Master Thesis in
Industrial Engineering and Management

Interorganizational Learning & Resilience

A Case Study of the Swedish Pharmaceuticals Supply Chain, under Normal Circumstances and in a Crisis.

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1 February 2019

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Acknowledgements

Abstract

Title Interorganizational Learning and Resilience - A Case Study of the Swedish Pharmaceuticals Supply Chain, under Normal Circumstances and in a Crisis

Background Increasing dependencies between Swedish societal sectors and the critical infrastructures upon which they depend as well as institutional fragmentation within the societal sectors, have caused a need to map the critical infrastructures in Sweden. The descriptive research aiming to map and understand the Swedish pharmaceuticals supply chain is to a high degree missing today. A potential strategy to meet the complexity of increasing dependencies and fragmentation in critical infrastructure, is to work with interorganizational learning with the aim of increasing resilience in the critical infrastructure.

Objective The objective of the thesis is to map the Swedish pharmaceuticals supply chain (SPSC) under normal circumstances and in a crisis, and analyze how the actors can work with interorganizational learning to become more resilient as a system.

Method Based on a systems philosophy, this qualitative single case study follows an abductive approach. A descriptive study is first conducted by mapping the SPSC based on interviews with practitioners in the SPSC and secondary sources. Further, an explanatory study is conducted by making a gap analysis between theory and empirics collected during interviews, for how interorganizational learning for resilience can be improved in the SPSC.

Conclusion SPSC is mapped in three dimensions: material flow, legal frames and collaboration. A framework for how to work with interorganizational learning for resilience in a critical infrastructure is presented. When the framework is applied to the SPSC, it is revealed that the actors should focus on a number of areas to improve the usage of interorganizational learning for resilience. For example, focus should be laid on ensuring that necessary learning prerequisites are in place, making more joint assessments, start using simulation and making strategic experience analysis for IT-disruptions.

Keyword Interorganizational Learning, Resilience, Critical Infrastructure, Swedish Pharmaceutical Supply Chain, Supply Disruptions, Crisis Management

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Abbreviations

Names

ARI	Group for Complaints and Withdrawals
AS	Swedish Pharmaceutical Society
CenCIP	Center for Critical Infrastructure Protection Research
EEA	European Economic Area
eHM	Swedish eHealth Agency
FGL	Association for Generic Pharmaceuticals and Biosimilars in Sweden
FHM	Public Health Agency of Sweden
FOI	Swedish Defence Research Agency
FS	Swedish Disability Rights Federation
IVO	Health and Social Care Inspectorate
LDF	Association of the Pharmaceuticals Distributors
LIF	Association of the Pharmaceuticals Industry
LH	Swedish Association of Pharma Traders
LV	Swedish Medical Products Agency
MSB	Civil Contingencies Agency
NLS	National Pharmaceuticals Strategy
R	Swedish Parliament
RSK	Council of Knowledge Management
SAF	Swedish Pharmacy Association
SBU	Swedish Agency for Health Technology Assessment and As. of Social Services
SD	Ministry of Health and Social Affairs
SF	Swedish Pharmacists Association
SKL	Swedish Association of Local Authorities and Regions
SLF	Swedish Medical Association
SoS	National Board of Health and Welfare
TLV	Dental and Pharmaceuticals Benefits Agency
VF	Swedish Association of Health Professionals

Concepts and roles

CBRN   Chemical, biological, radiological and nuclear
CC   County council
Cu   Customer, patient
D   Distributor
D-Ph   Distance- and e-Pharmacy
DD-Ph   Dose Dispensing Pharmacy
E-Ph   Extemporaneous pharmacy
H   Hospital
H-Ph   Hospital pharmacy
JIT   Just in time
LC   Lodging care
M   Municipality
O-Ph   Outpatient pharmacy
PC   Pharmacy contractor
PP   Pharmaceuticals producer
PrC   Primary care
Re   Retailer
RMM   Raw material manufacturer
SPSC   Swedish pharmaceuticals supply chain

1| Introduction

This chapter introduces the reader to the background and problem discussion of the study, leading up to the objective and research questions of the thesis. The delimitations, target audience, and structure of the thesis are also presented.

1.1| Background

Having access to hospitals and medication when we get sick, being able to buy food in grocery stores as well as having the possibility to travel to workplaces and schools using roads, sidewalks and public transportation, are things most people take for granted. Millions of people would agree that these, together with other basic functions, are necessary to live in a modern society. Still, event occurs which affect our ability to travel, to make phone calls and even to access life-giving medicines. Given a structure where most countries are dependent on these basic functions to work, an interruption in any of these can quickly cause severe problems. Thus, it is crucial to prevent such events as well as minimizing their consequences when they do (CenCIP, 2016A).

The basic functions described above are commonly referred to as *critical infrastructure*. The exact definition of critical infrastructure varies depending on the context and geographical scope and given the purpose of this thesis, the definition used by the Swedish Civil Contingencies Agency (MSB), will be adopted:

The term Critical Infrastructure refers to the activities, facilities, nodes, infrastructure and services that maintain Vital Societal Functions. Vital Societal Functions is the term for the activities that maintain a given functionality. Each such function is included in one or more Societal Sectors.

(MSB, 2015B)

This definition is further illustrated in Figure 1.1 together with an example. In the example, the pharmaceuticals supply chain is a critical infrastructure which maintains the vital societal function pharmaceuticals supply, which is a part of the societal sector healthcare.
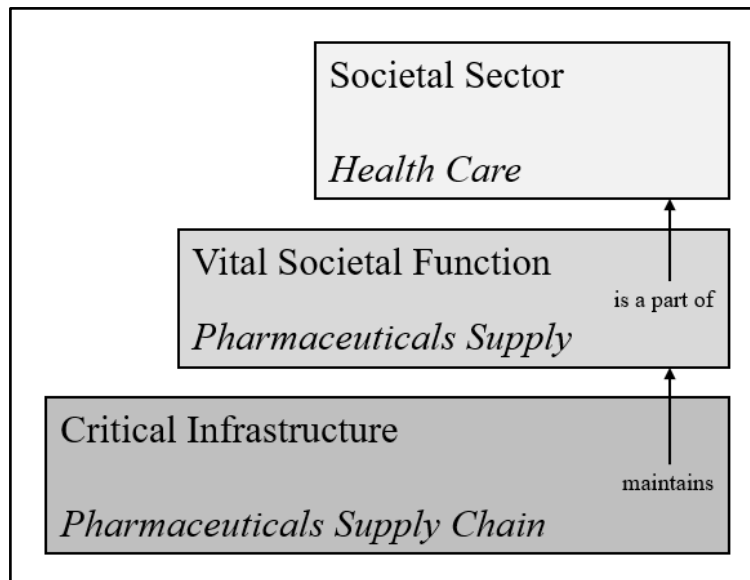
Figure 1.1: Definition of Critical Infrastructure (adopted from MSB, 2014, p. 11)

This definition directs attention to the producing part of a critical infrastructure, but it is important to also keep in mind, as Bologna (2016, p. 10) points out, that: "*A Critical Infrastructure is not only made of technologies but especially of people, processes and organizations.*" The focus of this thesis will mainly be processes and organizations as will be explained later.

The Swedish government delegated the 14th of April 2010 (Fö 2010/698/SSK) the mission to establish a national strategy for protection of vital societal functions to MSB. The national strategy was reported the 1st of March 2011 and aims to create a more resilient society with an improved ability to resist and recover from severe disruptions in vital societal functions (MSB, 2011, p. 3). The focus of the strategy is the energy and transport sector. However, the report identifies nine additional societal sectors with vital societal functions and critical infrastructure. These areas are: (1) financial services, (2) trade and industry, (3) health, medical and care services, (4) information and communication, (5) technical municipal services, (6) foodstuffs, (7) public administration - management, (8) safety and security, and (9) social security. These nine areas could be seen as potential areas to investigate further when the step-by-step approach progress (MSB, 2011, p. 21).

1.2| Problem Discussion

1.2.1| The Swedish Pharmaceuticals Supply Chain

MSB has in turn announced and founded numerous research assignments in the field and a Center for Critical Infrastructure Protection Research (CenCIP) has been established at Lund University (MSB, 2015A). In 2017, Johansson et al. (2017) from CenCIP did a systematic research overview in the areas of critical flows, supply security and interdependency on behalf of MSB. This was a pre-study to a major research project that aims to understand how different types of crises in sectors and supply chains critical to Sweden can be avoided and handled. In the pre-study, one of the researched critical infrastructure areas was healthcare. In accordance with the authors, the healthcare and medical sector appears to be a young research area, lacking empirical studies, frameworks and scenario analysis. The report also states that *"the descriptive research aiming to map and understand the medical flows that the healthcare system depends on, how they are dependent on these as well as the possible consequences, is to a high degree missing"*. Thus, there is an existing need to map the Swedish medical flow and to understand the relations and dependencies of the stakeholders involved in it. Moreover, Johansson et al. (2017) discovered that surprisingly few studies had been done in a Swedish context, since most of the studies had a global or international focus and stressed the need to relate the global models to a Swedish context.

Two important trends affecting the work with critical infrastructure is the increasing dependencies between the different sectors and infrastructures as well as the institutional fragmentation within the different sectors. The responsibility for ensuring pharmaceuticals supply chain resilience is a complex subject involving multiple actors with cross relations including both the private and public sector. The complexity of how to structure the risk governance to ensure supply chain resilience in such a network is present in several phases - before, during and after an event as well as under normal circumstances, in a crisis or in war (CenCIP, 2016B).

A critical and increasing problem in the Swedish pharmaceuticals supply chain (SPSC) is backordered pharmaceuticals. This means that a pharmaceuticals producer cannot deliver a specific pharmaceutical during a time period, which might be the result of for example problem in the production, shortage of active substances or an unexpectedly high demand for the pharmaceutical (Läkemedelsverket, 2018F). In November 2018, just under 240 pharmaceuticals were registered as currently backordered in the national register available at the Swedish Medical Product Agency's webpage (Läkemedelsverket, 2018F).

1.2.2| Interorganizational Learning and Resilience

The final goal of the efforts described above is to increase resilience in the critical infrastructure in Sweden.

A potential strategy to meet the complexity of increasing dependencies and fragmentation in critical infrastructure, is to work with interorganizational learning. Several methods for training and learning are commonly used by emergency management operators and a project at the Swedish Defense Research Agency (FOI), called the KOMET project, currently investigate how to make sure this is done in an efficient way (MSB, 2016A). By using existing knowledge from FOI and the KOMET project, the idea of tackling interorganizational complexity by working with learning can be applied to the development of strategies to increase the resilience of the pharmaceuticals supply chain as well as other critical infrastructures and vital societal functions in Sweden. Resilience in its most basic definition is the ability to absorb changes (Ponomarov and Holcomb, 2009). In the context of supply chains and critical infrastructure, resilience includes multiple dimensions. Thus, in the context of this study resilience involves the ability to *prepare*, *absorb*, *adapt* and *recover* from disruptive events (Ponomarov and Holcomb, 2009; NIAC, 2009). The final goal of all efforts that will be described is to increase resilience in the SPSC

To be able to analyze if and how the actors in the SPSC can work with interorganizational learning to become more resilient as a system, it is necessary to first model the structure of the current supply chain. Doing such a strategic supply chain map have several advantages according to Gardner and Cooper (2003) as presented in their article *Strategic Supply Chain Mapping Approaches*. Three of the main advantages relevant in this specific situation, is that a map can lead to a unified understanding of the supply chain, alert actors to possible constraints in the system and also function as a communication tool across actors and organization boundaries (Garner and Cooper, 2003, p. 39-40). This will be a necessary base when further analyzing how the actors work with interorganizational learning in the SPSC. According to Barroso et al. (2011, p. 171), "*a supply chain map allows to illustrate the core processes that must be considered when trying to improve the resilience of a supply chain to a disturbance*".

1.2.3| Crisis and Disruptions in Critical Infrastructure

This thesis focuses on mapping and analyzing the SPSC both under normal circumstances and in a crisis. What is characterizing for critical infrastructure and vital societal functions, is that a severe disruption to the activity alone or in combination with other events, rapidly can lead to a serious societal crisis. Another characterizing criterion for critical infrastructure and vital societal functions, is that the activity has an overall important role in mitigating the harmful effects of societal crisis (MSB, 2015A). Both criteria hold true for the SPSC and it is thus important to study both disruptions in the supply chain as well as its functionality under a societal crisis. A societal crisis in this case is defined as an event that affects many people and a large share of society (MSB, 2009).

Thyberg (2018) describes problems that may happen to the SPSC in terms of four categories, where the different types of problems require different types of solutions. First is *local increased demand*, referring to an event with a sudden local increase of demand of pharmaceuticals while supply is constant, for example as the result of a terror attack with a large number of injuries. The second type of problem, *global increased demand*, may for example be the result of a global epidemic outbreak or a sudden increase in demand of a specific substance as new scientific findings confirms that it is particularly efficient. Looking at the supply side, *local decreased supply,* may for example be traffic problems, problems in the IT-system for order handling or other local events preventing pharmaceuticals to reach their intended patients. Lastly, *global decreased supply* may for example be the result of a pharmaceuticals producing country stopping its international trade or that there is an explosion in the only factory producing an important active substance worldwide. These different kinds of problems are illustrated in Figure 1.2.

	Increased demand	Decreased supply
Local	*e.g. terror attack*	*e.g. traffic problem*
Global	*e.g. epidemic*	*e.g. trade interruption*

Figure 1.2: Types of Supply Chain Shortage Problems (adopted from Thyberg, 2018)

For the purpose of this thesis, focus will be on understanding how the SPSC is structured to handle disruptions and crises caused by local increased demand or local decreased supply. Attention will also be paid to understanding how the supply chain can become more resilient to global increased demand and global decreased supply caused by a crisis but not by a war. However, interorganizational learning during these kinds of global problems will be given less attention than the local problems during the interviews.

1.3| Objective and Research Questions

1.3.1| Objective
The objective of the thesis is to map the Swedish pharmaceuticals supply chain (SPSC) under normal circumstances and in a crisis, and analyze how the actors can work with interorganizational learning to become more resilient as a system.

1.3.2| Research Questions
RQ1: How is the SPSC structured under normal circumstances and in a crisis?

RQ2: How can the actors in the SPSC work with interorganizational learning to become more resilient as a system?

1.4| Delimitations
It is necessary to limit the scope of the study for it to be suitable for a master thesis. Thus, the following limitations have been made to the scope:

- The thesis focuses on the *availability* of pharmaceuticals in the SPSC, not the *quality* of the pharmaceuticals.
- The thesis focus on the SPSC under normal circumstances and in a crisis, but not in a war.
- No difference has been made for different products and between different types of products, for example chilled versus non-chilled pharmaceuticals, when strategically mapping the supply chain.
- The thesis focuses on *inter*organizational resilience and learning, not organizational, personal or physical resilience and learning.
- The study focuses on a high-level material flow why detailed data regarding transportation of pharmaceuticals will not be considered other than for the purpose of understanding of the magnitude of flows and stocks.
- The current legal reality is considered to be fixed.
- The integrated information system will not be mapped since it is estimated to take an extensive time which exceeds the scope of the thesis.

The delimitations have been chosen to not limit the objective of the thesis, even though they limit the usefulness of the study with regards to other research questions. The study will give an overview of how the SPSC is structured under normal circumstances and in a crisis, as well as how the actors work with interorganizational learning. It will though not give a complete and comprehensive understanding of all aspects of pharmaceuticals supply in Sweden. These delimitations will be further explained and argued for throughout this report.

1.5| Target Audience

One of the target audiences for this report is actors within the SPSC, as the thesis provides a structured description of the SPSC for facilitated collaboration and suggestions for how to work with interorganizational learning to strengthen the resilience in the SPSC.

Another key target audience is FOI, as the thesis provides an opportunity for FOI to learn more about interorganizational learning in the supply chain of a critical infrastructure, which hopefully can further enhance the value of the KOMET project. Moreover, FOI will learn about the SPSC and how to systematically describe such a system, knowledge that can be applied when building scenarios for training.

Moreover, the thesis is directed towards researchers that want to deepen and develop their knowledge within critical infrastructure, supply chain resilience and interorganizational learning.

1.6| Structure of Thesis

The chapters of this thesis are structured in the following way:

1| Introduction
This chapter introduces the reader to the background and problem discussion of the study, leading up to the objective and research questions of the thesis. The delimitations, target audience and structure of the thesis is also presented.

2| Methodology and Method
This chapter presents the research philosophy of the thesis as well as the corresponding research approach and research strategy. In the research strategy, the different phases of the project are explained which cover the design, preparation, data collection, data analysis and sharing of the findings. Lastly, the quality of the research is discussed.

3| Theory
This chapter presents the literature studies and theoretical foundation of the thesis. Two main theoretical areas are covered: resilience and interorganizational learning.

4| SPSC Structure
This chapter contains the strategic mapping of the SPSC, based on the contextual study, contextual interview and refinement during the case interviews. Three key processes in the SPSC are presented; the material flow, the legal frames and the collaborations.

5| Interorganizational Learning in SPSC
This chapter contains the empirical findings regarding interorganizational learning in the SPSC. The empirical findings presented are based on 12 conducted case interviews.

6| Analysis

This chapter summarize and analyze the developed strategic map of the SPSC. Further, the theoretical framework with regards to interorganizational learning is compared with the empirical findings in a gap analysis.

7| Conclusions

This chapter concludes with the main findings for each research question. This is followed by a discussion of the theoretical and practical implications, the delimitations of the study and the researchers' suggestions for further research.

2| Methodology and Method

This chapter presents the research philosophy of the thesis as well as the corresponding research approach and research strategy. In the research strategy, the different phases of the project are explained which cover the design, preparation, data collection, data analysis and sharing of the findings. Lastly, the quality of the research is discussed.

2.1| Structure of Research

The structure of the research in this thesis is illustrated by a modified version of the model called *research onion* as seen in Figure 2.1. The research onion, developed by Saunders et al. (2008), provides a framework that specifies the underlying decisions that leads up to the choice of the data collection method. They argue that a research should start with defining the philosophy influencing the researchers view of the world. Given the chosen philosophy an appropriate overall design of the research should be selected, i.e., the approach. The sequent three layers of the onion focus on the practical application of the approach, turning the research question into a research project. When the process is defined, decisions about appropriate data collection methods and data analysis procedures can finally be decided as the last step of the research structure (Saunders et al., 2008).
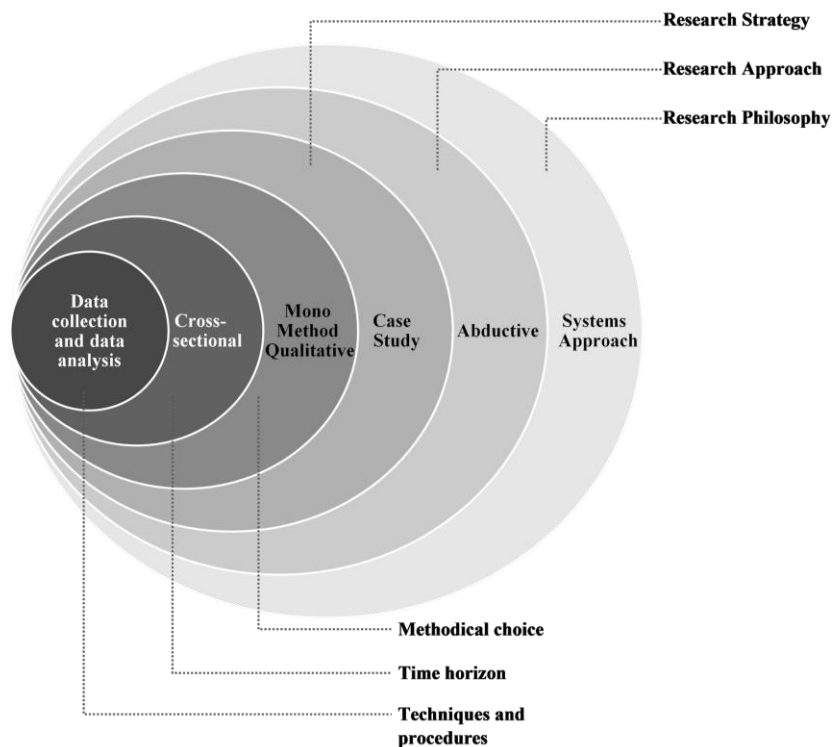
*Figure 2.1: Research Structure, inspired by the Research Onion
(adopted from Saunders et al., 2008, p. 108)*

In the following sections, the structure of this thesis will be laid out. The structure was influenced by the research onion but was adjusted to better fit together with the classical case study approach developed by Yin (2009). First, the research philosophy and research approach are presented. Thereafter the research strategy is described. This section includes multiple layers: choice of strategy, choice of method, time horizon as well as data collection and data analysis. Lastly, the quality of the research design is discussed.

2.2| Research Philosophy

How a researcher views the world, her or his taken-for-granted assumptions about human knowledge and about the nature of the realities encountered, inevitably shape how a research question is understood and the associated research design

(Saunders and Tosey, 2013)

In this study, the methodological framework by Arbnor and Bjerke (1994) was used to understand the two authors' research philosophy and thus their personal view on knowledge and the process for developing knowledge. According to Arbnor and Bjerke (1994), three distinct approaches to business studies can be classified as: (1) the analytical approach, (2) the systems approach and (3) the actors approach.

- In the *analytical approach*, reality is believed to be the sum of its smaller elements. According to this approach, there is an objective reality and knowledge should be independent of the individual researcher and study context.
- According to the *systems approach*, reality is more than the sum of its parts, since relations, motives and feedback mechanisms have a huge impact on the reality of the overall system. It is believed that knowledge is restricted to and dependent on a specific context and system.
- Lastly, the *actors approach* assume that reality is not objective, but socially constructed and built up by the actions of the involved actors. In this approach, knowledge is specific to individuals and contexts.

The authors of the thesis identified themselves with the systems approach. The authors take the perspective that a system, or in this thesis a supply chain, consisting of subsystems or actors, have more value than the subsystems would have apart. This, due to value existing in shared knowledge and multiple units working towards the same goal. Thus, the thesis takes a holistic perspective and strived to study a system with its parts, relations, motives and feedback mechanisms. The aim is to create a deep understanding within a given context to be able to improve the system within that context, not to generalize the findings to an objective truth.

2.3| Research Approach

During a research, different levels of abstraction are used. The two extremes are theories built on the general with a high level of abstraction and empirical data built on the concrete with low abstraction. There are three different approaches for how to move between the two extremes of abstraction: deduction, induction and abduction, as can be seen below in Figure 2.2 (Björklund and Paulsson, 2014, pp. 68-69).

Level of abstraction

High

Low

Theory   Theory   Theory

Induction   Deduction   Abduction

Facts   Facts   Facts
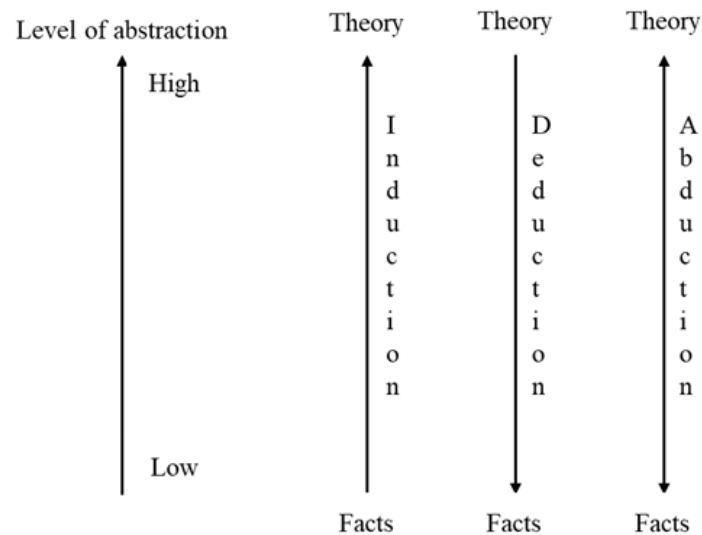
Figure 2.2: Illustration of Inductive, Deductive and Abductive Approaches
(from Björklund and Paulsson, 2014, p. 69)

Below the three approaches are explained in detail.

- The *deductive approach* is the most commonly used way of linking theory to research. By studying theoretical considerations and what is known about a domain, a hypothesis (or hypotheses) is deduced. This hypothesis must thereafter be empirically tested. Included in the hypothesis are concepts that have to be translated into researchable dimensions. The deductive strategy is often associated with a quantitative research approach (Bryman and Bell, 2015, pp. 23-25).
- When taken to the extreme, the *inductive approach* connects theory with findings/observations in the reverse order compared to the deductive approach. The process draws generalizable conclusions from observations. The process is often based on a grounded theory approach to data analysis and theory generation. The inductive strategy is often associated with a qualitative research approach (Bryman and Bell, 2015, p. 25).

- A recently developed approach is the *abductive approach*. The abductive logic takes a pragmatist perspective. Staring with a surprise or a puzzle the abductive approach tries to find an explanation for it. By a process enabling deconstruction and reconstruction between the abstract and the concrete, abduction consist of back and forth engagement with the empiricism as a source of theoretical ideas, in combination with the literature (Bryman and Bell, 2015, pp. 26-27). This view is essential to ensure researchers' susceptibility to surprises in the data instead of using data as confirmation to pre-understanding (Alvesson and Kärreman, 2007). The abductive strategy has gained attention in recent years and is specifically recognized among researchers conducting qualitative research (Bryman and Bell, 2015, pp. 25-26).

The objective of this thesis is to describe the structure of the SPSC in two different scenarios by mapping it as well as to explain how the actors could work with interorganizational learning to become more resilient as a system. The later by analyzing using both theory and empirical sources. Given the characteristics of this objective the authors believed that an abductive approach was the most appropriate choice for this research. This was supported by the fact that the SPSC was relatively unexplored in the theoretical field, why openness to unexpected findings in the empirical data were of high importance. Thus, this thesis took an abductive approach.

The conducted study is qualitative with the aim to create a more profound understanding of a specific area. (Björklund and Paulsson, 2014, p 69) The authors aspire to perform an *experiential study*, i.e., an empirical study where emphasis is put on observations made by recipients and on trying to be naturalistic in the sense that the authors do not intervene or arrange when collecting the data. Further the study will be *situational*, strongly connected to the uniqueness of the context consisting of the SPSC. The authors will seek the point of view of the actors in the supply chain to fully understand its components and dimensions. The above-mentioned aspects are all characteristics of a qualitative study in accordance with Stake (2010, pp. 15-16), why the study will be considered qualitative. This is further confirmed by the focus that will be put on the perceptions and understandings of the actors in the SPSC as well as previous researchers understanding of the area and relevant concepts, a thinking connected to the qualitative research (Stake, 2010, p. 11).

The purpose of the first research question is to take the SPSC, a complex system of public and private actors, and map the key dimensions in order to make it understandable. This by looking at key actors in the supply chain individually and then piece them together to a system. This approach matches Miles and Huberman's (1994, p. 90) definition of the term description why RQ1 should be considered as a *descriptive study*. The same conclusion can be drawn from Björklund and Paulson's (2014) explanation stating that a descriptive study is conducted with the aim to thoroughly describe something (Björklund and Paulsson, 2014, p. 64). Thus, corresponding with the ambition to fundamentally understand the SPSC by mapping it.

The second research question goes one step further. The aim of this question is not only to describe how interorganizational learning diffusion can create resilience but also to explain it. An approach called *explanatory approach*. (Björklund and Paulsson, 2014, p. 64) The ambition is to make the complex concept of interorganizational learning, and its relation to resilience, understandable by showing how they piece together in accordance with theory. This corresponds with Miles and Huberman's (1994, pp. 90-91) definition of explanation, confirming that RQ2 is an explanatory study.

The logic of starting with a descriptive research question and moving to an explanatory question can be recognized in Miles and Huberman's (1994, p. 91) explanation of the analytical progression in the explanatory question. Stating that it is difficult to provide a good explanation before understanding it fully, they propose a process to enable explanatory answers. Starting with a story; that can be used to construct a map; that enables the creation of theories and models into which the data is integrated resulting in an *explanatory framework*. In this case the process is divided into two different questions where RQ1 involves the first two steps and RQ2 consists of the two later.

2.4| Research Strategy

According to Yin (2009, pp. 8-14) a researcher should consider the three following conditions when deciding which research strategy to use for a project: (1) the type of research question posted, (2) the extent of control an investigator has over actual behavioral events, and (3) the degree on focus on contemporary as opposed to historical events. As the aim of the study is to answer "how" questions, in a contemporary setting where the authors have little or no control over behavioral events, a case study is the most suitable research strategy for the study according to Yin (2009, pp. 8-14). Thus, the research strategy for the study was specified to be a case study.

Based on the case research process steps described by Yin (2009) and seen in Figure 2.3, a research strategy model was constructed to clarify the process. The specific model is shown in Figure 2.4. This model is thus a part of the research strategy layer of the research onion and include methodological choice, time horizon as well as techniques and procedures.
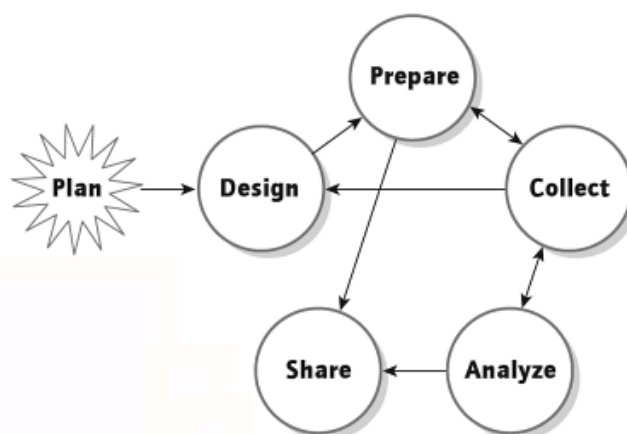
Figure 2.3: Case Research Process steps (from Yin, 2009, p. 1)
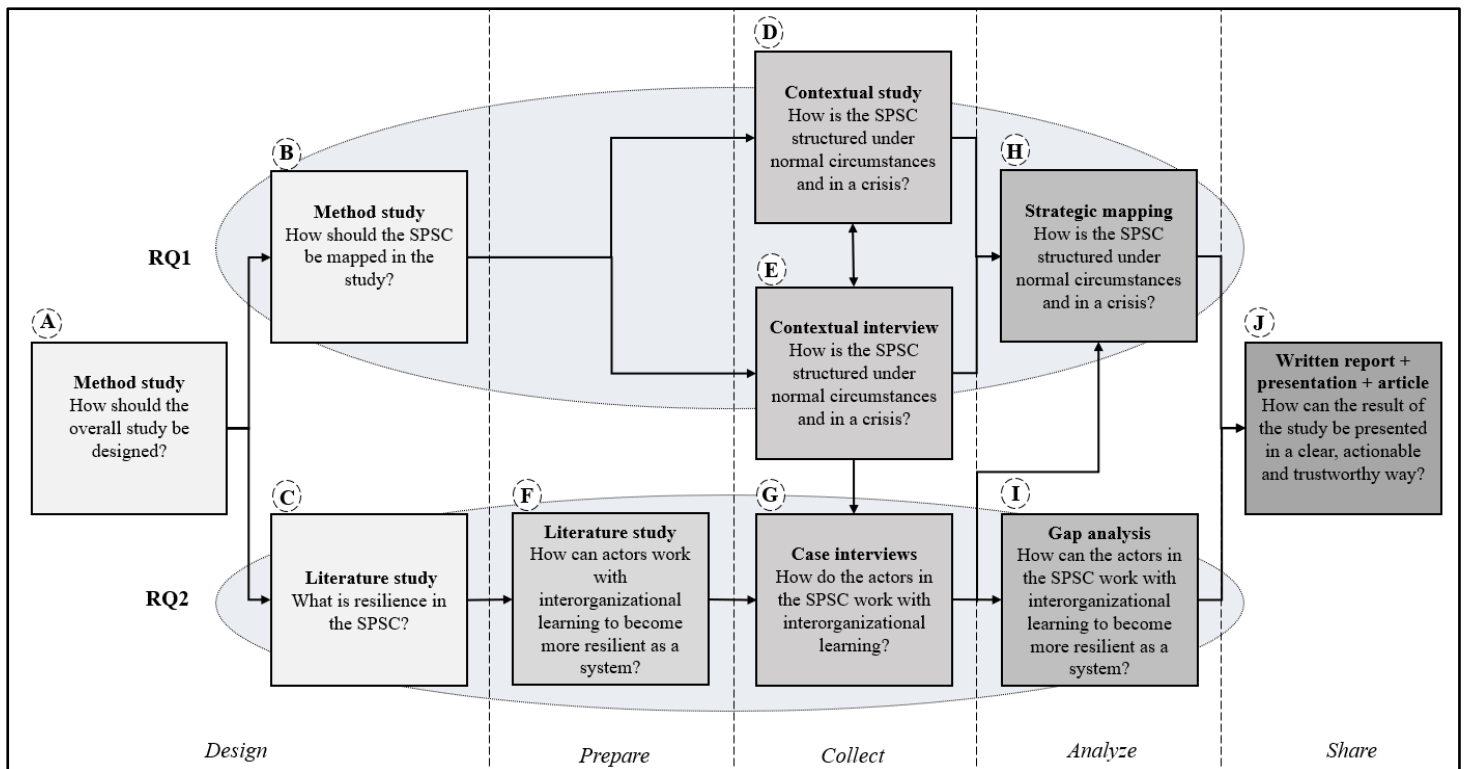
Figure 2.4: The Research Strategy Model, inspired by the
Case Research Process Steps (adopted from Yin, 2009, p. 1)

To generally describe the model in Figure 2.4, there were two parallel workflows answering RQ1 respectively RQ2[1]. RQ2 was partly dependent on process steps covered in RQ1[2]. The process steps in Figure 2.4 are named in alphabetically order from A to J to show in which order each step was performed. The partly separated process of RQ1 and RQ2 made it possible to first perform the initial contextual study and literature study for the research questions before conducting the contextual interview and the in-depth literature study. This was preferred since it gave the authors insight into the key concept of the study before conducting the contextual interviews, which helped them focus on relevant aspects of the key processes mapped.

Adopted from Yin (2009), the method model was divided into five process stages, shown as vertical sections. How the steps fit into each stage is shown in Figure 2.4 by the coloring and by dotted vertical lines functioning as dividers between the stages. In the following sections each process stage is presented in more detail.

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[1] As illustrated by two ellipses covering the top and bottom half of the model in Figure 2.4.
[2] Which is illustrated in the model in Figure 2.4 by how the output from step E and G becomes input for step G respectively H.

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2.5| Research Design
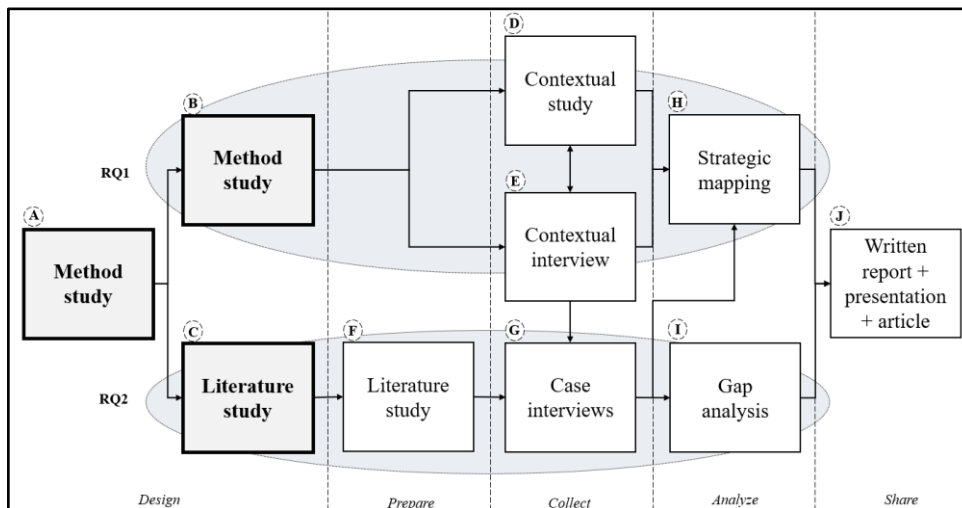
2.5.1| A: Method Study

The first step of the design phase aimed at answering the question: *"How should the overall study be designed?"* This was done by studying research methodology and research methods and formulating an overall research strategy.

In this process, the unit of analysis for the study was defined as "the Swedish pharmaceuticals supply chain". This unit of analysis include actors that govern and supply pharmaceuticals to and within the Swedish healthcare system, which may include Swedish as well as international actors.

A single- rather than a multiple-case design was used for the study. The rationale for this was that the SPSC represents a unique case as discussed by Yin (2009, p. 47). Further, an embedded case study design was used to allow for attention to more than one unit of analysis within the case. (Yin, 2009, pp. 50-52) The subunits were the different actors in the SPSC and they were studied within the case context, to inform and deepen the study and analysis of the overall case. The rationale for using an embedded single case study design rather than a holistic multiple case study design was that it doesn't contribute to the research objective to compare the different actors systematically before analyzing the overall system as a multiple case design would demand. To study how the different actors collectively contribute to and make up the overall system, which an embedded single case study design better capture, thus fulfilled our research objective.

2.5.2| B: Method Study

The second method study in the design phase aimed at answering the question: *"How should the SPSC be mapped in the study?"*

The purpose of the supply chain mapping in RQ1 was to understand which actors that are involved in the SPSC, who is operationally doing the different activities in the supply chain as well as to learn who decides over what. Further, the maps gave insight into the actors' relational links which formed the basis for identifying current and desirable work with learning to improve resilience in the entire supply chain. This strategy is supported by Scholten et al. (2014) that in accordance with previous research view the mapping of supply networks as a mean to understand the network.

To be able to fulfil the above stated purpose of the map, a so-called *strategic supply chain map* over the SPSC was constructed. A strategic map differs from a more conventional process map in regard to three distinctions: the orientation of the map, the level of detail included in the mapping and by the purpose of the mapping (Gardner and Cooper, 2003). The orientation of the mapping in this study was external to include the entire supply chain, the level of detail was comparably low to enable an overview and the purpose was, as explained, strategic rather than tactical. Miles and Huberman (1994, pp. 102-105) describes this type of map as a *context chart*, and explains it as a map in graphical form, catching the interrelationships among the organizations that make up the context of individual behavior. Moreover, they recommend using context charts early during fieldwork to summarize the findings and locate questions for next step data analysis. This was done throughout the data collection in the literature search and contextual interview.

