Mitigating risk in global supplies to the maritime industry

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Abstract: The purpose of this study is to embed using dialogue to mitigate risk in a supply network context. A detailed case narrative is provided of a Norwegian machine parts importer’s supply of goods from Shanghai to the maritime industry in Norway involving both shipbuilding and maintenance associated with shipping. The case shows how supply networks consist of tiers of suppliers working together. Risk is managed through an integrated effort involving how people communicate. Given that risk is perception, attention is directed to how risk may be conceived as boundary object; that through development of discourse, risk may be mitigated through dialogue in the supply network. This study provides insights for further conceptual development how to mitigate risk by integrating this conception as a dialogue element, a boundary object used to manage risk in the globalised physical distribution of parts in the maritime industry.

Keywords: risk management; supply networks; boundary objects; interaction; professional discourse.


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1 Introduction

Empirical focus is in this study directed to machine parts supply from China to Norway to shipbuilding customers as well as customers of spare parts once the ships are in service. This is a form of supply that is risk prone since it covers a vast distance both measured in relation to geography and culture. The theme of this study is associated with considering risk management (RM) through a case study of this particular form of machine parts supply from China to Norway. This supply of machine parts represents physical distribution and is characterised, following Thompson’s (1967) interdependency theory, as a long-linked form of supply; that is because it is physical, also predominately involves sequential interdependencies; one activity necessary follows another when the preceding activity is completed.

Metrics to measure quality supply in long-linked flows of goods are represented by features of time, place and form utility form utility of a product as perceived by the product flow end-user (Alderson, 1965). These sequentially interdependent indicators are ultimately measured from the perspective of the end-user, but may also be measured by intermediaries. Value is central to achieving customer satisfaction. Value in supply is perceived by the customer (Vargo and Lusch, 2004), production seeking ultimately to match goods transformations in the context if the supply network with end-user requirements. The supply network is in this study regarded in line with Engelseth (2011) as a complex long-linked production system that generates value through transforming interacting knowledge, information and product resources within a definable network boundary to achieve value from an end-user viewpoint. Hammervoll et al. (2014) argue, based on empirical evidence from a case study in the Møre region of Norway, that the maritime industry in Norway is organised as a cluster. It is a space where most actors know each other and relationships come and go; may be both latent and active. This industrial cluster configuration is also by no means limited to this region; its workings clearly dependent on global ties with suppliers. Even though many shipyards are located in proximity to each other in the Møre region, suppliers as well as customers or where the ships are operated when completed, encompasses a global space. The shipyard customer is in this picture an intermediary, the end-user formally being the ship owner. In cases of shipping, the ship operator may however often be different form the ship owner. This indicates that the concept of locating where to measure ‘value’ in supply networks is not always a simple straight forward procedure. In a supply network it is not always clear-cut whether trading takes place in a ‘market’ or ‘relationships’, with examples of markets characterised by strong inter-organisational bonding (Engelseth, 2016).Value perceptions are accordingly a conglomerate of attitudes, that also since they are perceptions, in a state of continuous flux. Furthermore, Engelseth and Zhang (2012) point to the high degree of reciprocal interdependency of these complex engineering management roles in the Møre maritime industry implying need to develop relationships to support integration facilitating quality supply. There are many types of engineering that need to be coordinated with each other, and coordinated with ship building, and customer value associated with shipping operations. This indicates that although parts supplies are sequentially interdependent, the customer market indicating the end of this flow of parts, the Møre maritime cluster, features a high degree of reciprocal interdependency.

