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Managing Supply Chain Disruptions in Healthcare - A Supply Management Perspective

Toimitusketjuhäiriöiden hallinta terveydenhuollossa - Hankintojen johdon näkökulma

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Author: Anton Blaskovic

Supervisor: Elina Karttunen

ABSTRACT

Author: Anton Blaskovic
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Supervisor: Elina Karttunen
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This thesis aims to give the reader a general idea of different methods used in managing risks and disruptions in supply chains, using the recent “COVID-2019”-pandemic as an example for a disruption in the healthcare sector. The theoretical background helps to understand what risks are in the context of supply chains, and how they can be prepared for. Alongside literature, three interviews were conducted where professionals from well-established organizations give their views on what is supply management, what are risks and how they protect themselves from them.

The main theme in risk management was its broad nature, where issues appear spontaneously and in many shapes. Due to this, there are many methods and tools deployed to control the entirety of risks the company is exposed to, often governed by the values of the respective organization. It is possible to plan and build operations and supply chains to withstand disruptions, and when environmental factors change, different solutions can become opportunities. The factors defining the ability of specific process to withstand the disruption are resiliency and robustness. As noted in previous literacy, they are often used inter-changeably. However, this thesis gives us a further foothold to keep the two separated.

A matter that should be elevated more by the management was tracking changes in the organization’s operational environment. The changes should be constantly monitored and

changes to processes done accordingly. Another matter for management to consider is both the responsibility and ability of the management and leadership, in changing how the processes and values are set through organization's culture.

TIIVISTELMÄ

Tekijä:	Anton Blaskovic
Tutkielman nimi:	Toimitusketjuhäiriöiden hallinta terveydenhuollossa - Hankintojen johdon näkökulma
Akateeminen yksikkö:	LUT-kauppakorkeakoulu
Koulutusohjelma:	Kauppätieteet, Hankintojen johtaminen
Ohjaaja:	Elina Karttunen
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Tämän tutkielman tarkoituksena on antaa lukijalle pääpiirteittäinen ajatus siitä, millaisia työkaluja ja tapoja voidaan käyttää toimitusketjujen riskienhallinnassa. Esimerkkinä vakavasta toimitusketjuhäiriöstä käytetään ”COVID-19”-pandemiaa, joka nosti terveydenhuollon tarvikkeiden riittävyyden esille. Teoreettinen tausta auttaa lukijaa ymmärtämään mitä riskit ovat toimitusketjujen yhteydessä, sekä miten niihin voidaan varautua. Kirjallisuuskatsauksen tukena toimii kolmen eri organisaation riskienhallintaan tai toimitusketjuihin liittyvää johtohenkilöä, jotka antavat näkemyksiään hankintojen johtamisesta sekä riskienhallinnasta ja niiltä suojautumisesta.

Pääteemaksi muodostui riskienhallinnan laaja luonne, missä ongelmat ilmestyvät yllättäen ja moninaisesti. Näistä seikoista johtuen riskienhallinnassa käytettyjä työkaluja on monia organisaatioiden pyrkiessä hallitsemaan kokonaisuutta, ja nämä työkalut määräytyvät usein organisaation arvojen kautta. Organisaation on mahdollista suunnitella ja rakentaa toimintojaan sekä toimitusketjujaan kestäväksi häiriöitä, ja häiriöiden ilmaantuessa uusien toimintatapojen muodostaminen mahdollistuu. Tekijät, jotka määrittävät tätä häiriönkestävyyttä ovat kestävyys sekä joustavuus. Kuten aiempi kirjallisuus on maininnut, näitä termejä käytetään usein kuvaamaan toisiaan. Tämä tutkielma kuitenkin antaa lisää jalansijaa niiden erottamiselle toisistaan, sillä ne kuvaavat kahta erilaista tapaa kestää häiriöitä. Hankintojen johdon kannalta

tärkeimmiksi seikoiksi nousivat organisaation toimintaympäristön seuranta, jonka avulla toimintatapoja muutetaan, sekä johdon rooli organisaation kulttuurimuutoksessa. Onnistuakseen uusien riskeihin liittyvien toimintatapojen ja asenteiden läpiviennissä, on johdon toimitava esimerkkinä organisaatiokulttuurin muutoksessa.

List of Abbreviations

CSR - Corporate Social Responsibility

RMS - Risk Management System

SC - Supply Chain

SCN - Supply Chain Network

SCM - Supply Chain Management

SSC - Service Supply Chain

NESA - (The Finnish) National Emergency Supply Agency

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1. Introduction

With the availability of global supply chains, it is only reasonable to assume companies and organizations utilize them to their best extent to increase efficiency. As per (Clausen, et al., 2013), *“Efficiency is about the improved ratio of (minimal) input to output.”*, costs play an inherently central part in efficiency. This affects the perceived feasibility of managing uncertainties, as they are often evaluated against the costs of preparing for, and the costs of the disruption happening. Different organizations can carry varying amounts of uncertainty, creating distinct strategies for finding the best way to respond to certain events affecting their supply chains. Healthcare organizations, regardless of whether operating in private or the public sector, often carry uncertainties with the ultimate stake of human lives.

Healthcare organizations consist of a multitude of different layers and systems, often building on top of each other. This creates a challenge in risk management as the complexity is not limited to the inbound flow of supply chain network (SCN), but to the outbound and intra-organizational flow as well, e.g., laundry service, food, and dispensaries. However, this thesis will be limited to the scope of protective personal equipment (PPE), and the ways how management can use different strategies and tools to keep such an elemental part of processes up to speed with every situation.

1.1. Background

The recent outbreak of the SARS-CoV-2 pandemic highlighted the vulnerabilities in supply chains. It is in common knowledge China is a big producer of virtually everything, and the PPE used by hospital staff to ensure the safety of both themselves and the patient’s is no exception. Before the pandemic, China produced half the world’s masks, increasing the production substantially as the disease progressed, but has claimed the output for itself (Bradsher & Alderman, 2020). In response, corporations in other countries are hiking their productions to meet both the local and international demand (Helsingin Sanomat, 2020a). Some are pivoting from their traditional operations to produce materials needed for PPE by local companies (Helsingin Sanomat, 2020b).