Initially, some basic decisions were taken regarding the SPSC mapping to simplify the data collection. Garner and Cooper's (2003) set of attributes were used to define the intended scope of the mapping.

- Geometry
  - The *direction* defines if the mapping will cover up- or down-stream the channel of distribution. This mapping was done both ways in what is called an **industry cyclical** direction.
  - The *length* of the mapping refers to the number of levels in each direction that is included. Given the purpose of the mapping this was defined by the **number of tiers in the SPSC**.
  - The *aggregation or width* defines the degree of details within each tier. This was mapped at a **medium level** where the types of firms at each level were identified, e.g., hospitals and pharmacies are two types of firms in the second last tier in the SPSC.
  - The *spatial attribute* defines if it is geographically representative, which it is **not**. This to keep simplicity as high as possible.

- Perspective
    - The *focal point* is an **industry-centric view**.
    - The *breath* or the product coverage is at a **SBU level** since only one flow including all product categories is covered.
    - The mapping was made with a **supply chain specific** *perspective*.
    - The *process view depth* defines the number of key business processes that will be considered in the mapping. To fulfill the above stated purpose **three processes** were included, see discussion below. This is considered as medium depth.
    - The mapping does **not** include a *cycle view* and does not cover return channels or feedback loops.
- Implementation issues
    - The *information density* integrated into the visual map is **low to medium**, again to keep simplicity where possible.
    - There are **no live links** to any *supply chain databases*, this to minimize the complexity of the mapping process.
    - The *delivery mode* includes both **paper and electronic**. In this thesis, figures of the map are included as a paper version of the map, but more interactive electronic versions were created to enable future modifications to be done as the SPSC changes.

To illustrate the core processes necessary to understand when aiming to improve the resilience of a supply chain, Barroso et al. (2011) proposes a supply chain map as a suitable tool and further presents six major dimensions to consider in the mapping. These dimensions are: (1) supply chain entities, (2) relational links between supply chain entities, (3) material flows, (4) information flows (5) management policies, and (6) lead times. Given the similar purpose of the supply chain mapping in this thesis, these dimensions formed a basis for the selection of business processes to map.

The supply chain mapping in this study consists of three business processes, where the common logistics dimension material flow has been combined with the dimension lead time. The processes that were chosen for the mapping are:

- Material flow, both a general process overview and a map with lead times and stocks.
- Management policies and legal frames.
- Collaboration and learning contexts between supply chain entities

These were the minimum of processes that the authors deemed necessary in order to understand the SPSC sufficiently to be able to draw reliable conclusions about resilience and learning in the supply chain. The supply chain entities formed the nodes in the mapping and was therefore not seen as a key process. The material flow and legal frames formed a basic understanding of the limitations for actions and current scope of the supply chain. Both material flow and legal frames can be changed, but for the focus of this thesis they were seen as static and was not used to further improve resilience in the SPSC. Instead, focus was laid on collaboration in RQ2. The

three processes were mapped at a basic level in the contextual study and contextual interview to understand the current situation and the conditions in the SPSC.

Initially, non-verbal information flow was considered as a fourth necessary process to map, but after the initial contextual study and contextual interview, the authors decided not to study information flow further. This process was estimated to take an extensive time to map and was not considered necessary to understand the SPSC and how to work with interorganizational learning to improve resilience.

2.5.3| C: Literature Study

The third part of the design phase was a literature study aiming at answering the question:
"What is resilience in the SPSC?"

Novices may think that the purpose of a literature review is to determine the answers about what is known on a topic; in contrast experienced investigators review previous research to develop sharper and more insightful questions about the topic.

(Yin, 2009, p. 14)

Yin (2009) argues that an essential step of the design phase in a case study is theory development. In order to explore and define the concept of resilience in SPSC in RQ2, a literature study was therefore conducted. The literature review aimed to develop a deep understanding of the proven strategies, models and theories that existed within the area. The literature review, aiming to define the theoretical knowledge on resilience in supply chains, functioned as a base to the second literature review, process step F, and for the case interviews, process step G.

Before a literature review begun, a literature search was conducted. A literature search can be done using numerous tools and information sources including library catalogues, search engines and online databases (Rowley and Slack, 2004). This thesis used the search engine *Google Scholar* in combination with the university search engine *LUBsearch*, an access point to joint resources in all the libraries (Lund University, 2018). The reason for using this combination was that the authors assessed that Google Scholar has a better algorithm for retrieving articles with high citation count as described by Beel and Gipp (2009), a feature increasing credibility and potential for relevance. However, Google Scholar does not give access to research journals why LUBsearch was used to get access to found articles and published research journals.

The authors used a combined search strategy starting with a *briefsearch* followed up with *citation pearl growing* (Rowley and Slack, 2004) and *berry picking* in the form of *footnote chasing* (Booth, 2008). The briefsearch was done by quickly and roughly retrieving three documents found to be insightful in regard to the concept of resilience: *Supply Chain Resilience Using the Mapping Approach* (Barroso et al., 2011), *Evolutionary Resilience and Strategies for Climate Adaptation, Planning Practice and Research* (Davoudi et al., 2013) and *Resilience*

of Critical Infrastructure Elements and Its Main Factors (Rehak et al. 2018). This was followed by a combined citation pearl growing and footnote chasing, starting from the three above named documents found in the brief search. By going through the documents, three definitions of the resilience concept were gathered and four precising terms for the concept were identified; *supply chain resilience, evolutionary resilience, critical infrastructure resilience* and *organizational resilience.* Using these terms, a search using Google Scholar and then LUBsearch was conducted. This resulted in a large set of new articles of which eight appeared to be relevant after reading the abstract and conclusion of the most relevant search result appearing in the Google Scholar search. The footnote chasing in the original sources returned fourteen research articles after reading abstract and conclusions of which two appeared in the Google Scholar search too. This set was used as input into the literature review. (Rowley and Slack, 2004)

In accordance with Rowley and Slack (2004) a five-step approach was thereafter followed in the literature review, see Figure 2.5.
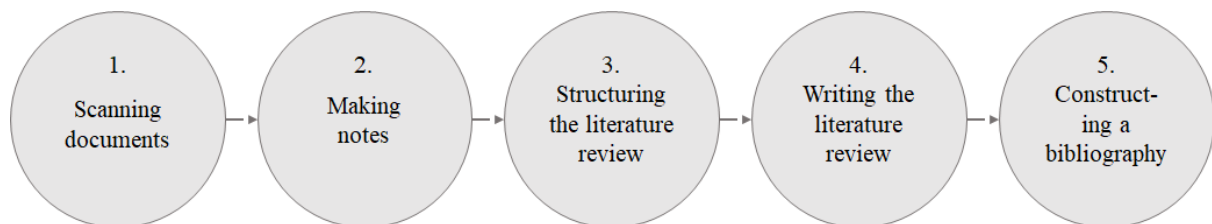
Figure 2.5: The Literature Review Process (adopted from Rowley and Slack, 2004)

1. **Scanning documents**
   Going through documents gave an initial familiarity with the existing literature and the classification of documents into groups. Furthermore, this gave insight into key themes that needed to be included into the literature review.

2. **Making notes**
   Key themes and messages were then refined by making notes of the reviewed documents. This included a markup of the documents, which enabled easy location of the key segments from the texts and figures.

3. **Structuring the literature review**
   The structure of the review was, in accordance with Rowley and Slack's (2004) process, derived from the literature. The process of structuring the literature review started with defining the key themes of the literature review and then sorting concepts and documents based on the identified themes.

4. **Writing the literature review**

   When the structure was set, an analysis of the existing documents began. This was done by grouping the documents under relevant sections in the literature review structure. When all documents were gathered in accordance with the structure, the writing began. Each section included three types of material: (a) refinement and understanding of key concepts, (b) questions, and (c) findings, theories and positions of other researchers

5. **Constructing a bibliography**

   The bibliography construction was an ongoing process throughout the entire literature review. This is a list of all sources referred to in the literature review. For the purpose of coherence, the bibliography of the literature review was merged with the bibliography of the thesis.

The literature review resulted in a definition of the concept **resilience** based on the current theoretical knowledge. This definition was used as input to the second literature review within RQ2, as described in section 2.6.2

2.6| Research Preparation
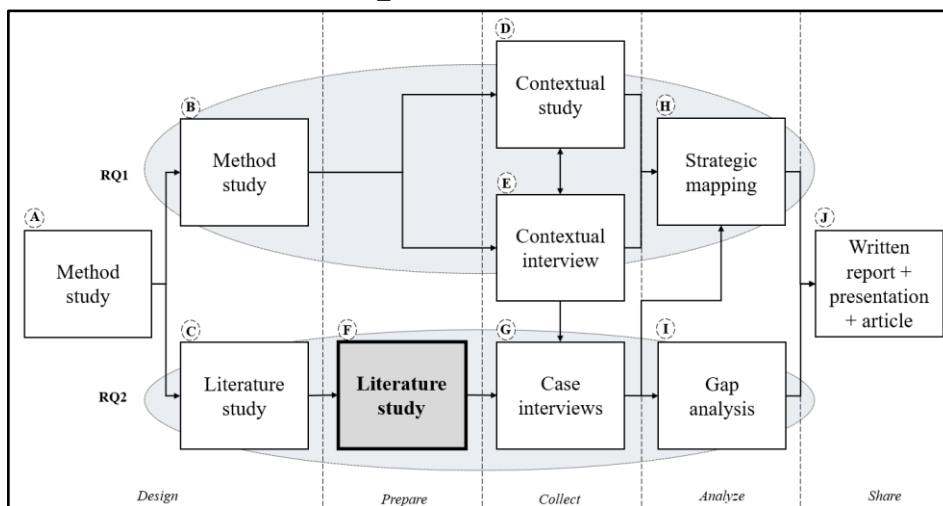
2.6.1| Case Study Protocol for the Contextual Interview

After the method study in B and the literature study in C, a case study protocol was developed for the contextual interview in D as suggested by Yin (2009, pp. 79-91), acting as a guide when conducting the interview. A main part of the study protocol was the case study questions, also referred to as the *interview guide*.

The interview guide was produced with guidance from Bryman and Bell's (2015, pp. 486-493) structure. With the research questions as a basis, interview topics were formed and questions formulated. To facilitate the generation of these, theory from the method study and the literature study were used in combination with discussions between the authors. The questions were designed to provide the knowledge needed to answer the research questions without being so specific that alternative ways of enquiries were closed off. Further, the authors adjusted the

language to match the respondents. To ensure a flow in the interview questions, the topic areas were ordered. Lastly, a set of questions to collect "factsheet" information were included in the interview guide. This to provide context to the interviewee's answers. The used case study protocol including the interview guide for the contextual interview can be found in appendix A.

2.6.2| F: Literature Study

The main literature study of the research aimed at answering the question: *"How can actors work with interorganizational learning to become more resilient as a system?"* The purpose was thus to find concrete learning methods that would increase resilience in a supply network.

The literature study began by going through Sheffi's book *"The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage"* (Sheffi, 2007) and identifying all learnings methods described there. Twenty-two methods divided into ninety concrete techniques were identified and categorized into nine areas.

Further, the authors read the comprehensive study *Consolidation of Resilience Concepts and Practices for Crisis Management* by Woltjer et al. (2015) and identified learning methods and corresponding references in the study. Out of the 297 presented studies in Woltjer et al.'s (2015) systematic literature survey, 74 articles were chosen for further study based on their titles and context in study. The abstracts of the articles were read and after selecting only the article containing several concrete learning methods, 11 articles were selected for detailed reading.

With the generated set of documents, the same five step approach as used for the literature reviews in process step C was performed. Given the new learning methods identified when briefly going through the set of articles derived from the study by Woltjer et al (2015), the nine areas were redefined to better reflect the methods. Additionally, the learning techniques were refined to twenty-seven. Going through the eleven articles in Woltjer et al.'s (2015) study thoroughly, the set of methods and the areas were combined into nine groups of learning methods. Two of the methods were in a last review combined and eight final learning methods were defined as further described in the theory chapter. These learning methods were displayed in a *conceptually clustered matrix,* as described below. The matrix formed the basis for developing the case study protocol as described in the next section and was also used as input into the gap analysis in process step I.

To highlight the learning methods described in the theory, learning goals and learning prerequisites were distinguished from learning methods in the theory and the matrix. Prerequisites for learning methods was defined as the structure or conditions that needed to be in place to allow the actors to use the corresponding learning methods. Learning goals was defined as the desired outcome by using a specific learning method, an outcome that in turn would lead to increased resilience in the supply network.

It's useful to do some early qualitative data analysis during the data collection phase, to help organize data for later and deeper analysis as described in section 2.8. Miles and Huberman (1994, p. 50) strongly recommend conducting early analysis to enable the researcher to constantly move between studying the existing data and develop better strategies for collecting new valuable data. One such early data analysis method is *coding*, i.e., when the researcher assigns codes, or *units of meaning*, to the descriptive information from a study (Miles and Huberman, 1994, pp. 55-69). For the purpose of the literature study, a provisional start list of codes was created prior to the literature study. These were based on the context study in D, the research question at hand and identified problem areas in the contextual interview in E. The start list consisted of three main codes, namely *learning methods, learning goals,* and *prerequisites*. These codes were revised during the collection phase until arriving at the final set of used codes, the eight learnings methods, under which sub methods were distinguished with codes in accordance to names similar to the finally chosen names.

To further structure the findings, a *conceptually clustered matrix* (Miles and Huberman, 1994, pp. 127-131) was used to analyze the literature with regard to conceptual themes. A conceptually clustered matrix is a type of matrix with rows and columns arranged to bring together items that conceptually belongs together, which for this study could be for example "items linked to the same strategy for interorganizational learning". The researcher may have some idea about how items relate to theoretical concepts, and structure the matrix with regards to that, or build the matrix solely based on the initial empirical findings. In this thesis, a clear link existed between the matrix and the developed codes, since some of the codes were used as concepts and thus made up the rows and/or columns in the matrix.

Several of the tactics to generate meaning of data presented by Miles and Huberman (1994, pp. 245-262) were used during this process step. Firstly, *noting patterns/themes*, i.e., finding patterns in variables or processes in the data, was used to find recurring learning methods in the literature compared. Secondly, the tactic of *clustering*, i.e., trying to understand something by grouping objects with similar characteristics, was used to boil down the findings to a matrix with a limited number of learning methods. Lastly, *partitioning variables*, i.e., unbundling concepts to its underlying variables, was done to sort the findings into the predefined matrix structure. Also, focus was put on *noting relations between variables*, i.e., understanding how variables related to each other, in this case how different components of interorganizational learning and resilience were related to each other in theory.

2.6.3| Case Study Protocol for the Case Interviews

After the in-depth literature review described in the previous section, a case study protocol for the case interviews was developed as can be found in Appendix B. The case study protocol was clearly structured around the theoretically found learning methods.

By thinking about the case analysis and case study report already in the design and preparation phase, it became easier to collect relevant data in a relevant format during the interviews. Kvale (1988) catches this idea in his article *The 1000-Page Question* by simply answering the question *"How shall I find a method to analyze the 1000 pages of interview transcript I have collected?"* with *"Never conduct interview research in such a way that you arrive at a situation where you [have to] ask such a question."* (Kvale, 1988, p. 90) This thesis falls in the frame of a *prestructured case* as described by Miles and Huberman (1994, p. 83-85). This means that the researchers had precise research questions, had developed a clear conceptual framework and a clearly defined collection plan, and had a collection frame, a *case outline*, during the collection phase. This was specifically obvious during the case interviews that were conducted in a very structured manner based on the theoretical findings and a clear plan for the analysis. Basic coding schemes and data displays were designed in advance, adopted as necessary during the collection process and finally revised to a firmer state when they could be grounded more empirically. The difference between the working processes for a prestructured case and a traditional analysis sequence can be seen in Figure 2.6.
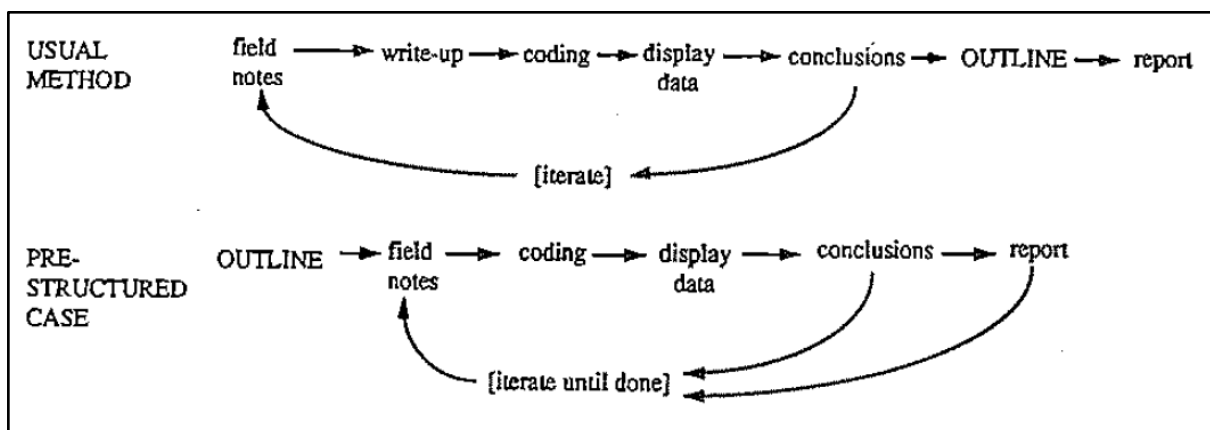
Figure 2.6: Traditional Analysis Sequence compared with
Prestructured Case (from Miles and Huberman, 1994, p. 85)

A danger with pre-structuring the research is that coding is done directly from field notes, not from an open write-up, bedding for too early conclusions drawing and tunnel vision. Being a research pair and using triangulation are two strategies to help minimize this risk. (Miles and Huberman, 1994, pp. 83-85). Because of the limited time and scope of the thesis, a prestructured case was assessed to be a suitable approach by the authors.

2.7| Data Collection
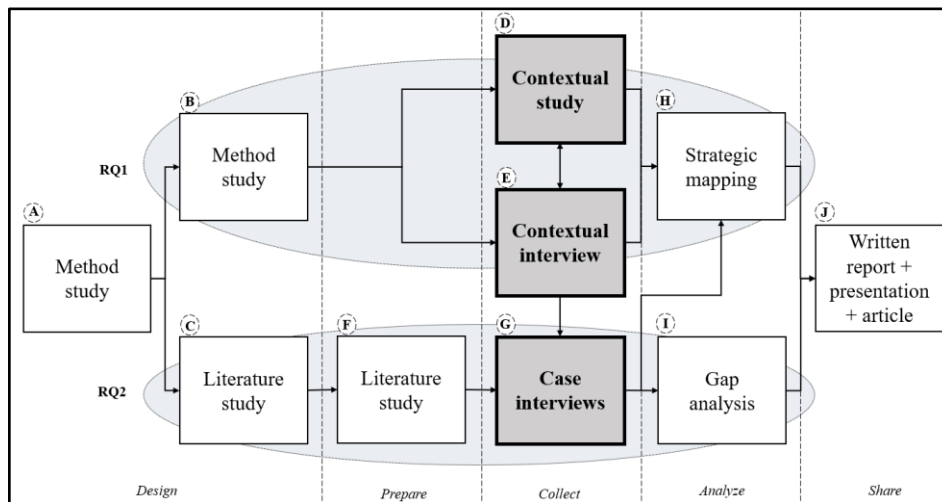
2.7.1| D: Contextual Study

The first step in the data collection phase, the contextual study, had the aim of answering the following question: *"How is the SPSC structured under normal circumstances and in a crisis?"*

To develop an insight into how the SPSC is structured and has been mapped in previous studies, a contextual study was conducted. The contextual study resulted in a basic mapping over the three key business processes of the SPSC defined in process step B, if so with some gaps. This mapping was then completed and elaborated in the contextual interview in process step E.

The contextual study used a method called *berry picking* to retrieve the information. Starting with a general query, a few documents were retrieved, functioning as the foundation for the search. These key sources were studies by KBM (2007), SOU (2013) and Riksrevisionen (2018). Based on these sources, key terms and references were identified and used to retrieve a larger set. As gaps in the map were filled the search was refined to generate missing information until the three key business processes were mapped on an overview level. (Booth, 2008)

In this process step, several of Miles and Huberman's (1994, pp. 245-262) tactics for generating meaning were used. Clearly, *noting patterns/themes*, *clustering* and *partitioning variables* were used to be able to compare how the SPSC has been mapped before in different studies, boil the findings to a map with a limited number of representative components and connections and sort the findings into the predefined network structure with its three defined processes. The goal was to code and develop a supply chain map.

2.7.2| E: Contextual Interview

The contextual interview closely followed the contextual study and aimed at answering the same question: *"How is the SPSC structured under normal circumstances and in a crisis?"*

A contextual interview with two key practitioners in the SPSC, aiming to answer RQ1, was conducted as the first part of the data collection phase. Because of the single case design, the contextual case was the same as the main case. The goal was to make a map of the stakeholders in the SPSC, their relations and dependencies, this in accordance with earlier discussions on how to develop a strategic supply chain map. Contact was established with one key actor in the SPSC who took the role of a key informant. Together with a colleague, the key informant participated in the contextual interview as presented in Table 2.1. The key informant was chosen because of her central role in the SPSC, being responsible for the supply of pharmaceuticals in one of the county councils.

Table 2.1: Conducted Contextual Interviews

Name	Organization	Position	Date and length of interview	Forum
Ulrika Whiss	Region Östergötland	Enhetschef Läkemedelsenheten	16 Oct 2018 (1 h)	Video conference
Anna Hendeby	Region Östergötland	Läkemedelsstrateg	16 Oct 2018 (1 h)	Video conference[3]

The contextual interview was performed in the format of a *Skype interview*. The format was chosen due to the aspect of being more flexible than *face-to-face interviews* as well as being more time efficient, given that the key informant and her colleague worked in another town than the authors. Additionally, according to previously conducted Skype interviews there seems to be little evidence that the researcher's ability to ensure rapport is significantly lower than with face-to-face interview (Bryman and Bell, 2015, p. 675).

A *semi-structured interview* approach was adopted. This choice was supported by Bryman and Bell's (2015, pp. 481-483) explanation that semi-structured interviews are used when there is a set of questions on a fairly specific topic to be covered, as was the case of this thesis. The interview was based on the developed interview guide in and followed the case study protocol in Appendix A. However, a flexible approach was taken, and the order of the questions were altered during the interview to better follow the interviewees' reasoning and answers. Additional questions, not included in the interview guide were also asked to follow up, specify, interpret or structure the answers. Silence were also used as a technique to nudge the interviewees to amplify or reflect over their answers (Bryman and Bell, 2015, pp. 490-493).

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[3] The interviewee's camera was turned off due to technical issues.

The interview was audio recorded after the agreement of both interviewees which enabled the authors to transcribe the interview. By transcribing the interview, the researchers were able go back and review the answers. This allowed the researchers to use quotations from the interviews and analyze the answers on a deeper level than if just taking notes. Transcribing is a time-consuming task and given the limited time given when writing a thesis, the authors chose to not transcribe sections that in advance were unrelated to the research questions (Bryman and Bell, 2015, pp. 494-501). Notes were taken as a backup if any problems with the recording would occur, which luckily did not happen during the contextual interview.

One additional important contribution of the key informant was to provide contact to corroboratory and contrary sources of information (Yin, 2009, p. 107). This was clearly done as the two key practitioners contributed with contacts in different part of the supply network for the case interviews. The contextual interview further helped to refine the data collection plan for RQ2, this by providing a context to RQ2 by clarifying the structure of the SPSC.

Several tactics for generating meaning (Miles and Huberman, 1994, pp. 245-262) were used in this process step. *Noting patterns/themes* was used to seeing patterns in the interviewees' answers, *clustering* made the discovered phenomena grouped into the predefined processes and *partitioning variables* unbundled the answers to fit into the predefined structure.

2.7.3| G: Case Interviews

The case interviews aimed at answering the question: *"How do the actors in the SPSC work with interorganizational learning?"*

The second round of interviews in the data collection phase were conducted in the form of case interviews. The interview guide for the case interviews was developed based on the interview protocol from the contextual interview as well as the learning methods found in the literature study in F. The interview was split into two parts, the first part focusing on confirming and deepening the understanding of the SPSC structure and the other half focusing on interorganizational learning methods used by the interviewed actor. The interviews were *semi-structured,* given the same reasoning as the contextual case. Again, a flexible approach was taken, and the interview guide was not followed strictly in the interviews (Bryman and Bell, 2015, pp. 481-483, 490-493).

Twelve interviews were conducted with thirteen actors in the SPSC during a four-week period as specified in the interview details in Table 2.2.

Table 2.2: Conducted Case Interviews

Name	Organization	Position	Date and length of interview	Forum
Claire Heaton	Södersjukhuset	Sjukhusapotekare	12 Nov 2018 (1 h)	Telephone conference
Per Kjörling	Apoteket AB	Regionchef Syd	13 Nov 2018 (1 h, 30 min)	Telephone conference
Magnus Thyberg	Stockholms Län Landsting	Avdelningschef Strategiska Vårdfrågor	14 Nov 2018 (1 h, 15 min)	Interviewee's office, Stockholm
Fredrik Boström	Apoteket AB	Chef Föreskrivna Produkter and Hälsotjänster	15 Nov 2018 (1 h)	Interviewee's office, Stockholm
Mari-Mall Winner	Kalmar Län Landsting	Apotekare	16 Nov 2018 (1 h)	Video conference[4]
Karin Gårdmark Östh	Läkemedelsverket	Projektledare Läkemedel i Användning	19 Nov 2018 (1 h)	Video conference[5]
Fredrik Ax	Sveriges Kommuner och Landsting	Konsult, Avdelningen för Vård och Omsorg	19 Nov 2018 (1 h)	Interviewee's office, Stockholm
Susanna Eklund	Sveriges Kommuner och Landsting	Handläggare Läkemedel och Klinisk Forskning	19 Nov 2018 (1 h)	Interviewee's office, Stockholm
Fredrik Vondracek	Västra Götalands-Regionen	Kvalitetsansvarig Apotekare	21 Nov 2018 (1 h, 15 min)	Interviewee's office, Stockholm
Niklas Hedberg	Tandvårds- och Läkemedels-Förmånsverket	Chefspharmaceut	22 Nov 2018 (45 min)	Conference area, Stockholm
Mikael Brammesjö	Tamro AB	Varuförsörjnings-Chef	24 Nov 2018 (1 h, 30 min)	Interviewee's office, Gothenburg
Anonymous interviewee	*Pharmaceuticals producing company*	Head of Regulatory Affairs and Product Quality	29 Nov 2018 (45 h)	Video conference

The interviewees were chosen based on their representation of actors with central roles in the SPSC structure as well as their insight into how their specific organization works with interorganizational learning with other actors in the supply network. Interviews representing almost all types of requested actors were conducted, as specified in Table 2.3.

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[4] The interviewer's camera was turned off due to technical issues.

[5] ibid.

Table 2.3: Type of Actors in Case Interviews

Abbrev.	Type of Actor	Requested interview	Nbr of conducted interviews
SoS	National Board of Health and Welfare	X	0
LV	Swedish Medical Products Agency	X	1
TLV	Dental and Pharmaceuticals Benefits Agency	X	1
SKL	Swedish Association of Local Authorities and Regions	X	1
CC	County Councils	X	3
PP	Pharmaceuticals Producers	X	1
D	Distributor	X	1
PC	Pharmacy Contractor	X	1
O-Ph	Outpatient pharmacy	X	1
H	Hospital	X	1

The interviews conducted were a mixture of face-to-face and skype interviews, depending on the availability and location of the respondents. The interviews were between 45 and 90 minutes long and all interviews were audio recorded with the permission of the respondents, although notes were taken as well. The relevant sections of the interviews were then transcribed shortly after each conducted interview.

In the literature study in process step F, coding of the transcripts was used as a method to do early analysis during the interviews. Based on the findings from the contextual interview in process step E and the literature study in F, a list of provisional codes was created before conducting the interviews. This list consisted of the identified learning methods and the learning goals. This list was, as previously described, revised during the collection and analysis phase to suit the collected data. For example, was the code *lacking* added as a category under each learning method as a lot of the interviewees talked about factors preventing them from using the learning method. The findings from the interviews were, like the theoretical findings, structured in a conceptually clustered matrix. The authors strived at using a display to structure the findings that enabled and simplified comparison of the interview answers with the collected theory in process step F. The reason for this was to simplify the gap analysis in process step I, that is further described in section 2.8.3 later in this report.

In the interview step, tactics used for generating meaning were *noting patterns/themes, seeing plausibility, clustering, partitioning variables, subsuming particulars into the general* and *noting relations between variables*. (Miles and Huberman, 1994, pp. 245-262). Noticing patterns/themes, clustering and partitioning variables were tactics used to be able to code the data from the interviews and display it in a conceptually clustered matrix. Seeing plausibility,

i.e., seeing possible conclusions looking reasonable at first glance but in need of further investigation, was used throughout this process step as pointers to plausible conclusions from the interview data. Subsuming particulars into the general, i.e., categorizing findings into a more general class on a higher abstraction level, was used to categorize the interview data into relevant theoretical concepts. Finally, noting relations between variables was a tactic used to understand how different variables of the collected data, in this case different component of interorganizational learning and resilience, were related to each other in practice.

2.8| Case Analysis
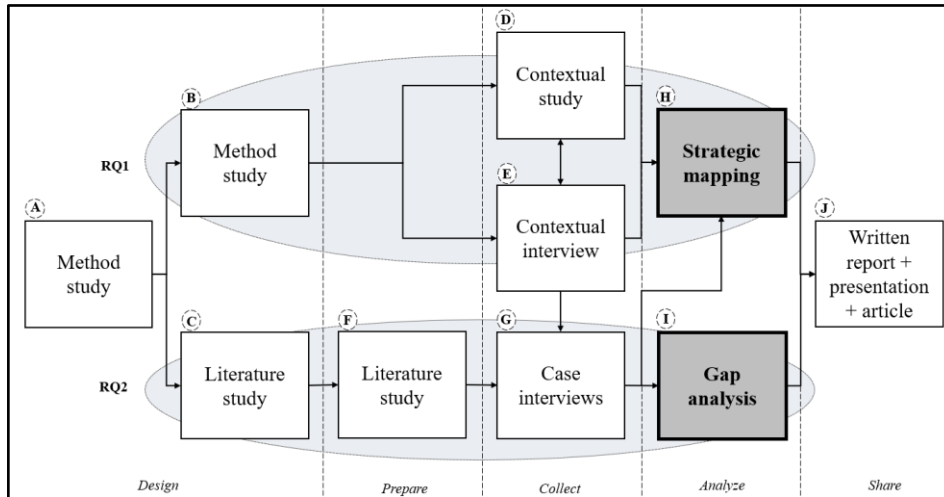
2.8.1| The Analysis Process

According to Miles and Huberman (1994), qualitative analysis consists of three types of activities, *data reduction, data display* and *conclusion drawing and verification*, occurring concurrent during the analysis phase. In this thesis, their perspective will be adopted for the analysis process. The differentiated processed are illustrated in Figure 2.7 and further described in the section that follows:
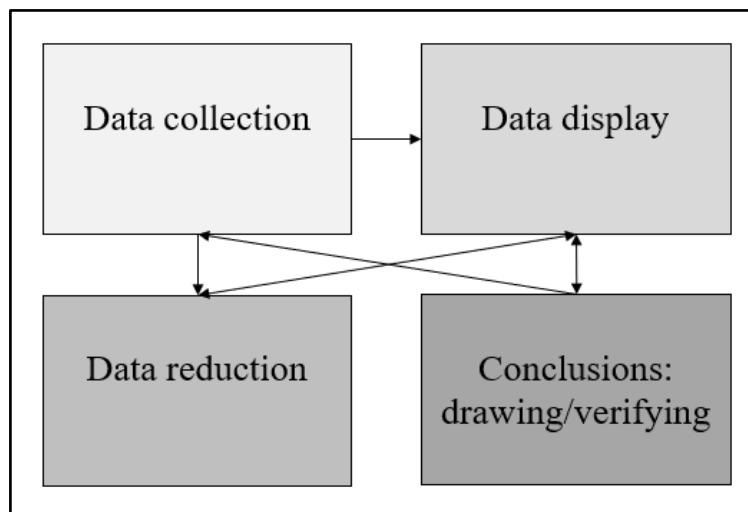
Figure 2.7: Components of Data Analysis (adopted from Miles and Huberman, 1994, p. 12)

- Data reduction is the process of sharpening the collected data, and includes activities like choosing, concentrating, simplifying, summarizing and transforming the data. It's considered being a part of analysis since important decisions need to be taken regarding, for example, how to code the data, which data to focus on and which evolving patterns to use. It is worth noticing that data reduction occurs even before the data collection starts, as the research questions, conceptual framework, specific cases and approaches limits the data to be collected (Miles and Huberman, 1994, pp. 10-11).
- Data display is the process of structuring the data in an organized, compressed format that permits conclusion drawing and further analysis or action taking (Miles and Huberman, 1994, p. 11). A lot of different data displays are possible, generally falling into either the category *matrices* (crossing dimensions or variables to see how they interact) or the category *networks* (a series of nodes connected by links). (Miles and Huberman, 1994, p. 239) The purpose of this process is to invent a helpful display that will give the reader reasonable answers to the questions being asked or facilitate further analysis, not to fit the data into a by theory specified structure. (Miles and Huberman, 1994, p. 240)
- Conclusion drawing and verification is the process of generating meaning in the data in a way that is valid, avoids bias and assure the quality of conclusions. (Miles and Huberman, 1994, p. 245). This can be done through several tactics for generating meaning, as explained throughout the presentation of the research strategy in sections 2.6 - 2.8 and summarized in Table 2.4, and tactics for verifications as explained in section 2.10.

Table 2.4: Tactics for Generating Meaning

Tactics for generating meaning	Used in process step(s)
Noting patterns/themes	C, D, E, G, H
Seeing plausibility	G, H
Clustering	C, D, E, G
Making contrast/comparisons	H
Partitioning variables	C, D, E, G
Subsuming Particulars Into the General	G
Noting Relations Between Variables	C, G

2.8.2| H: Strategic Mapping

The analysis in the strategic mapping aimed at answering RQ1: *"How is the SPSC structured under normal circumstances and in a crisis?"*

As earlier described, the findings from the contextual study in D and the contextual interview in E were displayed in a network in the form of a *strategic supply chain* (Gardner and Cooper, 2003) or a *context chart* (Miles and Huberman, 1994, pp. 102-105). A large portion of the analysis, the data reduction and the data display, was thus done throughout the project before entering this process step. The first part of the conducted case interviews in process step G was further used to continuously confirm and refine the strategic supply chain map. The final strategic supply chain map can be found in chapter 4.

In this process step, mainly the tactic of *noting patterns/themes* was used to compare the findings from the literature and the contextual interview to generate meaning in the data and finalize the strategic supply chain map. (Miles and Huberman, 1994, pp. 245-262)

2.8.3| I: Gap Analysis

The final analysis step, the gap analysis, had the purpose of answering RQ2 and the following question: *"How can the actors in the SPSC work with interorganizational learning to become more resilient as a system?"*

Based on the findings in the literature study in F and the case interviews in G, a gap analysis was conducted to compare the actual methods, with regards to interorganizational learning in the SPSC, with potential methods as specified in theory. The aim of the gap analysis was to identify areas that can be improved, thus aiming to answer RQ2. The gap analysis was facilitated by the aligned format of the collected information from theory (literature study in F) and empirics (interviews in G).

Once again, several tactics as presented by Miles and Huberman (1994, pp. 245-262) were used to generate meaning in the gap analysis. *Seeing plausibility* was as a tactic to pay attention to possible conclusions in need of further investigation throughout the process. Also, the tactic of *making contrasts/comparisons*, i.e., looking at different chunks of data and see how it differs, was the foundation of the gap analysis to compare the theoretical and empirical findings of how to work with interorganizational learning in the SPSC.

2.9| Presentation
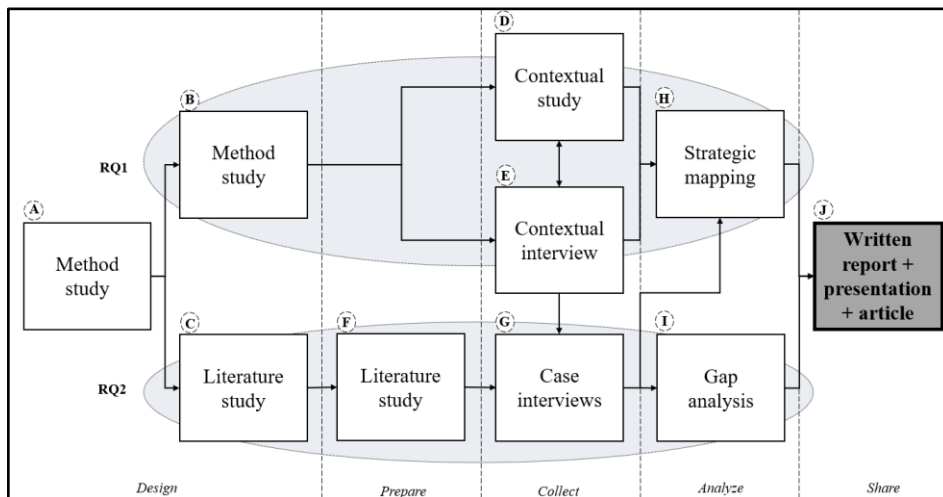
2.9.1| J: Reporting

The purpose of the final step in the research strategy process was to answer the question: *"How can the result of the study be presented in a clear, actionable and trustworthy way?"*

The findings of the study were presented in a written report and was summarized in an oral presentation and as well as a popular scientific article. A linear-analytic structure was used as the compositional structure in the written report. (Yin, 2009, p. 176)

2.10| Quality of Research

To ensure the quality of the research, attention was paid on forming methodological rigor. When the research philosophy is defined as positivistic, four criteria are regularly used to assess the quality of the research: *internal validity, construct validity, external validity* and *reliability* (Gibbert et al., 2008). Yin (2009) is an example of a researcher who takes a positivistic approach and has adopted these criteria when conducting and evaluating case studies. However, this thesis takes a systems approach and conducts a qualitative study, why the authors believe that the criteria used for evaluating research quality should reflect this. This discrepancy between positivistic/quantitative influenced criteria and a qualitative approach is brought up by Halldórsson and Aastrup (2003). They suggest a set of four related criteria which originates from the naturalistic/qualitative literature: c*redibility, transferability, dependability* and *confirmability*. Each of the criteria corresponds to one of the classical positivistic inspired criteria but take a more qualitative standpoint. These criteria assess the research quality though a concept called *trustworthiness* which Halldórsson and Aastrup (2003) presents as an alternative to quality assessment based on the classical concept *correspondence*. Due to the qualitative influence that better correspond with the research philosophy and construction of the thesis, the criteria of trustworthiness were chosen to evaluate the quality of the research. To use these criteria is further supported by Bryman and Bell (2015, pp 400-401), who present them as an alternative for evaluating the quality of a qualitative research study.