Interfirm interaction is always associated with risk. Cousins et al. (2008, p.181) propose that the term ‘risk’ be used to describe how firms and cope with uncertainty. Risk is also to some degree manageable, such as when speed is adjusted when driving a
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Mapping risks in relation to operations in various supply-dependent internal processes provides basis for a single firm directing managerial focus towards activities with high probability rates for malfunction thereby increasing the potential for control by a single firm through adjusting internal activities to perceptions of supply risk. RM is accordingly dependent on two factors; degree of manageability and the risk itself, all viewed from the perspective of the single firm. A network is characterised by interaction within single business relationships, as well as how different business relationships interface each other. The supply network, a complex phenomenon, has distinguishable atmosphere characteristics such as

1. power and dependence
2. conflict and cooperation

While network atmosphere characteristics impacts on supply network interaction, they are more limited in regards to creating normative business models providing managerial guidance in handling uncertainty through RM. This study considers how companies interact in to cope with risk through spanning inter-firm boundaries through both market and relationship governance modes (Engelseth, 2016). Importantly, the atmosphere and managerial discourse they use may be used integrate and cope with risks is vital in mitigating risk. In line with Roddy (2011) developing manufacturing and logistics processes is founded on the development of trust from bonding within management. This focus on discourse points to the importance of manual decision-making when taking RM to a supply network organisational level, that when coping with risk in a supply network it is people that are in focus, that have to cope with emergent risk situations that are always more or less unique and that risk is mitigated through the cooperation of several supply network actors. Risk needs to be understood as a ‘boundary object’ in the supply network, an integrating artefact of meaning in professional discourse that helps integrate the network, through a long-linked sequentially interdependent flow to a reciprocally interdependent and therefore tightly networked marketplace in the Møre region.

This study provides a detailed description of a long-linked machine parts supply through tiers of different actors. This is an ‘as-is’ description, where RM is empirically not found as an explicit management philosophy. It is an investigation in handling risk without the supply network actors strategically considering this way of doing management. This case description provides therefore basis for analysis to develop a framework for future studies of RM in inter-organisational settings. Key challenges concepts and conceptual modelling is sought. Inquiry that led to the creation of the case description was directed by the following research questions focusing on strategic-based use of individual business relationships:

1. What are the risks in the studied maritime supply network and how is this risk at present mitigated?
2. How does the purchaser and supplier in this network collectively manage risk through business relationships?
3. How do features of the supply network context as well as the wider environmental uncertainty impact on risk mitigation?
2 Literature review

Commonly supply risk is conceived in line with Zsidin’s (2003) definition as “the probability of an incident associated with inbound supply from individual supply failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to consumer life and safety” (Choi and Krause, 2006; Cooper et al., 2006; Kull and Closs, 2008; Neiger et al., 2009). Managing supply risk involves accordingly continuously probing into the future of integrated product manufacturing and logistics processes to increase procurement readiness in handling emergent supply variations. Fundamentally speaking, risk is associated with perceptions (Slovic, 2000a). There is accordingly no objective risk ‘out there’ (Slovic, 2000a). Stone et al. (1994) point to how even when objective data is available to support decision-making, interpretation may cause bias when assessing the strength of risk. Risk is accounted for through a range of metrics and approaches accounting for attitudes and observable outcomes of attitudes of a particular risk.

“People’s perceptions and attitudes are determined not only by the sort of unidimensional statistics used in tables, but also by the variety of quantitative and qualitative characteristics...” [Slovic (2000b), p.231]. March and Shapira (1987) propose that risk be viewed from either a managerial or economic perspective. The managerial perspective involves accounting for the probability of negative outcomes. Given an economic perspective, the concept of risk is widened to encompass probabilities of both negative and positive outcomes. The economic perspective concerns probabilities of variation regardless of perceptions of attractiveness. Based on the managerial perspective, Kaplan and Garrick (1981) risk assessment involves three fundamental questions posed by a manager:

1 “What can happen?”
2 “How likely is this outcome?”
3 “If it does occur, what are the consequences?”

More precisely, risk measurement from a consumer’s perspective may be regarded in line with Kaplan et al. (1974) as a function of financial, social, psychological, physical and performance risks.

Risk involves two main components:

1 the magnitude potential losses
2 the probability of losses (Manuj and Mentzer, 2008; Ellis et al., 2010).