In the meantime, hospitals were struggling to provide PPE to its staff. (YLE, 2020a) reported, that the HUS Helsinki University Hospital had to resort to washing single use plastics and monitoring the use of PPE. To withstand these short-term disruptions of vital facilities such as energy and healthcare, governments utilize emergency stockpiles. The Finnish National Emergency Supply Agency (NESA) was deployed to distribute and procure PPE.

Many of the masks supplied were inadequate, posing a potential threat to the users (YLE, 2020b). As the distribution of PPE started, NESA began procuring more equipment, eventually leading to questionable outcomes of both the procedure and the procured products (YLE, 2020c). The managing director of the NESA claims, that the Finnish stockpile has been held as a higher priority, compared to other European countries (YLE, 2020d)

This brings up the question of whether the emergency stockpiles really are at the adequate level, and how much can the individual organizations such as hospitals prepare for events like the SARS-CoV-2 pandemic.

A pandemic causing disruptions in the operations of companies is not a new topic either. (Bhattacharya, et al., 2013, p. 726) list “SARS in 2003, the mad cow disease in 2001, and the swine flu in 2009” as diseases causing major disruptions in supply chain networks prior to the current events.

1.2. Objectives, research questions, and limitations

The objective of this study is to find out, what kind of role does supply management have in ensuring operative capability. A set of secondary research questions will be sought answer to with existing literature, forming a theoretical basis. In addition, the recent pandemic will be used as a sort of “measuring stick” to examine how the current state of supply chains handled such a drastic event. With this a framework of risk management for healthcare will be formed, and a questionnaire will be done to see how an established organization handles this same theme, how does it differ from the findings of the study and can something useful be synthesized from this comparative analysis.

The primary research question is “How can supply management minimize and predict risks in the healthcare’s daily operations?”. To answer this question, a set of secondary research questions must be answered to synthesize a valid answer:

- What is a risk in the context of procurement?
- What means can be used to control and predict the risks while planning procurement?
- How do established companies manage risks regarding their supply?

The study will be limited to fields related to healthcare only, as risks are handled differently across industries.

1.3. Methodology

The bachelor’s thesis will be done as a qualitative study, conducted as a literary review forming a theoretical backdrop for a semi-structured questionnaire, which will then later be used in an interview or interviews with companies working in industries related to healthcare, such as pharmaceuticals, PPE-manufacturing, and hospitals. The semi-structured nature of questionnaire will aid in answering the research questions presented, as well as leaving enough open “space” for bilateral discourse and company-specific views. The semi-structured questionnaire helps in keeping the interview thematically consistent and tied to the matter at hand (Tuomi & Sarajärvi, 2018). Afterwards the conversation will be transcribed and coded. The interviews were performed as personal interviews, or via email in case one could not have been arranged.

The literature review will be split into two parts. In the first part, the more academical work and research around risk management will be reviewed, not limited to a specific field. Theories will be presented in a “backwards” manner, where the problem or broader framework will be presented first, and the more intricate solutions are presented to fill in the gaps. In the second part, research revolving the healthcare sector will be reviewed, expanding on the already-laid foundation of the previous part.

After the literature review and a presentation of the questionnaire, a cross-examination and a synthesis of the literature and outcomes of the interviews will be presented. By doing this

the thesis will be able to reassemble the theory and practice discovered during the research in a manner that is comprehensible, and easy to utilize. Furthermore, this will create space for the thesis to stand-up as a unique study contributing to a gap in existing knowledge regarding methods used to manage the risk (Golden-Biddle & Locke, 2007).

2. Risk Management in Supply Chains

Understanding risk management in supply chains requires us to lay out the basics of supply chain management first. Supply chain is a network of organizations, including but not limited to suppliers, manufacturers, distributors, and logistics providers, with the aim of producing and delivering products and services for the end customers (Kuei, et al., 2011).

Supply chain management is the management of financial, informational, and material flows. Within the three major categories, more processes and functions coordinate and collaborate, such as marketing, production, finance, and procurement. Managing an intricate system like this requires metrics, which can be divided to *operational performance metrics*, such as product development cycle time, cost related measures and even customer satisfaction. On the *strategic performance metrics*, variables such as profits, revenue growth, and return on assets are used. (Sodhi & Tang, 2012)

With the progression of technology leading to more effective coordination and communication, the modern supply chains have assumed traits like globalization, outsourcing and reduced size in supply base. This in turn has led to an elevated uncertainty and risk exposure, often in the form of longer supply chains increasing the probability of sudden disruptions. (Yusuf, et al., 2014)

2.1. Defining Supply Chain Risk

Setting clear boundaries as to what can be defined as a “risk” in this article, we first need to expand on what constitutes a risk. As per (Sodhi & Tang, 2012), the term can be used to describe underlying causes, and the occurrence of a risk event and its consequences. Where the underlying cause happens before impacting the supply chain, the risk event triggers a consequence that can be felt after the event.

The cause can often be described as a disturbance. (Svensson, 2000) breaks disturbances into two main categories of quantitative and qualitative disturbances. Quantitative disturbances refer to a lack of material, which can be caused by delays or other abrupt events, often caused by environmental causes. Qualitative disturbances on the other hand refer to the lacking quality of materials and products, resulting in inability to use them in production or other operations. A cause can also be an accidental event that cannot be easily foreseen, and directly affecting the operational stability of a system (Asbjørnslett, 2003).

The consequences following a risk event depend on the degree of vulnerability a certain part of the supply chain has. Vulnerability can be used to characterize a lack of robustness or resilience to threats, and it can derive both from the system's infrastructure as well as operation. The process models and management of the supply chain greatly affect the perceived vulnerability (Asbjørnslett, 2003). In their paper, (Christopher & Peck, 2004, p. 2) state "We define resilience as the ability of a system to return to its original state or move to a new, more desirable state after being disturbed". The same study states that the terms are often used interchangeably in industry. (Asbjørnslett, 2008) describes robustness as a systems ability to absorb a disturbance, whilst retaining the previous state.