2.10.1| Credibility

Credibility is the truth-value in the research. It is determined by the degree of correspondence between respondents' constructed realities and the realities expressed by the researcher. (Halldórsson and Aastrup, 2003) This can be compared to the conventional *internal validity* were the difference lie in the view of reality. This leads to slightly different approaches to achieve the two criteria. A context dependent reality (which credibility is based on) does not allow for, e.g., a clear *research framework* or *pattern matching* in different context, measures used to enhance internal validity. (Gibbert et al., 2008)

- However, the measure of *theory triangulation* is useful to enhance credibility irrespectively of the reality view, why that measure was applied throughout the study. Theory triangulation is used to verify findings by studying multiple theoretical perspectives. This was done in the literature reviews by studying how different researchers describe both the SPSC as well as the concepts studied in process step D. Second, it was used in the interviews where multiple interviews were conducted using the same questions to enable the authors to verify the respondents' answers by multiple perspectives. (Gibbert et al., 2008)
- *Pattern matching* between sources assessed to be formed for comparable contexts was also adopted using the same principles as the conventional measure. This by comparing patterns found in theory with the patterns discovered empirically. (Gibbert et al., 2008) Given that the theory in many cases took a positivistic approach and excluded a context dependent application, the authors assessed the relevance based on their judgement of theoretical applicability.
- The strategy of *getting feedback from informants* was also used, as structured data from interviews were sent back to interviewees for verification to ensure that no misrepresentation have occurred. (Miles and Huberman, 1994, pp. 275-277)
- Lastly, attention was paid on *weighing the evidence* as discussed by Miles and Huberman (1994, pp. 267-269). Stronger data were given more weight in conclusions and a log of data quality issues were kept enabling for the authors to do a thorough data quality analysis of the study.

2.10.2| Transferability

Transferability is the measure showing to which degree it is possible to make general claims based on the study, even though no true generalization is possible. (Halldórsson and Aastrup, 2003) The transferability is determined by the "similarities between sending and receiving contexts". (Erlandsson et al., 1993) This can be compared to the conventional term *external validity* or generalizability, which based on the belief that true generalization is possible. (Gibbert et al., 2008)

- Given the different views on generalization only one of the enhancing measures used by the conventional method is applicable to enhance transferability, i.e., to provide a *case study context*. This is to provide extensive details about the context of the case study to ensure the readers' understanding of the sampling choices. (Gibbert et al., 2008) Given the focus on context dependence in the concept of trustworthiness, this measure received great focus. On a high level RQ1 exists to provide a though context to RQ2 and on a lower level the authors had a strict structure for putting each empiric point of data into the overall context. (Halldórsson and Aastrup, 2003)
- Further, the transferability was enhanced by checking similarities in the contexts between used theory and the thesis. (Halldórsson and Aastrup, 2003)

2.10.3| Dependability

Dependability measures the stability of the data over time and can be translated to the conventional term *reliability*. (Halldórsson and Aastrup, 2003) Reliability consists of the two terms *transparency* and *replication*. Where transparency can be achieved using a *case study protocol*, i.e., a specification of how the case study has been conducted, while replication can be achieved using a *case study database*, i.e., a collection of all material used in the study sorted to simplify retrieval. (Gibbert et al., 2008) The difference between the two measures are that while reliability strives for invariance, dependability strives to achieve trackability or trackable variance. This means that dependability is achieved by clearly showing the logic of method and process decisions in the documentation. (Halldórsson and Aastrup, 2003)

- Transparency and traceability can be achieved using the same methods, why a case study protocol was used. In the protocol thorough notes of how, e.g., the maps and definitions changed over time was keep reflecting how better insight in the subject affected the research (Gibbert et al., 2008).
- Furthermore, a case study database was kept facilitating for future researchers to find relevant documentation and gain better insight into how the research was performed (Gibbert et al., 2008).

2.10.4| Confirmability

Confirmability asses if the findings show the results of the study and not the biases of the researchers. Thus, confirmability is achieved by showing that the findings can be confirmed by the data. (Halldórsson and Aastrup, 2003) This parallels to the conventional term objectivity or as it is called by Gibbert et al. (2008) *construct validity*. The difference is that construct validity assure objectivity based on method while confirmability does so based on the data, meaning that the data must be traceable to the sources.

- Confirmability was therefore enhanced in this thesis by clearly documenting how the process was completed enabling external parts to assert the findings. (Halldórsson and Aastrup, 2003) This is documented in section 2.1 to 2.9 above, including a visualization of the process in Figure 2.4. This documentation process is also suggested by Yin (2009) as a mean to enhance construct validity (2009, pp. 122-124) were he calls it a *chain of evidence*.
- Further Yin (2009, pp. 116-117) suggest *data triangulation*, i.e., collecting information about a specific fact from multiple sources, to enhance quality which was adopted by using both document and interviews to confirm the result.
- Lastly, the authors used the strategy of *checking the meaning of outliers* as discussed by Miles and Huberman (1994, pp. 269-270). This meant active search for exceptions and deviant examples throughout the study.

2.10.5| Checklist for Trustworthiness

Miles and Huberman (1994, pp. 277-278) suggest using a set of questions as a guideline to ensure research quality in qualitative studies. They suggest this list as queries that, with advantage, can be asked when reflecting over the quality and impression of the study. Given that this enables a simple and concrete approach to verify the overall quality, the idea was adopted in this thesis. Thus, a *quality checklist* as seen in tables 2.5-2.8 was developed based on the questions by Miles and Huberman (1994, pp. 278-279). The checklist includes questions relevant to this thesis, as well as the chosen research philosophy, and have been adjusted to use the same terms as used in the rest of the thesis. The checklist is divided into the four criteria of trustworthiness and was used to verify the quality of the research continuously throughout the study. The authors have made a self-evaluation based on the checklist and as suggested by Miles and Huberman (1994, p. 278), the checklist can further be used by the reader when assessing the trustworthiness of this thesis.

Table 2.5: Checklist for Credibility

Credibility	Self-evaluation by the authors
Does the report seem plausible, convincing and does it make sense?	*Yes*
Is the report comprehensive and respect the composition of context dependent factors?	*Yes*
Did the *theory triangulation* generate similar conclusions? If not, could a consistent explanation for it be shown?	*Yes*
Is the data clearly related to the categories developed based on theory? Are the measures representative?	*Yes*
Is there an internal coherence between the findings?	*Yes*
Are uncertain areas identified and discussed?	*Yes*
Do the original respondents find the conclusions accurate? If not, could a consistent explanation for it be shown?	*Yes*

Table 2.6: Checklist for Transferability

Transferability	Self-evaluation by the authors
Have the aspects of the original sample of respondent, context, processes etc. been described detailed enough to enable acceptable comparison?	*Yes*
Do the findings correspond with or confirm theory?	*Yes*
Are there any suggestions for where the findings could be tested by future research?	*Yes*

Table 2.7: Checklist for Dependability

Dependability	Self-evaluation by the authors
Have the research questions been clearly formulated and does the structure of the design phase correspond with them?	*Yes*
Can the findings be identified in multiple data sources?	*Yes*
Have fundamental paradigms and analytical conclusions been clearly stated?	*Yes*
Was the coding controlled to correspond across the data?	*Yes*

Table 2.8: Checklist for Conformability

Confirmability	Self-evaluation by the authors
Have the study's methods and processes been described detailed enough give the reader a complete understanding of how the study was conducted?	*Yes*
Is it possible for the reader to follow the process from data collection, via coding, data reduction and transformation to data display and then understand how conclusions were drawn?	*Yes*
Are personal assumptions, biases and values held by the researchers clearly stated and are possible influences on the study discussed?	*Yes*
Have the researcher investigated and discussed possible outliers?	*Yes*
Is the studied data available for future researcher?	*Yes*

3| Theory

This chapter presents the literature studies and theoretical foundation of the thesis. Two main theoretical areas are covered; resilience and interorganizational learning.

3.1| Resilience

3.1.1| Origin of Resilience

The origin of the word resilience comes from the Latin word *resi-lire*, which means "to spring back". This definition was adopted by physicists when explaining stability of materials and became the first use of resilience in science. The term entered the field of ecology alongside the rise of systems thinking in the 1960s and since then multiple meanings of the term have emerged. The development of resilience within the ecology field began with a scientist named Crawford Stanley Holling who described the difference between ecological and engineering resilience (Davoudi, 2012). Holling explained that when examining engineered devices to perform a specific task the "[…] *attention focused upon achieving constancy, the critical events seem to be the amplitude and frequency of oscillations"* (Holling, 1973). He goes on and explains that when examining systems affected by external change and unexpectancies, the focus of constancy changes to persistence. He thus defines ecological resilience as:

Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist. In this definition resilience is the property of the system and persistence or probability of extinction is the result.

(Holling, 1973)

The definition of resilience of a system with focus on *persistence* and the ability to *absorb* has been developed by Holling since (in later years in collaboration with other researchers) but his views of systems and resilience are still widely cited, e.g., Fiksel (2006); Ponomarov and Holcomb (2009); Pettit et al. (2011); Davoudi (2012); Pettit et al. (2013), Jovanovic et al. (2018); Rehak et al., (2018).

Resilience has further been studied within social sciences, primarily within psychology, social and economic perspectives. Within those disciplines, resilience is used in the context of behavioral reaction of institutions, communities and economies (Ponomarov and Holcomb, 2009). The definitions include concepts like: ability to *absorb* and *recover* (Timmerman, 1981); ability to continuously *anticipating* and *adopt* to important secular trends*;* and continuously *reconstruct*, requiring *innovation* (Hamel and Valikangas, 2003). Fiksel (2006) further defines enterprise resilience as "*the capacity for an enterprise to survive, adapt, and grow in the face of turbulent change*".

In 2012, Davoudi expanded the engineering and ecological resilience definitions one step further by introducing evolutionary resilience. Evolutionary resilience rejects the existence of equilibrium and puts emphasis on uncertainty. This by giving an understanding of how *adaptability*, *persistence,* and *transformability* interplay. The concept of transformability is new to the evolutionary approach and describes the uncertain and volatile transformation process when the system shifts into an entirely new state (Davoudi, 2013). The new focus enables grasping of how complex socio-ecological interdependencies function (Davoudi, 2012). Adding to his own work, Davoudi (2013) included a fourth concept, *preparedness*, to the explanation of evolutionary resilience. This to allow for human intervention and intentional actions. Preparedness is defined as learning capability and it is argued that a socio-ecological system can become resilient using their learning capacity to enhance the chances of being persistent, adaptable, and transformative.

These different perspectives of resilience from different disciplines includes the concepts: *anticipation*, *absorption* ability, *persistence*, *recoverability*, *continuous reconstruction*, *growth*, *adaptability*, *survival*, *transformability,* and lately also *preparedness*. It is relevant to understand which concepts are significant to resilience in supply chains.

3.1.2| Supply Chain Resilience

Ponomarov and Holcomb (2009) investigated supply chain resilience and proposed a multidimensional conceptualization of the definition:

The adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function.

(Ponomarov and Holcomb, 2009)

Recurring concepts are the *adaptive* ability, *preparedness*, *recoverability*, and, implicitly understood from the evolutionary resilience, also the capacity to maintain *continuity* at a desired level.

Barroso et al. (2011) highlights this definition and adopts a similar definition including the concepts ability to *react* and *maintaining* supply chain objectives. Christopher (2011) also discuss resilience in supply chains and defines resilient processes as able to *change* quickly, being both flexible and agile. He continues by conceptualizing supply chain resilience with elements including rapid access to information, collaborative working, visibility, shared information and knowledge as well as strategic decision making. He also refers to the ability of a system to return to the initial or a desired state after disruption (adopted from Cranfield School of Management in Christopher, 2011).

Supply chain resilience can also be understood as the ability to cope with change and as a concept formed by *agility* and *robustness* (Wieland and Wallenburg, 2013). Agility is defined as the *reactive* and *adaptive* ability and robustness as the capacity to *resist* change, this without adapting the original stable state (Wieland and Wallenburg, 2012). Looking into existing literature Wieland and Wallenburg argue that the concepts of *anticipation* and *visibility* as well as *preparedness* and *speed* are important aspects to consider, fitting into the dimensions of agility and robustness as shown in Figure 3.1 below:
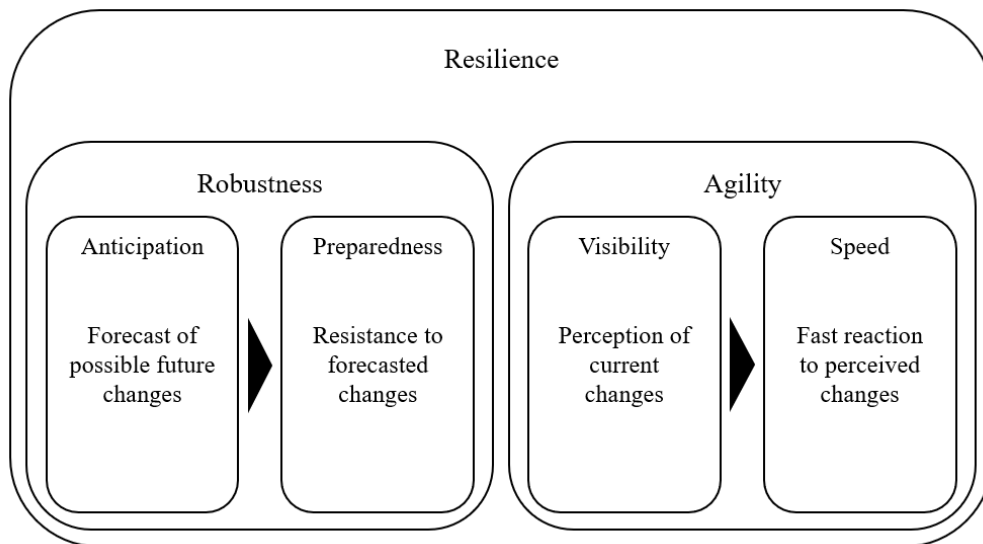
Figure 3.1: Mechanisms of Resilience (from Wieland and Wallenburg, 2013, p. 304)

This view includes many of the previously mentioned concepts but put the emphasis on agility, consisting on visibility and speed, rather than the *reactive*, *adoptive*, *recovering* and *transformative* dimensions that are mentioned in other research.

A specific type of supply chains is critical infrastructure, given their purpose to maintain vital societal functions as described in section 1.1| Background. Since the SPSC is classified as a critical infrastructure in Sweden, another aspect to understand before defining resilience is how critical infrastructure resilience is defined.

3.1.3| Critical Infrastructure Resilience
Multiple governmental agencies have started to investigate and define infrastructure resilience. Among those are the National Infrastructure Advisory Council acting through the U.S. Department of Homeland Security. They define infrastructure resilience as follows:

Infrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to <u>*anticipate*</u>, <u>*absorb*</u>, <u>*adapt to*</u>, *and/or* <u>*rapidly recover*</u> *from a potentially disruptive event.*

(NIAC, 2009)

This definition is adopted by Bologna and Carducci (2016). Based on the definition, they expand their explanation of the four identified capabilities, calling them *preventive*, *absorptive*, *adaptive* and *restorative* capabilities. The preventive ability is defined as the capacity to *anticipate* disruptive events; the absorptive ability concerns the degree to which a system can *absorb* system disturbances and minimize consequences; the adaptive ability is defined by the capability to *recover* system performance levels by self-organization, and the restorative ability is defined by the capacity to quickly and easily *repair* the system.

This definition includes most of the previously mentioned dimensions and connects the term resilience to critical infrastructure in clearly structured manner. However, the authors will, based on the studied literature, propose a few adjustments necessary to better capture the concept of resilience.

As described by Wieland and Wallenburg (2013) robustness is built of anticipation and preparedness. Thus, only using the word anticipation as NIAC (2009) does, will not fully capture the ability of human intervention. The use of the word preventive as adopted by Bologna and Carducci (2016) has the same weakness and limits the preventing to the capacity to anticipate, again, not allowing for human interaction. The authors agree with Davoudi (2013) and believe this capability should be included in a definition of resilience. However, in contrast to Wieland and Wallenburg (2013) the authors argue that preparedness includes anticipation. This since the ability to anticipate disruptive events are part of being prepared. Thus, the capability of preparedness is sufficient and superior to anticipation when describing the ability used during the pre-phase of disruptive events. Additionally, the initial formulation of resilience, being the ability to reduce the magnitude and/or duration of disruptive event lacks the recognition of the human ability to prevent a disruptive event altogether, why this will be included.

The absorption capabilities capture the essence of the ability also described as persistence and resistance, why the word and the description proposed by Bologna and Carducci (2016) will be adopted. Similarly, adaptability captures the ability of being flexible in a way relevant to the context of a critical supply chain, why also that description will be used. Rapid recovery or restorative capability captures the agility capability as described by Wieland and Wallenburg (2013). Bologna and Carducci's description corresponds with the authors view and this capability will similarly be adopted in its whole. One dimension not explicitly mentioned in the definition is, however, transformability, i.e., the possible shift into an entirely new state. The authors believe that the system doesn't necessarily need to go back to the same state as before the disruptive event but does also recognize it might be cases where the system does return to the same state. Thus, while the capability of transformability might be to extreme, it is important to capture the ability of a system to return to another state than the original one in accordance with Christopher (adopted from Cranfield School of Management in Christopher, 2011).

Given the above discussion, this thesis definition of critical infrastructure resilience is presented below.

Critical infrastructure resilience is the ability to prevent or reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient critical infrastructure depends upon its preparedness, absorption, adaptability, and/or rapidly recovering from a potentially disruptive event into a desired state.

The four capabilities of resilience will be described as follows:
- Preparedness: the ability to *prepare and anticipate* disruptive events
- Absorption: the ability to *absorb* system disturbances and minimize consequences
- Adaptability: the ability to *recover* system performance levels by self-organization
- Recovering: the ability to quickly and easily *repair* the system

The definition is visualized in Figure 3.2, a visualization inspired by the visualization made by Carlson et al. (2012).
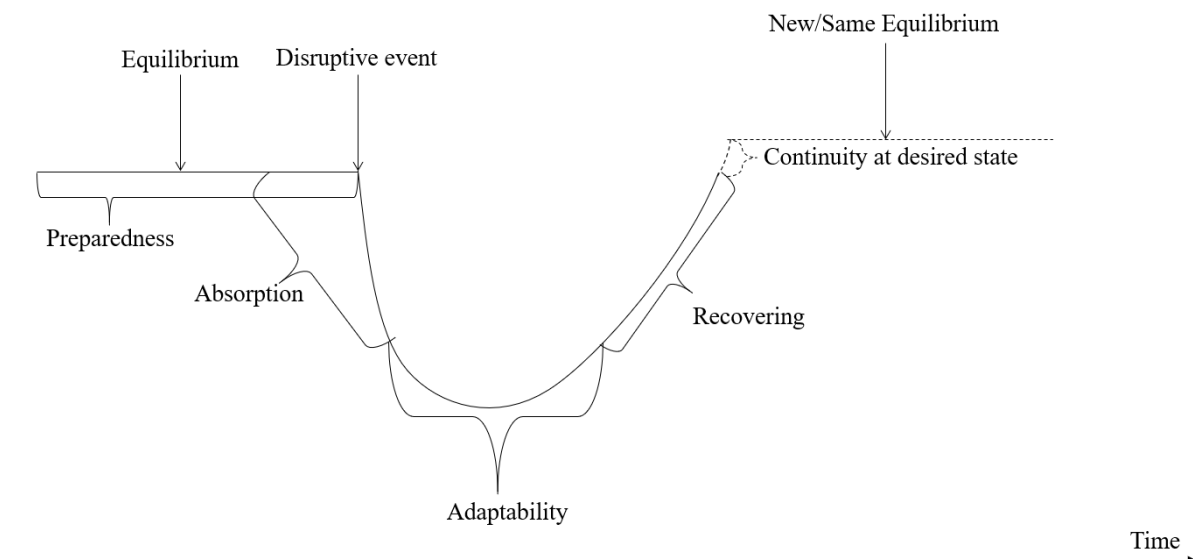
Figure 3.2: Components of Resilience (adopted from Carlson et al., 2012, p. 18)

To summarize the cited authors' perspectives on the resilience concept in relation to the definition adapted in this thesis, a table showing which concepts different articles embraced is presented in Table 3.1.

Table 3.1: References for Resilience

Reference	Phases of Resilience			
	Preparedness / Anticipating	Absorption / Persistence	Adaptability	Recovery / Transformability
Resilience				
Holling (1973)		X		X
Timmerman (1981)		X		X
Rose (2004)		X	X	
Hamel and Valikangas (2003)	X		X	X
Fiksel (2006)			X	X
Davoudi (2012)		X	X	X
Davoudi (2013)	X		X	X
Supply Chain Resilience				
Ponomarov and Holcomb (2009)	X	X	X	X
Barroso et al. (2011)				
Pettit et al. (2011)	X		X	
Pettit et al. (2013)	X		X	X
Christopher (2011)			X	
Wieland and Wallenburg (2012)	X		X	
Wieland and Wallenburg (2013)	X		X	
Critical Infrastructure Resilience				
NIAC (2009)	X	X	X	X
Bologna and Carducci (2016)	X	X	X	X
Jovanovic et al. (2018)	X	X	X	X
Rehak et al. (2018)	X	X	X	X

3.1.4| Resilience level

Resilience can be identified on multiple levels. Rose (2004, p. 229) defines three levels were resilience takes place:

- *Microeconomic*: the behavior of the individual household, firm or organization
- *Mesoeconomic:* the sector, cooperative group or individual market
- *Macroeconomic*: where all markets and individual units are combined into something bigger than its parts

Relating to the previous perspective, these levels are valid at the supply chain and firm level. (Ponomarov and Holcomb, 2009) Bologna and Carducci (2016) similarly defines four dimensions of system resilience based on abstraction level. The first level is defined as the *logical and physical dimension* and is concerned with sector specific technology. The second, *personal dimension*, looks into resilience skills, training and motivation for experts and CI personnel. The third level of abstraction, the *organizational dimension*, considers Resilience Management Systems at an organizational level including implementation and responsibilities. The highest level of abstraction, *the cooperative dimension*, involves the cooperation among different public and private CI operators, i.e., how to encourage cooperation, divide responsibility and find best practices.

As earlier explained, focus will be put on the interorganizational dimension. This means that, although the authors embrace the fact that resilience take place on all above-mentioned levels and that all levels needs to be resilient, only the inter-organizational level will be considered. Adopting Bologna and Carducci's (2016) division this thesis will only look into matters at the cooperative level, see Figure 3.3.
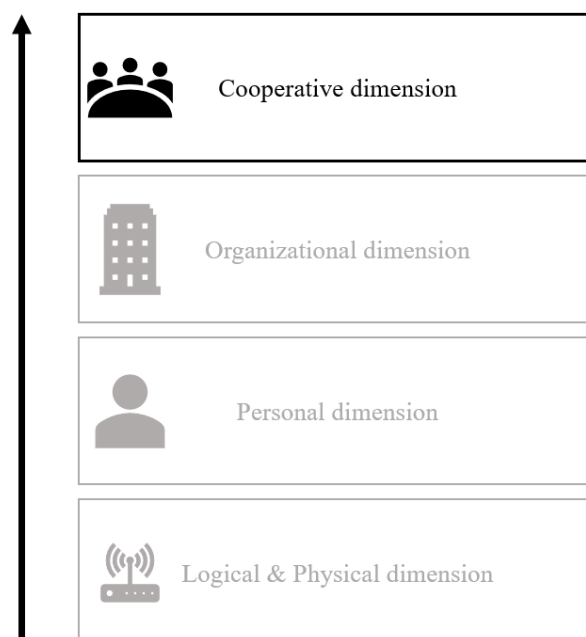
Figure 3.3: The Cooperative Dimension (from Bologna and Carducci, 2016, p. 15)

3.2| Interorganizational Learning

Interorganizational learning is a central concept in several research studies regarding supply chain performance. Rajala (2018) recently made a meta-study analyzing interorganizational learning and its link to performance in different studies.

Several perspectives on interorganizational learning are presented in the study by Rajala (2018). Similar for all studied perspectives, is that they emphasize that knowledge sharing and learning occurs during continuous interaction between organizations. The perspectives also share the belief that interorganizational learning begins with information sharing, is followed by information interpretation and finally ends in application to practice. What differs between the perspectives, is the belief of how and where in the process that the learning occurs, whether it is at the relationship level or at the organizational level. The *relation learning perspective* (Selnes and Sallis, 2003) states that learning occurs in the joint sense-making process between two parties leading to knowledge integration, while the *interactive learning perspectives* (Hernández-Espallardo et al., 2010) means that knowledge is transferred between two parties but that the interpretation and application of the knowledge occurs within the respective organizations. Rajala (2018) summarizes these different perspectives as *relationship learning* being joint learning and *interactive learning* being more about knowledge acquisition, which might be a catalyst for internalized learning. For the purpose of this thesis, interorganizational learning will be seen as a concept that includes both joint learning as well as knowledge acquisition used for internalized learning.

The presented meta-study (Rajala, 2018) concludes that information sharing is the basis of interorganizational learning and that it is thus necessary to create structures and clear rules that enable information sharing among the practitioners in a supply network. The author further states that it is though important to notice that information sharing per se does not lead to interorganizational learning. Instead, learning does not occur until the relationship or respective actors interpret and utilize the knowledge acquired.

3.3| Interorganizational Learning and Resilience

To build resilience in a supply chain it is necessary to unite all organizations in a network and apply an integrated approach. This is done by collaboration among the actors (Sheffi, 2001). This fact is supported by Scholten et al. (2014), who, in their study of previous research, have found consent with the view that collaboration is an essential dimension when creating resilience. The importance of collaboration between different supply chain members is further highlighted as a mean to increase resilience by Blackhurst et al. (2011). Based on their study, they found evidence in multiple companies that when the risk management function consists of cross functional teams, they are able to optimize the whole supply chain, avoiding sub-optimization. Further, by avoiding a "silo mentality" firms in the supply chain are able to stabilize more quickly and efficiently after a disruption (Blackhurst et al., 2011).

The belief that supply chain integration is an essential part of resilience is recognized in Ponis and Koronis (2017) research about disaster supply chain management. They explain how the

practice is dependent on interorganizational networks and synergy development. During crises in a supply chain, when the resilience is put to the test Ponis and Koronis (2017) argue that the supply chain relies on processes in the network and recognize the knowledge circulation and sharing as crucial, emphasizes the necessity of integrated collaboration.

An important part of collaboration is interorganizational learning. This can be detected as an element in the above reasoning about collaboration and is further emphasized by Christopher and Peck (2004). They define the foundation of collaboration as the utilization of mutual knowledge in the entire chain and information exchange that may enable decrease of uncertainty (Christopher and Peck, 2004). The specific importance of learning is further highlighted by Kayes (2015) who, building on previous research, suggests that learning may offer ways to improve resilience in organizations.

Looking at the need for increasing resilience for intentional attacks, e.g., cyber-attacks, in the preparedness phase, Mitroff and Alpasan (2003) shows that the key lies in the development of learning processes that gives executives confidence, mental capabilities and flexibility to be able to envisage the crisis. Thus, to increase preparedness resilience the importance lies in finding tools and processes to enable this learning.

3.4| Interorganizational Learning Methods for Resilience

3.4.1| About the Learning Methods

For the purpose of this thesis, we define *method* as a systematic or established procedure for accomplishing or approaching something. An *interorganizational learning method for resilience* in this context is thus *a systematic procedure for interorganizational learning, either joint learning or knowledge acquisition used for internalized learning, with the goal of increasing systems resilience.*

In this theory chapter, interorganizational learning methods found in the literature are described. However, given the early stage of the research area, not all of the described methods are developed specifically for how the SPSC can improve its resilience through *interorganizational* learning. Some are developed at an organizational level and others have only been tested within other industries than the healthcare sector. All methods are developed with the aim of increasing resilience, but some are not specifically called learning methods, but rather collaboration models or models to increase resilience. The adapted methods have in these cases shown strong elements of learning in accordance to the definition presented above. Therefore, the authors have through comparisons of the descriptions, practical examples and specific contexts where the methods have appeared made the judgement that all methods presented are relevant both for the interorganizational perspective and in the context of the SPSC. Important to note is, however, that the methods described not necessarily are effective due to being relevant. To be able to ensure each learning methods effectiveness, the theories would have to be tested individually within an interorganizational perspective in the SPSC

which is outside the scope of this thesis. The theories will instead be compared to learnings methods used in the SPSC today.

Table 3.2 provides an overview of the learning methods and their sources. The rest of this chapter will further describe each of the learning methods in more detail. In the end of the chapter, *learning goals* and *learning prerequisites* found during the literature study of interorganizational learning methods will be presented. The goals and prerequisites have been overall linked to the learning methods as presented throughout tables 3.3-3.10 but will not be further discussed until the end of the chapter.

Table 3.2: References for Interorganizational Learning Methods

		References											
		Sheffi (2017)	Blackhurst et al. (2011)	Stewart et al. (2009)	Scholten et al. (2014)	Labaka et al. (2015)	Christopher and Peck (2004)	Ouyang (2013)	Djalante et al. (2013)	McManus et al. (2015)	Sikula et al. (2015)	Coates (2006)	Miltroff and Alpasan (2003)
Learning methods	Vertical information sharing	X	X	X	X	X	X	X					
	Vertical joint assessment	X	X	X	X	X	X		X		X		
	Vertical collaborative planning	X	X	X	X	X	X	X	X				
	Horizontal information sharing	X			X								
	Interorganizational education	X	X	X		X	X						
	Simulation	X	X	X	X				X	X	X	X	X
	Analyzing experiences		X	X		X		X					
	Stimulate flexibility	X	X	X	X					X			

3.4.2| Vertical Information Sharing

Vertical information sharing means that actors with different roles in the supply chain share information with each other with the purpose of learning more about supply chain resources, interdependencies, threats and/or vulnerabilities etc. According to Scholten et al. (2014), constant information sharing with vertical partners is essential to keep the skills levels up and be prepared in a supply chain. The general learning method of vertical information sharing can be further broken down in four different sub-methods: *information sharing for resource knowledge, information sharing for dynamics knowledge, information sharing for managing a crisis, and information sharing for improving regulations*. These sub-methods are summarized in Table 3.3 and are further described below.

Table 3.3: Overview of Vertical Information Sharing

Learning sub-methods	Learning goals	Learning prerequisites
Information sharing for resource knowledge	Understand resources in supply chain	Vertical collaboration committee
Information sharing for dynamics knowledge	Understand interdependencies and dynamics	
Information sharing for managing a crisis	Understanding risks and external threats	Vertical communication structure
Information sharing for improving regulations	Enabling high situational awareness in a crisis	Trust

Information sharing for resource knowledge

A fundamental purpose of vertical information sharing is to increase the knowledge about the resources held by the different actors in the supply chain (Scholten et al., 2014). This can for example be done by each actor summarizing a list of the resources that they can provide and sending it to other actors in the supply chain, as exemplified in Scholten et al. (2014). Christopher and Peck (2004) discuss the concept of *Supply Chain Visibility;* the importance of having knowledge about inventories, demand, supply condition, production and purchasing schedule of upstream and downstream actors in the supply chain. Knowledge about resources held by the different organizations in a supply chain is also a prerequisite for horizontal collaboration to use the actor's resources in the most effective and efficient way, as indicated by data gathered by Scholten et al. (2014). Information sharing concerning resource knowledge between different actors in the supply chain increase resilience by strengthening the *absorption* ability. This ability increases due to the higher awareness of the other actors' resources, giving the supply chain as a whole a greater ability to use all available resources to minimize and avoid disruptions. In other words, a greater ability to absorb disruptions.

Information sharing for dynamics knowledge

Another important aspect of vertical information sharing is learning about threats, interdependencies and present dynamics in a supply chain and its external context (Ouyang, 2013). This can for example be done by different actors sharing identified risks and uncertainties in their operations and relations, with the other actors in the supply chain (Christopher and Peck, 2004). Learning about the dynamics in a supply chain can help all actors manage disruptions more effectively because they understand how different kinds of risks will affect the system and thus their specific operations (Blackhurst et al., 2011). Labaka et al. (2015) stresses that the government should be aware of the events that may lead to a large-scale crisis in a critical supply chain, in other words understanding the main risks and vulnerabilities. Understanding system dynamics can also minimize the so-called bullwhip-effect, meaning that fluctuations often increase the further one goes up the supply chain (Sheffi, 2007, pp. 86-87). In the case of the SPSC, one hypothetical example could be a pharmacy communicating to its pharmaceuticals producers that an increased demand for a specific vaccine three months was due to a marketing campaign for vaccination and that the increased demand is not expected to repeat next year. This way, the pharmaceutical producer can better plan their forecasting and production. One technical method for learning about the dynamics in a supply chain, is to establish a network that monitor and update systems in real time, for example in a Bayesian network calculating the probability for different scenarios (Ouyang, 2013). This demand that an accurate supply chain map has been developed as a basis for the network visualization. Sharing information about systems dynamics increase the resilience by strengthening the *adaptive* capacity of a company. This by enabling the actors to understand how the system function as a whole and thus, how to best adapt to new conditions.

Information sharing for managing a crisis

A third important category of vertical information sharing is information sharing for managing a crisis. A success factor for a successful crisis response is that the different actors in the supply chain continuously share information through the system in a crisis, since immediate and accurate information about the system allows the actors to respond intelligently and immediately (Sheffi, 2007, pp. 255-256). Stewart et al. (2009) provides an example of this, suggesting that governance, in the threat of a hurricane, exchanges information with hospitals, hotels and retailers in advance to allow for them better manage the changed demand because of the flow of people. Labaka et al. (2015) states that the government has an important role in a crisis to centralize information from the different stakeholders and communicate effectively with both the public and the involved actors. Information sharing for managing a crisis might also include integrating emergency alert systems between private and public actors (Stewart et al., 2009). Information sharing to improve crisis management increases resilience by strengthening the *adaptive* capacity. By continuously sharing information rapidly to the right people during a crisis, the adaption to the new conditions is faster. By extension, continuous information sharing also leads to a faster recoverability.

Information sharing for improving regulations

Lastly, a fourth method of vertical information sharing is to teach the government things that might improve the regulatory environment. Because a lot of knowledge exists with the different actors in the supply chain, the actors may advice the government on proper standards so that the cost of commerce stays within reasonable limits (Sheffi, 2007, p. 275). By sharing insights and suggestions of improvements on the regulations with the government the resilience of the system increases by strengthening the *preparedness.* This since properly formulated regulations may help to minimize potential vulnerabilities.

3.4.3| Vertical Joint Assessment

The learning method of *vertical joint assessment* means that different actors collaborate to construct assessment with the goal of achieving a joint understanding of supply chain resources, interdependencies, threats and/or vulnerabilities. Vertical joint assessment is thus similar to vertical information sharing, but goes one step further by having the actors jointly assessing the collected information. Several sub-methods exist: *joint assessment of current state, joint risk analysis,* and *joint forecasting.* These sub-methods are summarized in Table 3.4 and are further described below.

Table 3.4: Overview of Vertical Joint Assessment

Learning sub-methods	Learning goals	Learning prerequisites
Joint assessment of current status	Understand resources in supply chain	Supply chain management team
	Understand interdependencies and dynamics	
Joint risk analysis		Supply chain map
	Understanding risks and external threats	
Joint forecasting		Trust
	Minimize vulnerability in supply chain	

Joint assessment of current status

Instead of just sharing information to develop a resource knowledge, the actors can go one step further by jointly assessing the current status of the resources in the supply chain. Internal and external audits can be performed to make a periodical and detailed analysis of the status of a system, technically as well as in terms of management (Labaka et al., 2015). Scholten et al. (2014) stresses that demand satisfaction, alternative sources of supplies, inventory and capacity level for all parts of the supply chain have to be known prior to a crisis to prevent further complications that could easily be avoided. Christopher and Peck (2004) talks about supply chain visibility and that the different actors should agree on "one set of numbers". Dialogue mapping or other communication techniques can be used to jointly defining the components and services critical for the functionality of the system. Since it is impossible for a system to constantly be resilient to everything, it is important to identify the overall critical functionality that is most important to protect (Sikula et al., 2015). To make joint assessments of the current status of the system increases the *preparedness* of the supply chain and thus the resilience. The preparedness is increased by the joint assessment of the current situations since it creates a

shared view of the most critical and vulnerable areas of the supply chain and enables the actors to jointly protect those, minimizing the vulnerabilities.

Joint risk analysis

Understanding interdependencies and potential for cascade effect can often not be done only by vertical information sharing. Most times, it demands some sort of joint assessment between the vertical actors in the supply chain. A conducted assessment may for example result in a supply chain risk register - a specification of vulnerabilities identified in critical nodes and links in the supply chain accompanied by defined monitoring and mitigation strategies (Christopher and Peck, 2004). Assessment of anticipated vulnerability leads to supply chain resilience according to Stewart et al. (2009). According to Sheffi (2007, p. 68), one must evaluate how a disruption can affect the rest of a supply chain, for example in terms of cascading effects from governmental actions. By monitoring the supply chain and its individual nodes, disruptions may also be predicted before they occur. Often this allows the actors to employ tactics to avoid the disruption, or at least employ tactics that allows the system to recover faster (Blackhurst et al., 2011). Djalante et al. (2013) also stresses that by diversifying the sources and processes when developing knowledge through assessment of hazards, risk, vulnerability and impact, the knowledge is more likely to be accurate, relevant and appropriate. Routine meetings and regularly reviews are essential to keep the evaluations updated (Scholten et al., 2014). The creation of a shared view of potential risks and effects of the supply chain enables the actors in the supply chain to identify more widespread risks more accurately increasing the *preparedness* to manage disruptions. This thus makes the supply chain more resilient as a whole.