Supply chain management (SCM) literature points to a range of five different forms of risks internal and contextual to the firm:

1 supply
2 demand
3 process
4 control
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these four risks embedded in:

5 environmental risk (Christopher and Peck, 2004).

Environmental risk is associated with uncertainty. This study concerns mainly supply risk. However the other forms of risk must be accounted for, and are considered as contextual to supply risk. Demeter and Kolos (2009) point to how marketing, logistics and manufacturing together impact on a company’s overall performance. In line with this view, Carr et al. (2008) provide empirical evidence based on a survey inquiry that firms can benefit from cross-functional coordination between operations, marketing, engineering and purchasing. From a manufacturing management viewpoint, Hill and Scudder (2010) point to in the case of developing use of electronic data interchange (EDI) the importance of developing partnerships with suppliers and a systems and technology focus with customers. Furthermore Dean and Cohen (2010) exhibit based on empirical evidence derived from a framework to measure the worth of relationships with buyers that actors in supply relationship need to develop an appropriate relationship to enhance supply network integration. Wu and Ragatz (2010) demonstrate how, in the case of new product development, that success in this function is dependent not only on the suppliers knowledge and expertise, “…but also in the purchasing firm’s integrative capabilities to absorb knowledge and increase efficiency of knowledge integration”. Ponce-Cueto et al. (2010) discuss in relation to modelling strategic supply management, that there is not “…a unique model for supply management, valid for all industries”. Developing business relationships should take into consideration the nature of the business relationship and also indicates that the nature of risk handled though in various types of business relationships and the business function being handled. With Thompson’s (1967) classification of the nature of interdependencies in various business contexts in mind, supply risk is associated with predominately sequentially organised operations within and between firms generating product transformations adapted to end-user needs. In services, based on the classification of service-sector dependencies by Stabell and Fjeldstad (1998), supply risk may be interpreted as concerned predominately with pooled and reciprocal dependencies. Supply risk is accordingly associated with perceptions outcomes of production through resource transformations; perceptions associated with potential of successful value creation.

Having discussed the meaning and suggested classifications of risk, the next step is to consider handling risk. Manuj and Mentzer (2008) point to that management perceives RM “...as something that slows down the process of achieving company objectives”. The potential hazards associated with risk are interlinked with costs of mitigating risk. These operational costs are mainly associated with creating, communicating and efficiently using information about risk factors. Ellis et al. (2010) point to the important role representations of risk play in the risky decision-making process suggesting that risk be handled through

1 contingency planning
2 suppliers’ investment in flexible manufacturing, back-up systems, and spare capacity
3 buyer’s investments in in-house manufacturing capabilities
4 buyer’s and supplier’s joint investment in the development of relational norms.
IT may be used to facilitate risk mitigation. Rodriguez and Al-Ashaab (2007) studied how IT supports effective collaboration to support e-manufacturing in a global engineering environment supporting a knowledge-driven collaborative product development system. Kirche and Srivastava (2010) studied in a build-to-order environment, how risk is minimised and profitability increased through collaboration using a specifically designed model facilitating real-time order management through supplier capacity reservation. Li and Chandra (2007) focus on the knowledge dimension of supply network integration proposing an adaptive knowledge fusion framework illustrated through a case study concerning supply chain RM and the knowledge network. Manuj and Mentzer (2008) provide an overview of six RM strategies in literature:

1. postponement (Alderson, 1950; Zinn and Bowersox, 1988; Chiou et al., 2002)
2. speculation (Bucklin, 1965)
3. hedging including
4. control/share/transfer (Achrol et al. 1983; Agrawal and Seshadri, 2000; Cachon, 2004)
5. security (Downey, 2004)
6. avoidance (Miller, 1992).

The same authors continue by suggesting supply chain complexity and inter-organisational learning as moderators to RM outcomes (Manuj and Mentzer, 2008). Bahli and Rivard (2003) integrate agency theory and transaction cost theory to describe risk scenarios concerning:

1. lock-in based on investments
2. contractual amendments
3. unexpected transition and management costs
4. disputes and litigation.

