 1).

In addition to the graphical illustration, the participants discussed the list of recommendations automatically given by the SCRM maturity model to improve the SCRM. In total 37 activities were recommended. Table 4.1 show an extract of recommendations for the dimension identification and evaluation how to achieve maturity stage 1.

Table 4.1 Recommendation for supply chain risk identification (extract)

Supply Chain Risk Identification	**Further literature**
Identify the operational and strategical supply chain risks on a regular basis (fixed dates).	Christopher and Peck, 2004
Divide the identified supply chain risks into categories (e.g. supply risks, process risks, demand risk, control risks).	Norrman and Lindroth, 2004
Try to identify risk proactively.	Wente, 2013
Make use of analytical methods (e.g. FMEA) together with creative methods (e.g. brainstorming) to identify supply chain risks.	Pfohl et al., 2008
Make sure that the process of supply chain risk identification can easily be adapted if the risk situation suddenly changes.	Burger and Buchhart, 2002

The discussion, which took part among the participants, demonstrated that the recommendations deliver a good contribution how to proceed. Nevertheless, the company's

representatives must decide for themselves, how many and in which sequence the proposed measures are to be implemented and which maturity stage to be achieved in the single dimensions. This often depends on the management support as well as on available human and financial resources.

Strengthens and weaknesses in different SCRM dimensions were revealed in applying the SCRM maturity model. The model was considered appropriate, comprehensible and practice-oriented. The method itself was easy to apply with the reasonable effort so that there was no further advice necessary on how to conduct the self-assessment.

5. CONCLUSIONS AND IMPLICATIONS

Companies often have difficulties to identify strengthens and weaknesses of their SCRM to increase their competitiveness. In addition, the comparability with best practices can be challenging. A maturity model can counteract these problems.

During the last years, numerous maturity models have been adopted by industry and developed for various disciplines, e.g. in the area of business process management, information technology, software development, product development or supply chain management. Nevertheless, a literature analysis conducted by the authors focusing maturity models in the area of SCRM has clearly revealed that the guidance provided by the existing SCRM frameworks and maturity models focusing SCRM for selecting and prioritizing measures to improve SCRM is rather limited.

All analysed models provide insights into general SCRM maturities and first approaches for improvement, but they do not cover the requirements of theoretical foundation, detailed descriptions of assessment, calculation, and validation of the model as well as a catalogue of measures, including best practices. Therefore, a SCRM maturity model was developed, which meets these requirements.

By conducting a survey, the authors first gathered facts regarding the status quo of implemented SCRM measures. These results show that there is a need for measures how to improve the SCRM in companies. Due to the fact that most of the employees deal only for some hours per month with the topic the SCRM maturity model should be easy to apply and it should also include concrete measures how to improve the SCRM.

Afterwards, expert interviews were conducted to deeper analyze the determination of SCRM maturity. Based on the results the SCRM maturity model was developed. The SCRM maturity model consists of 7 dimensions, and 16 categories dealing with organisational and process-related SCRM aspects. By evaluating a catalogue of statements the companies are able to conduct the self-assessment in a structured order. Furthermore, a catalogue of more than 135 measures was developed which help companies to steadily improve SCRM in each of the four maturity stages. Last, the authors conducted a case study to validate the developed SCRM maturity model in a company.

By using the developed SCRM maturity model a company can quickly assess its SCRM. It can be used as a diagnostic tool to determine the current SCRM maturity level. Weaknesses and strengthens can easily be detected for both organisational and process-related SCRM aspects. In addition, the catalogue of measures helps the company by providing improvement measures to reach a higher SCRM maturity level.

The model can serve as a guide for practitioners to identify the SCRM level at which their companies are operating. In addition, the results provide guidance for strategic management

decisions. Finally yet importantly, the companies must decide for themselves which measures they should initiate and which maturity level makes sense to achieve in the near future.

The SCRM model has a few limitations. The validation only included one producing company. More case studies would help to create confidence in the model. For future research, the model will be tested in additional companies. Lastly, an additional research study is necessary to examine the link between the model's improvement advice and the actual impact on the company's efficiency.

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