Joint forecasting

To be able to overcome difficulties concerning forecasting, more than data sharing is necessary. To be able to develop reliable forecasts a collaborative process is required, involving comparison of prognoses to identify discrepancies and align these to create a shared forecast (Sheffi, 2007). The trend of conducting joint forecasting have further been observed by Ireland et al. in Christopher and Peck (2004), who points towards significant collaboration between manufacturers and retailers in the fast-moving consumer goods industry. The underlying reason of collaboration and joint forecasting is the reduced uncertainty due to exchange of information and joint creation of "supply chain intelligence" (Christopher and Peck, 2004). By aligning the actors' views and creating joint forecasts more accurate judgements can be done due to a larger information base and multiple perspectives, this leads to improved *preparedness* and therefore increased resilience.

3.4.4| Vertical Collaborative Planning

Vertical collaborative planning takes vertical information sharing and vertical joint assessment one step further by using the information and forecasts to develop a joint plan for the supply chain system. The goal of this learning method is to minimize vulnerability in the supply chain, learn how to avoid holes and duplication in response effort and enable a fast response and a high situational awareness in a crisis. Vertical collaborative planning can be further broken down in the sub-methods: *coordinated prevention of disruptions, coordinated contingency plans, coordinated crisis management procedures,* and *coordinated response effort* as seen in Table 3.5.

Table 3.5: Overview of Vertical Collaborative Planning

Learning sub-methods	Learning goals	Learning prerequisites
Coordinated prevention of disruption	Avoid holes and duplication in response efforts	Supply chain management team
Coordinated contingency plans	Minimize vulnerability in supply chain	
		Supply chain map
Coordinated crisis management procedures	Enabling high situational awareness in a crisis	Trust
Coordinated response effort		

Coordinated prevention of disruptions

One of the key goals of vertical collaborative planning, is taking actions to minimize the probability for and scale of potential disturbances, a sub-method here named coordinated prevention of disruptions. Since many disruptions originate outside the borders of one specific actor in the supply chain, coordinated prevention efforts to learn how to minimize the potential disturbances in the overall system is potentially advantageous to all individual actors in the supply chain (Sheffi, 2007, p. 137). Ouyang (2013) states that a resilience improvement strategy for critical infrastructures is to design and prepare redundancy, backup and substitution, all to lower the interdependency impact and thus hopefully prevent disruptions. Djalante et al. (2013) states that a network of actors that focus on common problems can deal with more complex problems at larger scales, than the single actors can do alone. Cross-functional risk management teams are also better at optimizing the entire supply chain instead of just small parts, in other words better able to eliminate bottlenecks in the system (Christopher and Peck, 2004). One thing that actors may do to minimize the scale of disturbances, is integrating their emergency alert systems to enable faster information flow about disruptions (Stewart et al., 2009). By creating coordinated preventions of disruption, the system is able to *absorb* and manage larger and more complex incidents and prevent or minimize damage, thus increasing the resilience of the system.

Coordinated contingency plans

Several researchers (, e.g., Sheffi, 2017; Blackhurst et al., 2011) stresses the importance of having coordinated contingency plans ready if a disruption occur in the supply chain. The purpose of the sub-method of coordinated contingency plans is therefore to learn how to handle some specific types of disasters. Developing and practicing contingency plans will help the system to reduce response time in a crisis (Blackhurst et al., 2011), since the implementation of the pre-established plan can begin the minute an emergency occurs (Scholten et al., 2014). It is thus important that the plan is truly learned throughout the supply network so that every employee of every organization know what to do once the plan kicks in (Scholten et al., 2014). When implementing a developed disaster plan as well as evaluating its direction and control, vertical collaboration is a necessary prerequisite (Scholten et al., 2014). When an event occur that has not got a specific contingency plan, the actors in the supply chain instead need to trust their developed crisis management procedures as described in the next section below. By developing coordinated contingency plans, specific large-scale events can be handled more rapidly and the supply chain is able to regain full function faster. This improves the resilience by increasing the *recoverability* and to some extent the adaptability capacity.

Coordinated crisis management procedures

The actors in the supply chain cannot predict and develop a contingency plan for every possible risk in the supply chain and thus need to develop some ground structure for response that can be used in all kinds of disruptions. As a complement to the contingency plans, the actors should therefore establish crisis management procedures to pre-define the roles and responsibilities of each stakeholder during a crisis (Labaka et al., 2015). Labaka et al. (2015) talks about two types of procedures to establish and learn; operating procedures as well as organizational procedures. A learning process that can be used to develop coordinated crisis management procedures is shared-learning-dialogue, a process in which several actors, knowledge and perspectives are considered and negotiated until common understanding, trust and different interests are met (Djalante et al., 2013). By developing pre-defined crisis management procedures and dividing responsibilities of each stakeholder in advance, the supply chain as a whole is able to better react to a disruption and *adapt* to the new conditions. It will further improve the recoverability process.

Coordinated response effort

A fourth important sub-method of vertical collaborative planning is ongoing learning during a coordinated response effort. This is important to avoid holes and duplication in response effort, since redundancies otherwise may have harmful effects on the recovery process (Stewart et al., 2009) and the motivation of the involved actors. One example is coordination between national and local actors, as well as coordination between public and private actors. By continuously coordinating the response of the supply chain the *recoverability* process becomes more effective, strengthening the resilience.

3.4.5| Horizontal Information Sharing

When it comes t*o horizontal information sharing*, the purpose of this learning method is to understand interdependencies in the industry, understand external threats to industry and learn successful strategies and best practices by studying the actions and strategies used by horizontal actors; actors with a corresponding role in the supply chain. Two sub-methods of horizontal information sharing will now be further presented: *information sharing for industry coordination* as well as *horizontal benchmarking*, as summarized in Table 3.6.

Table 3.6: Overview of Horizontal Information Sharing

Learning sub-methods	Learning goals	Learning prerequisites
Information sharing for industry coordination Horizontal benchmarking	Understand interdependencies and dynamics Understanding risks and external threats Learn successful strategies	Horizontal collaboration committee Trust

Information sharing for industry coordination

Sheffi (2007) describes how horizontal actors can share information on threats, create coordinated interfaces with law enforcement agencies and develop industry wide security standards to increase supply chain resilience. To be able to use the resources and complementary skills in a supply chain optimally, the horizontal actors further need to share information and knowledge about their different resources with each other (Scholten et al., 2014). Pre-defined communication structures and knowledge about the resources held by different organizations further enable communication and evaluation is a standardized and unified way, simplifying the response during a disruption (Scholten et al., 2014). As in the case with vertical information sharing for resource knowledge, the information sharing between horizontal actors in a supply chain increases the *absorptive* capacity, and thus resilience, by enabling the industry to use available information to minimize or avoid disruptions.

Horizontal benchmarking

Another sub-method of horizontal information sharing is horizontal benchmarking where the purpose is to benchmark and learn successful strategies from experiences of corresponding actors in the supply chain. This could for example be to share security best practices between competitors (Sheffi, 2007). Scholten et al. (2014) state that constant information exchange between horizontal partners is essential to keep the skill levels up in the supply chain. By jointly sharing information about security practices, competitors within an industry are able to use benchmarking for find security best practices and thus increase the *preparedness* of the supply chain.

3.4.6| Interorganizational Education

Interorganizational education is a learning method with the purpose of theoretically learning successful strategies in the supply chain, further divided into and described as three sub-methods: *education in appropriate response, education in supply chain structure,* and *education in security procedures* as summarized in Table 3.7.

Table 3.7: Overview of Interorganizational Education

Learning sub-methods	Learning goals	Learning prerequisites
Education in appropriate response Education in supply chain structure Education in security procedures	Understand interdependencies and dynamics in supply chain Learn successful strategies	Vertical collaboration committee Horizontal collaboration committee

Education in appropriate response

Educating different actors in the supply chain on how to respond appropriate in a crisis is a central part of interorganizational educations. Labaka et al. (2015) describes how operators of critical infrastructures are often the ones to both detect a disruption or failure and the one that immediately need to respond to it. Educating these operators on appropriate behavior can both lead to a faster discovery of problems as well as the most effective response. Top government officials and key actors in a critical infrastructure also need to be well prepared for handling crises, and interorganizational education may be a way for this group to continuously improve its theoretical crisis management knowledge (Labaka et al., 2015). Interorganizational education form the basis for knowing when it is appropriate to take action, for example by initiating communication with vertical actors (Blackhurst et al., 2011). By educating actors on how to respond appropriately to a problem, the *adaptation* ability increases given that the actors involved can both discover the problem more quickly and respond more efficiently. Due to the improved management of problems at the source, the resilience of the supply chain as a whole is increased.

Education in supply chain structure

Another sort of interorganizational education is training in supply chain structure, which is similar to vertical information sharing to create resource knowledge. This could for example be learning high level employees from one actor about the production process at another actor (Sheffi, 2007). Or maybe learn the county councils how their contracted pharmacies organize their distribution, to facilitate a shared understanding. By creating shared knowledge of the supply chain, each actor develops an understanding of the system as a whole and the resources available why the *absorption* ability and thereby resilience increases.

Education in security procedures

A third sub-method of interorganizational education is education in security procedures. An actor can for example work closely with its key suppliers to help them improve their risk management practices (Christopher and Peck, 2004). Education and security audits are two methods to make sure security standards are developed and maintained in the suppliers' organizations (Sheffi, 2007, p. 133). National actors often take the role of helping local actors to build capacity and knowledge when it comes to security procedures (Djalante et al., 2013). Stewart et al. (2009) describes one such important education area, as government should influence the preparedness of companies and supply chains when it comes to backing up critical data. The loss of critical data, for example concerning an actors supply base, its financial records and customer, can often be devastating to organizations and the government should therefore teach the organizations in critical supply chains processes and options for protecting data. By working closely with key suppliers and improving their security procedures as well as backing up all critical data, the resilience in the supply chain increases due to improved *preparedness*.

3.4.7| Simulation

S*imulation* is a learning method consisting of practical techniques based on learning through *scenario-based* training, *practice* and *role-playing* as summarized in Table 3.8. By simulating disruptions, employees get exposed to a potentially damaging situation and can learn how to react (Sheffi, 2007, p. 278).

Previous research suggests that establishing routines through simulation and learning exercises are critical components of the *preparedness* process given their ability to identify necessary institutional roles and links in the supply chain to build resilience (Scholten et al., 2014). These findings are confirmed by Sikula et al. (2015) establishing that system vulnerability can be identified by running different scenarios. The critical role of simulation is partly due to the rarity of real opportunities to acquire experience from disruptive events (Scholten et al., 2014).

Table 3.8: Overview of Simulation

Learning sub-methods	Learning goals	Learning prerequisite
Scenario-based training	Understand interdependencies in supply chain	Supply chain management team
Practice exercises	Understanding external threats to supply chain	
Role-playing	Avoid holes and duplication in response efforts	Supply chain map
	Learn successful strategies	

Scenario-based learning

Scenario exercises increase an organization's awareness of how the operating environment function in a crisis and what potential impacts different types of events can have (McManus et al., 2008). Further, it is suggested by Coates (2006) that organizations have a limited imaginative capability to solely observe incidents in other companies and apply the lessons learned to their business. Thus, the use of scenario- based learning is an especially valuable method for external interconnected organizations (McManus et al., 2008). The use of scenario-based learning is further presented as a strategy to improve learning in disaster risk reduction by Djalante et al. (2013).

The use of consequence scenarios is one example of scenario exercises that help organizations improve their situation awareness. The consequence scenarios are designed to simulate a spectrum of possible effects and is divided into four groups of event consequences, based on regional, nationwide, localized and distal events. The purpose of the sub-method is to enable identification of potential events and consider how to handle unanticipated outcomes from those. It can further be used as a technique to understand how organizations can handle failure of linked organizations. Lastly, the technique facilitates for companies the preparation for multiple disruptive events with similar consequences. (McManus et al., 2008). Another example of scenario exercise is highlighted by Mitroff and Alpasan (2003), describing how some companies use professionals to stage hypothetical disruptions or assaults on the company. By creating a hypothetical scenario the company is able to identify weaknesses in the security system and, at the same time, test the employees responses. (Mitroff and Alpasan, 2003). One scenario-based tool highlighted by McManus et al. (2008) is the "readiness exercises and disaster simulation" or REDS. This tool provides a platform to assess decision making and communication in a simulated crisis environment giving the organization an insight into their strengths and vulnerabilities. Further the tool can be used to test emergency and business continuity plans during a simulated disruption scenario. (McManus et al., 2008) This increase the *adaptive* capability given that the company is able to improve the decision making and initial communication in a real crisis after these exercises.

Practice exercises

Practice exercises is the second sub-method to simulation and focus on the learning based on repetition. Blackhurst et al. (2011) found that contingency plan practicing has the potential to reduce mistakes. This is confirmed by Coates (2006) who argues that plans are ignored if not practiced and that emergency plans have to be exercised if they are going to be useful. The need to practice emergency processes is further mentioned by Sheffi (2007, p. 278). Sheffi (2007, pp. 129-130) additionally sees the need to routinize tests, exercises and other events designed to practice security processes. The importance of conducting practice exercises is further highlighted by Mitroff and Alpasan (2003) who identifies the need for executives to understand the importance by crisis preparation. They suggest a function, which they call crisis center, with responsibilities including the development of "real crisis capabilities" and the execution of practice exercises. To practice exercises, thus improve the supply chains reaction when a disruption or crisis occurs which improves the *adaptive* capability.

Role-playing

Another strategy to identify and prevent potential threats is to use the knowledge of each actor's employees. Employees know the organization better than anyone, why they are best suited to spot weaknesses, if given the right tools. By using *role-playing*, where middle or top-level executives assume the role of internal assassins or terrorists, they are helped to think beyond rational and moral behavior. Instead, the executives detailed knowledge of company specific information can be used to find weaknesses and plans for how to destroy the company, identification of disruptive scenarios. (Mitroff and Alpasan, 2003). When a new weakness or threat is detected the second step is to gather a team of "counter assassins" with the task to create a system that is able to prevent the threat or fix the weakness. In this way the organization can find and prevent whole categories of threats that otherwise would have been overlooked due to routines and focus on applying the knowledge for benefit of the organization. (Mitroff and Alpasan, 2003)

The role-playing method is normally used on an organizational level. However, due to the fact that actors within a critical infrastructure are deeply dependent on each other and potential threats will affect the whole supply chain, this method should be applied on an interorganizational level in this context. In this context executives from multiple actors in the supply chain should jointly look at where and how an assassin could create a disruption in the chain, and how they jointly could prevent that. When using joint knowledge of employees in multiple companies in the supply chain, new potential threats and weaknesses can be identified and taken care of, improving the *preparedness* of the system and thereby increasing the resilience.

3.4.8| Analyzing Experiences

Analyzing experiences is another widely used learning method with the purpose of learning successful strategies and improving routines to avoid holes and duplication in response effort. Several sub-methods will be presented: *post-disruption analysis, share experiences and lessons learned* as well as *near misses analysis* as presented in Table 3.9.

Table 3.9: Overview of Analyzing Experiences

Learning sub-methods	Learning goals	Learning prerequisites
Post-disruption analysis	Avoid holes and duplication in response efforts	Vertical collaboration committee
Share experiences and lessons learned	Learn successful strategies	Supply chain map
Near misses analysis		Trust

Post-disruption analysis

It is important that the supply chain has structured learning processes to evaluate the lessons learned from incidents, and that the actors based on this develop and implement corrective actions in their operations (Stewart et al., 2009). Analysis should not only be conducted for failures, but clearly also for disruptions that are handled successfully. It will be very helpful to understand the success factors; how and why the incident was handled in such a successful way. Actors that learn from post disruption analysis will generally be better prepared to handle future disruptions in the supply chain (Blackhurst et al., 2011). Some methods to analyze and learn from accidents exist in the literature, such as the STAMP (System Theoretic Accident Model and Processes) approach. It might also be helpful to establish a specific database of incidents to allow for identification of frequent and significant failure patterns in the supply chain (Ouyang, 2013). By analyzing lessons learned after a disruption, companies are able to improve procedures and increase their *preparedness* for similar incidents in the future, strengthening the resilience in the supply chain.

Share experiences and lessons learned

Besides conducting joint post-disruption analyzes, the actors in the supply chain can also share and learn from other vertical and horizontal actors' experiences. To allow for this, it is important to create a trusted network community, where the actors trust each other to share experiences and believe that by sharing lessons learned the crisis management knowledge in the total system will be improved and therefore increase the number of skilled actors involved in solving a crisis (Labak et al., 2015). Learning from other actors' experiences allow the supply chain to be more *prepared*, and resilient, than if each actor only learned from their own incidents.

Near misses analysis

A third sub-method of analyzing experiences is near misses analysis. Sheffi (2007, pp. 41-43) describes how for example the aviation industry has long realized the value of analyzing and learning from a mistake even though it did not cause an accident. They also have an industry central reporting system, where near misses are reported and analyzed. Sheffi (2007, pp. 41-43) further describes how unsafe conditions and insecure processes and practices can cause numerous close-calls or minor incidents and if not addressed, leading to crises and incidents with larger impact. By conducting joint near misses analysis, some larger incidents can thus be prevented. Similar to post-disruption analysis, near misses analysis enables the actors to improve their procedures and be more *prepared*, thus strengthening the resilience in the supply network.

3.4.9| Stimulate Flexibility

To constantly improve and develop the supply chain and its crisis management is the foundation of why all the learning methods are used. A specific learning method, *stimulate flexibility*, is though used to learn how to stimulate an environment where adaptation and development is continuously done in a fast and strategic way. This learning methods is further broken down in two sub-methods: *continuous reorganization* and *continuous improvement of crisis management procedures* as summarized in Table 3.10.

Table 3.10: Overview of Stimulate Flexibility

Learning sub-methods	Learning goals	Learning prerequisite
Continuous reorganization Continuous improvement of crisis management procedures	Avoid holes and duplication in response efforts Learn successful strategies Minimize vulnerability in supply chain	Supply chain map Trust

Continuous reorganization

A sub-method to stimulate flexibility is to continuously work on the flexibility of the supply chain. If constantly making small and fast reorganizations in a supply chain, it will require efficient coordinated actions by many actors, thus developing the system's skills on how to collaborate and make adjustments in the supply chain (Sheffi, 2007, p. 129). Some companies constantly rearrange to make it more difficult for saboteurs as well as to keep their employees alert (Sheffi, 2007, p. 255). It is useful to learn how to quickly redesign the supply chain to reduce the impact of disruptions (Blackhurst et al., 2011). Also, the flexible sensing capabilities that enables actors to identify potential threats and respond fast are useful to avoid disruptions (Stewart et al., 2009). Fostering the right workplace culture has shown to be advantageous for easier adaptation to changes in the operating environment. One such advantageous culture is that both managers and general employees should see crises and changes from a positivistic and opportunistic perspective (McManus et al., 2008). The ability to rapidly rearrange parts of the supply chain improves the ability to *absorb* smaller incidents and prevent a large disruption. If a disruption does occur the flexibility learned from constant reorganization also strengthens the adaptability.

Continuous improvement of crisis management procedures

Beside continuously working on the flexibility of the supply chain, another strategy to stimulate flexibility is to constantly update the crisis management procedures and culture. Working with improving the crisis management procedures, for example constantly updating the preparedness plan, may help to identify, avoid and eliminate inefficiencies in the supply network before a crisis occurs (Scholten et al., 2010). The continuous improvement of procedures improves the ability to respond appropriately to incidents increasing the *absorption* and in extension also the adaptability capacity.

3.4.10| Learning Goals

Learning goals are defined as the desired outcome by using a specific learning method, an outcome that in turn would lead to increased resilience in the supply network. The learning goals found during the literature study of interorganizational learning methods are presented below.

Understand resources in the supply chain

Christopher and Peck (2004) argues that visibility and, as a part of that, the understanding of how inventories are allocated in the supply chain are important features when building a resilient supply chain. This, since visibility in a supply chain, together with a short "end-to-end" production time, enables the development of an ability to respond quickly to unforeseen changes (Christopher and Peck, 2004). Data by Scholten et al. (2014) additionally indicates that to manage the supply chain in an efficient way all actors need access to knowledge and information concerning resources help by other actors. Thus, a clear goal of using interorganizational learning methods is increasing the understanding of resources in the supply chain since it creates visibility and thereby resilience.

Understand interdependencies and dynamics

To be able to increase resilience, each organization in a supply chain must first overcome the limited understanding of their operating environment in which the organization exists. It is necessary to be aware of the entire community of stakeholders, both on a daily basis and in a crisis situation. This includes an understanding of the employees and external actors', expectations, obligations and weaknesses (McManus et al., 2008). The external actors include both actors in the supply chain and competitors within the industry. The fact that operators of an infrastructure system need to have elaborate knowledge of vulnerabilities, risks and their assets positions is further highlighted by Stewart et al. (2009), who also point towards the necessity of collaboration between public and private sector when planning critical infrastructure protection. By understanding the interdependencies between actors and evaluating the potential impact on the entire network, managers in the supply chain are able to quickly evaluate, adapt and evolve their strategies (Stewart et al., 2009). Further, the network perspective enables prioritization of critical nodes in the supply chain which facilitates resilience (Falasca et al., 2008). The goal of several of the described interorganizational learning methods are to achieve this network understanding, since it is a critical step to achieve a resilient supply chain.

Understanding risks and external threats

Another aspect of increasing the operational environment awareness is to understand the hazards and emergencies that could occur in a supply chain or within an industry (McManus et al., 2008). Given the risks, it is thus important to understand the potential consequences that could affect the supply chain or the industry (Stewart et al., 2009). To fully understand the risks, critical vulnerabilities must also be identified to ensure that each actor in the supply chain prioritize their available resources in an optimal way (McManus et al., 2008). Hence, interorganizational learning methods striving to increase the awareness of risks and external threats are important methods to increase resilience in the supply chain.

Enabling high situational awareness in a crisis

The purpose of both the goal to *understand interdependencies and dynamics in the supply chain* and *understanding risks and external threats to the supply chain* is to increase the awareness of their operational environment. This is equally important during crises, why an ability to understand new situations is critical. Resilience can be created in a supply chain by quickly evaluating areas of anticipated weaknesses, finding disruptions in supply and establishing strategies that focus on the actual situation. Immediately after a disruption managers in the supply chain should begin the process of creating situational awareness and when responding to a crisis it is important to assess all potential vulnerabilities given the uniqueness of each event (Stewart et al., 2009). To summarize, interorganizational learning methods that enables high situational awareness in a crisis are important for increasing supply chain resilience

Minimize vulnerability in the supply chain

To successfully manage a crisis, all organizations in a supply chain need to understand that they are not working alone but are part of a network (McManus et al., 2008). Thus, there is an opportunity to proactively create resilience and minimizing vulnerabilities by coordinating the capabilities in the supply chain to manage disaster consequences jointly (Stewart et al., 2009). It is not hard to understand that interorganizational learning methods with the goal of minimizing vulnerabilities in the supply chain are important for achieving resilience.

Avoid holes and duplication in response efforts

As been described by the learning sub-method *coordinated response effort*, duplications in the response effort can have harmful effects on the recovery process and involved actors motivation (Stewart et al., 2009). Stewart et al. (2009) highlights an example where the government, due to lack of coordination, distributed food, water and other commodity supply after a hurricane no more than two blocks away from a grocery store trying to sell the same things in an attempt to rebuild the retail sector in the area. These types of redundancies have considerable negative impact and should be prevented by coordinating actions. An important goal of using interorganizational learning methods is therefore to maximize the utility and value of all available resources in the supply chain to increase resilience.

Learn successful strategies

In order to manage disruptions and crises in the best possible way it is important to learn successful strategies for how to act. As an example, it has been observed that actors that are able learn from disruptions are better prepared for future disruptions (Blackhurst et al., 2011). It has further been shown that in networks of actors where lessons learned have been shared, crisis management knowledge are improved (Labaka, 2015). Sharing best practices between horizontal actors are yet another example of a sub-method to identify successful strategies to improve the crisis management in both the supply chain and in the industry, hence increasing resilience.

3.4.11| Learning Prerequisites

Prerequisites for learning methods is defined as the structures or conditions that needs to be in place to allow the actors to use the corresponding learning methods. The learning prerequisite found during the literature study of interorganizational learning methods will now be presented.

Vertical communication structure

As has been observed in multiple organizations in different industries, to identify and internalize the unexpected indications or disruptions is hard for many organizations since it involves questioning fundamental assumptions regarding possible scenarios and moving information in other channels than the once normally used. To be able to do that, it is important to have extensive communication with other actors in the supply chain and to implement channels for critical information in advance where communication can flow rapidly. (Sheffi, 2017,). To establish robust channels for communication with key stakeholders is further presented as one of the prerequisites for sharing information concerning an incident to enable an effective communication between relevant parties, a shared understanding between impacted actors, and a mutual communication with media (Norris in Stewart et al., 2009). Labaka et al. (2015) underlines this description and describes the information system as a tool that, among multiple functions, facilitates a proper management of incidents. A robust communication structure between actors in a supply chain is thus necessary to enable the described learning methods based on rapid and critical information sharing.

Vertical collaboration committee

Cross-functional risk management teams have the ability to include multiple perspectives and thus, optimize the whole supply chain. This allow cross-functional teams to avoid bottlenecks and sub-optimization of the system, enabling actors in the supply chain to recover more quickly and efficiently after a disruption (Christopher and Peck, 2004). This is also observed in supply chains which span over multiple countries where it is necessary for all actors to collaborate to be effective (Sheffi, 2007, p. 126). In accordance with Christopher and Peck (2004), cross functional management teams should report to the board of directors through a supply chain director and be charge with the task to regularly update risk registers and reports. Given the importance of collaboration between vertical actors in a supply chain a collaboration committee of some sort, is necessary to do numerous of the above described learning methods.

Supply chain management team

To have involvement from senior management is important when conducting inter-organizational learning methods. To be able to build a resilient supply chain, the first step is to enforce a planning team with efficient leadership. This requires support from top management in combination with risk awareness, and without it no method for learning how to build a resilient supply chain can take place (Scholten et al., 2014). These capabilities of knowledge management and risk awareness are also shown to be needed to maintain continuity and control over functions as well as to be able to achieve recovery, in other words the later phases of the resilience concept. As an example, to conduct the "readiness exercises and disaster simulation" (REDS) described by McManus et al. (2008), senior management and decision-making roles

need to be involved to ensure impact. To ensure an up-to-date assessment of supply chain resources, capabilities and possible risks, reviews and routine meetings with the planning team is critical (Scholten et al., 2014). To have a supply management team is thus a prerequisite to be able to involve in numerous learning methods.

Supply chain map
To be able to identify critical disruptions and understand the potential magnitude at an early stage, it is necessary to have the ability to realize the effects a disruption can cause. This is dependent on a deep knowledge of how the supply chain operates (Sheffi, 2007, p. 166). The importance of understanding multiple aspects of both internal and external parts of the supply chain is also stated by McManus et al. (2008). This knowledge can be achieved by constructing a supply chain map. Understanding how the government and relevant businesses operate is furthermore critical for developing working relationships with other actors. Supply chain maps also facilitates resilience by being a tool to balance redundancy with flexibility (Stewart et al., 2009). In conclusion, a supply chain map is an important tool to illustrate the relations between actors and enable resilience improving methods.

Horizontal collaboration committee
To be able to achieve the advantages with horizontal collaboration as described by Scholten et al. (2014) and presented in section 3.4.5, supply chain actors need a communication structure and a collaborative network where expertise knowledge of different actors can be exchanged (Scholten et al., 2014). This requires some sort of collaborative forum where the learning can take place, here called horizontal collaboration committee. This committee can, as an example, take the form of a trade organization. The critical function of the committee is that it enables horizontal actors to exchange information and practices to unify the industry, benchmark and learn from each other (Sheffi, 2007).

Trust
The foundation to be able to vertically and horizontally share information, make joint assessments, collaborative planning, analyzing experiences and simulate adaptive capacity, is to trust the other actors in the supply chain. Trust is critical to be able to learn from another actor and Dodgson, Doz as well as Dyer and Singh in Selnes and Sallis (2003) suggest that when it comes to creating effective and collaborative relationships, trust is the most powerful governance mechanism. Relational trust is defined as "the perceived ability and willingness of the other party to behave in ways that consider the interests of both parties in the relationship" and thus includes the belief that information sharing increases the total size of the pie more than information withholding increases an actor's specific share of the pie (Selnes and Sallis, 2003). According Stewart et al. (2009) the identification of trusted information sources is necessary for actors to develop a shared understanding of an incident as well as to be able to develop relations with media.

Although stressing the importance of trust for interorganizational learning, Selnes and Sallis (2003) also warn companies about the hidden cost of high levels of trust which might moderate the positive effect of interorganizational learning. High levels of trust may lead to systematic

avoidance of negative information, no explicit control mechanism against opportunistic behavior and lost innovativeness due to groupthink, and it is thus important to apply strategies to avoid these hidden costs to maximize the interorganizational learning.

3.5| Description Model

To summarize the theoretical findings, Figure 3.4 shows how the identified interorganizational learning sub-methods influence the different components of resilience. The learning sub-methods are often influencing more than one component of resilience but only the most significant influence is being shown in the figure below.

Preparedness

Information sharing for improving regulations

Joint assessment of current status

Joint risk analysis

Joint forecasting

Horizontal benchmarking

Education in security procedures

Post-disruption analysis

Share experiences

Near misses analysis

Role-playing

Practice exercises

Absorption

Information sharing for resource knowledge

Coordinated prevention of disruptions

Information sharing for industry coordination

Education in SC structure

Continuous reorganization

Continuous improvement of crisis management procedures

Recovering

Coordinated contingency plans

Coordinated response effort

Adaptability

Information sharing for dynamics knowledge

Information sharing for managing a crisis

Coordinated crisis management procedures

Education in appropriate response

Scenario-based learning

Figure 3.4: Description Model for Interorganizational Learning
Methods Influencing the Different Components of Resilience

Further, Figure 3.5 summarizes the *interorganizational learning methods* and their corresponding *learning sub-methods, learning goals* and *learning prerequisites*. The figure thus gives and overview of the complexity of using interorganizational learning for resilience, but also clearly illustrates the connection between the three level of concepts. Several learning prerequisites are needed as a base to use each interorganizational learning methods, and by using interorganizational learning methods the actors can reach several learning goals, contributing to the overall goal of resilience in the critical infrastructure. The figure further reveals that the actors can work with several learning methods to achieve the same learning goals and that there thus is not a need to use all the described methods.

However, the reader should be aware that the exact links between the concepts, i.e., *learning prerequisites, learning methods* and *learning goals*, in Figure 3.5 are not confirmed by theory, and thus need further research before stated explicitly.
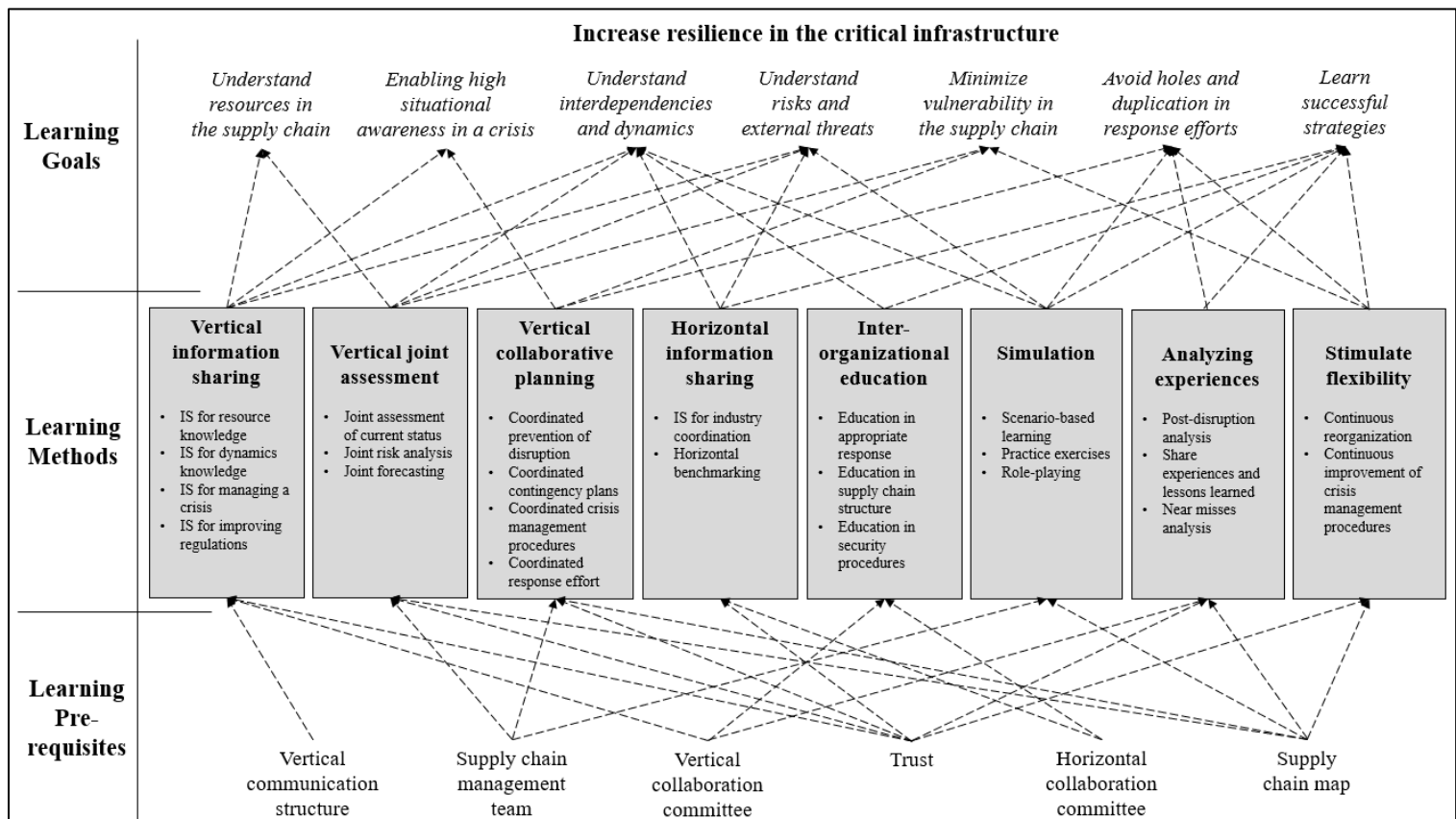
Figure 3.5: Description Model for Interorganizational Learning Methods
and their Connections to Learning Prerequisites and Learning Goals.

4| SPSC Structure

This chapter contains the strategic mapping of the SPSC, based on the contextual study, contextual interview and refinement during the case interviews. Three key processes in the SPSC are presented; the material flow, the legal frames and the collaborations.

4.1| Basic Components of the SPSC Structure

Based on laws, public enquiries and previous studies of the SPSC in combination with a contextual interview with practitioners in the SPSC, three key processes showing how the SPSC is structured under normal circumstances and in a crisis have been mapped. As previously described, these three key processes are material flow, legal frames, and collaboration. The maps have further been confirmed and refined during the conducted case interviews.

Actors and processes of similarities have been grouped and simplified to enable the mapping. Abbreviations have been assigned to all central organizations and functions as presented in Table 4.1 respectively Table 4.2.

Table 4.1: Abbreviations for Organizations in SPSC

Abbrev.	Swedish name	English name
R	Riksdag	The Swedish Parliament
SD	Socialdepartementet	Ministry of Health and Social Affairs
SoS	Socialstyrelsen	National Board of Health and Welfare
LV	Läkemedelsverket	Swedish Medical Products Agency
TLV	Tandvårds- och Läkemedelsförmånsverket	Dental and Pharmaceuticals Benefits Agency
eHM	E-hälsomyndigheten	Swedish eHealth Agency
FHM	Folkhälsomyndigheten	Public Health Agency of Sweden
SBU	Statens Beredning för Medicinsk och Social Utvärdering	Swedish Agency for Health Technology Assessment and Assessment of Social Services
IVO	Inspektionen för Vård och Omsorg	Health and Social Care Inspectorate
SKL	Sveriges Kommuner och Landsting	Swedish Association of Local Authorities and Regions
LIF	Läkemedelsindustriföreningen	Association of the Pharmaceuticals Industry

FGL	Föreningen för Generiska Läkemedel och Biosimilarer	Association for Generic Pharmaceuticals and Biosimilars in Sweden
LH	Läkemedelshandlarna	Swedish Association of Pharma Traders
LDF	Läkemedelsdistributörsföreningen	Association of the Pharmaceuticals Distributors
SAF	Sveriges Apoteksförening	Swedish Pharmacy Association
SF	Sveriges Farmaceuter	Swedish Pharmacists Association
AS	Apotekarsocieteten	Swedish Pharmaceutical Society
VF	Vårdförbundet	Swedish Association of Health Professionals
FS	Funktionsrätt Sverige	Swedish Disability Rights Federation
SLF	Sveriges Läkarförbund	Swedish Medical Association

Table 4.2: Abbreviations for Functions in SPSC

Abbrev.	Swedish name	English name
RMM	Råvarutillverkare	Raw Material Manufacturer
PP	Läkemedelstillverkare	Pharmaceuticals Producer
D	Partihandlare	Distributor
E-Ph	Extemporeapotek	Extemporaneous Pharmacy
H-Ph	Sjuhusapotek	Hospital Pharmacy
PC	Apoteksentreprenör	Pharmacy Contractor
O-Ph	Öppenvårdsapotek	Outpatient Pharmacy
DD-Ph	Dosapotek	Dose Dispensing Pharmacy
D-Ph	Distans- och Internetapotek	Distance- and e-Pharmacy
Re	Detaljhandlare	Retailer
H	Sjukhus	Hospital
LC	Hemvård	Lodging Care
PrC	Primärvård	Primary Care
CC	Landsting	County Council
M	Kommun	Municipality
P	Patient	Patient

The functions in Table 4.2 does not necessarily represent a single organization. For some of them, for example the hospital pharmacies, the function can be jointly performed by for example pharmacy contractors, distributors and county councils (Brammersjö, 2018). Likewise, outpatient pharmacies sometimes have the distributing role for pharmaceuticals, which is the case for most of the nonprescription pharmaceuticals and the parallel traded pharmaceuticals (Bostöm, 2018). However, the functions in Table 4.2. represent the functions or actors that need to exist in the SPSC material flow and that have legal and contractual requirements surrounding them. Between the different functions in SPSC, transportation of the pharmaceuticals needs to take place, which may be performed by the either the supplier or the receiver, or a third actor. Transportation is though not studied further throughout the study. It is further worth highlighting that until the regulatory changes of the SPSC in 2009, it was a monopoly market with only one distributor, one actor doing extemporaneous pharmaceuticals and one pharmacy actor managing both the inpatient and outpatient care (Kjörling, 2018).