The same authors underline that these four scenarios not be viewed as ‘acts of God’ suggesting that risk mitigation mechanisms be developed for each of these risk scenarios (Bahli and Rivard, 2003). A perception of ‘risk’ as a complex phenomenon emerges. Power (2005) points to the plasticity of risk and therefore considering it be viewed as a ‘boundary object’. According to Star and Griesemer (1989),

“Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds.”

Considering ‘risk’ as a boundary object in the context of a business relationship embedded in a supply network consisting of multiple business relationships, represents accordingly an approach to risk mitigation. Since ‘risk’ is perception, this coincides well
with also considering risk as a boundary object. From a practical viewpoint the challenge is, to translate ‘risk’ into an information resource that may be used as a resource component in communication operations. Risk interpreted as a boundary object may is accordingly proposed viewed as both a knowledge component (perceptions) as well as information (explicitly) used to facilitate boundary spanning; here directing focus towards techniques interconnecting different supply network actors. RM is accordingly proposed in the context of individual business relationships to be viewed both as both ‘knowledge’ and ‘information’; although these two aspects of risk never will be exactly the same when considering a specific future state which the specific risk in question is related to. Through considering ‘risk’ as a boundary object in the context of a business relationship two interacting forms may develop semantic interoperability which also will expectedly impact on making operations more seamlessly interconnected when they transcend firm boundaries. This should impact on supply efficiency. Semantic interoperability is as a term applied within information and communications technology (ICT) to describe and analyse the quality of interconnectivity between various information systems within and between firms (Menzel, 2011). A challenge when developing connectivity between firms is that the various information systems do not speak the same ‘language’ demanding some form of ‘translation’. In this context of uncertainty connected with discourse boundary objects may be developed and applied as organisational resources facilitating more efficient communication (Star and Griesemer, 1989). Here a wider use of ‘semantic interoperability’ is applied probing into interaction between people embedded in the organisational sphere of business relationships as well as a wide industrial network context; how risk may be mitigated through developing semantic interoperability involving use of words and perceptions of what these words mean.

Modelling RM is proposed involving deconstructing risk through a gradual and continuous line of developments aimed at impacting discourse found in business relationships. At core, the different types of risk must first be accounted for to enable mitigating risk. This involves classifying operations through, e.g., classifying first the type of risk associated with goods transforming processes in our physical distribution type case; supply, demand, process, control or environment (Christopher and Peck, 2004). Questions such as asking “What can happen?”, “How likely is the outcome?” and “If it does occur, what are the consequences?” may now be posed (Kaplan et al., 1974). This creates an indication of the magnitude and probability of the risk issue in question. These relatively established exercises create information. However, risk mitigation is proposed attained through an alternative approach through developing business relationship discourse. The point advocated is that the common ‘language of risk’ of a supply network acting efficiently as a boundary object must be developed to secure semantic interoperability that again is foundation for process interoperability. Attention is accordingly directed to information flows and knowledge features supporting boundary spanning in business relationships; here purposeful information flows concerning risk mitigation. This study provides an initial modelling of this view. The following case narrative provides an as-is description of international machine-parts supply, its structure, its currently applied lead-time related efficiency metrics evoking internal as well as contextual/environmental challenges. Based on this case narrative we will in the following analyses attempt to provide a framework that may be used to actually develop RM procedures better understanding ‘risk’ as boundary object to mitigate risk through
dialogues taking place in a collaborative relationships involving multiple networked supply actors; network that both may be recognised as a local cluster while still being dependent on global interaction.