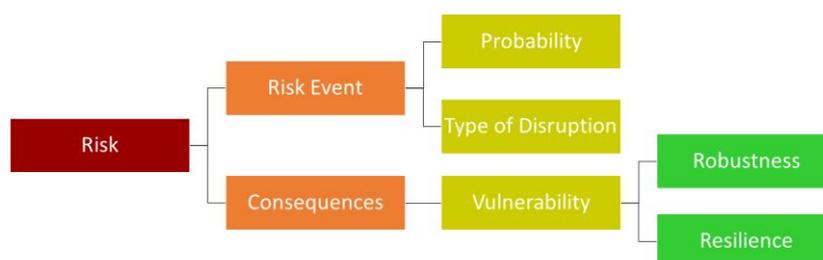


Figure 1. Supply Chain Risk Topology - Blaskovic (2020)

In figure 1 we now have the term "risk" broken down to two major categories. Understanding the inner pieces of the broader term allows us to closer inspect the underlying factors, and further review and develop strategies to control the severity of risks. One possible description could be *"The higher the probability of a disruptive event is, and the more radical the consequences are, more serious the risk"*.

2.2. Controlling the Risk

In the prior chapter, responding to disruptions in SCNs comes in the form of robustness and resiliency. In other words, planning and designing of the network for such events. As table 1 shows, disruptions can come in many forms. Depending on the event, the event of disruption might be very improbable, and the willingness to prepare for such risks is often small. The scale and effectiveness of the process varies by industry, and even at a company-to-company level within same industry, bringing forth the need for a standard and a rationalized approach.

Natural disruptions	Forced disruptions
Natural calamities (point load)	Terrorism (impact load)
Infectious diseases (distributed load)	Accident due to negligence (impact load)
Economic recession, inflation in currency (distributed load)	Organizational problems (e.g. strikes, labor unrest) (impact load)
Market fluctuations (distributed load)	Contamination of raw materials/products (e.g. pharmaceutical, protective gear, food sector) (impact load)
Psychological panic among customers (impact load)	Failure in delivery (distributed load)

Table 1. Classification of Disruptions - Adapted from Bhattacharya et al., (2013)

(Spekman & Davis, 2004) identified three risks as inherent to the supply chain: Goods, information, and financial. Dimensions rising from their study also included:

- security of the corporation's internal information systems,
- relational matters between supply chain partners
- corporate social responsibility (CSR) and reputation.

Let us toy with the idea of having an imaginary company manufacturing for example, mobile phones. The core of a modern mobile phone is comprised of chipsets such as the motherboard, antennae; the casing made of plastic and glass; the software used to operate the hardware. As the classical theory of economics suggests, specialization is used so the main factory only puts the phone together and sources the individual parts from another set of companies

or subsidiaries, which in turn source the raw materials from refineries, which in turn source their raw materials from other suppliers. It becomes clear as to why risk management is not a straight-forward task and how it quickly convolutes into a wide-spanning array of possible “go-wrongs”.

2.3 Tools Developed to Predict and Evaluate Risks

The academia has developed multiple ways to tackle the characteristic complexity of real-world risks. Some utilize quantitative methods such as probability and models, and others place their attention on the more intangible things like relations and information. Like Spekman and Davis noted, risks are not solely tied on material loss such as goods and money, but CSR and reputation and trust in company are affected as well.

As demonstrated in the earlier thought experiment, the “sets” of event & consequence quickly spin out of hand in terms of amount, and computational approaches become more feasible. (Goh & Lim, 2007) proposed a stochastic model for managing risks, to develop a unified model for global supply chains. Attempts to quantify risks have been made as well. Using hierarchical holographic modeling, (Haimes, et al., 2002) further broke down the metrics piece-by-piece, measured often by the probability and severity. Expanding on the quantitative metrics, (You, et al., 2009) utilized variables such as variance and probabilistic financial risk. The underlying numerical methods are the building blocks in risk analysis and are often found overlapping one another.

A more qualitative and practical approach to analyzing vulnerability was presented by (Asbjørnslett, 2003). A flow sheet designed to break down several “sets” in 7 steps. Most of the strategies and theories share a very similar scale matrix, that has probability on one axis and severity on the other. A generally applicable type of such matrix, known as qualitative risk matrix, is presented in figure 2:

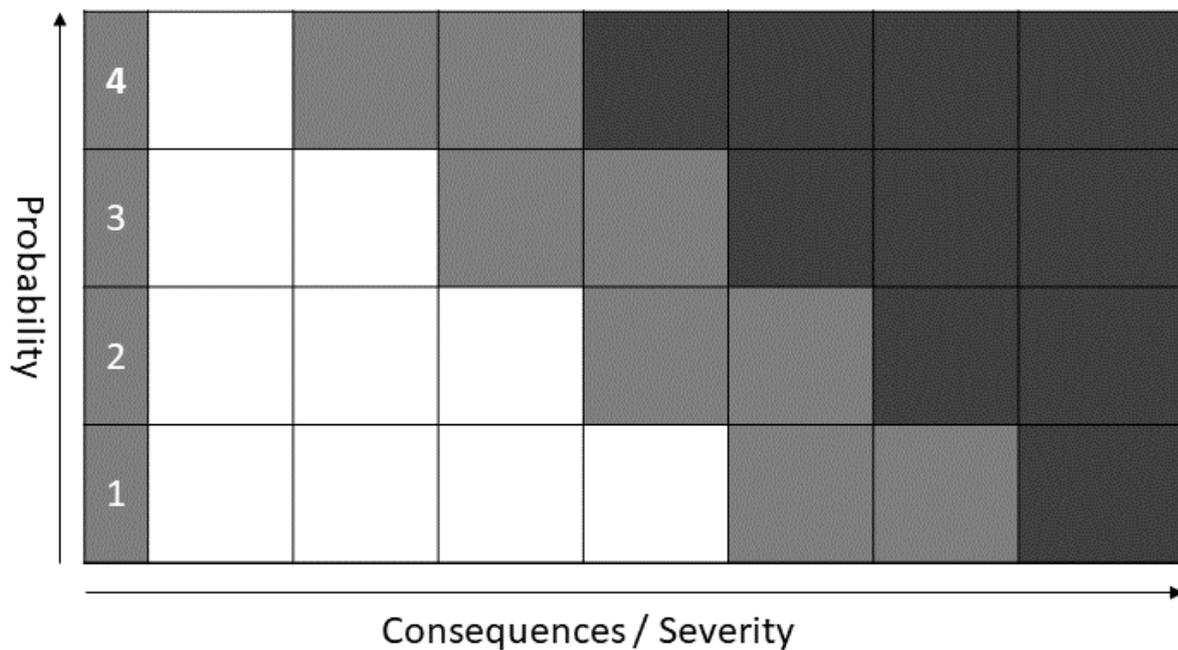


Figure 2. Qualitative Risk Analysis Matrix - adapted Haimes et al. (2002) & Asbjørnslett (2003)

Sometimes strategies elaborate on existing concepts, such as the Risk Management System proposed by (Mullai, 2009). In the RMS, he proposes an on-going dynamic process model of three steps: Risk analysis, risk evaluation and risk management. These three phases can happen simultaneously and affect one another, such as deeming risks being negligible and getting dropped from further analysis.

2.4 Different solutions to different issues

Diving down further into separate points from the broader models, many solutions have been developed to combat specific issues and to help management understand their operations. Utilizing these strategies requires the management to know their product, the market they operate in, and the companies they operate with. To assess what kinds of risks are involved with the operation, a look at the supplies used to keep the processes uninterrupted is required.

One of the tools considered elementary in supply management is the purchasing portfolio, presented by Peter Kraljic in 1983. The 2-by-2 matrix is designed to help identify critical components, with the matrix' axes being "importance of buying" and "complexity of supply market" (Kraljic, 1983). The matrix revolves around the power of a purchasing company on the

market. Steering away from the rather antagonistic approach of Kraljic, the purchasing portfolio models have evolved to support partnerships and contracting. (Van Weele, 2002) Suggests new variables for the axes as “Profit impact” and “Supply risk”, more in line with the nature of risk management whilst still retaining necessary information and to good extent, the categories. Despite evolution, the core of the strategies has remained same for response on different issues: Secure sufficient stocks, keep or shift production, incorporate partnering.

Elaborating on partnering and supplier relationships, (Blome & Henke, 2009) bring the single vs multiple sourcing question from the risk managements viewpoint. A set of pros for the four most used supplier relationships was synthesized, shown in table 2:

Pros of cooperative supplier relationships	Pros of transactional supplier relationships
<ul style="list-style-type: none"> • Strategic cost-reduction potential • Commitment • Use of supplier’s knowledge and faster development of new products • Improved planning options and information exchange • Simple sourcing process • Reduction of stock 	<ul style="list-style-type: none"> • Lower supplier relationship costs • Lower prices due to competition • Higher flexibility due to lower switching costs • Lower dependence on a single supplier • No decline in supplier motivation due to long-term contracts
Pros of single sourcing	Pros of multiple sourcing
<ul style="list-style-type: none"> • Cost reduction through bundling • Cost reduction through standardization • Smaller number of suppliers and interfaces • Lower transaction costs • Easier quality assurance • Higher specialization • Easier processes 	<ul style="list-style-type: none"> • Lower prices due to competition • Lower dependence on a single supplier • Lower dependence on a single technology • Flexible change of suppliers

Table 2. Advantages of types of supplier relations - adapted from Blome & Henke (2009)

As according to Blome & Henke, on a short- and mid-term basis there is often no real choice between the type of relationships with suppliers. They also point out that even though following the old idiom “don’t put all your eggs in one basket” would seem feasible for reducing risk, the possibility of a risk grows by the number of suppliers. Where trying to keep constant exchange of information with multiple suppliers can be challenging, a single supplier can help recognize and manage risks proactively, even if the single point is more vulnerable to considerable damage.

(Zsidisin & Ellram, 2003) present two orientations in managing supplier related risk: behavior-based management and buffer-oriented. Improved information sharing, monitoring and closer relationships are the fundamental parts of behavior-based orientation. Listed as useful techniques focusing on supplier's behavior and processes are supplier certification, quality management program, target costing and supplier development. The core of each technique can be described as follows in table 3:

Certificates	Often standardized, they help in aligning the suppliers' values with the purchasing organization and reducing the need for first-hand inspections and audits.
Quality management programs	They can be used to improve the ability and activity of a supplier, specifically on the purchasing company's guidelines.
Target costing	A strategy featuring a two-way discourse and negotiation on expected needs and schedules.
Supplier development	Refers to the method where improving a supplier's ability to respond to purchasing organization's needs on shorter and longer term is done by a program often done by the purchasing organization.

Table 3 - Behavior-based orientation - Adapted from Zsidisin & Ellram (2003)

The behavior-based orientation is, by nature, more focused on the qualitative side of pre-emptive operations to minimize risk causes. The buffer-oriented techniques on the other hand focus on reducing the consequences caused by a disruption, i.e., the robustness. The three techniques mentioned are: Managing inventory, for example, in form of a safety stock. Safety stock is described as particularly effective way of protecting a company from risk but carries a great cost both from the purchasing company's and the supplier's point of view, as costs related to internal inventory rise, and might cause issues with transportation. Safety stock on purchasing firm becomes a burden in terms of logistics and room, whilst a safety stock as a

mean to control supply risk, that is, supplier managing an inventory of finished goods, the additional costs caused by this are often passed to the purchaser. As noted by Blome & Henke in the previous section, *multiple sourcing* is seen as an option for both reducing price hikes, and supply disruptions caused by a single supplier being unable to operate.