The presented abbreviations recur throughout the next sections. In all sections, a map of the key process will be presented, followed by a description of the involved actors and their specific roles under normal circumstances as well as in a crisis.

4.2| Material Flow

4.2.1| Map of Material Flow in SPSC

The overall material flow in the SPSC is presented in Figure 4.1. In large, pharmaceuticals basic components are extracted at raw material manufacturers (RMM), distributed to pharmaceutical producers (PP) where defined and approved pharmaceuticals are produced. These pharmaceuticals are distributed via distributors (D) to the Swedish market, either to the inpatient or the outpatient care[6]. Some pharmaceuticals are also produced at extemporaneous pharmacies (E-Ph). The inpatient care distribution is done via hospital pharmacies (H-Ph) to hospitals (H) and lodging cares (LC) where the pharmaceuticals is given to a patient (P). In the outpatient care, pharmaceuticals are distributed to patients via different types of pharmacies; outpatient pharmacies (O-Ph), dose dispensing pharmacies (DD-Ph), distance- and e-pharmacies (D-Ph) and other retailers (Re). Regarding the primary care (PrC), some vaccines can be accessed directly via the distributor and other types of pharmaceuticals are distributed via the hospital pharmacies. The National Board of Health and Welfare (SoS) and the Public Health Agency of Sweden (FHM) are responsible for keeping small safety stocks of certain pharmaceuticals.

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[6] As illustrated by the two grey ellipses in Figure 4.1.
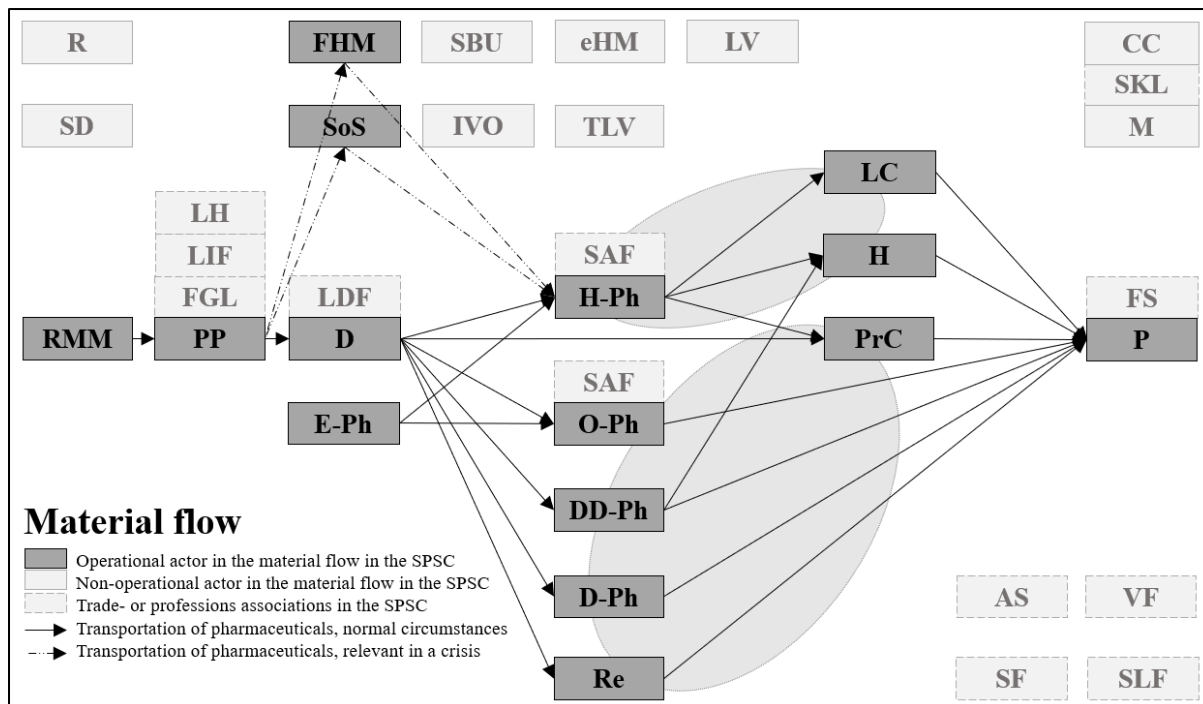
Figure 4.1: Material Flow in SPSC

The actors involved in the material flow[7] in the SPSC will now further be described in terms of their specific roles under normal circumstances as well as in a crisis.

4.2.2| Production and Distribution

Raw Material Manufacturer (RMM)
- ○ *Normal circumstances:* In Sweden, about 15 manufacturers produce chemical raw materials for pharmaceuticals. However, most pharmaceuticals produced in Sweden and pharmaceuticals produced globally for the Swedish market, is dependent on raw material from other countries. The global manufacturing of raw material is concentrated to a few large manufacturers, primarily located in China and Asia (Reiman-Suijerbuijk, 2017).
- ○ *Crisis:* No difference from normal circumstances.

Pharmaceuticals Producer (PP)
- ○ *Normal circumstances:* Most pharmaceuticals for the Swedish market is produced outside Sweden and the lead time from production to final use by patient can be long (Reiman-Suijerbuijk, 2017). According to practitioners, the production plan is often decided and hard to change 3-4 months before planned distribution (*Head of Regulatory Affairs and Product Quality at a global pharmaceuticals producing company*, 2018). A few large manufacturers have part of their production in Sweden, for example AstraZeneca and Pfizer (Reiman-Suijerbuijk, 2017). No vaccines are produced in

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[7] As illustrated by the darker grey rectangles in Figure 4.1

Sweden (MSB, 2016B, p. 15). Pharmaceutical producers licensed by any country in the European Economic Area (EEA) can sell and distribute their pharmaceuticals to all countries within EEA (Läkemedelsverket, 2015) as further explained in the following chapter about legal requirements.

○ *Crisis:* No difference from normal circumstances.

Distributors (D)

○ *Normal circumstances:* The distribution between pharmaceuticals procedures and all the downstream steps in the Swedish supply chain, is almost exclusively done by two large distributors (Reiman-Suijerbuijk, 2017; Whiss and Hendeby, 2018). Both of these distributors are globally owned (Brammersjö, 2018). Moreover, every single pharmaceuticals is only stocked and distributed by one of the wholesalers (Reiman-Suijerbuijk, 2017; Brammersjö, 2018). Because of the oligopoly situation where the distributors are closely tied to the pharmaceuticals producers, the outpatient pharmacies have little influence over their distribution situation. The pharmaceuticals producers for original as well as generic pharmaceuticals show little interest in other distribution solutions than via the two large distributors (Sveriges Apoteksförening, 2018; Boström, 2018). The distribution in Sweden is based on fast and continuous deliverance on small batches from central stocks in line with the *Just In Time* (JIT) philosophy (Reiman-Suijerbuijk, 2017). From a logistics perspective, the Nordics is almost seen as one country when it comes to pharmaceuticals. This means that there are large warehouses storing pharmaceuticals for all the Nordic countries, often located either in Gothenburg or Copenhagen (Brammersjö, 2018).

○ *Crisis:* No difference from normal circumstances.

Extemporaneous Pharmacy (E-Ph)

○ *Normal circumstances:* Extemporaneous pharmacies produce customized pharmaceuticals, often cytostatics or antibiotics, for both inpatient and outpatient care (Sveriges Apoteksförening, 2018). The word extemporaneous pharmaceuticals refers to three categories of pharmaceuticals; *individual extemporaneous* which are produced for a specific patient, *stock preparations* which are standardized extemporaneous pharmaceuticals that are not available on the market and *national licensed pharmaceuticals* which is stock preparations produced in more than 1 000 packages a year. Reasons for prescribing extemporaneous pharmaceutics may be that the pharmaceuticals have a very short durability, is not available in the right dose and form or contain some substance that a patient is allergic to (APL, n.d.).

○ *Crisis*: No difference from normal circumstances.

In Sweden there are two main channels for providing the end customer or patient with pharmaceuticals, the *inpatient care* and the *outpatient care*. Inpatient care refers to treatments at hospitals and other forms of institutional care, here called lodging care, where the patient is given pharmaceuticals on set (Riksrevisionen, 2018). This channel is governed by the county councils, even though they are not always involved in the physical flow of the medicines.

Instead, hospital pharmacies, often managed by pharmacy contactors, physically supply the pharmaceuticals for the inpatient care (Whiss and Hendeby, 2018).

Outpatient care, the other main channel for providing patients with pharmaceuticals, is non-institutional care where the patient is provided with pharmaceuticals prescribed by a doctor as well as non-prescriptive pharmaceuticals (Riksrevisionen, 2018). The main form of outpatient care is given via outpatient pharmacies, where patients can collect both prescribed and non-prescription pharmaceuticals. The patient can also get some pharmaceuticals via distance and internet pharmacies as well as retailers for non-prescriptive pharmaceuticals. Further, special dose dispensing pharmacies repack and distribute pharmaceuticals in personal doses for patients having this prescribed service (Sveriges Apoteksförening, 2018). Lastly, patients are given for example vaccines via some form of primary care facility.

These two main channels will be further described in the following sections.

4.2.3| Inpatient Care

Hospital Pharmacies (H-Ph)
- ○ *Normal circumstances:* Every hospital and other healthcare service need to have a hospital pharmacy responsible for the pharmaceuticals distribution to and within the hospital. This is a function, not an activity tied to a specific room (SOU, 2013, p. 88; Whiss and Hendeby, 2018). Before the deregulation of the pharmacy market in 2009, Apoteket AB operated all hospital pharmacies in the country. After the deregulation, the county councils needed to purchase this function and ended up with different kinds of solutions. In some cases, the county council operates the hospital pharmacies and in other cases the function is fully or partly performed by a pharmacy contractor (Whiss and Hendeby, 2018). Further, some pharmacy contractors have placed their stocks in distributors' distribution centrals, hence involving the distributors in the hospital pharmacy function as well (Brammersjö, 2018). There are currently three pharmacy contractors on the Swedish market performing part of or the hole hospital pharmacy function, of which two have almost the entire market (Kjörling, 2018). The trend is that more and more county councils decide to perform the function partly or fully in-house (Whiss and Hendeby, 2018).
- ○ *Crisis:* No difference from normal circumstances.

Hospitals (H)
- ○ *Normal circumstances:* Patients get pharmaceuticals in hospitals according to prescription made by a doctor, or for some pharmaceuticals, nurses or midwives (Läkemedelsverket, 2018H).
- ○ *Crisis:* No difference from normal circumstances.

Lodging Care (LC)

- ○ *Normal circumstances:* Lodging care refers to retirement homes, some home care and daycare which often is under the municipality's responsibility, but is included in county councils purchasing contracts. A stock of pharmaceuticals can be set up at a municipality's retirement home after decision from the associated county council (SOU, 2013, p. 88; Whiss and Hendeby, 2018).
- ○ *Crisis:* No difference from normal circumstances.

4.2.4| Outpatient Care

Primary Care (PrC)

- ○ *Normal circumstances:* Primary care refers to all sort of basic medical treatment, medical care, preventative care and rehabilitative care that do not need a hospital's medical and technical resources and expertise (SFS 2017:30, 2 kap 6 §). Vaccines are a part of the primary care, and some vaccines can be ordered directly from the distributor by the healthcare providers while other types of vaccines are distributed via the hospital pharmacies (Gårdmark Östh, 2018).
- ○ *Crisis:* No difference from normal circumstances.

Outpatient Pharmacies (O-Ph)

- ○ *Normal circumstances:* Pharmaceuticals prescribed by a doctor as well as non-prescription pharmaceuticals can be bought at pharmacies (SOU, 2013, p. 90). Since the deregulation of the pharmacy market in 2009, several actors exist in the market, where the five largest actors in the market operated 97% of the 1 412 outpatient pharmacies in December 2017. A patient in Sweden today can get around 15 000 different pharmaceuticals prescribed by a doctor, of which 3 000 - 4 000 are continuously stocked at an outpatient pharmacy of normal size. These standard pharmaceuticals make up the vast majority of all sales and only a few boxes of the more specialized pharmaceuticals are sold in Sweden every month, why they normally are not stocked at all pharmacies (Sveriges Apoteksförening, 2018).
- ○ *Crisis:* No difference from normal circumstances.

Dose Dispensing Pharmacy (DD-Ph)

- ○ *Normal circumstances:* Dose dispensing pharmacies is a special form of outpatient pharmacy that repack and distribute pharmaceuticals in personal doses. This service is often prescribed for older patients to make it easier for them to continuously take several different pharmaceuticals. Around 190 000 patients have dose dispensed pharmaceuticals prescribed in Sweden. This service is purchased by the county councils and primary distributed in the outpatient care, even though some dose dispensed pharmaceuticals are also produced for the inpatient care. By December 2017, three dose dispensing pharmacies with one facility each was present in the Swedish market (Sveriges Apoteksförening, 2018).
- ○ *Crisis:* No difference from normal circumstances.

Distance and e-Pharmacy (D-Ph)
- ○ *Normal circumstances:* Distance and e-pharmacy refers to pharmacy units with a retail permission issued by LV and a full pharmacy assortment of prescriptive pharmaceuticals, but that cannot be physically visited by a patient. In December 2017, there were nine distance and e-pharmacies in the market. The e-sales for pharmaceuticals is increasing fast and by January 2018, sales via distance and e-pharmacies made up 8% of the total revenue and 11% of the total volume of pharmaceuticals in the outpatient care (Sveriges Apoteksförening, 2018).
- ○ *Crisis:* No difference from normal circumstances.

Retailers (Re)
- ○ *Normal circumstances:* Selected non-prescription pharmaceuticals can be bought via some retailers, for example grocery stores and gas stations.
- ○ *Crisis:* No difference from normal circumstances.

4.2.5| Crisis Preparedness

National Board of Health and Welfare (SoS)
- ○ *Normal circumstances:* Not involved in the material flow
- ○ *Crisis:* SoS is responsible for a security stock with rarely used antidotes, antidotes for chemical, biological, radiological and nuclear (CBRN) accidents and infusion solutions, that can be used by the county councils. The security stock for rarely used antidotes and selected vaccines is kept in Stockholm and antidotes for CBRN accidents in Malmö, Gothenburg and Stockholm. These stocks are accessed via Apoteket AB. Infusion solutions for large-scale and serious scenarios are accessed after decision from the National Board of Health and Welfare. All costs associated with using the stock is paid for by the county councils (Socialstyrelsen, 2016). However, this security stock is considered to be very small according to practitioners in the SPSC (Whiss and Hendeby, 2018). SoS is further responsible for monitoring the stock levels of two selected vaccines at the distributors (Socialstyrelsen, 2016).

Public Health Agency of Sweden (FHM)
- ○ *Normal circumstances:* Not involved in the material flow
- ○ *Crisis:* FHM is responsible for security stocks for pandemics and disease control. Currently, antiviral pharmaceuticals and antibiotics for an influenza pandemic as well as antibiotics for a large-scale contagious disease is security stocked. In September 2015, three types of antiviral pharmaceuticals in totally 2.4 million boxes were kept in a security stock. It is though doubtful whether this information is updated or not, since undated information on FHM's webpage states that only two types of antivirals and around 2 million boxes are kept in the security stock (Folhälsomyndigheten, n.d.). This security stock is, however, accessed after decision from FHM. For antibiotics, FHM have contracts for disposal with three pharmaceuticals producers, and when needed get to buy pharmaceuticals from their stock. In September 2015, nearly 150 000 boxes with

eight different antibiotics in different strengths was reserved for FHM. This reserved stock of antibiotics can also be made available for the distributors in the normal pharmaceuticals supply chain in case of rapidly increasing demand. All costs associated with using the mentioned stocks of antivirals and antibiotics is paid for by the county councils (Folkhälsomyndigheten, 2015).

Beside this, no officially known other security stocks are currently kept in Sweden (Reiman-Suijkerbuijk, 2017; Folkhälsomyndigheten, 2015). Neither FHM or SoS has the responsibility to stock other pharmaceuticals than what have been presented above and FHM stresses that county councils should overlook their contingency planning for pharmaceuticals where a disruption in the supply fast could lead to serious problems. The county councils are encouraged to be prepared to handle local increased demand and local decreased supply for pharmaceuticals (Folkhälsomyndigheten, 2015). However, the county councils believe that it is difficult to know exactly how to prepare and thus request more guidelines and precise requirements from the authorities (Whiss and Hendeby, 2018).

One challenge with the material flow in the SPSC is that both private and public actors in the supply chain focus on streamlining their processes and minimizing their stocks, in line with principles like *lean* and JIT which influence the supply chain resilience and ability to tackle disruptions (MSB, 2017, p. 4; Whiss and Hendeby, 2018; Reiman-Suijerbuijk, 2017). Both wholesalers, pharmacies and hospitals are constantly reducing their stocks according to MSB (2016B, p. 15). However, several practitioners are worried about the more or less non-existing pharmaceuticals stock in the SPSC. Two practitioners in the SPSC explain that a heavy snowfall or a terrorist attack is enough to cause serious problems for the pharmaceuticals flow in the SPSC (Whiss and Hendeby, 2018). Several actors in the SPSC stress that there is an escalating problem with back-ordered pharmaceuticals (e.g., Whiss and Hendeby, 2018; Kjörling, 2018; Vondracek 2018).

4.2.6| Data about the Material Flow in the SPSC

To further deepen the knowledge about the material flow and the involved actors in the SPSC, some logistics data have been summarized below in Table 4.3. The data provided is not meant to be used for statistical purposes as it is collected from different sources and rounded of, but it is meant to give the reader a rough overview of the proportions in the SPSC.

Table 4.3: Detailed Material Flow in SPSC

Ab.	Nbr of actors	Product flow	Revenue
D	2 large D companies in Sweden in Nov 2018[8, a]	Ca. 1 M boxes a day are sent from the Ds. The Ds have ca. 2-3 weeks of the total Swedish demand in stock[9, b]	
E-Ph	17 E-Ph locations in Sweden in Dec 2017[a]	0.6 M expedited prescriptions during 2017[c]	0.6 Bkr in 2017[c]
H-Ph	2 large PCs performing H-Ph functions in Sweden in 2018. 40 registered H-Ph functions in Sweden in Dec 2017[a]		8.4 Bkr in 2017[c]
O-Ph	5 large O-Ph companies in Sweden in Dec 2017[a]. Ca. 1 400 O-Ph locations in Sweden in Dec 2017[10, a]	79 M expedited prescriptions during 2017[d]. 95,6% service level on prescriptions[11, a] Daily deliveries from the distributors[b]	29.1 Bkr on prescriptions in 2017[c]
DD-Ph	3 DD-Ph companies having one location each in Sweden in Dec 2017[12, a]		1.3 Bkr in 2017[c]
D-Ph	9 D-Ph companies in Sweden in Dec 2017[a]		

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[8] Two actors have 90% of the Swedish market, Tamro (55%) and Oriola (35%) (Brammersjö, 2018)

[9] This number is true for Tamro, that have 2-3 weeks stock of the total Swedish demand divided at three distributions centres in Sweden as follows, Stockholm (55%), Göteborg (35%) and Umeå (10%). (Brammersjö, 2018). No information is given for Oriola.

[10] Five actors operate 97% of the outpatient pharmacies, Apoteket AB (28%), Apoteket Hjärtat (27%), Kronans Apotek (23%), Apoteksgruppen (13%) and Lloyds Apotek (6%) (Sverige Apoteksförening, 2018).

[11] Service level of pharmaceuticals is here defined as the number of patients that get their prescribed pharmaceuticals at the first visit at an outpatient pharmacy (Sverige Apoteksförening, 2018).

[12] The three dose dispensing companies are Apoteket, Svensk Dos and Apotekstjänst (Boström, 2018)

[a] (Sverige Apoteksförening, 2018)
[b] (Brammersjö, 2018)
[c] (eHälsomyndigheten, 2018)

4.3| Legal Frames

4.3.1| Map of Legal Frames in SPSC

The overall legal frames in the SPSC are presented in Figure 4.2 and Table 4.4 below. In large, the Swedish Medical Products Agency (LV) issues authorizations and permissions for marketing, distribution, extemporaneous production, dose dispensing, wholesaling and retail to the actors in the SPSC. LV further performs supervision over all actors with an issued authorization[13], IVO performs supervision for the healthcare actors[14] and TLV performs supervision for pharmaceuticals sold within the Swedish pharmaceuticals benefits system[15].

In addition to the laws and regulations specified in Table 4.4, some actors in the SPSC have contracts with each other. The county councils (CC) have contracts with some pharmaceuticals producers (PP), with extemporaneous pharmacies (E-Ph), with dose dispensing pharmacies (DD-Ph) and often with a pharmacy contractor running their hospital pharmacies (H-Ph). The pharmaceuticals supply to hospitals (H), lodging cares (LC) and primary cares (PrC) in a country are included in the county council's above-mentioned contracts[16]. Further, the pharmaceutical producers have contracts with a distributor (D) in Sweden. All mentioned authorities respond to the Ministry of Health and Social Affairs (SD)[17] and their work is governed by decisions and laws regulated by the Swedish Parliament (R).
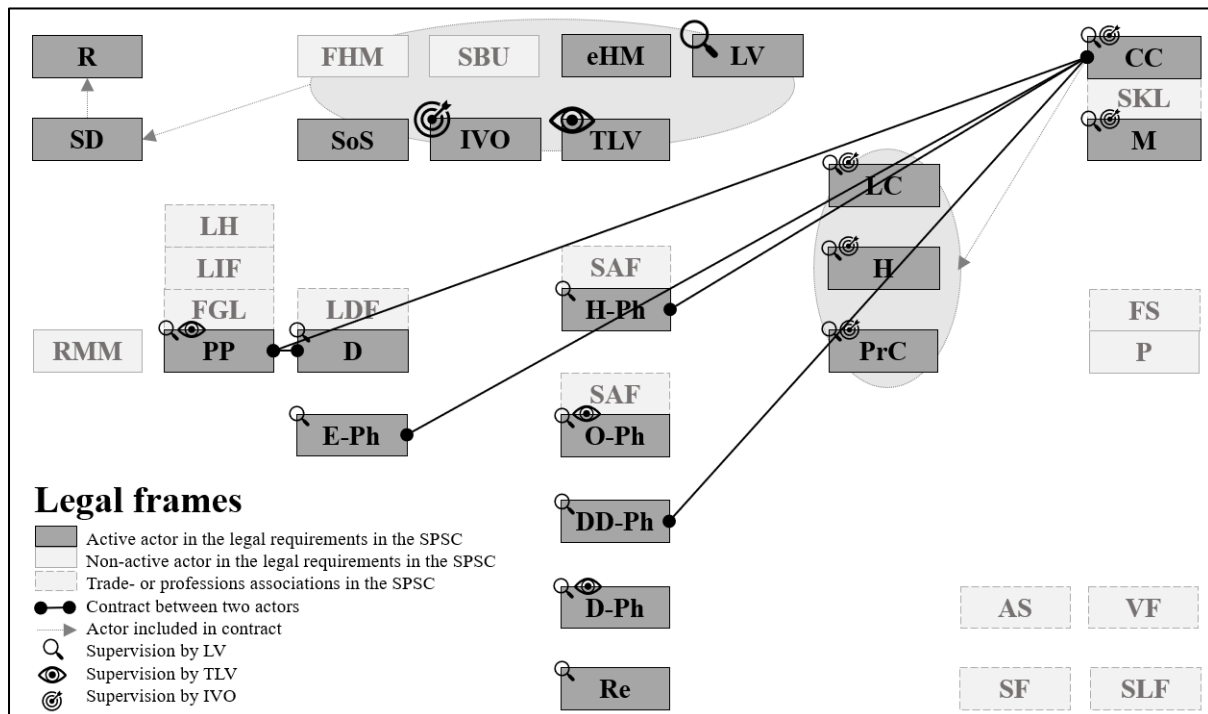
Figure 4.2: Legal Frames in SPSC

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[13] As illustrated by the small loups in Figure 4.2
14 As illustrated by the small scoreboards in Figure 4.2
15 As illustrated by the small eyes in Figure 4.2.
16 As illustrated by one of the grey ellipses in Figure 4.2.
17 As illustrated by the other grey ellipses in Figure 4.2.

As seen in Table 4.4, there are several specific laws and regulations affecting the availability of pharmaceuticals in the SPSC, both under normal circumstances and in a crisis. The most important and influential laws and regulations for different actors in the supply chain will be further presented later in the text.

Table 4.4: Laws and Regulations in the SPSC

Nbr	Swedish name	English translation	Actors normal circumstances	Actors crisis
		Laws		
1996:1156 (2018:1212)	Lag om receptregister (Lag om nationell läkemedelslista)	The Prescription Registration Act (The National Pharmaceuticals List Act)	eHM	-
2006:544	Lag om Kommuners och Landstings Åtgärder inför och vid Extraordinära Händelser i Fredstid och Höjd Beredskap	The Act about Municipalities' and County Councils' Preparation for and Management during Crises and State of Alert	-	CC, M
2009:366	Lag om Handel med Läkemedel	The Medicinal Products Trading Act	D, H-Ph, O-Ph, DD-Ph, CC, H, D-Ph, R	CC, H
2015:315	Läkemedelslagen	The Medicinal Product Act	PP, E-Ph, LV	-
2017:30	Hälso- och Sjukvårdslag	Health and Medical Services Act	CC, M, *Health Care Providers*	CC
		Regulations		
2007:1205	Förordning med Instruktion för Läkemedelsverket	Regulation with Instructions for the Swedish Medical Products Agency	LV	-
2009:659	Förordning om Handel med Läkemedel	Regulations for Medicinal Products Trading	D, O-Ph	-
2013:176	Förordning med Instruktion för Inspektionen för Vård och Omsorg	Regulation with Instructions for the Health and Social Care Inspectorate	IVO	IVO
2015:155	Förordning om Statlig Styrning med Kunskap avseende Hälso- och Sjukvård och Socialtjänst	Regulations about National Knowledge Management concerning Healthcare and Social Services.	SoS, eHM, FHM, IVO, LV, SBU, TLV, some CC, some M	-
2015:284	Förordning med Instruktion för Socialstyrelsen	Regulations with Instructions for the National Board of Health and Welfare	-	SoS
2017:1206	Förordning med Instruktion för Tandvårds- och läkemedelsförmånsverket	Regulations with Instructions for the Dental and Pharmaceuticals Benefits Agency	TLV	-

Directions				
2012:8	Läkemedelsverkets Föreskrifter om Sjukhusens Läkemedelsförsörjning	The Medical Products Agency's Directions for Hopital's Pharmaceuticals Supply	CC, H	-
2014:8	Läkemedelsverkets Föreskrifter om Partihandel med Läkemedel	The Medical Products Agency's Directions for Wholesaling with Pharmaceuticals	D	-

4.3.2| Basic Legal Concepts

As can be understood from the previous sections, the pharmaceuticals market is heavily regulated. Before explaining further how the laws and regulations affect the actors in the SPSC, some basic regulatory and legal concept of the pharmaceuticals market will be explained that will be used further throughout the text.

- *Original pharmaceuticals* are pharmaceuticals that a pharmaceuticals producer invent, that gets approved in the market and that the company grants a patent for (TLV, 2018B).
- *Generic pharmaceuticals* are pharmaceuticals that contain the same active substance as an original pharmaceutical with an expired patent, and thus have the same effect as the original pharmaceutical (TLV, 2018B).
- *Parallel imports* of pharmaceuticals mean that an actor import original or generic pharmaceuticals from another country in Europe where the price of the pharmaceuticals is lower, repack it in a Swedish box and then promote and sell the pharmaceutical in the Swedish market after approval from LV. The system is based on free trade within ESS (Sveriges Apoteksförening, 2018). Similarly, *parallel export* is when an actor buys pharmaceuticals in Sweden and sell it in another European country.
- A *healthcare provider* is a physical or juridical person that professionally manage or provide healthcare services to patients (SFS 2009:366 1 kap 4 §). This includes both public and private actors and the healthcare provider may for example be a governmental agency, a county council, a municipality, a hospital or a primary care facility (Socialstyrelsen, 2017). Several healthcare providers can be present in a county council's or municipality's geographical area of responsibility (SFS 2017:30, 2 kap. 2 §)

4.3.2| Basic Principles for Crisis Preparedness

Three fundamental principles govern the system for crisis preparedness in Sweden. The *principle of responsibility* means that whoever is responsible for an activity under normal circumstances also has the corresponding responsibility during a crisis. Moreover, the actors have a responsibility to cooperate with and support each other. *The principle of proximity* means that crises should be handled by the closest possible actor, organizationally as well as geographically. Lastly, *the principle of equality* means that involved actors should not make more changes in the organization than deemed necessary in the specific crisis and that they should strive to maintain ordinary operations as far as possible (MSB, 2009). These principles guide and govern all actors involved in the public crisis preparedness system in Sweden and thus influence the SPSC. However, since these principles are not specified in any law or regulation, they are not mandatory for private actors in the SPSC. Since large parts of the SPSC is made up of private actors, these principles do not have a strong governing effect on the SPSC in practice (Riksrevisionen, 2018, pp. 18-19).

Moreover, there are no overall law or and regulation specifying the requirements on private actors in a crisis (Riksrevisionen, 2018, p. 25). Only during state of alert, is it specified that companies with "specific agreements or obligations" to maintain their operation in war, should take necessary actions in terms of planning and preparation. (SFS 1992:1403) As this thesis focus on crises not caused by war, these regulations do not apply to the situation.

The main actors[18] with regards to the legal frame for pharmaceuticals supply in the SPSC will now further be described in terms of their specific roles under normal circumstances as well as in a crisis.

4.3.4| Government Agencies

Swedish Medical Products Agency (LV)
  ○ *Normal circumstances:* Every pharmaceutical to be sold in Sweden needs to get a marketing authorization issued by LV, who also decide whether the pharmaceutical will be classified as prescriptive or non-prescriptive (SFS 2015:315, 4 kap. 20 §). Further, LV decide whether the pharmaceutical is considered to be exchangeable or not (SFS 2015:315, 4 kap. 22 §). Besides marketing authorizations, LV further issue authorizations for extemporaneous pharmacies, dose dispensing pharmacies, wholesaling and retail. LV should further perform supervision on pharmaceuticals and compliance with laws and regulations (SFS 2009:366, 7 kap. 1 § and SFS 2007:1205, 1 §). LV thus have contact with actors throughout the whole SPSC and have the right to get information, documents and access that enables supervision (SFS 2009:366, 7 kap. 2§; SFS 2015:315, 14 kap. 2 §). All actors authorized by LV are also required to report to LV if they plan to make major changes. LV should further work for collaboration between actors in the pharmaceuticals value chain (SFS 2007:1205, 2 §).

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[18] As illustrated by the darker grey rectangles in Figure 4.2

For the county councils, LV's supervisions are done continuously every third year (Whiss and Hendeby, 2018). However, LV is not specifically responsible for supervising that pharmaceuticals are available in sufficient quantities (Riksrevisionen, 2018, p. 54).

○ *Crisis:* LV are required to support SoS and FHM in their contingency planning with regards to pharmaceuticals (SFS 2007:1205, 2 §), but have no other specific responsibilities with regards to pharmaceuticals availability in a crisis. Backorder situations may develop into shortages and crises if not handled by the actors in the SPSC. For every backorder situation, LV gives an advice about the most appropriate action to take in the specific case. The advice may be to make a generic interchange, to change the dose, formulation or active substance of the prescribed pharmaceutical, to apply for an exemption for foreign packages or apply for licenses for specific patients (Läkemedelsverket, 2018B).

Dental and Pharmaceuticals Benefits Agency (TLV)

○ *Normal circumstances:* TLV should contribute to appropriate and cost-effective use of pharmaceuticals as well as good availability of pharmaceuticals in Sweden. Moreover, they should contribute to a well-functioning pharmacy market (SFS 2007:1206, 1 §). TLV decides what prescription pharmaceuticals that are included in the Swedish pharmaceuticals benefits system and thus is subsidized in accordance with the Swedish high-cost protection of pharmaceuticals (SFS 2007:1206, 1a §). This is done after an application from the pharmaceuticals producers. For the pharmaceuticals included in the Swedish pharmaceuticals benefits system, TLV also sets the product price (TLV, 2017). The pharmacies gross margin for these prescriptive pharmaceuticals are further decided by TLV, in other words they decide the difference between the sale and the cost prices for the pharmacies. This gross marginal should compensate the pharmacies for, e.g., their cost associated with handling prescribed pharmaceuticals and their cost of keeping pharmaceuticals stocks (Sveriges Apoteksförening, 2018). Another way to ensure cost-effective use of pharmaceuticals in Sweden, is that TLV regularly decide *the products of the period*[19]. These are the generics pharmaceuticals, within each interchangeable pharmaceutical category as specified by LV, that have the lowest price and can be offered to the whole Swedish market during the specified period. Every month, the winning pharmaceutical in each category is offered to the customers in all outpatient pharmacies in the country (TLV, 2018C). This process is done for around 1 300 pharmaceuticals exchange groups every month. If an outpatient pharmacy runs out of products from the specified assortment, they are not allowed to sell another pharmaceutical from the exchange group to the patient as long as the product of the period is available to order from the distributor (Sveriges Apoteksförening, 2018).

○ *Crisis:* TLV has no specific responsibilities with regards to pharmaceuticals availability in a crisis.

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[19] Translated from "periodens varor"

National Board of Health and Welfare (SoS)
- ○ *Normal circumstances:* SoS has no specific responsibilities with regards to pharmaceuticals availability under normal circumstances.
- ○ *Crisis:* SoS is responsible for ensuring that expertise with regards to disaster medicine and emergency preparedness is developed and spread. They can finance external activities contributing to this purpose (SFS 2015:284, 8 §). SoS should participate in crisis preparedness and total defence and on behalf of the government, they should coordinate and monitor the preparations with regards to pharmaceuticals supply to ensure emergency preparedness (SFS 2015:284, 9 §).

Health and Social Care Inspectorate (IVO)
- ○ *Normal circumstances:* IVO should perform supervision to ensure that population get high qualitative healthcare in line with existing laws and regulations (SFS 2013:176, 2 §). IVO often make supervisions after actors signalizing that there has been an incident associated to their operations, for example a healthcare related accident. These types of incidents may be linked to pharmaceuticals supply, but in most cases, they are not (Whiss and Hendeby, 2018).
- ○ *Crisis:* County councils and municipalities are responsible for giving good healthcare under normal circumstances as well as in a crisis, a responsibility that includes ensuring a sufficient supply of pharmaceuticals. Thus, IVO should perform supervisions both under normal circumstances and in a crisis (Riksrevisionen, 2018, p. 54).

Swedish eHealth Agency (eHM)
- ○ *Normal circumstances:* eHM is allowed to keep a register of prescriptions of pharmaceuticals to patients and use it to, e.g., manage expeditions of pharmaceuticals, overlook the pharmaceuticals benefits system, invoice county councils and make statistical analyzes. EHM is further required to distribute some information to other actors in the SPSC, e.g., prescribing doctors, county councils, SoS, IVO, TLV and LV (SFS 1996:1156, 6 §). Likewise, operational actors in the SPSC are required to send some data to eHM. The exact requirements on eHM will change in 2020 as the National Pharmaceuticals List will be implemented in accordance with a new law; SFS 2018:1212. The purpose with the change is to provide national and equal information about a patient's prescribed and expedited pharmaceuticals to the healthcare providers, pharmacies and patients.
- ○ *Crisis:* eHM has no specific responsibilities with regards to pharmaceuticals availability in a crisis.

4.3.5| Trade Actors

Pharmaceuticals Producer (PP)
○ *Normal circumstances:* Every pharmaceutical to be sold in Sweden needs to have a marketing authorization issued by LV. If a pharmaceutical has been given a marketing authorization in another country in EES, the pharmaceutical should be authorized for the Swedish market by LV as well (SFS 2015:315, 4 kap. 6 §). With such a marketing authorization, the pharmaceutical can be sold in the Swedish market the same way as pharmaceuticals where Sweden has been the reference country for the marketing authorization (SFS 2015:315, 4 kap. 8 §). Pharmaceuticals producers should inform LV at least two months before they stop selling and distributing a pharmaceutical approved for the Swedish market, regardless of if it is temporarily or permanently (SFS 2015:315, 4 kap. 18 §). Moreover, a producer should immediately inform TLV if they cannot supply a product of the period in sufficient quantities during a price period (TLVFS 2009:4, 13 §). County councils normally sign contracts with some pharmaceutical producers for specific pharmaceuticals used in the inpatient care, often pharmaceuticals with a large total cost due to large volumes or high prices. These contracts specify the price and allocated quantity for the county council (Whiss and Hendeby, 2018). The contracts usually include penalties if specified quantity is not delivered in accordance with agreement. However, the penalties are relatively low compared to other countries (Kjörling, 2018).
○ *Crisis:* Pharmaceuticals producers have no specific responsibilities with regards to pharmaceuticals availability in a crisis.

Extemporaneous Pharmacy (E-Ph)
○ *Normal circumstances:* All extemporaneous pharmacy need to have a production permission issued by LV (SFS 2015:315, 8 kap. 2 §)
○ *Crisis:* Extemporaneous pharmacies have no specific responsibilities with regards to pharmaceuticals availability in a crisis. However, LV can issue licenses for extemporaneous production as a strategy to manage demand increases due to crises or shortages in pharmaceuticals.

Distributor (D)
○ *Normal circumstances:* All distributors need to have a wholesale permission alternatively a marketing authorization issued by LV to operate in the Swedish market (SFS 2009:366 3 kap 1 §). The distributors are required to deliver pharmaceuticals included in the wholesale permission to all outpatient pharmacies in the market as fast as possible when requested (SFS 2009:366 3 kap 3 §). Since 2018, pharmaceuticals distributors are responsible for delivering pharmaceuticals ordered before 4.00 p.m. on a weekday to the ordering outpatient pharmacy before 4.00 p.m. the next coming weekday (SFS 2009:659, 10 §). Before the change in 2018, the outpatient pharmacies and not the distributors were responsible for ensuring this "24-hours rule" (Sveriges Apoteksförening 2018, p. 30). This responsibility though only applies to

pharmaceuticals normally available at the distributor, not when it is shortage at the producer or if it is a rarely used pharmaceutical. Moreover, the distributors should ensure sufficient and continuous deliveries to their own warehouses to minimize the risks for pharmaceuticals shortages (LVFS 2014:8, 16 §). The distributors are further required to handle and repay returns of pharmaceuticals from outpatient pharmacies under certain conditions (SFS 2009:366 3b kap 1 §). Normally, there are no direct contracts between the distributors and the actors in the downstream material flow (Whiss and Hendeby, 2018; Brammersjö, 2018). Instead, the pharmaceuticals producers are seen as the main customers for the distributors (Brammersjö, 2018). The distributors may, however, be indirectly connected to the hospital pharmacies, since there often is a chain of contract from distributors, via pharmaceuticals producers and county councils, to the pharmacy contractors that operate the hospital pharmacies in many counties (Whiss and Hendeby, 2018), as seen in Figure 4.2. When it comes to the outpatient pharmacies, the distributors are required to make daily deliveries to every single pharmacy with a retail permission in Sweden, why there is no need for individualized contract between the distributors and the pharmacies (Brammersjö, 2018).