3 Research method

This is a single case study, providing according to Voss et al. (2002), the necessary detail for developing, in line with Eisenhardt (1989), new empirically-founded theory. Since this study was in search of new insights, the study followed an inductive methodological procedure, which according to Barrat et al. (2011) is the most common form of case study in operations management. The unit of analysis in this study is the risk-prone flow of goods, meaning that risk perceptions are approached as contextual to goods in transformation, meaning also that risk is associated with how goods are supplied. This means that a detailed description of a physical flow is provided and risk, its mitigation and managing this risk is interpreted based on the actual configuration of operations in a supply network context; an ‘as-is’ goods supply narrative involving importantly features of supply timing.

The following case narrative provides an overview of a mechanical parts supplier’s goods supported by an information flow associated with the maritime industry, as well as an overview of the maritime supply network focused around offshore supply vessels (OSV) produced in the Møre (around Ålesund city) industrial maritime cluster of Norway. The choice of this case was based on convenience, since the study was based on a developed professional relationship that is continuous and involves providing the parts importer in Norway insightful dialogue in developing their supply procedures. The focal processes of the mechanical parts supplier were mapped based on a single interview coupled with understandings derived from consultancy in the mentioned firm over several years. The main data collection was initiated in November 2010 and finalised in March 2011. A follow-up interviews were conducted in October 2011 and June 2014 to update this data. Inquiry was carried out using a semi-structured interview technique permitting dialogue to help explore.

To consider the Møre maritime industry network context, altogether 21 additional interviews have been carried out mainly in 2010. This data was originally collected to study the sustainability of the Møre maritime network (Engelseth and Hakam, 2011). However, this data collection includes a large amount of detailed qualitative transcripts where portions have been used to enrich research regarding engineering roles in a maritime industrial network (Engelseth and Zhang, 2012) and maritime clusters in a global context (Hammervoll et al., 2014). In a similar fashion this data set is here employed to complement our focus on developing interaction in long-linked supply of machine parts to this maritime industry. In this study, a focal maritime industrial actor working in the financial sector was interviewed to create an initial overview and suggest different types of informants and provide an overall plan for further inquiry. This interview was followed by interviews with different types of actors, choosing to interview at least three different actors carrying out comparable types of business functions in the network. In this manner, e.g., three different perspectives of ship design are accounted for. Both interviews and observations were open, meaning that the true intention of research was communicated to all informants. All interviews were taped and transcribed. Data analysis followed an inductive procedure, meaning that literature
discussed in the preceding literature review provides theoretical basis for interpretation. This implies focus on risk and risk mitigation. In addition, especially important in this study since this represents the novelty of this study, is the focusing on RM in a supply network context.

4 Case narrative

The focal firm was established in the early ‘90s as a trading firm. It has now eight employees. The main products are ball bearings and related products, which are used as parts in machines and other types of mechanical equipment. The ball bearings are designed in accordance with DIN and ISO standards. This is a simple product since potential for innovation through design is limited. The company actively uses branding to differentiate itself. There are variations of the products regarding materials usage. The company has never produced these products themselves. However, in 2000 the company started sourcing products from Chinese suppliers, and in 2005 invested in a joint-venture operation in Shanghai China to develop efficiencies in product supply. This Shanghai Company consists of a warehouse facility and has 35 employees mainly working with purchasing and quality control of the products produced at factories within a range of 2–3 hours driving time form the Shanghai facility. In addition to the standard machine parts, the company also facilitates machine and parts construction based on designs provided by customers. The main business relationships in the case are illustrated in Figure 1:

Figure 1 The main business relationships of the focal machine parts supplier

The company has some limited design capability to adapt these designs in accordance customer requests for adjustments of standard parts produced in China. There is an abundance of factories in the Shanghai region that can accommodate the production needs of the Norwegian company. The Norwegian company is responsible for mainly sales and sourcing, as well as coordinating the logistics of supplies onwards to the mainly Norwegian customers. Coupled with its branding efforts, the company strives to reach high qualities in these activities to achieve customer satisfaction. More than 90% of the sales are to Norwegian customers. This is a relatively transparent professional network where reputation management is vital. Based on its good reputation recurrent sales are secured. 35% of the customers are found in the maritime industry, mainly machine producers. This market is divided into about 75% parts for new machinery and 25% are spare parts. The spare parts production is more profitable. In addition the parts are sold for use in agricultural and food processing machinery.
The machine parts are sent to Norway twice a monthly using full load container (FLC). The joint-venture company seeks to fill up this container, but since it has increased for a monthly transport, also sells space to other, smaller firms in Ålesund for their goods from Shanghai. Should a critical part a customer needs quickly not make this transport, air freight may be organised at an additional cost to the customer. An alternative is using less-than fully loaded container, involving in practice outsourcing transport fully to a logistics service provider at an additional cost compared with using their own fully loaded container. Figure 2 illustrates lead-time and the focal firm’s materials flow of supplies from China to Norway:

**Figure 2** The materials flow and lead time (see online version for colours)

Figure 3 illustrates the information flow concerning standard machine parts between customers of the focal company and the Chinese supplier factories through the Shanghai joint-venture company:

**Figure 3** The information flow (see online version for colours)

Production is driven by a combination of long-term contracts lasting two years. These are mainly for deliveries to new machines. In addition there is a substantial amount of orders for spare parts. The Norwegian suppliers keep an inventory mainly for spare parts supplies. The lead-time from order to delivery is between 12–20 weeks. The company expresses that there are great challenges in orders communication. There is an ongoing development to interlink the Chinese-language-based information system of the
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Shanghai-based joint-venture firm to English to interlink this system with user in the focal Norwegian company to improve information flow transparency.

Figure 4 provides an overview depicting key activities in the OSV related Møre maritime supply network. The direct materials flows (indicating customers) of the focal parts supplier are to the following processes:

1. installation processes new shipbuilding at Norwegian shipyards
2. ship maintenance and upgrading at shipyards or other locations.

The OSV sector in shipbuilding in the Møre region on the Northwestern coast of Norway is clearly dominant much due to the importance of the offshore petroleum industry of Norway.

**Figure 4** Overview of the OSV network from a Norwegian perspective (see online version for colours)

Notes: The focal ship design – shipping operations unit of analysis indicated by bold interconnecting line. Interconnectivity between ship investment and installation at a shipyard represents the functional basis for contracting an OSV ship indicated by a double-headed arrow. The two bold lines indicate the direct modes of physical distribution-related interconnectivity between the focal firm and its industrial network.

To the left in the figure the focal company’s role as a supplier of predominately standardised to order (STO) products is indicated. This figure exhibits the complexity of the supply network.
5 Analysis

Risks evoked in the supply network are predominantly related to environmental uncertainties concerning supply from a changing set of Chinese suppliers, uncertainties in demand, especially concerning spare parts supply, and finally interlinking these uncertainties through operations inhibiting their own logistical uncertainties. The supplied parts are relatively small and comparable to other ship parts, inexpensive parts. These are also relatively standardised items that are ordered by the ship yards following a postponement strategy, mainly because it takes time from the need to purchase these parts is clear, and the demanded time of supply. Postponement is a form of risk mitigation. This strategy is applied in shipbuilding, but not applied in cases of spare parts supplies to shipping operators due to the urgency of such supplies. In these cases risk is mitigated through holding critical inventory. The severity of supply disruptions is accordingly only moderately high in supplies to shipyards, and higher in supplies to shipping operators. The use of these two supply strategies simultaneously indicates also how risk cannot be mitigated by only considering features of the supply side. Information systems are continuously in development to manage risk. The flexibility of the operations resources in the studied goods flow is limited. Risk mitigation is in the case solved through organising the inherent sequential dependencies in a logical manner adapted to variations in risk. Risk is mitigated through relatively routine processes as thorough quality control at the joint-venture facility in Shanghai and efficiently filling FLCs of goods with options for alternative forms of more costly transport upon demand. Risk mitigation is at core in the case accordingly concerned technical procedures and not associated with building business relationships within which these product flows. Risk is managed by simplifying human intervention. This is, however, a traditional single firm perspective of RM.