Loss of goods does not necessarily stem from the supply drying up, or relations taking a turn for the worse. Experts estimated losses of about 10 to 30 billion dollars a year directly from stolen goods, and the estimate does not account for the indirect costs of the event (Anderson, 2007). In addition to selling the stolen cargo, perpetrators often supply counterfeiters with original products for more accurate counterfeits. In a report produced by (OECD/EUIPO, 2019) it is stated that in 2016, based on customs seizure data the value of imported fake goods added up to 509 billion USD, comprising 3.3% of imports. This results in both direct and indirect losses, in sales revenue and potential damage to image. On a more serious note, counterfeits, and contamination of products like pharmaceuticals can result in loss of lives (Coghlan, 2006).

To combat this, a set of standards can be used ensuring security during transportation, and where applicable, on the product itself. Such standards as ISO 20858:2007 on port security assessment and development, or ISO 18185-3:2015 on electronic seals (ISO, 2020). Agreeing on globally set and agreed upon standards effectively eliminates the issues often brought up operating with international partners, where culture and views might differ.

Contracts are a tool that can be used to share risk and liability. One of such contracts can be Code of Conduct, a standardized contract between supplier and a client forming a legal relationship. It requires the suppliers to comply with the agreed set of rules and ask the same from their own suppliers (Zakaria, et al., 2012). Even if mostly associated with corporate social responsibility, value can be seen in supporting fair play and responsible guidelines, reducing the risk of organizational problems, embezzling, and possible consequences of events negatively impacting company image.

3. Concepts of Risk Management in Healthcare Organizations

In the previous chapter, a look at the more traditional and general processes of risk management were inspected. The inherent complexity of supply chains, and by causality the risks, became clear and it is easier to understand why they sometimes fail. In the following part, we will go through some literature regarding sector-specific processes of healthcare organizations.

Healthcare organizations are characterized by their own unique factors, making it difficult to transfer methods used in industrial sector directly. However, many of the existing solutions can be used to support supply chain management in health services. The importance of studying the strengths, and more-over, the weaknesses of lean, agile, and lean six sigma as well as business process management, have been noted. The performance measures are not always as clear-cut in healthcare as they are in an industrial sector. In the light of this, it is suggested that a more interdisciplinary focus is required, and knowledge from the healthcare as well as industrial side of the supply chain is a must. (de Vries & Huijsman, 2011)

3.1. Cooperation and Outsourcing in Healthcare

In a case study presented by (Bhakoo, et al., 2012), five factors extended from extant literature and were then synthesized with healthcare supply chain context. These five factors with simplified descriptions are:

- Product characteristics - value and demand
- Spatial complexity - the distance between HC organization and supplier
- Degree of goal congruence and trust/commitment - qualities between the organization and the supplier
- Regulatory environment - requirements of a single product presented by legal regulation
- Physical characteristics - the size of the organization's working space and the stage of IT adoption

Based on these factors, a framework on level of control over individual products was built, suggesting how much of internal control and complete outsourcing should be practiced. The findings of the study are easiest to comprehend by the following, in figure 3:

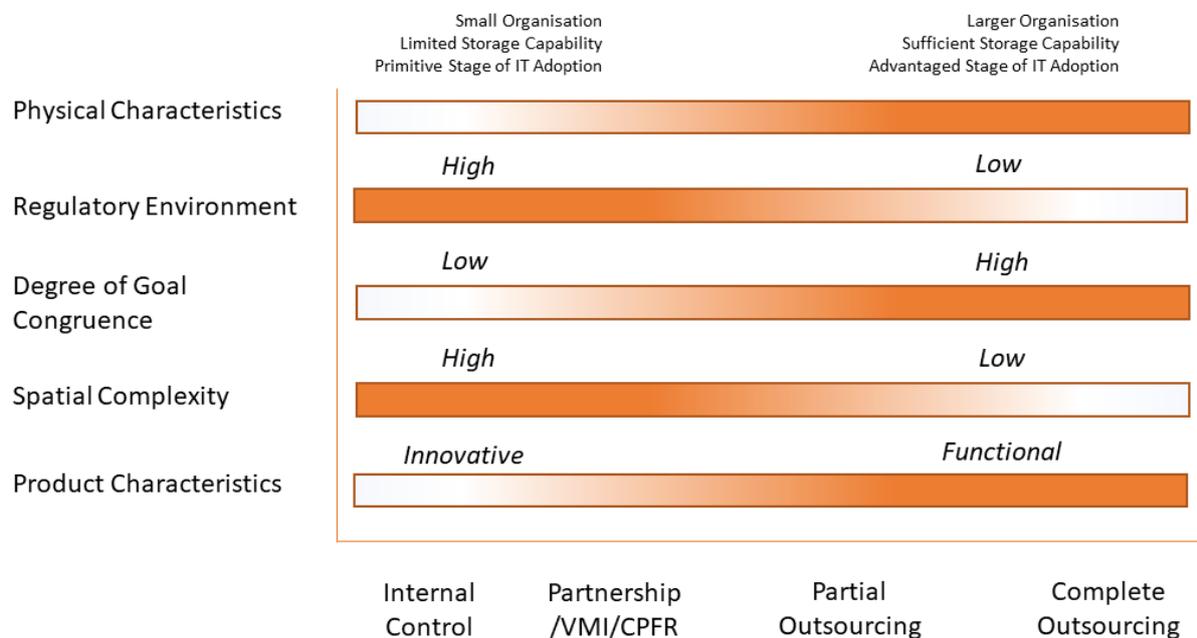


Figure 3 - Relationship collaboration factors - Adapted from Bhakoo, et al., 2012

Sometimes, producing all the necessary services to fit patients' needs are not available or optimal under on single organization. This can be utilized to also control the risk in certain areas. (Getele, et al., 2019) tested three hypotheses of institutional, inter-agency and social ties, of which it was found that inter-agency collaboration plays a significant role in managing service supply chain (SSC), especially in an environment of volatility and uncertainty. The recommended procedures were thorough analysis of the supply chain, planning for necessary actions in areas required, actively managing, and monitoring inter-agency relations.

4. Data and Analysis Gathered From Interviews

The following chapter focuses on three interviews, one of which are directly from the healthcare as to observe current practices in the sector regarding risks, and two that are from different sectors to form a contrast on the healthcare sector. The interviews were performed during the summer and fall of 2020. There are currently 20 healthcare districts in Finland, governing the healthcare for a total of 294 municipalities (Kuntaliitto, 2020), playing a central role in harmonizing the procedures and raising efficiency of operations.