○ *Crisis:* The distributors have no specific responsibilities with regards to pharmaceuticals availability in a crisis.

Outpatient Pharmacies (O-Ph)

○ *Normal circumstances:* All outpatient pharmacies need to have a retail permission issued by LV to operate (SFS 2009:366 2 kap. 1 §). The purpose of the outpatient pharmacies is to contribute to a good and safe pharmaceuticals usage for patients, by providing prescribed pharmaceuticals to customers as fast as possible, providing individualized information and inform about the generic interchange (SFS 2009:366 2 kap 3 §). All outpatient pharmacies should have a Medical Products Manager that is required to report to LV if serious shortages or serious deviations happens or risk to happen (SFS 2009:366 2 kap 6 §). Every outpatient pharmacy should be able to provide all prescribed pharmaceuticals and pharmaceuticals specified in SFS 2002:160 to customers as fast as possible when requested (SFS 2009:366, 2 kap. 6 §). When a non-available pharmaceutical has been requested by a customer, the pharmacy or retailer should inform the patient about other outpatient pharmacies where the pharmaceuticals can be found (SFS 2009:366 2 kap 3 §) as well as order it from a distributor before 4.00 p.m. the same day (SFS 2009:659, 9 §). Outpatient pharmacies have the right to return and be repaid for prescribed pharmaceuticals that are saleable and do not require cool storage if they, e.g., have made an large ordering mistake, if the patient have not collected an expensive pharmaceuticals within 25 working days or if the expiry day has passed and the outpatient pharmacy follows the routine of selling the oldest product first (SFS 2009:366; 3b kap. 2 §). It is not allowed to transfer pharmaceuticals between different pharmacies except if there is an emergency demands, a rule which limits the outpatient pharmacies possibility to collaborate in case of local backorder situations (Sveriges Apoteksförening, 2018). The outpatient pharmacies sometimes have the role of distributing pharmaceuticals from a central stock to their outpatient pharmacies, e.g.,

for non-prescription pharmaceuticals and parallel imported pharmaceuticals, and are then required to have a wholesale permission (Boström, 2018).

○ *Crisis:* There are no specific requirements on pharmacies to supply or prepare for supply of pharmaceuticals in a crisis (Riksrevisionen, 2018, p. 52). Before the deregulation of the pharmacy market in 2009, Apoteket AB had specified in its contract with the government to ensure satisfactory pharmaceuticals supply in Sweden both under normal circumstances, in a crisis and in war. This responsibility has not been assigned any of the other actors after the deregulation of the market (Riksrevisionen, 2018, pp. 46-47; Whiss and Hendeby, 2018). The outpatient pharmacies though try to build up a flexibility to secure pharmaceuticals supply in normal circumstances as well as in a crisis, by having contracts for parallel imported pharmaceuticals from several different distributors, as is possible under the current laws and regulations (Boström, 2018).

Dose Dispensing Pharmacy (DD-Ph)
○ *Normal circumstances:* All dose dispensing pharmacies need to have a dose dispensing permission issued by LV to operate (SFS 2009:366, 6 kap. 1 §). Every county council contract a dose dispensing pharmacy to supply patients with this prescribed service within their regional area of responsibility (Boström, 2018).
○ *Crisis:* The dose dispensing pharmacies have no specific responsibilities with regards to pharmaceuticals availability in a crisis.

Distance- and e-Pharmacies (D-Ph)
○ *Normal circumstances:* All distance- and e-Pharmacies need to have a retail permission issued by LV to operate (SFS 2009:366, 2 kap. 1 §)
○ *Crisis:* The distance- and e-pharmacies have no specific responsibilities with regards to pharmaceuticals availability in a crisis.

Other retailers (Re)
○ *Normal circumstances:* All other retailers need to have a retail permission issued by LV to operate (SFS 2009:366, 2 kap. 1 §)
○ *Crisis:* The retailers have no specific responsibilities with regards to pharmaceuticals availability in a crisis (Riksrevisionen, 2018, p. 52).

Hospital Pharmacies (H-Ph)
○ *Normal circumstances*: Both actors with a wholesale permission and a retail permission are allowed to sell and distribute pharmaceuticals to the inpatient care, the primary care and personal with authority to prescribe pharmaceuticals (SFS 2009:366 4 kap 1 §).
○ *Crisis:* The hospital pharmacies have no specific responsibilities with regards to pharmaceuticals availability in a crisis according to laws and regulations. When the hospital pharmacy function is performed by a pharmacy contractor, it is often not specified in the contracts what responsibilities the pharmacy contactor has in a crisis or with regards to, e.g., safety stocks. However, since it is contractually agreed that the pharmacy contractor should supply the healthcare services in the county council with

sufficient pharmaceuticals within a certain time frame, it can be said that the pharmaceuticals contractor have this responsibility both in normal circumstances and during a crisis (Whiss and Hendeby, 2018). Additionally, it is often contractually specified that the pharmacy contractor should present their contingency plan to the county council (Whiss and Hendeby, 2018).

4.3.6| Actors under the County Council's Contracts

The county councils are responsible for purchasing pharmaceuticals for the institutional care in their respectively geographical areas. This refers primarily to the care given at hospitals, where these so-called requisition pharmaceuticals are requisitioned by the hospitals to treat individual patients (SOU, 2013, p. 88). The county councils further pay for the pharmaceuticals provided in lodging cares in the county's municipalities (SFS 2017:30, 12 kap. 4 §; Whiss and Hendeby, 2018).

All healthcare providers are responsible for organizing their activities and functions in a way that ensures that the requirements for satisfactory healthcare are met (SFS 2017:30, 5 kap. 1 §). Healthcare does in this law refer to all actions to medically prevent, investigate and treat diseases and injuries (SFS 2017:30, 2 kap. 1 §). In addition to the responsibilities as healthcare providers, the county councils and municipalities have additional responsibilities, as being responsible for the healthcare within their specific geographical areas.

County Councils (CC)
- ○ *Normal circumstances:* The county councils are responsible for organizing the healthcare in a way that ensures that the requirements for satisfactory healthcare are met within their geographical areas of responsibility (SFS 2017:30, 8 kap. 1 §). The county councils are responsible for organizing the institutional care at hospitals in the geographical area. As healthcare providers, the county councils together with the hospitals are further required to organize the pharmaceuticals supply to and within the hospitals in a rational way that ensures the availability of safe and effective pharmaceuticals. It is also a requirement that there is a pharmaceuticals pharmacy connected to each hospital with at least one present pharmacist at any time (2009:366, 5 kap. 1§). As healthcare providers, the county council and hospitals within its geographical area need to report to LV how the pharmaceuticals supply to and within the hospitals will be organized (2009:366, 5 kap. 2 §).
- ○ *Crisis:* The county councils should plan the healthcare within their geographical areas so that they have a medical crisis preparedness (SFS 2017:30, 7 kap. 2 §). County councils are required to conduct a risk analysis to analyze how their activities and organizations might be affected by societal crises, as well as develop a contingency plan and take actions to reduce vulnerability in its organizations and activities (SFS 2006:544, 2 kap. 1 §). Relevant authorities should be informed about the taken preventative actions and in a crisis continuously be given information about the current status, planned and taken actions (SFS 2006:544, 2 kap. 9 §). The county councils are further required to have a crisis management committee leading the work in a crisis

(SFS 2006:544, 2 kap. 2 §). County councils and hospitals are also required to inform LV if pharmaceuticals shortage or other serious deficiencies in the pharmaceuticals supply to and within hospitals happens or risk to happen (SFS 2009:366, 5 kap. 3 §). However, reports show that there is a lacking overall picture of how to practically ensure sufficient availability of pharmaceuticals in a crisis in the different county councils (see for example MSB, 2016B, p. 15). On request, the county councils are allowed to help each other to manage a crisis (SFS 2006:544, 4 kap. 1 §).

Municipalities (M)
- *Normal circumstances:* The municipalities are responsible for organizing the primary care and the lodging care in a way that ensures that the requirements for satisfactory healthcare are met within their geographical areas of responsibility (SFS 2017:30, 12 kap. 1 §).
- *Crisis:* Municipalities, just as the county councils, are required to conduct a risk analysis to analyze how their activities and organizations might be affected by societal crises, as well as develop a contingency plan and take actions to reduce vulnerability in its organizations and activities (SFS 2006:544, 2 kap. 1 §). Authorities should be informed about the taken preventative actions and in a crisis continuously be given information about the current status as well as planned and taken actions (SFS 2006:544, 2 kap. 9 §). Additionally, municipalities are required to have a crisis management committee leading the work (SFS 2006:544, 2 kap. 2 §). The municipalities have a geographical responsibility regarding coordination and collaboration between different actors, both in the preparation for and in the handling of a crisis (SFS 2006:544, 2 kap. 7 §). On request, the municipalities are allowed to help each other to manage a crisis (SFS 2006:544, 4 kap. 1 §).

4.4| Collaboration

4.4.1| Map of Collaboration in SPSC

An overview of the interorganizational collaboration links in the SPSC is seen in Figure 4.3. below. The Figure presents the main collaborative links as presented by the interviewed actors in the thesis. The interviewed actors represent functions in the SPSC as illustrated by the darker grey rectangles in Figure 4.3.

From an overall perspective, a lot of the interorganizational collaboration in the SPSC is done between relevant authorities and relevant trade- and professions associations represented in the National Pharmaceuticals Strategy (NLS) which forms a natural collaborative forum. Naturally, there is also a close collaboration between the trade- and professions associations and their members. The county councils (CC) have close collaboration with their specific hospital pharmacy (H-Ph) and extemporaneous pharmacy (E-Ph), and the pharmaceuticals producers (PP) and the distributors (D) further have a very strong collaborative relationship.
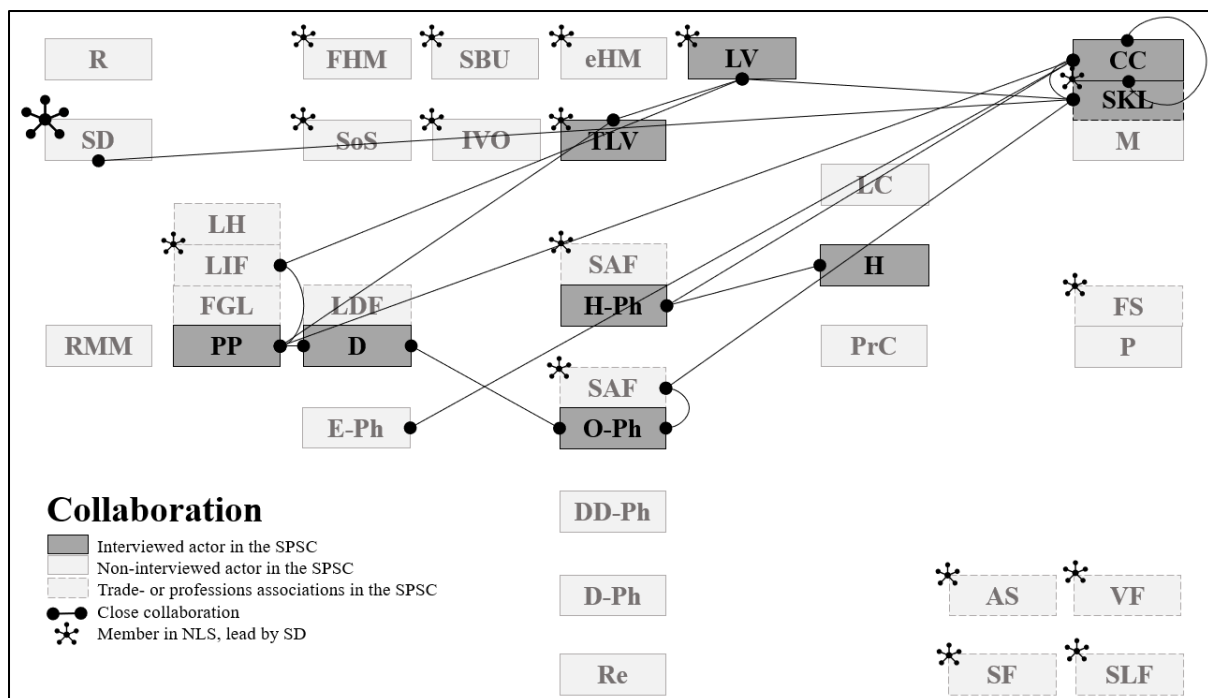
Figure 4.3: Collaboration in SPSC

As chapter 5 will thoroughly describe the collaboration and interorganizational learning between the actors in the SPSC in details, this section will focus on the overall existing collaborative forum rather than specific actors. However, the chapter will start with a short introduction to the trade- and professions associations in SPSC that have not yet been introduced.

4.4.2| Trade- and Professions Associations

Swedish Association of Local Authorities and Regions (SKL)

SKL is an employers' organization as well as an advocating and representing organization for all local governments in Sweden. All regions, county councils and municipalities are members of SKL. The organization's mission is to provide its members with improved conditions for self-government on a local and regional level (SKL, 2018). As a part of this, SKL is additionally part of different networks concerning specific pharmaceutical issues together with all county councils, e.g., pharmaceuticals supply (Eklund and Ax, 2018).

Association of the Pharmaceutical Industry (LIF)

LIF is the trade association for researched-based pharmaceuticals producers in the Swedish market, representing 90 companies that together produce around 80% of the pharmaceuticals sold in Sweden. LIF represents its members in industry wide questions and have a lot of external contact, as well as informs its members of relevant trends and regulations (LIF, n.d.A).

Association for Generic Pharmaceuticals and Biosimilars in Sweden (FGL)

FGL is a trade association representing the generic and biosimilar industry and working to sustain and develop the Swedish system for generic and biosimilar medicines. FGL represent its 20 members in dialogue with governmental agencies and other actors in the healthcare sector (FGL, n.d.).

Swedish Association of Pharma Traders (LH)

LH is a trade association representing companies doing parallel import in Sweden. Their goal is to work for optimal conditions for parallel import of pharmaceuticals to the Swedish market, enabling cost-efficient and reliable pharmaceuticals supply (Läkemedelshandlarna, n.d.).

Association of the Pharmaceuticals Distributors (LDF)

LDF is a trade association consisting of the two large distributors in Sweden. The association often represents the distributors in governmental investigations and in joint attempts to influence regulations or actors in the SPSC (Brammersjö, 2018).

Swedish Pharmacy Association (SAF)

SAF is a trade association representing different types of pharmacies, outpatient pharmacies, distance pharmacies as well as pharmacy contractors, in the Swedish market. Its nine member-organizations operates almost 100% of the outpatient pharmacies in Sweden. SAF represents the pharmacy industry towards other actors in the SPSC and further owns a service company providing its members with legal and strategic consulting (Sveriges Apoteksförening, 2018).

Swedish Pharmaceutical Society (AS)

AS is a society for professionals working within the field of pharmaceuticals, and its members are individuals with professions like chemists, engineers, physicians, pharmacists, nurses and prescriptionists. The aim of the organization is to support research and innovation in

pharmaceuticals and healthcare and promote high professional standard throughout the whole SPSC (Apotekarsocieteten, n.d.).

Swedish Pharmacists Association (SF)
VF is the trade union and professions association for pharmacists and prescriptionists. Its main objective is to support its members and strengthen the terms of the professions (Sveriges Farmaceuter, n.d.).

Swedish Association of Health Professionals (VF)
VF is the trade union and professions association for nurses, midwives, biomedical scientists and radiographers and its main objective is to develop and strengthen these four professions as well as influence the development of healthcare (Vårdförbundet, n.d.).

Swedish Medical Association (SLF)
SLF is the trade union and professions association for doctors and the organization strives to work with questions relevant to individual doctors as well as tries to influence the overall development of healthcare in Sweden (Sveriges Läkarförbund, n.d.).

4.4.3| The National Pharmaceuticals Strategy
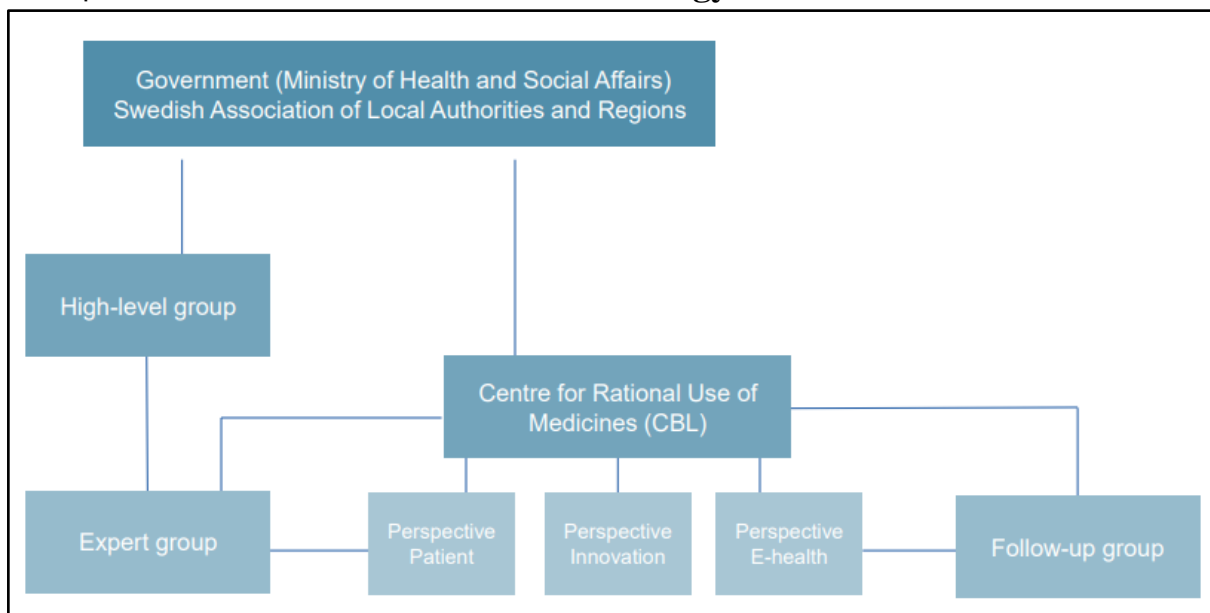
Figure 4.4: Organization Chart, National Pharmaceuticals Strategy
(from Läkemedelsverket, 2018D)

Since 2009, NLS has been used as a collaborative forum for pharmaceuticals questions for actors in the SPSC. The three goals of NLS are to ensure sufficient and safe use of pharmaceuticals, available pharmaceuticals and equal use as well as socio-economically and environmentally sustainable pharmaceuticals use (Läkemedelsverket, 2018C). The structure of NLS is illustrated in Figure 4.4 and further described below.

High-level group

The work of NLS is led by a high-level group that every year decide on an updated course of action for NLS, based on external analyzes conducted by different expert groups in NLS. The high-level group also prioritize what collaborations that needs to take place between authorities and other actors in the SPSC. The group meets twice a year or more often if required and is led by the state secretary of SD. The following organizations have one member each representing them in the high-level group: SD, SKL, SoS, eHM, FHM, LV, IVO, SBU, TLV, LIF, SAF, FS, AS, VF, SF and SLF (Läkemedelsverket, 2018B).

Centre for Rational Use of Medicines

To follow up and coordinate the work with the NLS, a specific Centre for Rational Use of Medicines (CBL) have been created. CBL leads the follow-up group, help with the coordination of the implementation of NLS's action plan and communicate the work of NLS to society and the industry. CBL continuously report to LV and should further give SD a yearly report of the current status of the work in NLS (Läkemedelsverket, 2018G).

Expert group

All organizations represented in the high-level group get to nominate one person to represent their organization in the expert group of NLS. Thus, the same organizations are represented in the expert group as the high-level group, namely: SD, SKL, SoS, eHM, FHM, LV, IVO, SBU, TLV, LIF, SAF, FS, AS, VF, SF and SLF. CBL also participates in the work. The expert group prepare a yearly external analysis about the SPSC and prepare material for the high-level meetings. The expert group is further responsible for continuously working with the strategy and activities of NLS and also to have continuous dialogue and collaboration around pressing areas in the SPSC. The work in the expert group is led by SD (Läkemedelsverket, 2018A).

Perspective groups

Three additional expert groups are part of NLS, called the perspective groups for patient, innovation respectively e-health. For these three perspectives, there are certain questions and challenges that need to be handled in collaboration with other strategies and projects outside NLS. The perspective groups are hence meant to bridge and fuse the work in NLS with other external strategies. The perspective groups prepare yearly external analysis for the high-level group. Some of the previously mentioned actors are part of the perspective groups, but the groups also include a larger range of interdisciplinary organizations (Läkemedelsverket, 2018E).

Follow-up group

The follow-up group is responsible for describing how NLS contributes to the stated goals and strategy. The follow-up group analyzes the conducted activities within NLS and the current development of the SPSC and assess whether NLS have contributed to the development. The follow-up group is further responsible for enabling and developing the cooperation among government bodies and organizations in the SPSC. The following organizations are represented in the follow-up group: SoS, FHM, LV, SBU, TLV, LIF, SAF and SLF (Läkemedelsverket, 2018G).

NLS functions as an umbrella, discussing and prioritizing different initiatives brought up by the involved actors. However, NLS has no funding to distribute and can therefore not assign actors to investigate the prioritized issues. Instead, the actors conducting the investigations have to apply for funding elsewhere. Often the involved governmental agencies decide to do the investigations and it then falls under their ordinary assignments. The agency conducting the investigation, then applies for funding from the SD or include it in an existing budget. An issue prioritized by the networks high level group is, however, considered easier to get funding for (Boström, 2018).

4.4.4| Other Swedish Pharmaceuticals Collaboration Forums

In addition to NLS, there are many broader networks partly covering questions related to pharmaceuticals supply as well as groups focusing on very specific areas within the SPSC. In these, different combinations of the actors in the SPSC participate. Given the large numbers of official and non-official collaboration forums, only the networks mentioned by the interviewed actors will be presented below. This is deemed to be sufficient for the purpose for this thesis and also highlights which collaboration forums that the actors believe enables interorganizational learning for resilience in regard to pharmaceuticals supply. However, important to highlight is that only a limited number of actors in the SPSC have been interviewed and thus, if more actors had been asked, other forums would probably have been mentioned as well.

RSK

The Council of Knowledge Management[20] (RSK) consists of a group of governmental agencies within the healthcare and social service sectors. The group is led by the state secretary of SoS and the following governmental agencies have their state secretaries representing them in RSK, SoS, eHM, FHM, IVO, LV, SBU, TLV, the Research council for Health, Working Life and Welfare (FORTE) and the Agency for Participation (MFD). The purpose of RSK is to support the county council and municipalities as well as other actors in the healthcare and social service sectors with their operations and strategy, and further ensure that this support is coordinated, efficient and customized to what is requested by the actors. To ensure this, a specific council with members from the county councils and municipalities is connected to RSK, informing them about what is needed from the view of the profession. RSK is further responsible to collaborate with other public and private actors, not directly included in RSK (SFS 2015:155).

SKL's and the county councils' pharmaceuticals supply network

SKL and the county councils have a specific network for pharmaceuticals supply (Winner, 2018; Vondracek, 2018; Eklund and Ax, 2018). This network was originally started in 2011 by the county councils, but SKL has also been involved since a few years back. Current issues with regards to pharmaceuticals supply are discussed by a leading committee that gets together three to four times per year. Once a year, the leading committee assembles the whole network with representatives involved in supply questions from all county councils and SKL and have

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[20] Translated from "Rådet för styrning med kunskap"

seminar days discussing experiences, best practices and knowledge concerning pharmaceutical supply (Winner, 2018).

SNÄL

SoS's network for Pharmaceuticals Issues in case of Crisis or State of Alert[21] (SNÄL) is a network with the purpose to present a forum for information exchange and knowledge transfer within the topic. LV, FHM, MSB, the Armed Forces, the National Veterinary Institute, the National Food Agency, the Board of Agriculture and representatives from some CCs are members in the network led by SoS (Riksrevisionen, 2018).

ARI

The Group for Complaints and Withdrawals[22] (ARI) was founded in 1978 by LIF to ensure a high security concerning pharmaceuticals. The purpose of the forum is to enable the actors to work with common and safe routines in regard to complaints and withdrawals. Today, the task force consists of representatives from the researching pharmaceuticals producers, the generic pharmaceuticals producers, the parallel importers, the pharmacies, the retailers, the distributors as well as LV (LIF, n.d B).

4.4.5| International Collaboration Forums

Some of the actors in the SPSC are additionally part of international collaboration forums with corresponding functions in other countries in either the Nordics or Europe. The focus of this thesis is the SPSC, why international collaboration forums are outside the scope. Therefore, even if many pharmaceuticals producers and distributors are global companies and most of the pharmaceuticals are produced outside Sweden, collaboration on a Nordic and European level will not be described in further detail and only briefly discussed in chapter 5.

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[21] Translated from "Socialstyrelsens nätverk för läkemedelsfrågor vid kris eller höjd beredskap"
[22] Translated from "Arbetsgruppen för Reklamationer och Indragningar"

5| Interorganizational Learning in SPSC

This chapter contains the empirical findings regarding interorganizational learning in the SPSC. The empirical findings presented are based on 12 conducted case interviews.

5.1| Overview of Interorganizational Learning in SPSC

In the following section, the findings from the case interviews will be presented. The actors in Table 2.2. have been asked if and how they work with the methods of interorganizational learning for resilience presented in chapter 3.4. The interviews were conducted in accordance with the guide in Appendix B.

A summary of the interorganizational learning methods used by each interviewed actor in any of its collaborative relationship is seen in Table 5.1. The findings from each conducted interview will further be presented in summarizing tables in the next coming sections. For further details and explanations of the information provided in the summarizing tables, the reader is referred to Appendix C.

Table 5.1: Overview of Interorganizational Learning in SPSC

Learning methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Vertical information sharing	X	X	X	X	X	X	X	X	X	X	X
Vertical joint assessment		X	X	X	X		X	X			
Vertical collaborative planning	X	X	X	X	X		X	X	X	X	X
Horizontal information sharing	X	X	X	X	X	X	X	X	X	X	X
Interorganizational education	X	X	X	X		X				X	
Simulation	X	X		X			X				
Analyzing experiences	X	X	X	X	X	X	X	X			X
Stimulate flexibility				X	X		X	X	X	X	

5.2| Pharmaceuticals Producer

All information in chapter 5.2 was received during a conducted interview with the *Head of Regulatory Affairs and Product Quality at a global pharmaceuticals producing company* (2018).

Representing organization:	The interview was conducted with an *anonymous global pharmaceuticals producing company* present in the Swedish market, mainly selling pharmaceuticals to the inpatient care.
Representing interviewee:	Representing them was an *anonymous interviewee*, being Head of Regulatory Affairs and Product Quality at the pharmaceuticals producer's Swedish subsidiary and further responsible for the company's Swedish marketing authorization.

Large pharmaceuticals producers often have local subsidiaries with knowledge about the national market, including national laws and regulations. These subsidiaries handle all contact with the national market. This is the case with the interviewed pharmaceuticals producer, who have a global producing company and multiple local subsidiaries. The interviewee represents the Swedish subsidiary who is responsible for the contact with the Swedish pharmaceutical market and thus signs contracts and is involved in national collaborations on the behalf of the pharmaceuticals producer. To simplify, the Swedish subsidiary will be seen as a representative for the entire pharmaceuticals producer and will be referred to as *the pharmaceuticals producer* in the text below if not a distinction between the global producer and the subsidiary has been done.

An overview of the pharmaceutical producer's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.1 and a summary of the pharmaceuticals producer's used interorganizational learning methods in these relationships can be seen in Table 5.2.

Figure 5.1: Collaborative and Learning Relationships, Pharmaceuticals Producer

Table 5.2: Summary of Interorganizational Learning, Pharmaceuticals Producer

Learning method used by PP	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Distributor (D) County councils (CCs) LV TLV	PP has daily information sharing w/ their D through a warehouse mgmt. system about inventory levels and positions of PP's pharmaceuticals. PP further has to manually approve all pharmaceuticals taken into Sweden. PP has contact w/ CC in connection to potential procurements and contract signing for certain pharmaceuticals for the inpatient care. PP share information w/ CC regarding upcoming new pharmaceuticals and changes to prepare the CCs in advance. PP has regular contact w/ TLV concerning price negotiations of pharmaceuticals. PP has contact with LV though LIF concerning regulations and PP's opinion about their practical application. Crisis communication is conducted w/ LV when a large disruption happens at PP.	Information sharing for resource knowledge Information sharing for dynamics knowledge Information sharing for managing a crisis Information sharing for improving regulations	Understand resources in the supply chain Understand interdependencies and dynamics Understanding risks and external threats Enabling high situational awareness in a crisis	
Vertical joint assessment	*Learning method not used*				Risk analysis and forecasts are only done internally. D can though be asked to share their internal risk analyzes w/ PP during a supervision so that PP can secure that they are satisfactory.
Vertical collaborative planning	LV Distributor (D)	PP has developed a crisis communication structure w/ LV to enable fast contact w/ the right people. The PP visits the D to perform inspections, i.e., control inventory, crisis management procedures and contingency plans.	Coordinated crisis management procedures Coordinated response effort Coordinated contingency plans	Enabling high situational awareness in a crisis	Contingency plans are only done internally.

Horizontal information sharing	LIF	Contact w/ other PPs through LIF where industry wide issues and solutions are discussed, e.g., coordination of reclamation and withdrawals systems, routines for 2D codes. Joint comment letters to governmental agencies through LIF.	Information sharing for industry coordination	Understand interdependencies and dynamics Learn successful strategies	PP is represented by LIF in NLS. By having discussions w/ other PPs in LIF forums, enforcement of competition act is ensured by, e.g., having a LIF lawyer present.
Inter-organizational education	Distributor (D)	PP participate in information days held by the D two times per year. One-time educations about upcoming changes in the SPSC are sometimes held by, e.g., LV, inviting all interested actors.	Education in appropriate response Education in supply chain structure	Understand interdependencies and dynamics Learn successful strategies	
Simulation	Distributor (D)	Simulation of crises and practicing of safety routines are regularly conducted internally at PP, the exercises sometimes include information exchange w/ D, that, however, is not aware that it is a simulation until afterwards.	Practice exercises	Understand interdependencies and dynamics Avoid holes and duplication in response efforts	D is not involved in the planning or aware of the simulation in advance.
Analyzing experiences	Distributor (D)	PP may require D to perform and share an incident analysis w/ corrective and preventive actions after incidents linked to the PP.	Post-disruption analysis	Learn successful strategies	Experience analysis is not conducted w/ D, only shared by D. Extensive analysis of incidents and disruptions is done internally by PP, however, not shared w/ other actors. Does not analyze near misses and success factors.
Stimulate flexibility		*Learning method not used*			PP tries to increase flexibility in the ordering process in SPSC by internally allowing for more regular deliveries w/ smaller volumes. Electronic instead of physical leaflets are believed to increase flexibility in SPSC which PP tries to convince LV via LIF. Parallel distribution causes large volatility in demand which is problematic for PP. Product of the period system causes volatility in sales for the generics producing PPs.

5.3| Distributor

All information in chapter 5.3 was received during a conducted interview with Brammersjö (2018).

Representing organization: The interview was conducted with Tamro, that is the largest pharmaceuticals distributor in the SPSC.

Representing interviewee: Representing them was Mikael Brammersjö, Supply Chain Management Director at Tamro. Brammersjö is part of the Swedish management team and is responsible for all areas concerning the product flow.

An overview of the distributor's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.2 and a summary of the distributor's used interorganizational learning methods in these relationships can be seen in Table 5.3.
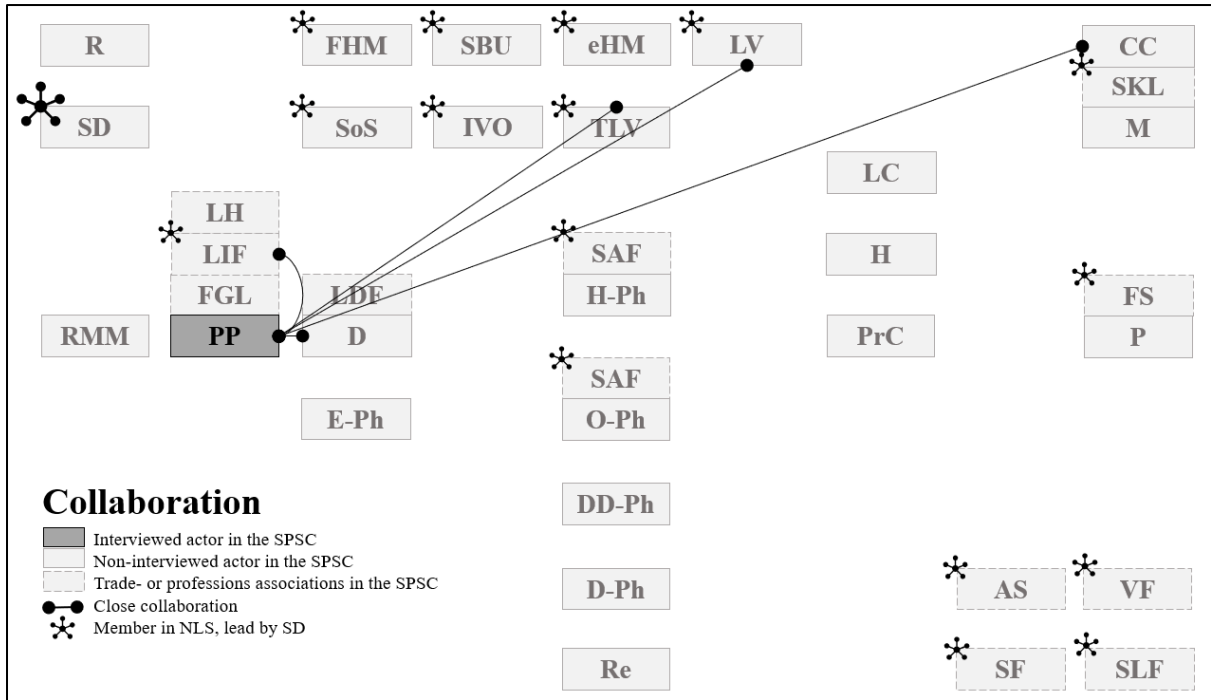

Figure 5.2: Collaborative and Learning Relationships, Distributor

Table 5.3: Summary of Interorganizational Learning, Distributor

Learning method used by D	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Pharma-ceuticals producers (PPs) Outpatient pharmacies (O-Phs) Pharmacy contractors (PCs) TLV LV eHM	D has distribution contacts w/ 150 PPs for pharmaceuticals to the Swedish market. With these actors, D shares or sells, e.g., sales statistics and logistics analyzes. D shares basic information w/ PCs and O-Phs about availability and delivery times of pharmaceuticals. Intense information sharing from D to PCs and O-Phs during disruptions. D has regular contact w/ PPs concerning suspected cases of intended parallel export, though sharing abnormalities in ordering data from PCs and O-PHs. TLV shares price information of pharmaceuticals w/ D, who base their invoices on this. D has regular contact w/ LV, trying to impact LV to change their regulations. D continuously shares sales statistics and product information with eHM in an integrated IT-system.	Information sharing for resource knowledge Information sharing for dynamics knowledge Information sharing for managing a crisis Information sharing for improving regulations	Understand resources in the supply chain Understand interdependencies and dynamics Understanding risks and external threats Understand how to improve regulations	One of the D's largest sources of income comes from selling data and statistics to other actors in the SPSC. The information shared by D concerning stocks is limited due to contractual agreements w/ PPs. D focuses a lot on analyzing their transaction information to improve their operations and believes that other actors in SPSC can become better at doing this as well. E.g. CC and planning healthcare provided at patients' homes. An ongoing tendency for PPs and Ds to centralize the D service and create European distribution agreements, which potentially will lead to a reduction of pharmaceuticals inventories kept in Sweden.
Vertical joint assessment	Pharma-ceuticals producers (PPs) Pharmacy contractors (PCs) Outpatient pharmacies (O-Phs)	D develops joint risk analyzes regularly w/ some PPs, due to strong interdependence and interlinked goals. D has a partnership w/ one PC regarding the management of cycle stock for hospital pharmacies, why joint risk analyzes are developed between the two actors. D conduct joint forecasts of the pharmaceuticals demand once a month w/ the central unit of each O-Ph chain.	Joint risk analysis Joint forecasting	Understand interdependencies and dynamics Understanding risks and external threats Minimize vulnerability in the supply chain	The joint forecast and daily delivery could be improved if each O-Ph store shared data about their current stock and ordering rules. According to D, the problem w/ back-orders in the inpatient care is primarily not shortages in production but stockpiling at caregivers, preventing the pharmaceuticals to be sent to and used where there are mostly needed, since law prevents pharmaceuticals from being reallocated once distributed. This problem could possibly be prevented by joint forecasts between D and CCs. The problems with back-order caused shortages are not widespread at O-Phs, where D delivers in accordance to the 24-hour rule.

Vertical collaborative planning	LV Pharma-ceuticals producers (PPs)	D is part of LVs contingency plans for large national crises. Specific contingency plans and routines for how to handle back-orders are developed jointly by D, PPs and LV.	Coordinated prevention of disruption Coordinated contingency plans	Avoid holes and duplication in response efforts Minimize vulnerability in the supply chain	
Horizontal information sharing	LDF	Some coordination between the Ds through LDF concerning joint issues to be discussed with other types of actors, e.g., back-orders or regulatory issues.	Sharing for industry coordination	Understanding risks and external threats	Best practices are shared extensively between the different local units in D's concern.
Inter-organizational education	Pharma-ceuticals producers (PPs)	D regularly arranges theoretical educations for the PPs, e.g., about trends and new regulations in the Swedish market D participates in one-time educations about upcoming changes, held by governmental agencies or any other relevant actor depending on topic, e.g., about 2D coding of pharmaceuticals boxes	Education in appropriate response Education in supply chain structure	Understand interdependencies and dynamics Learn successful strategies	
Simulation	Pharma-ceuticals producer (PPs)	D practices safety procedures with some of their PPs on a yearly basis D has participated in scenario-based exercises about severe crisis or war situations arranged by the Defense Agency.	Practice exercises Scenario-based training	Understand interdependencies and dynamic Understanding risks and external threats Avoid holes and duplication in response efforts Learn successful strategies	
Analyzing experience	Govern-mental agencies Police	D conducts extensive deviation and incident analyzes as well as near misses analyzes due to the pharmaceuticals large value and consequences if something goes wrong. These analyzes are sometimes conducted or shared with governmental agencies and the police	Post-disruption analysis Near misses analysis	Avoid holes and duplication in response efforts Learn successful strategies	
Stimulate flexibility	*Learning method not used*				Due to the size of D's operations, it is difficult to quickly reorganize the distribution logistics. The size, however, enables the D to absorb disruptions not only in their own company but potentially large disruptions at the other D. D sees potential to increase flexibility in the internal logistics flow and, e.g., optimize emergency orders

5.4| Outpatient Pharmacy

All information in chapter 5.4 was received during a conducted interview with Boström (2018).