The next step is to consider this technical form of risk mitigation in a supply network context. This is simple to analyse since the case shows how product supply involves multiple tiers of purchase:

1. the joint venture company in Shanghai from producers in China
2. the importer in Norway from the joint venture company in Shanghai
3. the customers in Norway from the importer in Norway.

Only the trading between the importer and its Shanghai joint venture company is well integrated. The other forms of trading take place on a commodity-like marketplace since the parts supplied are technologically simple and easy to copy. These more loose tiers of trading through relationships are weakly integrated but still, in accordance with Engelseth (2016), feature relationships that seemingly cut through the market. Once goods are intermittently traded these practices follow a routine pattern; trust is developed but not continuous. Likewise, these relationships involve numerous alternative suppliers that actors switch between. Risk in this scenario is associated with revitalising a dormant trading potential founded in intermittently latent relationships. In this long-linked supply chain of machine parts, each actor uses its goods handling facilities accordingly as a buffer against uncertainties to mitigate risk of stock out.

The case also exhibits how ‘risk’ is not a commonly used term when managing supply of the machine parts in question within any of the actors in question or in communications between these first. There is only a weak conception of risk as a boundary object in the case with the exception of the middle business relationship.
between the importer and its joint venture company in Shanghai. Communication is in the other business relationships focused on technical matters, characterised by arms-length relationships with recurring sales. In the case of China, these relationships are likely arms-length since the joint venture company is miniscule, a fly on the wall, form the viewpoint of the Chinese supplier. In Norway, even though bonds are stronger here due to close geographical and cultural proximity, the importer competes with similar suppliers of relatively standardised goods. There are indications of collective development efforts in the business relationship between the Norwegian importer and the Shanghai joint venture company it is part-owner in. This is mainly associated with developing the interconnectivity in the information flow. Furthermore, the information flow is secured since the personnel from the importing firm regularly and often visit the joint venture company in Shanghai. It is possible to utilise boundary spanning to enhance ‘risk’ as boundary object in this relationship mainly because this is a developed and continuously further developing business relationship.

The supply network is a complex context. The case exhibits two industrial network dimensions (ship-building and shipping) with different environments, interconnected by the focal machine parts supply. The customer network in Norway is impacted by market contingencies of this country and the global maritime industry. Since the costs of manufacturing have steadily been rising in Norway over a longer period of time, supplies of machine parts to this industry are inputs into increasingly advanced manufacturing processes coupled with advanced logistics processes. On the other hand, the Chinese manufacturers likewise have developed manufacturing and logistics technology moving away from, pure price competition indicating differentiation and relationship-based pricing. Although this process is just in the beginning, the case evokes a clear picture of an increasingly complex and advanced industrial network that may be described as sets of business relationship systems susceptible to risk and therefore RM and optimisation. A business challenge is evoked regarding how the global pipeline described in the case narrative may be developed to more efficiently bind these two industrial networks, customers in Norway, with suppliers in China. This requires an approach adapted to industrial particularities as well as the long-linked inter-cultural character of this supply. This indicates how risk mitigation is should be embedded in relationships; a component associated with building trust to smooth the flow of goods.