The interviewee from healthcare sector works as a quality manager, with two decades of experience in healthcare district. Having a background in health sciences, they oversee building the of the district's quality assurance and its certification. From the interviewees outside of healthcare sector, the first one is a risk manager in a large, private corporation engaging in both buildings and infrastructure. They manage risks in bidding and tendering and choose as well as oversee projects. The second interview is from a category manager at a large public organization. They have a wide view on both the ICT-sector, leadership, and corporate law. The interviewees were chosen due to the complexity of their respective operations, with very similar risk-carrying nature.

There was a total of 14 questions asked to create a baseline for the interview, allowing to gauge the nature of their respective organizations are their views in risk management, and the relevancy of their responses. The structure was designed to be open, giving the answers enough space to be formulated by the interviewee rather than getting a specific answer. All the questions were not necessarily answered, either due to their knowledge or relevancy of the process in their field. The interviewee's will be called "Healthcare", "Public", and "Private". The questionnaire can be found in the appendix 1.

4.1. Supply Management and Supply Chains in the Respective Fields of Interviewees

Supply management was seen as a supporting operation inside the organization itself by all parties. However, its role was considered significant for the success of efficient organization, and a successful supply management requires strong knowledge of their current situation. The situational awareness should be derived from facts and observations from both inside the organization and the outside, constituting from legislative requirements as well as changes in the environment. Supply management is also a very broad subject, from the conception of a need to everything in-between finally ending in the fulfilment. A well-led supply chain is not only managing the flow of material, but employees, suppliers and even stakeholders. This enables the management to create new value and innovations.

The supply chains used by healthcare were undetermined, as the interviewee could not answer the question. The other two fields use more traditional models of supply chains, where there are differing amounts and sizes of suppliers, but centralizing and risk sharing models of “alliance” and co-operation are used.

4.2. The Risks in the Organizations and How They Are Managed

From every answer, loss of capital or its inefficient use were most prominent. Lackluster goods, bad contracting or not following the organizations protocol can lead to necessary re-evaluation of the specific procurement and wasted resources. Issues in services are often characterized by quality, responsibility, and reliability.

To measure these risks, different methods are utilized for different processes. Follow-ups and scheduled meetings with roadmaps are used for larger, single-sourced projects, whereas smaller suppliers are pre-emptively evaluated by performance or credit ratings.

Risk management tools used ranged from broader to smaller scale. There was a “severity classification” used by the healthcare, that was used to define the risk factors and actions required to correct them. The “Private” sector had divided the risk management into five stages, mostly

due to their vastly differing projects. The stages were different types of tendering, preselection of contractors, metering the performance of said contractors, developing the contractors and finally meeting with the procurement team to assess the current situation, market events and risk factors.

The interviewees were asked about their view on how useful their ways of managing risks were, and all of them agreed on the usefulness of the current tools. However, the existence of “hidden information”, where there is knowledge of a certain aspect or issue, but which does not reach the management or other necessary actors in the process can lead to disruptions in the future. A cumulative approach to knowledge management regarding the relationships between the suppliers was also proposed.

4.3. The Effects of Recent Pandemic on the Organizations Operations

As noted earlier, preparing for all the risks is increasingly unfavorable, and exceptional situations such as the pandemic has had its impact on the organizations as well. As more data is gathered from past experiences, the tools can and should be adapted to take them into account. Processes that were seen previously unlikely to be affected by distributed loads were now found to require new attention and adaptation, such as financial risks of clients and availability of supply contracts.

One of the interviewees, “Public”, commented on his interview in September, that “on a more general scale, now that the pandemic has taken a while and the situation has somewhat stagnated, “Force Majeure”-clause is not really applicable in contracts anymore as the effects of the pandemic are now known was environmental factors that affect the supplier and supply chain, one way or another.”

5. Managerial implications for Risk Management in Healthcare Supply Management

We now have a basic look on risk management, and especially its complexity. One trait that makes it a challenging field is that it needs to be as proactive as possible and preparing for every possible kind of risk is extremely difficult, if not nearly impossible.

From the findings in literature, it could be suggested that risk management is partially built into the supply chain from the beginning using quantitative models, rather than applied as a band-aid after the chain has already been designed. (Christopher & Peck, 2004) This also means that, should the risk management be applied reactively, situations rise where considering a restructuring of the supply chain or process might be the best if not the only option. Of course, the environmental factors change, and parts of the supply chain may become permanently unavailable and choosing new suppliers and actors will be necessary. Tools such as the risk assessment matrix and the RMS can be applied at any given time and should be an ongoing effort. Contracts are a powerful tool to make sure both parties abide by the same set of rules, and usage of standards as well as defined processes should be defined in the contract.

In the interviews, the most prominent user of different tools was from the “private”-sector, where there were numerous tools from procurement systems to different qualitative and quantitative tools to measure contractor and supplier eligibility. It should be noted that the specific interviewee works in a very project-oriented environment where supplier relationships may be very brief, lasting either a season or a specific contract. However, this also means that tools can and should be fabricated to fit the specific needs. One of such tools was the risk category system created by “Healthcare”, which allows them to prioritize, focus and discover new risk factors.

In the context of healthcare and items such as PPE, categorization of risks can be deemed a very useful tool at a cursory glance. As with any organization, certain operations are required for reaching an operational status and must be secured, such as instruments to provide safe care of patients, and should most likely be placed in a high-priority category. Items that are aimed to improve the quality of patients and staff alike may be placed on a lower priority. This in turn gives us a more accurate image on the necessary precautions.

An interesting note made by “public” on changing the way how risks are seen in the organization. Be it any kind of change in the organization, it is boiled down to leadership and top management. How issues are seen and in the context of risks, reacted to, must be ingrained to the organizational culture, and management is in key role setting the precedent.