Representing organization: The interview was conducted with Apoteket AB that is the largest outpatient pharmacy actor in the SPSC.

Representing interviewee: Representing them was Fredrik Boström, currently Head of Prescribed Products and Health Services at Apoteket AB. Boström will work full time as Chief Pharmacist of the Swedish Pharmacy Association from 7th January 2019.

An overview of the outpatient pharmacy's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.3 and a summary of the outpatient pharmacy's used interorganizational learning methods in these relationships can be seen in Table 5.4.
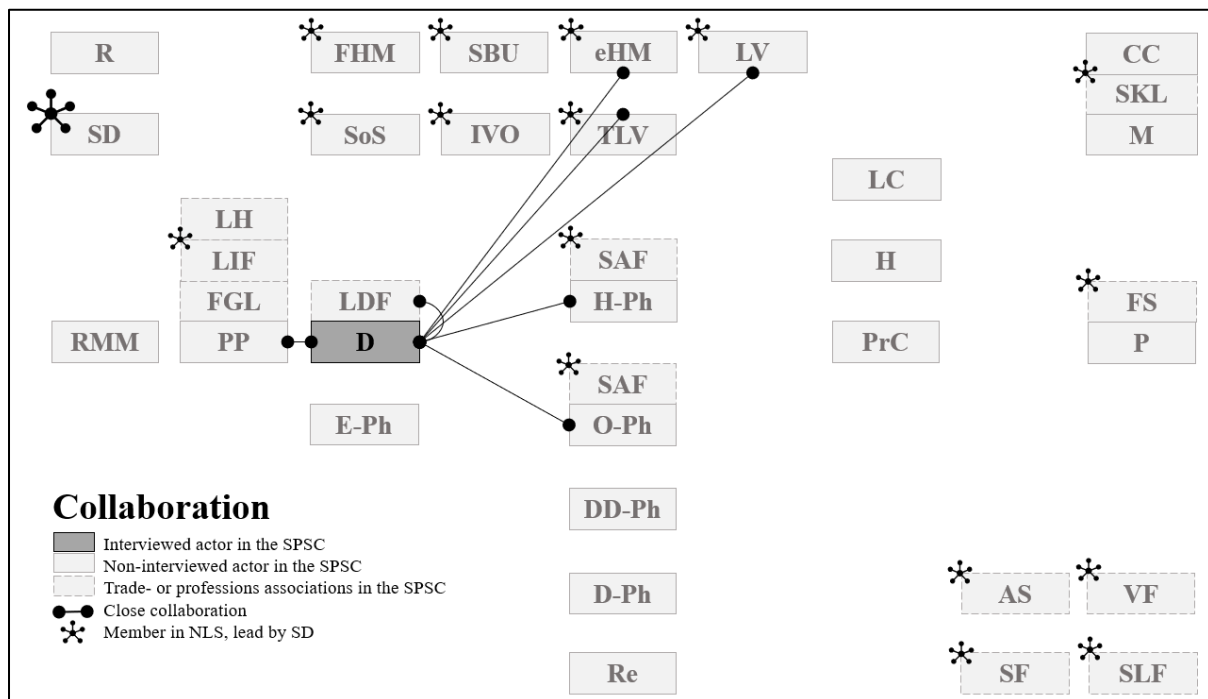

Figure 5.3: Collaborative and Learning Relationships, Outpatient Pharmacy

Table 5.4: Summary of Interorganizational Learning, Outpatient Pharmacy

Learning method used by O-Ph	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Distributors (Ds) Pharma-ceuticals producer (PP) LV TLV	D shares information w/ the O-Ph regarding pharmaceuticals availability, non-availability and expected delivery times. O-Ph shares information about their needs through direct ordering w/ D. O-Ph has contact w/ PP reactively if an item is not delivered to get information on why the disruption occurred and when it will be back in stock. O-Ph shares information w/ TLV, regarding regulations and their application, both separately and through SAF.	Information sharing for resource knowledge Information sharing for dynamics knowledge Information sharing for improving regulations	Understand resources in the supply chain Understand interdependencies and dynamics	Problems w/ back-orders are reoccurring, but the product of the period system facilitates interchange of pharmaceuticals, it only becomes critical when no substitutes are available. The inventory information provided by D is very basic. Information sharing w/ PP is done via PP's local subsidiaries.
Vertical joint assessment	Distributor (D)	Joint assessments are done continuously w/ the D concerning the delivery reliability.	Joint assessment of current status	Understand interdependencies and dynamics	
Vertical collaborative planning	Distributors (Ds) Dose dispensing pharmacies (DD-Phs) eHM	During supply disruptions or high demand, a joint prioritization plan between O-Ph and D is made to minimize effects on the patients. O-Ph is involved in DD-Ph's contingency plans as an alternative way to deliver dose dispensed pharmaceuticals to the patients, eHM is also part of this process, temporarily transferring the patient registers.	Coordinated prevention of disruption Coordinated response effort	Minimize vulnerability in the supply chain	Limited collaboration and planning w/ Ds and PPs, due to the view that O-Ph is just a distribution channel.
Horizontal information sharing	SAF	SAF represents all O-Ph in NLS. Information about stock status for all pharmaceuticals, if not classified as narcotics, is shared by all O-Ph through FASS. O-Ph's jointly try to influence TLV via comment letters from SAF. Though ARI a system for how to communicate withdrawals has been developed by actors including LV, LIF and SAF, representing O-Ph.	Information sharing for industry coordination	Understand interdependencies and dynamics Develop a joint front towards governmental agencies	Direct information sharing w/ other O-Ph is limited because of the competitive nature of the market.

Inter-organizational education	SAF	O-Ph's occasionally participate in educations held by SAF about upcoming changes, e.g., about 2D coded boxes.	Education in supply chain structure	Understand interdependencies and dynamics	
Simulation	*Learning method not used*				In contrast to O-Ph, DD-Ph's are known to be part of large scenario exercises w/, e.g., CC.
Analyzing experiences	Distributors (D) Pharma-ceuticals producer (PP)	Disruptions and incident analyzes are conducted, sometimes this process includes requesting data from involved actors.	Post-disruption analysis	Learn successful strategies	
Stimulate flexibility	*Learning method not used*				O-Ph rely partly on flexibility build into the Ds system. The O-Ph's possibility to be flexible is limited by regulations preventing them to send pharmaceuticals between different stores. Individual patients cannot hold security buffers of prescriptive pharmaceuticals of more than 3 months use due to pharmaceuticals benefits regulations. Some pharmaceuticals can be sent back to the D.

5.5| Hospital Pharmacy

All information in chapter 5.5 was received during a conducted interview with Kjörling (2018).

Representing organization:	The interview was conducted with Apoteket AB that is a pharmacy contractor managing hospital pharmacies for county councils in the SPSC.
Representing interviewee:	Representing them was Per Kjörling, Regional manager (South region) at Apoteket AB. Kjörling is the contact person for the county council and the hospitals having Apoteket AB as their contracted hospital pharmacy.

An overview of the hospital pharmacy's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.4. and a summary of the hospital pharmacy's used interorganizational learning methods in these relationships can be seen in Table 5.5.
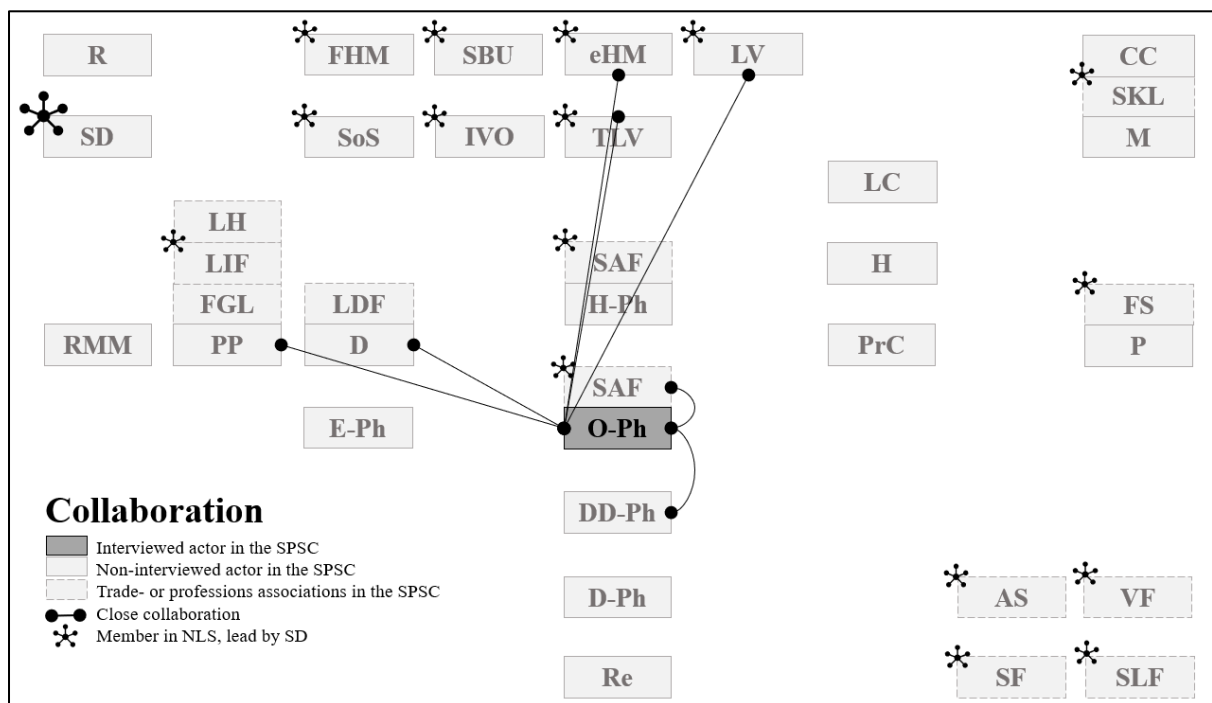

Figure 5.4: Collaborative and Learning Relationships, Hospital Pharmacy

Table 5.5: Summary of Interorganizational Learning, Hospital Pharmacy

Learning method used by H-Ph	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	County councils (CCs) Extemporaneous pharmacy (E-Ph)	PC shares, e.g., statistic of deviation, consumption, and risk of theft w/ CC. CC shares, e.g., holiday planning, specific patient needs and potential demand increase/decrease w/ PC. PC has limited contact w/ E-Ph concerning the distribution of extemporaneous pharmaceuticals and w/ a few Ps concerning specific pharmaceuticals delivered directly to the P	Information sharing for dynamics knowledge Information sharing for resource knowledge	Understand resources in the supply chain Understand interdependencies and dynamics Understand risks and external threats	
Vertical joint assessment	County councils (CCs)	PC and CC jointly try to identify areas of improvement based on shared information. PC conduct joint risk analyzes w/ CC in connection to new contract signings. PC perform joint assessments of routines w/ CC after contract signing.	Joint assessment of current status Joint risk analysis	Understand resources in the supply chain Understand interdependencies and dynamics Understand risks and external threats Minimize vulnerability in the supply chain	
Vertical collaborative planning	County councils (CCs)	PC together w/ CCs conduct continuous efforts to avoid faulty deliveries. PC and CC develop coordinated prioritizing plans for e-business disruptions as they happen. Tight collaborative planning w/ CCs for unexpected disruptions. PC and the CCs have created a crisis communication structure to enable fast and accurate information paths.	Coordinated contingency plans Coordinated prevention of disruptions Coordinated response effort Coordinated crisis management procedures	Minimize vulnerability in the supply chain Enabling high situational awareness in a crisis	

Horizontal information sharing	Pharmacy contractors (PCs) SAF	When a CC changes PC, the two PCs need to share information when transferring operational knowledge and routines regarding the hospital. Limited industry coordination takes place though SAF.	Information sharing for industry coordination	Understand interdependencies and dynamics	Only two competing PCs in the market, therefore they do not share more than bare minimum.
Inter-organizational education	County councils (CCs)	PC create and sells education about pharmacy knowledge to, e.g., CC.		Increase knowledge about pharmaceuticals handling in SPSC	
Simulation	County councils (CCs) Hospitals (Hs)	PC conducts scenario-based crisis exercises w/ one CC and its Hs. PC practice communication structure and crisis routines during scenario trainings w/ one CCs.	Scenario-based training Practice exercises	Understand interdependencies and dynamics Understanding risks and external threats	Simulation is only done w/ one CC.
Analyzing experiences	County councils (CCs) LV	PC and CC jointly analyze scenario-based exercises. PC analyze deviations and share and discuss it with CCs, but also LV during inspections.	Post-disruption analysis Share experiences and lessons learned	Learn successful strategies	Does not analyze near misses or successful practices and strategies.
Stimulate flexibility	Hospitals (Hs)	Provide Hs w/ inventory systems to increase transparency of pharmaceuticals positions and enable movement of pharmaceuticals between the departments w/i a H.	Continuous reorganization	Minimize vulnerability in the supply chain	Inventory levels of the pharmaceutical stock at the H's departments are not up to date. Regulations constrain movement of pharmaceuticals between different Hs.

5.6| County Council 1

All information in chapter 5.6 was received during a conducted interview Thyberg (2018).

Representing organization:	The interview was conducted with Stockholm County Council, one of the largest county councils in the SPSC. The county council have contracted a pharmacy contractor to manage their hospital pharmacies.
Representing interviewee:	Representing them was Magnus Thyberg, the Head of Division of Strategic Healthcare Issues. The division is responsible for pharmaceutical issues, disaster medicinal preparedness, healthcare hygiene and antibiotics resistance. Thyberg has an assigned responsibility for pharmaceutical supply and the pharmaceuticals prescription processes in SLL. Thyberg is additionally part of the SNÄL network.

An overview of the county council's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.5 and a summary of the county council's used interorganizational learning methods in these relationships can be seen in Table 5.6.
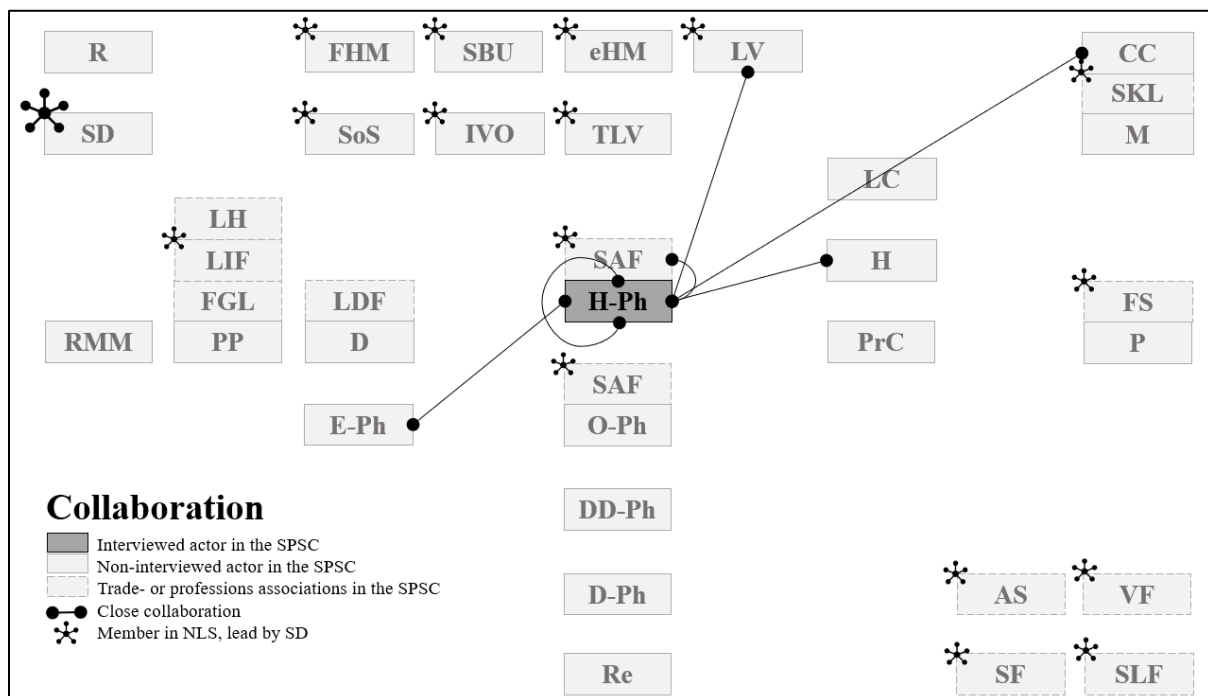

Figure 5.5: Collaborative and Learning Relationships, County Council 1

Table 5.6: Summary of Interorganizational Learning, County Council 1

Learning method used by CC1	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Pharma-ceuticals producers (PPs) Pharmacy contractor (PC) LV	For contracted pharmaceuticals, CC share forecast based on historical consumption and expected large deviations in demand w/ PPs. CC request early information regarding issues in supply from PP and D, via PC, e.g., regarding back-orders. PC shares information regarding pharmaceuticals supply w/ CC. CC shares information with LV regarding regulations that does not work as well as intended.	Information sharing for resource knowledge Information sharing for dynamics knowledge Information sharing for improving regulations	Understand resources in the supply chain Understand interdependencies and dynamics	Low information quality from PP and D concerning back-orders. Thus, hard to take decisions based on this information. All information sharing w/ D is done via PC, not directly.
Vertical joint assessment	Pharmacy contractor (PC) LV	CC conducts daily assessments regarding issues in pharmacy supply w/ PC. Occasionally, LV is involved in joint assessment of back-orders.	Joint assessment of current status	Understand resources in the supply chain	Forecasting is only done internally.
Vertical collaborative planning	Pharmacy Contractor (PC) Dose dispensing pharmacy (DD-Ph) Distributor (D) Hospital (H)	CC conducts joint contingency plans w/ PC specifying, e.g., how to act if there is a disruption in the digital systems. CC has developed basic coordinated crisis management procedures together their contracted DD-Ph. During a local disruption, the response effort and management is continuously coordinated between CC, PC, D and involved Hs.	Coordinated contingency plans Coordinated crisis management procedures Coordinated response effort Coordinated prevention of disruption	Minimize vulnerability in the supply chain Enabling high situational awareness in a disruption and crisis	Currently no collaborative planning is done w/ PPs. Collaboration and contingency planning w/ PPs would preferably be done with the global units, as the local subsidiaries are believed to have little influence over production and distribution. The SPSC is sub-optimized and the service level therefore low. All actors work with JIT and there are no incentives to keep security stocks. Long distance between producer and user. CC rarely has contact with global units of PPs. CC believes there are unclarities concerning who is responsible for what in a crisis and that the CCs are not given sufficient support from governmental agencies for how to prepare for such situations.

Horizontal information sharing	County councils (CCs) SKL	CC participates in yearly meetings w/ all CCs where current issues are discussed. Some networks are coordinated by SKL, e.g., the contact person network and the pharmaceuticals supply network. Specific issues are discussed in smaller configurations of CCs, depending on, e.g., county size, geographical proximity or contracted pharmacy contractor. The specific CC has close collaboration with the three other large CCs in Sweden. Nearby CCs have close contact to help each other during crises, organized on a case by case basis. A lot of collaboration is conducted on a person specific level, where pharmacists in different CCs personally know each other and each other's expertise areas. The hospital pharmacists, e.g., have an informal network where they ask and answer questions.	Information sharing for industry coordination Horizontal benchmarking	Understand risks and external threats Learn successful strategies Achieve synergy effects by close collaboration w/ similar CC Safety network for emergencies	
Inter-organizational education	*Learning method not used*				
Simulation	*Learning method not used*				Overall contingency plans and communication structures for pharmaceuticals are somewhat practiced when the regional healthcare crisis management practice their routines. These types of exercises are, however, not done on a regular basis and mainly done internally in the county council.
Analyzing experience	Pharmacy contractor (PC) Extempo-raneous pharmacy (E-Ph) Hospitals (Hs)	CC regularly conducts learning seminars after large incidents or projects w/ involved actors, e.g., PC, E-Ph and H. CC and involved actors regularly analyze deviations using a deviation management system, including near misses.	Share experiences and lessons learned Post-disruption analysis Near misses	Learn successful strategies	

Stimulate flexibility	Pharma-ceuticals producer (PP) Pharmacy contractor (PC) County councils (CCs)	CC work with several parallel strategies to ensure pharmaceuticals supply and uphold flexibility and negotiation power. These strategies cannot be executed without collaboration with other actors in the SPSC. The strategies for backorders are, e.g., import of pharmaceuticals, change of treatment, rations in prescriptions, application for license or exemption, pressure PP to prioritize Sweden.	Continuous reorganization.	Learn successful strategies Minimize vulnerability in the supply chain	Limited tests of reorganization ability during simulations of contingency plans and routines within the CC Close organizational connection between pharmaceuticals and disaster medicine divisions in the CC is advantageous for flexibility and collaboration.

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5.7| County Council 2

All information in chapter 5.7 was received during a conducted interview with Winner (2018).

Representing organization:	The interview was conducted with Kalmar County Council. The county council have contracted a pharmacy contractor to manage their hospital pharmacies.
Representing interviewee:	Representing them was Mari-Mall Winner, Head Pharmacist at Kalmar county council. Winner is responsible for ensuring the county council's compliance with LV's regulations.

An overview of the county council's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.6 and a summary of the county council's used interorganizational learning methods in these relationships can be seen in Table 5.7.
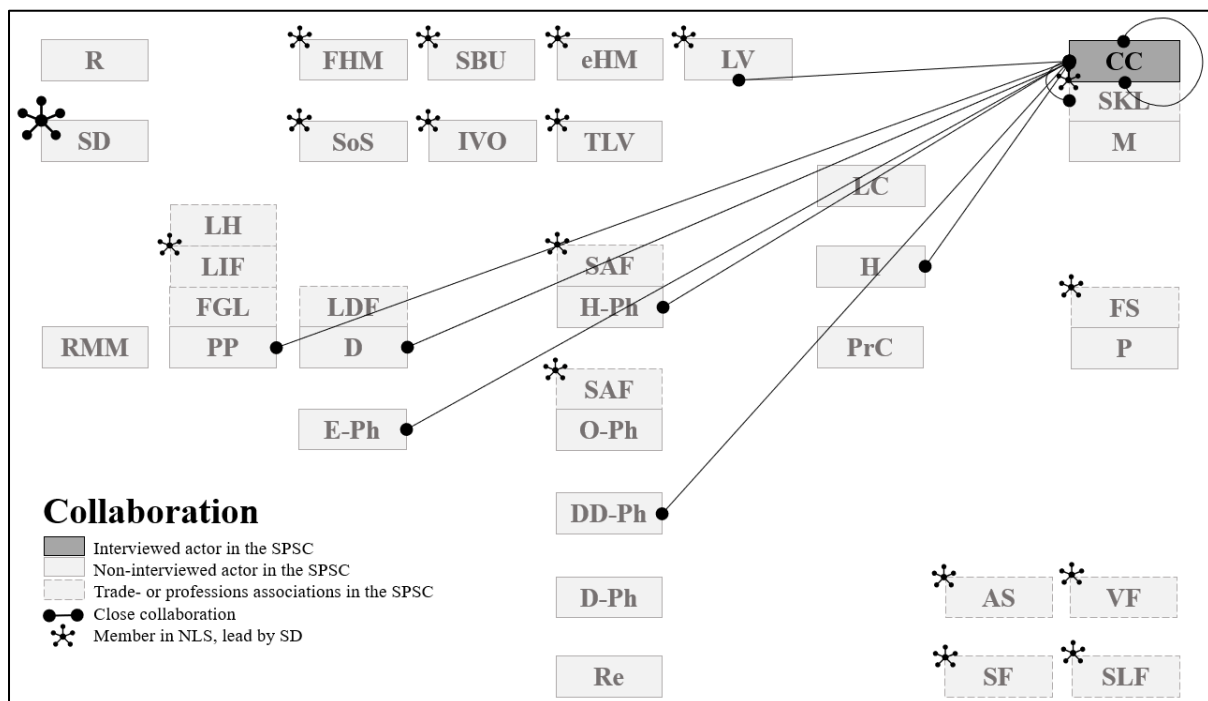

Figure 5.6: Collaborative and Learning Relationships, County Council 2

Table 5.7: Summary of Interorganizational Learning, County Council 2

Learning method used by CC2	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Pharmacy contractor (PC) Pharma-ceuticals producers (PPs) LV SoS	CC has extensive sharing w/ contracted PC concerning daily operations, joint routines and compliance w/ legal requirements. Regular follow-up meetings are held concerning their agreement. CC has contracts and thus contact with some PPs for certain pharmaceuticals. CC shares information regarding large disruptions or changes w/ LV as this is required by law. CC has contact with SoS when in need of advice concerning pharmacy management. CC shares opinions w/, e.g., SoS and LV about referrals and how regulations work in practice, often via a joint effort in SKL.	Information sharing for resource knowledge Information sharing for dynamics knowledge Information sharing for improving regulations	Understand resources in the supply chain Understand interdependencies and dynamics Understanding risks and external threats	CC has ensured information sharing and transparency from PC by specifying required actions in contract. CC shares information regarding potential risks and threats with the other actors in the SPSC through the county council's publicly available RSA. This is through a broad analysis, not only focusing on the pharmaceuticals supply.
Vertical joint assessment	*Learning method not used*				CC awaits better national instructions for how to work with joint risk assessments with other actors in the SPSC.
Vertical collaborative planning	*Learning method not used*				CC only develops internal contingency plans and crises management procedures but may, however, share them w/ relevant actors if requested. CC would like to collaborate more concerning prevention of disruptions and response efforts together w/ other CCs, but are constrained from doing so by current laws. CC would therefore like to increase collaboration w/ governmental agencies to get more guiding and understanding for how to jointly become more resilient as a system.

Horizontal information sharing	County councils (CCs) SKL	CC conducts joint procurement of pharmaceuticals w/ two other CCs CC have regular meetings with other CCs with the same PC, where they share experiences, routines and learnings from working with the PC. All CCs have extensive collaboration through SKL, e.g., by having a specific network for pharmaceuticals supply. Regular meeting includes discussions about current issues, experiences and best practices. There are also different types of expert area network between CCs.	Sharing for industry coordination Horizontal benchmarking	Understand interdependencies and dynamics Understanding risks and external threats Learn successful strategies	The networks and collaborations in SPSC are all developed after the deregulation of the monopoly in 2009. Thus, they are relatively new, and it has taken some time to develop the interorganizational learning ability w/i them.
Inter-organizational education	County councils (CCs) Pharmacy contractor (PC)	The CCs and SKL has regular workshops w/i different pharmaceuticals disciplines, including topics concerning pharmaceuticals supply. CC occasionally holds introductory education for new PC employees, for them to understand why the interorganizational procedures and requirements look like they do. CC has also participated in introductory education in PC's operational processes	Education in appropriate response Education in supply chain structure	Understand interdependencies and dynamics Learn successful strategies	
Simulation	*Learning method not used*				Practice exercises are made to control that the integrated technical systems work when entering contract with a new PC. These exercises have turned out to be helpful in preventing disruptions in the start-up phase.
Analyzing experiences	Pharmacy contractor (PC) LV	CC has clear routines for analyzing disruptions and deviations concerning the delivery reliability, often involving discussions with PC to understand why and how to prevent similar events in the future. Large deviations are reported to LV. Near misses w/ serious consequences are analyzes w/ the same method as disruptions	Post-disruption analysis Share experiences and lessons learned Near misses	Avoid future disruptions Learn successful strategies	
Stimulate flexibility	*Learning method not used*				CC has an upcoming project to create back-up routines and flexibility to be able to manage rare problems. The project will likely be done in collaboration with PC, to be able to jointly increase flexibility.

5.8| County Council 3

All information in chapter 5.8 was received during a conducted interview with Vondracek (2018).

Representing organization:	The interview was conducted with the County Council of Västra Götaland (VGR), one of the largest county councils in the SPSC. The county council is overall responsible for the pharmaceuticals supply within the country and have contracted a pharmacy contractor to manage parts of the hospital pharmacy, even though most operations are coordinated and performed by the country council.
Representing interviewee:	Representing them was Fredrik Vondracek, Quality Manager at the hospital pharmacy function in VGR.

An overview of the county council's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.7 and a summary of the county council's used interorganizational learning methods in these relationships can be seen in Table 5.8.
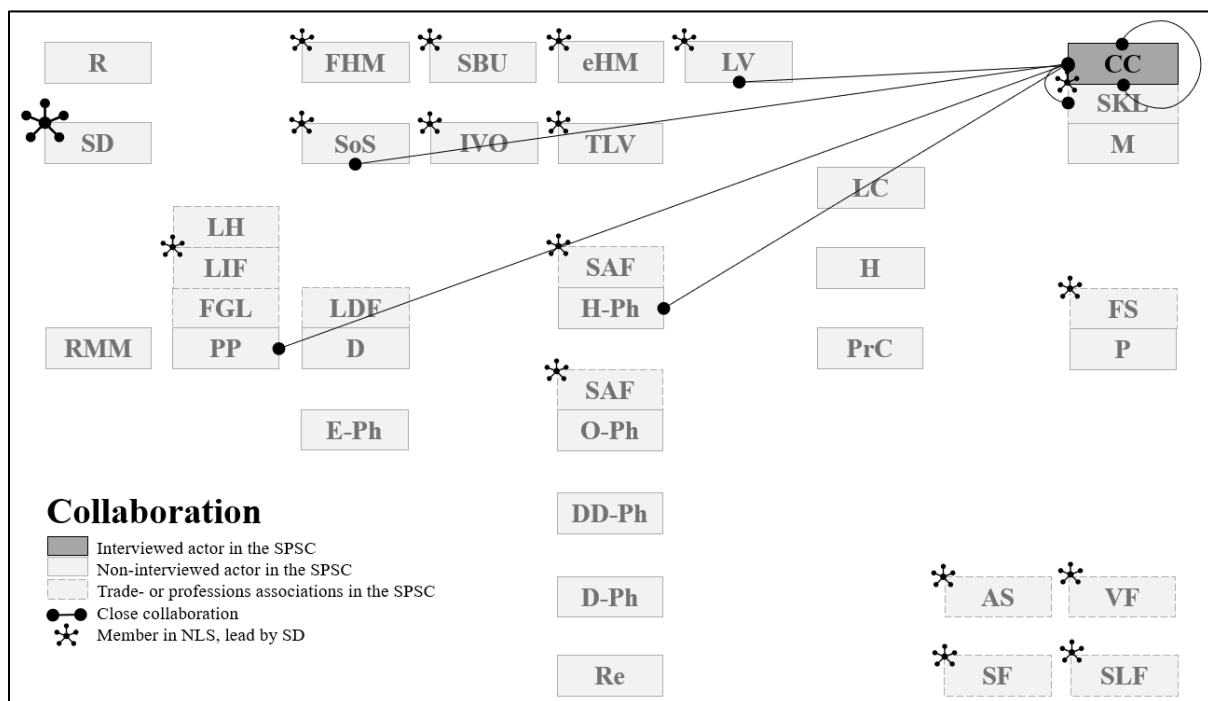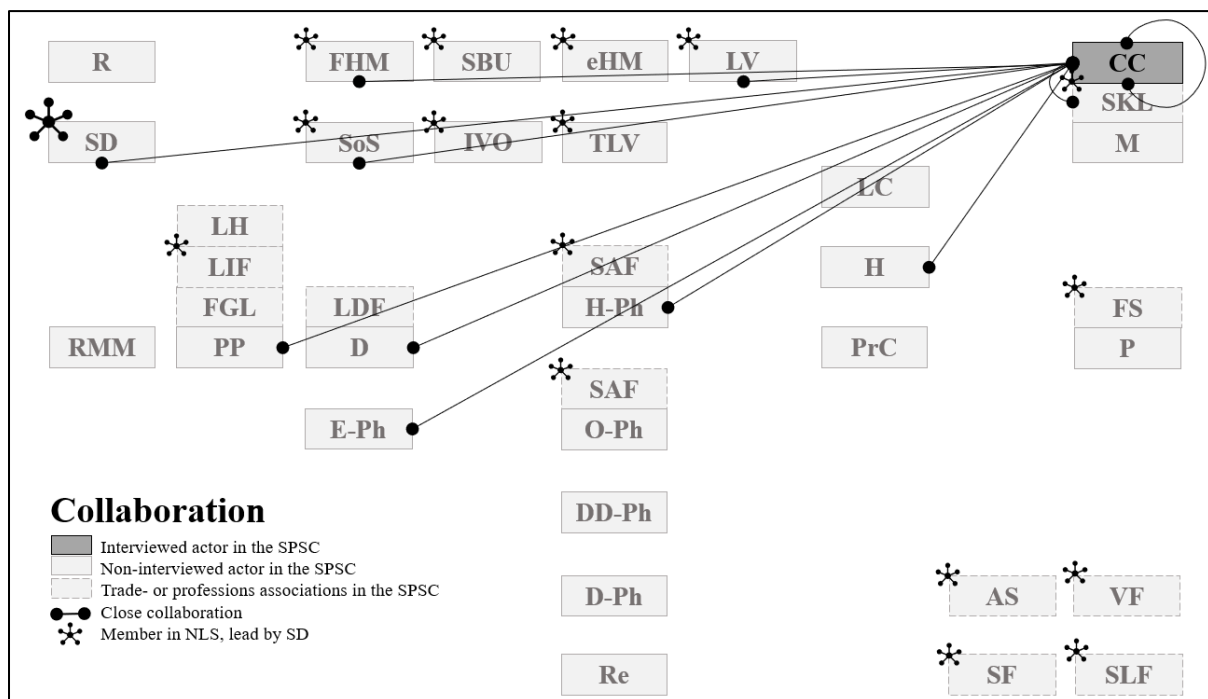

Figure 5.7: Collaborative and Learning Relationships, County Council 3

Table 5.8: Summary of Interorganizational Learning, County Council 3

Learning method used by CC3	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Pharmacy contractor (PC) Hospitals (Hs) Extempo-raneous pharmacy (E-Ph) Pharma-ceuticals producers (PPs) LV SoS SD Actors in SNÄL	CC has daily contact w/ PC about how to solve problems w/ availability of pharmaceuticals. Often Hs are involved in the information flow as well. CC has intense information sharing w/ PC and H during disruptions and crises. CC has regular contact with E-Ph regarding availability of extemporaneous pharmaceuticals. Contact with some PPs regarding contracts for specific pharmaceuticals. CC has contact with, e.g., SoS, FHM, eHM and LV through the SNÄL network, where information regarding pharmaceuticals supply in crisis or state of alert and current issues are shared. CC shares information regarding regulations and their applicability with governmental agencies, e.g., LV, SoS and SD. This is often done via SKL, via referral response or via participation in governmental investigation teams.	Information sharing for resource knowledge Information sharing for dynamics knowledge Information sharing for managing a crisis Information sharing for improving regulations	Understand resources in the supply chain Understand interdependencies and dynamics Understanding risks and external threats Enabling high situational awareness in a crisis Understand how to improve regulations	Information from PPs regarding back-orders is not accurate enough nor proactively sent. CC is about to implement an IT system to facilitate information sharing w/ PC and Hs. CC's contact with PP is often done by procurers lacking specialist medical knowledge and knowledge about the SPSC. In large scale crises, the communication w/ governmental agencies is done via a temporary crisis organization in the CC; not including pharmaceuticals expertise.
Vertical joint assessment	Pharmacy contractor (PC) Extempo-raneous pharmacy (E-Ph)	PC and E-Ph identifies critical processes in their operations and create risk analyzes, these are then refined by CC.	Joint assessment of current status Joint risk analysis	Understand interdependencies and dynamics Understanding risks and external threats Minimize vulnerability in the supply chain	The risk analyzes are not based on a joint assessment. Forecasting is only done internally.