The company has already, through establishing the joint venture operation in Shanghai, taken a decisive step in mitigating risk through developing technical and knowledge resources that better support the flow of goods as opposed to managing this flow from Norway. The joint venture company is accordingly the present foundation for mitigating supply risk, procedures which the case already illustrates examples of. This is proposed achieved through establishing inter-organisational learning processes as the initial step, integration that may be achieved by, e.g., flagging SCM as a philosophy of integration. However, by instead do a communicative maritime-type flagging exercise between the partners applying ‘risk mitigation’ as ‘flag’, a more precise connotation of the grounds for inter-organisational cooperation and learning is achieved. Since RM is mainly a strategic imperative, a human construct used to understand and analyse supply, when two or more companies initiate cooperation with risk mitigation in mind, risk is recommended evoked as a boundary object. This places focus on ‘risk’ as knowledge that through interaction gradually achieve status as a collective conception laying grounds for inter-organisational learning in a complex supply network setting. It is especially evident
through analysis that when coping with risk in a network and when attempting to develop operations, the single firm perspective of RM is challenged. Risk mitigation emerges accordingly as a boundary object even though nobody in this supply chain really is aware of this. Risk mitigation is accordingly proposed understood as a research approach that in a subtle and indirect fashion supports business practice.

6 Concluding remarks

When RM is considered from a supply network perspective a different view of RM is called for, one that places focus on people and how they interact. A picture evolves that risk mitigation involves the wider picture of developing semantic interoperability, both involving the information flow, but also concerning developing the atmosphere of the business relationships involved in interlinking these industrial networks. The development of discourse facilitating interaction quality when using dialogue to integrate and solve problems, in this setting this development of communication represents a strategic initiative supporting operations development in different levels and tiers of relationships in long-linked supply chains. The different levels include actor bonding through using ‘risk mitigation’ as a boundary object, a concept in flux. This accordingly is the suggested key component RM from a supply network perspective, in developing the discourse enveloped in business relationships. These discourse-dependent dialogues are a form of administrative operations; exchange processes. This realm of perceptions may seem ‘fluffy’ upon initial encounter. Deconstructing the actors’ perceptions of actual marketing and supply involves a ‘tearing down’ previous conceptions of how supply works; the ‘modelled rubble’ of perceived present product supply to remodel product supply through joint efforts in the supply network in line with SCM philosophy to develop technical and organisational inter-linkages between them. Risk mitigation is not an isolated technical effort. This also represents a challenging mode of inter-organisational development since it take into account in such a process three time perspectives:

1. learning from past experiences
2. understanding present operations
3. taking into consideration the future.

Managing supply risk to mitigate it makes explicit the future in operations management. In developing supply operations these three time perspectives are balanced. Finally, this long-term and strategic perspective is then integrated operations on a daily basis. It is at the operational level that developed procedures are interlinked with knowledge development from the more long-term development process. This inter-linkage between technical processes with RM in mind, interlinked with actors more consciously aware of the meaning of risk and how risk is management should increase the robustness of the supply network. A picture of practical RM emerges.

This illustrates some foundations for developing RM from a business relationship and wider industrial network perspective. RM may be interlinked with SCM to embed RM in a wider inter-organisational integration initiative. By improving how one talks about uncertainty between firms, this enables through RM the mitigation of risk, a search process to develop improved technical process in the systems that each business
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relationship embodies. Furthermore, since, in accordance with the supply network view (Gadde et al. 2010), companies usually each have a set of different competing or complementary business relationships, using these different business relationships efficiently through multiple sourcing to develop efficiencies in mitigating risk. RM encompasses therefore from this view not only mitigating risk per se, but doing this efficiently and enhancing thereby customer satisfaction.

A major limitation is that this work needs to be complemented by further dedicated case studies on developing RM in line with the framework proposed in this study. This framework admittedly still lacks detail. This is however intentional since it is believed that this RM must be an emergent process where solutions are found in a continuous process. Finally, in line with ‘kaizen’ thinking, this process will expectedly never end. It is therefore pertinent to develop an organisational culture supporting RM in layers of dynamic contexts;

1. the focal firm context
2. immediate business relationships of this firm
3. the network collective of interacting business relationships
4. the wider natural, societal and competitive environment.

Figure 5 illustrates RM as developing discourse embedded in layers of contexts:

**Figure 5** RM as developing discourse supporting RM in layers of context

The wider natural, societal and competitive environment
The network collective of interacting business relationships
The immediate business relationships
The focal firm context
Developing discourse supporting RM

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