6. Conclusions

Reviewing the gathered material, it can be deemed there is sufficient information to answer all the proposed research questions. A risk in the context of procurement could be defined in the following way: A risk consists of two main categories, the risk event, and its consequences. The risk event is composed of the probability of the event, and the type of disruption. The consequences are determined by the vulnerability of specific operation, that in turn is defined by its robustness and resiliency.

Multiple means of predicting and controlling the risk were presented. These processes and their efficacy can be improved by different measuring models, building risk-managing qualities to the supply chain itself, as well as facilitating new tools for specific needs. It is stressed by both literature and the interviews that risk management is an on-going process, which should never rest. The awareness of the environment the organization operates in is a must, and the changes should be tracked, as noted with the introduction of pandemic and later the stagnation of the situation.

Established companies manage risks in various ways, and we had a glance over several different sectors ranging from healthcare to public and to private. Whilst there was a small and

limited sample from the healthcare sector, the crosscut of different sectors could be a way to bring novel ideas from one field to another. This approach also gives us a view on how many kinds of processes can be used to manage risk. Another theme that has become clear was risk management being pre-emptive as a field, and when successful, no attention might be paid to it from an outside view. Once issues arise, risk management will be the first one in the spotlight to be reviewed.

References

- Anderson, B., 2007. Securing the Supply Chain - Prevent Cargo Theft. *Security*, 44(5), pp. 56-57.
- Asbjørnslett, B. E., 2003. *Project Supply Chain Management: From Agile to Lean*. Oslo, s.n.
- Asbjørnslett, B. E., 2008. Assessing the vulnerability of supply chains. Teoksessa: G. A. Zsidisin & B. Ritchie, toim. *Supply chain risk*. New York: Springer, pp. 15-33.
- Bhakoo, V., Singh, P. & Sohal, A., 2012. Collaborative management of inventory in Australian hospital supply chains: practices and issue. *Supply Chain Management: An International Journal*, 17(2), pp. 217-230.
- Bhattacharya, A., Geraghty, J., Young, P. & Byrne, P. J., 2013. Design of a resilient shock absorber for disrupted supply chain networks: a shock-dampening fortification framework for mitigating excursion events. *Production Planning & Control*, Osa/vuosikerta 24 (8-9), pp. 721-742.
- Blome, C. & Henke, M., 2009. Single Versus Multiple Sourcing: A Supply Risk Management Perspective. Teoksessa: G. A. Zsidisin, toim. *Supply Chain Risk - A Handbook of Assessment, Management, and Performance*. New York: Springer Science+Business, pp. 125-134.
- Bradsher, K. & Alderman, L., 2020. *The World Needs Masks. China Makes Them, but Has Been Hoarding Them..* [Online] Available at: <https://www.nytimes.com/2020/03/13/business/masks-china-coronavirus.html> [Haettu 11 6 2020].
- Christopher, M. & Peck, H., 2004. Building the Resilient Supply Chain. *International Journal of Logistics Management*, The, 15(2), pp. 1-14.
- Clausen, U., Hompel, M. & Klumpp, M., 2013. *Efficiency and Logistics*. Berlin: Springer.
- Coghlan, A., 2006. The medicines that could kill millions. *New Scientist*, 191(2568), pp. 8-9.
- de Vries, J. & Huijsman, R., 2011. Supply chain management in health services: an overview. *Supply Chain Management: An International Journal*, 16(3), pp. 159-165.
- Gelderman, C. J. & Van Weele, A. J., 2005. Purchasing Portfolio Models: A Critique and Update. *Journal of Supply Chain Management*, 41(3), pp. 19-28.
- Getele, G. K., Li, T. & Arrive, J. T., 2019. Risk Management in the Service Supply Chain: Evidence From the Healthcare Sector. *IEEE ENGINEERING MANAGEMENT REVIEW*, 47(4), pp. 143-152.

Goh, M. & Lim, J. Y., 2007. A stochastic model for risk management in global supply chain networks. *European Journal of Operational Research*, 182(1), pp. 164-173.

Golden-Biddle, K. & Locke, K., 2007. *Composing Qualitative Research*. 2nd toim. London: Sage Publications.

Haimes, Y. Y., Kaplan, S. & Lambert, J. H., 2002. Risk Filtering, Ranking, and Management Framework Using Hierarchical Holographic Modeling. *Risk Analysis*, 22(2), pp. 383-397.

Heckmann, I., Comes, T. & Nickel, S., 2015. A critical review on supply chain risk – Definition, measure. *Omgea - The International Journal of Management Science*, Osa/vuosikerta 52, pp. 119-132.

Helsingin Sanomat, 2020a. *Helsingiläisyhtiö aikoo valmistaa puolet Suomen hengityssuojainten tarpeesta – ”Suojainmateriaalien hinnat ovat yli 15-kertaistuneet maailmalla”*.

[Online]

Available at: <https://www.hs.fi/politiikka/art-2000006470766.html>

[Haettu 11 6 2020].

Helsingin Sanomat, 2020b. *Tampereella alkaa materiaalin valmistus 10 miljoonaan hengityssuojaimen kuukaudessa – joukko suomalaisia yrityksiä käynnistää koronasuojainten massatuotannon Suomessa*. [Online]

Available at: <https://www.hs.fi/talous/art-2000006468588.html>

[Haettu 11 6 2020].

ISO, 2020. *International organization for standardization*. [Online]

Available at: www.iso.org

[Haettu 20 July 2020].

Kraljic, P., 1983. Purchasing Must Become Supply Management. *Harvard Business Review*, 61(5), pp. 109-117.

Kuei, S.-h., Madu, C. N. & Lin, C., 2011. Developing global supply chain quality management systems. *International Journal of Production Research*, 49(15), pp. 4457-4481.

Kuntaliitto, 2020. *Sairaanhoidopiirien jäsenkunnat*. [Online]

Available at: <https://www.kuntaliitto.fi/sosiaali-ja-terveysasiat/sairaanhoidopiirien-jasenkunnat>

[Haettu 20 June 2020].

Mathur, B., Gupta, S., Meena, M. L. & Dangayach, G., 2018. Healthcare supply chain management: Literature review and some issues. *Journal of Advances in Management Research*, 15(3), pp. 265-287.

Mullai, A., 2009. A Risk Analysis Framework for Maritime Transport of Packaged. Teoksessa: G. A. Zsidisin & B. Ritchie, toim. *Supply Chain Risk*. Bowling Green: Springer Science+Business Media, pp. 83-101.

OECD/EUIPO, 2019. *Trends in Trade in Counterfeit and Pirated Goods*. Paris: OECD Publishing.

Ritchie, B. & Brindley, C., 2007. Supply chain risk management and performance: A guiding framework for future development. *International Journal of Operations & Production Management*, 27(3), pp. 303-322.

Sodhi, M. S. & Tang, C. S., 2012. *Managing Supply Chain Risk*. New York: Springer Science+Business Media.

Spekman, R. E. & Davis, E. W., 2004. Risky business: expanding the discussion on risk and the extended enterprise. *International Journal of Physical Distribution & Logistics Management*, 34(5), pp. 414-433.

Svensson, G., 2000. A conceptual framework for the analysis of vulnerability in supply chains. *International Journal of Physical Distribution & Logistics Management*, 30(9), pp. 731-750.

Thomas, D. J. & Griffin, P. M., 1996. Coordinated supply chain management. *European*, 94(1), pp. 1-15.

Tuomi, J. & Sarajärvi, A., 2018. *Laadullinen tutkimus ja sisällönanalyysi*. Helsinki: Kustannusosakeyhtiö Tammi.

Van Weele, A., 2002. *Purchasing Management: Analysis, Planning and Practice*. 3rd toim. London: Chapman & Hall.

YLE, 2020a. *Yle selvitti: Suojavarusteet paikoin loppumassa – kertakäyttöisiä käsidesipulloja pestään, HUSissa hengityssuojainten käyttöä alettu valvoa*. [Online]

Available at: <https://yle.fi/uutiset/3-11268965>

[Haettu 11 6 2020].

YLE, 2020b. *Sairaalat saivat varmuusvarastoista vuosia sitten vanhentuneita hengityssuojaimia – "Ihan kuranttia ei kaikki tavara ole ollut", sanoo HUS-johtaja*. [Online]

Available at: <https://yle.fi/uutiset/3-11286164>

[Haettu 11 6 2020].

YLE, 2020c. *Ylen tieto: Huoltovarmuuskeskuksen irtisanottua johtajaa Jyrki Hakolaa epäillään rikoksesta maskikaupoissa – KRP iski Hakolan sähköposteihin.* [Online]

Available at: <https://yle.fi/uutiset/3-11354440>

[Haettu 11 6 2020].

YLE, 2020d. *Huoltovarmuusvarastojen ovet ovat auenneet vain muutaman kerran tällä vuosituhanella – mitä kaikkea varastot pitävät sisällään?.* [Online]

Available at: <https://yle.fi/uutiset/3-11272633>

[Haettu 11 6 2020].

You, F., Wassick, J. M. & Grossmann, I. E., 2009. Risk management for a global supply chain planning under uncertainty: Models and algorithms. *AIChE Journal*, 55(4), pp. 931-946.

Yusuf, Y. Y. ym., 2014. A relational study of supply chain agility, competitiveness and business performance in the oil and gas industry. *International Journal of Production Economics*, Osa/vuosikerta 147, Part B, pp. 531-543.

Zakaria, M., Garanca, Z. & Sobeih, A., 2012. Cultural and legal challenges in implementing code of conduct in supply chain management of mobile phone industries: Sony Ericsson case study. *Social Responsibility Journal*, 8(2), pp. 227-241.

Zsidisin, G. A. & Ellram, L. M., 2003. An Agency Theory Investigation of Supply Risk Management. *Journal of Supply Chain Management*, Osa/vuosikerta 39, pp. 15-27.

Appendices

Appendix 1 Interview Questionnaire

#	Question	Kysymys
1.	Could you please tell us more about yourself, who you are, what is your background and description in the company	Kertoisitteko itsestänne, kuka olette, minkälainen tausta teillä on ja mikä on työkuvanne yrityksessä?
2.	What are your areas of responsibility?	Mitkä ovat vastualueitanne?
3.	What do you consider as supply management?	Mitä on mielestänne hankintojen johtaminen?
4.	What do you consider as a risk in the domain of supply management?	Mitä ovat mielestänne riskit, kun puhutaan hankinnoista?
5.	How do you measure risk in your supply chain?	Miten mittaatte riskiä toimitusketjuissanne?
6.	How do you manage risks in your company's operation on supply chain? What about at the operational side? (Robustness and resiliency)	Miten käsittelette ja hallitsette riskejä yrityksenne toimitusketjuissa? Entä huomioitteko riskejä yrityksen toiminnoissa kuten tuotanto tai muu päivittäinen toiminta? (Vakaus ja joustavuus)
7.	Do you feel like managing risks are important to keep your company operational?	Koetteko, että riskien hallinnointi on tärkeää yrityksen toimintakyvyn ylläpitämiseksi?
8.	What kind of tools do you use to manage risk?	Minkälaisia työkaluja käytätte riskienhallinnassa?
9.	Could you tell how useful/effective these tools are, by putting them in order from most useful to least? Do you feel some are easier to use than others?	Kertoisitteko, kuinka hyödyllisiä/toimivia nämä työkalut ovat, laittamalla ne järjestykseen hyödyllisimmästä vähiten hyödyllisempään? Koetteko, että osa näistä on helpommin käytettäviä kuin toiset?
10.	Are there any other tools that you know of, but don't currently utilize? If so, are there any reasons as to why You do not use them?	Onko olemassa sellaisia työkaluja, joita ette käytä? Jos on, mikä on syy päätöksen takana olla käyttämättä niitä?
11.	How has the recent pandemic affected your company and its policies regarding risk management?	Miten äskettäinen pandemia on vaikuttanut yrityksenne ja sen riskienhallinnan menettelytapoihin?
12.	Do you have anything else to add to the interview?	Haluaisitteko lisätä jotain keskustelun aiheesta?