Vertical collaborative planning	Pharmacy contractor (PC) Extempo-raneous pharmacy (E-Ph) Distributors (Ds) Hospitals (Hs) LV SoS FHM	Contingency plans are developed by PC and E-Ph w/ input from CC. E.g. specific joint contingency plans for how to manage disruptions in the ordering flow. Communication routines for disruptions and back-order situations are established w/ PC and Hs. CC has been part of multiple investigations lead by governmental agencies, e.g., FHM, SoS and LV.	Coordinated contingency plans Coordinated crisis management procedures Coordinated prevention of disruptions	Avoid holes and duplications in response effort Minimize vulnerability in the supply chain Enabling high situational awareness in a crisis.	The contingency plans are not truly developed jointly and the collaboration concerning them could be improved. Back-orders are considered to be a large problem. Difficult for CC to influence Ds due to no contracts. CC would though like to increase and improve the collaboration with Ds. CC3 sees a need to coordinate the Hs better to increase their collaboration and sharing of best practice. CC believes that there is a need to clarify roles and responsibilities for actors in the SPSC during a crisis, since there currently are holes in the preventive and response efforts. CC is part of a Nordic network discussing the back-order situation a couple of times per year to find high level solutions.
Horizontal information sharing	County councils (CCs) SKL	CC is the convening actor in a pharmaceuticals supply network for CCs within SKL, that share experiences and, e.g., learn about supply structures and procurement negotiations. Large meetings with all CCs once or twice per year. Discussions about regulations and referrals with other CCs through SKL. Informal but widely used joint mail group between different functions in the CCs, sharing information, advice and experiences. Tight collaboration w/ one CC with the same hospital pharmacy structure and a shared regional warehouse.	Information sharing for industry coordination Horizontal benchmarking	Understand interdependencies and dynamics Understanding risks and external threats Learn successful strategies	The networks and collaborations between the CCs today are developed after the deregulation of the monopoly, as a lot of people working in the county councils today have a background in Apoteket AB and were used to collaborate and learn from each other. CC is a large organization that is more like an umbrella of multiple organizations, between witch interorganizational learning methods are believed to be needed and useful as well.
Inter-organizational education	*Learning method not used*				

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Simulation	Pharmacy contractor (PC) Hospitals (Hs)	Once a year CC practice their contingency plans and crisis management procedures together with their PC and Hs through scenario exercises, followed by an evaluation and improvement of routines.	Scenario-based training Practice exercises	Understand interdependencies and dynamics Understanding risks and external threats Avoid holes and duplication in response efforts Learn successful strategies	CC believes that simulation exercises cannot be replaced, only complemented, by other interorganizational learning methods. CC have started to involve IT-functions in the simulations since it is currently a weak area. CC believes it would be beneficial to include more actors in the simulations, but it requires much work to make it possible.
Analyzing experiences	Pharmacy contractor (PC) Extemporaneous Pharmacy (E-Ph)	Every time a large indecent occurs or a contingency plan or crisis management procedure is activated, CC together with involved actors, e.g., PC or E-Ph, conduct an event analysis to understand what went wrong and find preventive actions. CC looks at near misses through incident measurements conducted by either PC or E-Ph, which are then analyzed jointly. Success factors are analyzed for large changes and events, which may be shared on, e.g., network meetings.	Post-disruption analysis Share experiences and lessons learned Near misses	Avoid holes and duplication in response efforts Learn successful strategies	Event analysis can be improved when it comes to IT-disruptions. This area is complicated to understand why the analyzes conducted today are weak. Success factors are rarely analyzed for smaller changes or events.
Stimulate flexibility	Pharmacy Contractor (PC) Extemporaneous Pharmacy (E-Ph)	CC contribute to making the SPSC more flexible by preparing and practicing PC and E-Ph on disruptive scenarios and constant reorganization.	Continuous improvement of crisis management procedures	Avoid holes and duplication in response efforts Learn successful strategies Minimize vulnerability in the supply chain	Hard for CC to impact early actors in SPSC to be more flexible, due to SPSC's structure and incentives. Laws and regulations limit CCs' and Hs' flexibility in operations, e.g., limiting movement of pharmaceuticals and preventing CC from providing primary care with pharmaceuticals. A future problem is how the distribution of pharmaceuticals will work when an increasing number of patients are treated at home or outside hospitals.

5.9| Hospital

All information in chapter 5.9 was received during a conducted interview with Heaton (2018).

Representing organization:	The interview was conducted with Södersjukhuset, being a hospital actor in the SPSC and located in Stockholm, Sweden.
Representing Interviewee:	Representing them was Claire Heaton, Head Pharmacist at Södersjukhuset. Heaton is responsible for ensuring pharmaceuticals supply at the hospital and making sure the constant pharmaceuticals supply is secured and without disruptions.

An overview of the hospital's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.8 and a summary of the hospital's used interorganizational learning methods in these relationships can be seen in Table 5.9.

Figure 5.8: Collaborative and Learning Relationships, Hospital

Table 5.9: Summary of Interorganizational Learning, County Council 3

Learning method used by H	Actors	Specification	Sub-methods	Learning goals	Lacking, problems and barriers
Vertical information sharing	Pharmacy contractor (PC) LV	PC shares delivery reliability and reported deviations w/ H Status of the electronic ordering system is continuously communicated Contract follow-up meetings are held to find recurring problems and possible solutions to them H share opinions regarding LV's regulations, often together with other Hs in the county	Information sharing for dynamics knowledge Information sharing for improving regulations	Understand interdependencies and dynamics Minimize disruptions Understand how to improve regulations	Improvement meetings based on shared information from PC are not conducted regularly. PC does not share enough information for resource knowledge enabling proactive work with back-orders
Vertical joint assessment	Pharmacy contractor (PC)	Conduct joint risk analysis w/ PC when entering new PC contract	Joint risk analysis	Understand risks and external threats Minimize vulnerability in the supply chain	The risk analysis needs to be updated more continuously to reflect current structures.
Vertical collaborative planning	Pharmacy contractor (PC) County council (CC)	Conduct some specific joint contingency plans w/ PC and CC when entering new PC contract Create a crisis communication structure w/ PC and CC to ensure that the right people get the information in a disruption or crisis Proactive planning meetings w/ PC before specific and anticipated events Back-order focused meetings w/ PC and CC	Coordinated contingency plans Coordinated crisis management procedures Coordinated response effort Coordinated prevention of disruption	Having clear routines for handling inter-organizational problems Minimize vulnerability in the supply chain Enabling high situational awareness in a disruption and crisis	The current communication structure is dependent on people, not functions
Horizontal information sharing	Hospitals (Hs)	Share solutions to problems and identify best practice among H in county H in county discuss common contract with PC H in county develop joint centralized solutions to common problems Coordinate response to foreseeable threats w/ other Hs in county	Information sharing for industry coordination Horizontal benchmarking	Understand interdependencies and dynamics Understand risks and external threats Learn successful strategies	Prohibition to transfer pharmaceuticals between hospitals/care providers limit the possibility for horizontal interorganizational coordination
Inter-organizational education	*Learning method not used*				

Simulation	*Learning method not used*				H experience a need to jointly practice routines and crisis plans as well as training and simulations of large incidents in CC
Analyzing experiences	Pharmacy contractor (PC) County councils (CC) Hospital (H)	Analyze experiences after new contract realization w/ PC Analyzing crises and large incidents w/ involved actors, e.g., PC, CC and other Hs Analyzing large specific events and project launches w/ involved actors, e.g., CC and other Hs	Share experiences and lessons learned Post-disruption analysis	Strengthen and improve routines Learn successful strategies	Near misses and successful handling are not analyzed on a regular basis. No known and clear method for analyzing experiences
Stimulate flexibility	Pharmacy contractor (PC)	H demand PC to develop and present a contingency plan for reorganization	Continuous improvement of crisis management procedures	Minimize vulnerability in the supply chain	Limited data availability prevents actors from carrying out other actor's tasks Limited number of each type of actor in the market Different PC in different CC

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5.10| Swedish Association of Local Authorities and Regions (SKL)

All information in chapter 5.10 was received during a conducted interview with Eklund and Ax (2018).

Representing interviewees: Representing SKL was Susanna Eklund and Fredrik Ax, both working at SKL with questions regarding pharmaceuticals and pharmaceuticals supply.

An overview of SKL's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.9 and a summary of SKL's used interorganizational learning methods in these relations can be seen in Table 5.10.
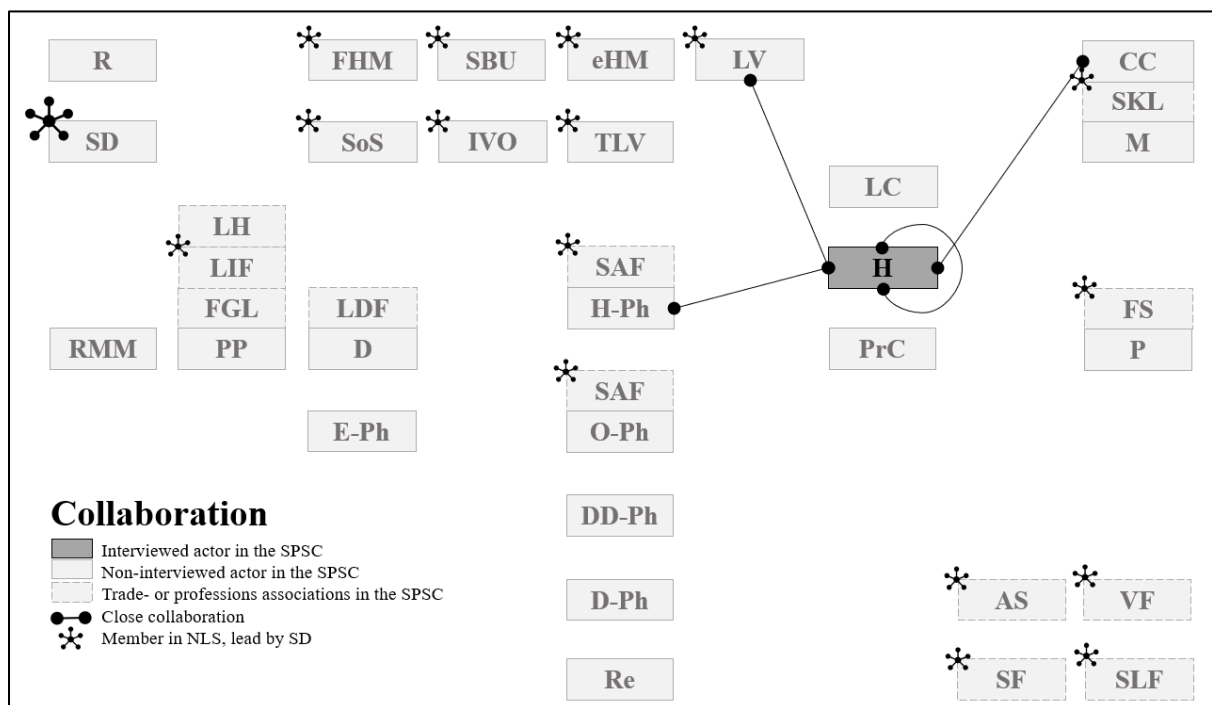

Figure 5.9: Collaborative and Learning Relationships, SKL

Table 5.10: Summary of Interorganizational Learning, SKL

Learning method used by SKL	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	LV SAF Actors in NLS SD	SKL works with strategic questions on a national level together with other actors, e.g., discussions w/ LV to find industry-wide solutions to backorder problems. General information between CCs and O-Phs is often shared via SKL and SAF, enabling the use of their efficient communication paths. A lot of SKL's interorganizational information sharing and collaboration is conducted within NLS. SKL has contact with SD regarding general issues, e.g., by representing CCs and Ms when discussing dysfunctional regulations or when trying to influence SD to launch investigations.	Information sharing for dynamics knowledge Information sharing for improving regulations	Understand interdependencies and dynamics Understanding risks and external threats Understand how to improve regulations	SKL has no official role in regard to crisis management as SoS takes the coordinating role, but still believe they would get involved somehow if a national crisis occurred. NLS functions as a platform to facilitate contact between different actors in the SPSC and enables finding the right person for information sharing.
Vertical joint assessment	*Learning method not used*				
Vertical collaborative planning	Actors in NLS	SKL's vertical collaboration with regards to pharmaceuticals supply is mainly conducted through NLS. Here, actors from all parts of the SPSC discuss current problems, which creates awareness and enables new perspectives and solutions.	Coordinated prevention of disruption	Avoid holes and duplication in response efforts Minimize vulnerability in the supply chain	The actors in NLS may have different understandings of common problems regarding pharmaceuticals supply, which in combination with, e.g., regulations sometimes make it hard to solve problems in the optimal way. There is a lacking structure for how to make sure that projects discussed in NLS are implemented in practice, as NLS is just a collaborative but not a decision-making forum. SKL wishes for closer collaboration between governmental agencies due to overlapping roles and regulations.

Horizontal information sharing	County councils (CCs)	SKL has extensive contact with all CCs and combines their joint opinions for representation in NLS and in contact with governmental agencies. SKL and the CCs have a network specifically focused on pharmaceuticals supply. The purpose is experience sharing and joint development.	Information sharing for industry coordination Horizontal benchmarking	Understand interdependencies and dynamics Understanding risks and external threats Learn successful strategies	The European collaboration is currently limited. SKL has collaborations w/ corresponding groups on an European level regarding, e.g., pharmaceuticals approvals.
Inter-organizational education	*Learning method not used*				There are big differences in how the CCs structure their healthcare, hence making interorganizational educations difficult.
Simulation	*Learning method not used*				SKL has no by law defined role during a crisis but tries to assist CCs and Ms on a case to case basis during crises. SKL has been part of workshops arranged in NLS to illustrate important problematic areas, but these cannot be classified as simulations.
Analyzing experiences	*Learning method not used*				SKL would hypothetically analyze after a national crisis, but this has not happened yet.
Stimulate flexibility	County Council (CC) SD	SKL tries to facilitate for CCs to increase adaptive capacity, by influencing SD to launch investigations with the aim of changing the regulations preventing CCs from being flexible.	Continuous improvement of crisis management procedures	Minimize vulnerability in the supply chain	Flexibility methods in the SPSC are limited by strict laws and regulations. SKL believes that one important task for the parliament is to rewrite the laws and for SD to authorize relevant governmental agencies to change regulations to suit a modern healthcare perspective, e.g., making it easier for CCs to organize advanced healthcare outside hospitals.

5.11| Dental and Pharmaceutical Benefits Agency (TLV)

All information in chapter 5.11 was received during a conducted interview with Hedberg (2018).

Representing interviewee:	Representing TLV was Niklas Hedberg, Chief Pharmacist at TLV and overall responsible for pharmaceuticals questions at TLV. Hedberg additionally has a lot of contact with governmental agencies and pharmaceuticals actors in Europe, since he is Chair of Executive Board at the European Network for Health Technology Assessment, EUnetHTA.

An overview of TLV's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.10 and a summary of TLV's used interorganizational learning methods in these relationships can be seen in Table 5.11.
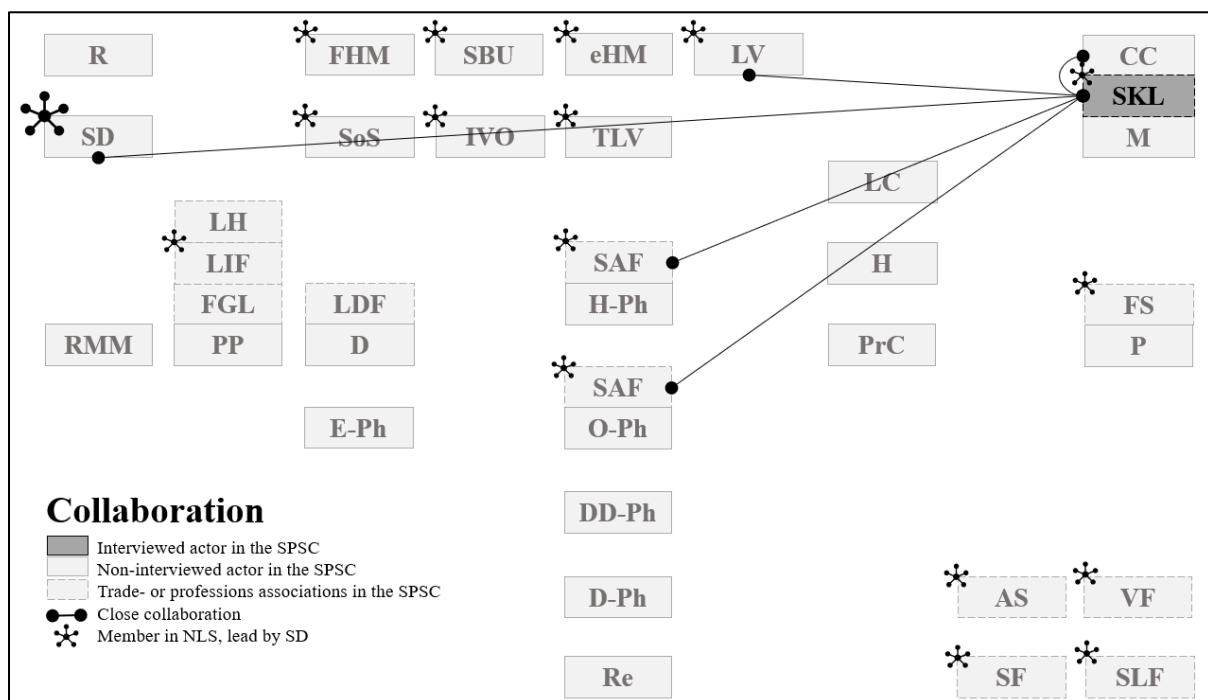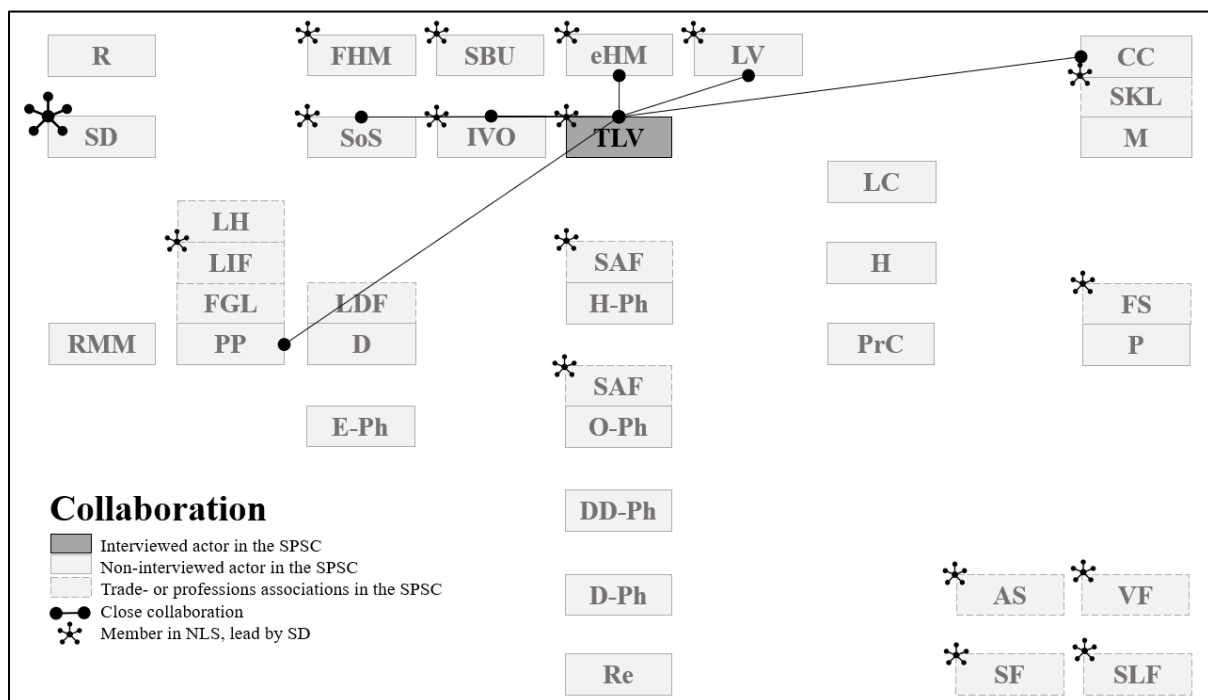

Figure 5.10: Collaborative and Learning Relationships, TLV

Table 5.11: Summary of Interorganizational Learning, TLV

Learning method used by TLV	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	Pharma-ceuticals producers (PPs) County councils (CCs) Actors in the NLS	TLV has contact and information exchange with PPs concerning, e.g., applications to the benefits system and prices negotiations. TLV and LV jointly give early scientific advice to PPs to ensure that good product come to the Swedish market. TLV tries to have a proactive communication w/ CCs concerning, e.g., new regulations, new types of pharmaceuticals and new routines. This information is distributed via specific CC employees with decision mandates. Other governmental agencies can also use the communication channel if needed. Sharing potential treats and possible problems through NLS, e.g., about the back-order situation, are regularly done by all involved actors.	Information sharing for dynamics knowledge Information sharing for managing a crisis	Understand interdependencies and dynamics Understanding risks and external threats Enabling high situational awareness in a crisis	Most times, TLV's c contact with the PPs are done via the PP's Swedish or Nordic subsidiaries. In some European projects, contact is though established with the global levels of the PPs. The Public Access to Information and Secrecy Act strictly regulates the secret information a governmental agency can share. However, it is possible to share the information with appointed representatives in the CCs, due to the CC's legal right to have deliberations with TLV. TLV has a communicative but not operational role during crises.
Vertical joint assessment	*Learning method not used*				
Vertical collaborative planning	Actors in the NLS Actors in the RSK County councils (CCs) Pharma-ceuticals producers (PPs)	TLV continuously develops joint market analyzes, action plans and solutions together with other actors through NLS. TLV conducts strategic collaborative planning w/ other governmental agencies in RSK. TLV facilitates the negotiation process between CCs and PPs for agreements outside the pharmaceuticals benefits system. TLV further helps CCs to coordinate pharmaceuticals contracts on a national level.	Coordinated prevention of disruption Coordinated response effort	Avoid holes and duplication in response efforts Minimize vulnerability in the supply chain	TLV has previously been part of different governmental investigations regarding Swedish crisis preparedness.

Horizontal information sharing	LV IVO eHM SoS Actors in the NLS Actors in the RSK	TLV has a close collaboration w/ LV regarding approvals of pharmaceuticals and follow-ups. The two parties may share expert opinions during the application process. TLV has contact with eHM concerning different types of data and eHM maintains the system for the *product of the period* that is managed by TLV. TLV has extensive contact w/ SoS concerning national guidelines and projects as well as and non-quantitative sales data. TLV and eHM assist SoS in preparing prognosis of future pharmaceuticals sales. TLV has occasional collaboration w/ FHM concerning governmental assignments about antibiotics and vaccines. TLV conducts joint risk analysis and assessments of critical situations w/ other governmental agencies in RSK.	Information sharing for industry coordination Horizontal benchmarking	Understand interdependencies and dynamics Understanding risks and external threats Learn successful strategies	TLV believes that because of NLS, governmental agencies have increased their interorganizational collaborations due to identifies synergies. This is advantageous, e.g., since TLV, LV and IVO all perform supervisions on the outpatient pharmacies. TLV collaborates with corresponding agencies on an European level, often within the European Network for Health Technology Assessment. TLV further participates in Nordic collaborations regarding health economy.
Inter-organizational education	Actors in the NLS	Workshops and seminars on broad healthcare topics are regularly held with actors in the SPSC. Who participate differ depending on the topic. Educational workshops are regularly held in NLS, e.g., a workshop concerning back-orders held by LV.	Education in appropriate response Education in supply chain structure	Understand interdependencies and dynamics Learn successful strategies	TLV has taken part in seminars concerning clinical efficiency where both European actors and CCs were represented.
Simulation	*Learning method not used*				
Analyzing experiences	*Learning method not used*				
Stimulate flexibility	County councils (CC)	TLV tries to create flexibility by adjusting regulations, e.g., allowing temporarily subventions, and clarifying roles in the SPSC. The flexibility measures taken often involve the country councils.	Continuous reorganization	Minimize vulnerability in the supply chain Learn successful strategies	TLV constantly tries to find ways to increase flexibility in the SPSC by making adjustment within the limits of the law

5.12| Swedish Medical Products Agency (LV)

All information in chapter 5.12 was received during a conducted interview with Gårdmark Östh (2018).

Representing interviewee:	Representing LV was Karin Gårdmark Östh, Project Leader for Medicinal Products in Use at LV. Gårdmark Östh has worked at LV for more than 15 years and has, e.g., recently been coordinating the project and workshops about backorders within NLS.

An overview of LV's collaborative and learning relationships in questions concerning pharmaceuticals supply can be seen in the map in Figure 5.11 and a summary of LV's used interorganizational learning methods in these relationships can be seen in Table 5.12.

Figure 5.11: Collaborative and Learning Relationships, LV

Table 5.12: Summary of Interorganizational Learning, LV

Learning method used by LV	Actors	Specification	Sub-methods	Learning goals	Further aspects and comments
Vertical information sharing	LIF FGL SKL Pharma-ceuticals producers (PPs)	Information about, e.g., the current status of pharmaceuticals is shared w/ the other actors in the SPSC though LV's website. Information about back-orders is published at LV's website through a back-order list. LV has continuous contact w/ trade- and professions associations, mainly LIF, FGL and SKL. Concerning large disruptions, e.g., back-orders of important pharmaceuticals w/ no generic substitutes, LV has a direct information exchange w/ involved PPs. TLV and LV jointly gives regulatory advice to PPs to facilitate obedience of regulations.	Information sharing for dynamics knowledge Information sharing for improving regulations Information sharing for managing a crisis	Understand interdependencies and dynamics Enabling high situational awareness in a crisis Understand how regulations influence operations and how they can be improved	LV prefers contact via trade- and professions associations to avoid unfair advantages for individual actors in the market.
Vertical joint assessment	*Learning method not used*				
Vertical collaborative planning	Actors in NLS	Collaborative planning is conducted in strategic questions w/i the NLS network. Collaborative planning is also conducted with actors not part of NLS, e.g., D and FGL, when they are invited to topic specific workshops in NLS. Coordinated crisis mgmt. procedures are developed for withdrawals of pharmaceuticals, including, e.g., PPs, Ds, O-Phs, H-Phs and Hs.	Coordinated prevention of disruption Coordinated crisis management procedures	Minimize vulnerability in the supply chain Avoid holes and duplication in response efforts Enabling high situational awareness in a crisis Find strategic solutions to overall problems	

Horizontal information sharing	eHM TLV Actors in NLS	LV has a close collaboration w/ eHM, sharing IT-platform and thus a lot of information, e.g., approval status and deregistration of pharmaceuticals. LV shares information regarding interchangeable pharmaceuticals groups w/ TLV. TLV and LV further jointly gives regulatory advice to PPs. LV often collaborates w/ other governmental agencies though investigations assigned by the government after discussions held in NLS.	Sharing for industry coordination Horizontal benchmarking	Understand risks and external threats Learn successful strategies	LV has horizontal information sharing and interorganizational learning with other countries' governmental agencies in EMA and the Nordics.
Inter-organizational education	*Learning method not used*				An education of how the SPSC is structured and the different actors' roles in it, held for all actors in the supply chain, is believed to be missing.
Simulation	*Learning method not used*				Simulations are only done internally. No overall simulations are believed to be conducted in the SPSC.
Analyzing experiences	eHM SKL	LV conducts strategic experience analysis together with multiple actors after larger disruptions. This involve different actors depending the disruption, but eHM and SKL are often involved. Deviation analyzes are conducted on an operational level by all actors in the SPSC, often CC, H, Ph-C and/or O-Ph. Larger deviations are reported to LV. The process is regulated in law and well established.	Post-disruption analysis	Understand why frequent errors occurs Improve operational routines Avoid holes and duplication in response efforts	There is a need to do more consequence analysis in NLS regarding the IT and information flow to understand why errors occurs. A more structured method for conducting interorganizational analysis of incidents on a strategic level is needed. It is believed that it would be favorable with more collaboration during the whole analysis process, instead of just summarizing the actors' individual thoughts in the end. The lack of a joint understanding of the SPSC structures and systems is believed to hinder interorganizational experience analysis.
Stimulate flexibility	*Learning method not used*				LV tries to be flexible and find practical solutions w/i the limits of the law.

6| Analysis

This chapter summarize and analyze the developed strategic map of the SPSC. Further, the theoretical framework with regards to interorganizational learning is compared with the empirical findings in a gap analysis.

6.1| Strategic Mapping of SPSC

Based on the developed maps of the material flow, regulatory frame and collaboration in the SPSC under normal circumstances and in a crisis as presented in chapter 4 and illustrated in Figure 4.1-4.3, some interesting aspects will be pointed at and further briefly discussed.

6.1.1| Material Flow

JIT and no safety stocks

One characteristic of the SPSC that repeatedly is being discussed and stressed as a potential barrier for resilience, is that both private and public actors in the supply chain have gradually streamlined their operations and stocks in accordance with, e.g., Lean and JIT. Also, no specific actor has a pronounced responsibility to keep safety stocks as Apoteket AB had before the deregulation of the pharmacy market in 2009, except the small and very specific stocks held by SoS and FHM. Practitioners mean that there currently are no incentives or strategic arguments for any individual actor in the SPSC to keep safety stocks. Still, the concern about the system's resilience during a large-scale crisis is obvious among practitioners and the increasing number of shortages, e.g., due to backorders, is a well-known problem in the SPSC. Moreover, regulations limit patients from collecting pharmaceuticals for more than three months use, hence making individual patients very dependent on a well-functioning pharmaceuticals supply under normal circumstances as well as in crises.

Increasing number of backorders

Several actors in the SPSC stress that there is an escalating problem with backordered pharmaceuticals that may lead to shortages and inadequate healthcare to the patients. This is believed to be a large problem in all countries in Europe, but especially in smaller countries like Sweden. Several potential reasons for the problem are presented, for instance there is a shortage of active substances at the raw material manufacturers, it is a consequence of the JIT focus in the SPSC and that pharmaceutical producers choose to supply other markets with higher prices or volumes than Sweden. Other actors explain how the problem might be due to inadequate forecasting and ordering by the county councils, so that large stocks end up at some hospital pharmacies, while other hospital pharmacies request the product, leading to backorder situations. Because of regulations, the pharmaceuticals cannot be transferred between the hospital pharmacies, and may instead be sent back to the distributors for destructions when they pass their expiration date. Further, other practitioners state that the problem is hampered

by key actors, e.g., pharmaceuticals producers and distributors, not being transparent about their stock levels and known upcoming changes in operations, which makes it hard for the other actors in the supply chain to work proactively. It is hard for the actors in the SPSC to respond to sudden changes, since all kind of changes with regards to pharmaceuticals needs to be approved by authorities in time consuming regulatory processes. Unstructured or rare inventory updates in the integrated ordering systems may also be to blame for some shortage situations. Several actors in the SPSC explain that they feel powerless and constrained in regard to what they can do to minimize the backorder problems.

However, the backorder situations do not automatically lead to pharmaceuticals shortages for the patients, since the situation often can be solved by a generic interchange, by allowing a foreign package or issuing a temporary license. These alternatives are widely more used today than a few years ago. Actors in the SPSC has worked hard to find such joint routines for how to handle backorder situations to avoid shortages in the healthcare, a work that mainly has been conducted via workshops in NLS. Although most actors are happy about the issue being raised in NLS, opinions differ about what the problem at hand really is. A lot of attention has thus been paid to treating the symptoms of backorders, but several practitioners stress that the actors in the SPSC have not truly agreed on the root cause and thus not taken actions to tackle it.

Global dependency

A third important aspect of the material flow in the SPSC is that the Swedish market, as well as the European and global market, is highly dependent on international trade. Most pharmaceuticals for the Swedish market are produced in foreign countries and from a global perspective, the Swedish market is small and has relatively low penalties for missed deliveries. The long distance between the production and healthcare providers makes it both impractical and rare with close collaboration and interorganizational learning between the different actors. An increasing collaboration and coordination in the public sector is though done on an European level, to be able to increase the negotiation power and better match private global pharmaceuticals producers and distributors.

Moreover, there is a trend that Europe is increasingly seen as one market from a logistics perspective, why Swedish distributors stress that the central warehouses currently supplying the Swedish market may gradually move away from the Nordics and instead be placed more centrally in Europe. This could potentially be devastating in a situation where the international trade is stopped, while the pharmaceuticals intended for the Swedish market are located outside the national borders.

Better segmentation is needed for crisis preparedness

Several actors in the SPSC stress that a better segmentation of pharmaceuticals and a specification of which illnesses to treat are needed for both crises and wars. It is not possible nor necessary to constantly keep security stocks for all pharmaceuticals available in the Swedish market, why a segmentation is needed to form the basis for stock levels of different types of pharmaceuticals. One county council has made a list of critical pharmaceuticals, consisting of approximately 3000 pharmaceuticals, and put together an assortment council monitoring the availability and risks of back-orders for these pharmaceuticals. If a back-order situation does occur for any of the pharmaceuticals in the list, the council has further created a process for how to act. Some other county councils have also started to make lists of critical pharmaceuticals to later be able to organize their operations and inventories depending on this list. A lot of county councils, however, still have not looked at segmentation of pharmaceuticals. In summary, what is assessed to be critical may differ between the county councils, why a national segmentation and assessment of critical pharmaceuticals would be valuable to ensure a national crisis preparedness.

When it comes to the small stocks kept at the outpatient pharmacies, these are currently based on the regular demand in the geographical area. Roughly 3 000 - 4 000 types of 15 000 available prescriptive pharmaceuticals are kept at an outpatient pharmacy of normal size. The cycle stocks kept at the distributor are also based on the normal consumption or demand in the Swedish market, even though the total stocks are so large so that they can cover sudden increases in demand due to crises. Practitioners believe that national guidelines for how these types of actors should segment and handle their stocks is necessary to uphold an overall crisis preparedness in the healthcare and pharmaceuticals system.

6.1.2| Legal Frames

Lack of contracts in single distribution channel system

Most times, there are no direct contracts between the distributors and the actors in the downstream material flow in the SPSC as seen in Figure 4.2. Instead, the distributors are by law required to offer daily deliveries of the pharmaceuticals included in its wholesale permission to every single pharmacy with a retail permission in Sweden. Hence, there is no need for individualized contract between the distributors and the pharmacies, since all pharmacies are to receive the same type of service. The same is true for the pharmacy contractors often running the hospital pharmacies on behalf of the county councils They distributors may, however, though be indirectly connected to the pharmacy contractors. This since there often is a chain of contract from distributors, via pharmaceuticals producers and county councils, to the pharmacy contractors that operate the hospital pharmacies.

The lack of contracts and heavy reliance on laws and regulations causes problems in the SPSC. It clearly weakens both the outpatient and the hospital pharmacies negotiation power towards the distributor. This since they have no direct influence methods or levers on the distributors but instead have to press the parliament, SD and governmental agencies to change laws and

regulations or in the case of the pharmacy contractor, influence the distributor through a long chain of contracts. However, the single distribution channel system also ensures equivalent pharmaceuticals supply for all actors in the market. No judgement is made about whether it is a good overall system or not, but it is important to be aware of that the current system clearly limits some actors strategy and operations, forcing them to work in different ways than actors that can rely more on interorganizational contracts.

Horizontal movement of pharmaceuticals is not allowed

One major barrier for resilience in the SPSC is the regulations preventing healthcare providers from moving pharmaceuticals between their facilities. Practitioners in almost all parts of the SPSC stress that these regulations cause problems in the daily operations, affecting both the given healthcare, costs and crisis preparedness. Currently, the regulations do not allow redistribution of pharmaceuticals between the healthcare providers, which practitioners believe is suboptimal for the resilience of the overall system and further limits interorganizational collaboration and learning, since the healthcare providers are forced to either have their own full-service stocks or trust that the larger actors upstream in the SPSC have sufficient stocks for a well-functioning JIT system. For example, the county councils mean that these regulations prevent them from working with healthcare and pharmaceuticals supply from a countywide perspective, thus not fulfilling their responsibility with regards to countywide crisis preparedness. Further, smaller county councils stress that they do not have the necessary resources to build crisis preparedness if they are not allowed to collaborate with regards to pharmaceuticals supply between different healthcare providers in the same and different counties. Several of the interviewed actors have repeatedly raised the issue with relevant governmental agencies, but still no investigations or changes have been initiated within the area. These actors doubt whether, e.g., LV have understood the practical limitations and associated weaknesses of these laws and regulations. A possible reason for this is that most communication and interorganizational learning between governmental agencies and the actors involved in the physical material flow in the SPSC, is done via different types of trade- and profession associations. It might be that these organizations do not fully manage to mediate the real operational problems to relevant governmental agencies.

Constraining regulations for giving advanced healthcare in a patient's home

Another area where current laws and regulations limit the county council's operational possibilities, is when it comes to prescriptions for pharmaceuticals for advanced healthcare given in a patient's home. Currently, the county councils cannot deliver the needed medicines directly to the patient as if they were treated at a hospital but need a doctor to prescribe the pharmaceuticals whereby the patient collects the pharmaceuticals from a pharmacy. Even if the patient undergoes, e.g., dialysis and the medicines used in that case make up large volumes of liquids which the patient needs help to transport to their home, the county councils are not allowed to do this directly but need the patient to go via a pharmacy actor. Several interviewed actors stress that the current laws and regulations are not compatible with a modern healthcare, where patient are no longer treated only in hospital facilities. County councils further stress that they want an extended responsibility for organizing advanced healthcare in patients' homes.

Undefined crises responsibilities

Several county councils tell how they have been assigned a lot of responsibility and requirements when it comes to pharmaceuticals crisis preparedness and planning for civil defense, while at the same time receiving minimal national support to be able to fulfill these requirements. The county councils thus find it very hard to execute their work in a satisfactory way. The limits of the county council's geographical responsibility is further unclear, for example should they ensure that the outpatient pharmacies within the county's geographical area keeps sufficient stock, or is this more of a national matter?

Further, the responsibilities of and limits between different actors in terms of crisis preparedness and crisis management are not clear in the SPSC. Several central actors stress that they do not know what their role would be during a crisis. Some central strategic and coordinating actors, e.g., SKL and TLV, have no formal responsibilities in crisis management, while operational actors often are not required to work with large scale crisis preparedness. This since there are no overall law or regulation specifying the requirements on private actors, e.g., pharmaceuticals producers, distributors, pharmacy contractor and outpatient pharmacies, in a crisis. Hence, the majority of the actors involved in the material flow of pharmaceuticals have no responsibility in a crisis if not specified so in contractual agreements. Only during a state of alert, is it specified that companies with "specific agreements or obligations" to maintain their operation in war, should take necessary actions in terms of planning and preparation.

6.1.3| Collaboration

Strong link between contracts and collaboration

Comparing the legal frames and the collaborative landscape, it can be seen that there is a clear link between the actors having contracts with each other and the actors having strong collaborative links. For example, the pharmaceuticals producers and distributors versus the county councils and pharmacy contractors and extemporaneous pharmacies are actors closely linked together both contractually and collaboratively. Comparing the legal frames and the collaborative map, it is also clear that there are few contracts and little collaboration between the distributors and actors further down the material flow. Because of the Swedish single channel distribution system of pharmaceuticals, there is no need for direct contract between these actors, which though the later actors in the supply chain believe is problematic as they have no leverage towards the distributors. There is though some collaboration between the distributor and the outpatient pharmacies, as the distributors have initiated this, but there is no collaborative connection with the inpatient care. The distributors are further not represented in NLS by any trade- or professions association, which otherwise has the potential to be a natural collaboration forum.

Collaboration forums are newly developed

One large trend looking at collaboration in the SPSC, is that most networks and collaboration forums in the SPSC are relatively new and have been developed within the last ten years. When the monopoly was deregulated in 2009, the existing networks were dissolved, and the knowledge was spread out between the private actors and the county councils. Corresponding networks and knowledge as well as the ability to learn from each other have therefore taken time to rebuild, which may be a causing factor for the current structure of the collaboration in the SPSC.

Competition law

Naturally, the Competition Act regulates how much competing actors can collaborate, and most interviewed actors in the SPSC are very careful to strictly follow this law. This can for example be seen in discussions in LIF and LDF, where a legally educated person is present in the discussions and interrupts all collaborations that could potentially break the law. In total, this is probably an underlying factor why little collaboration is seen between horizontally competing actors.

6.2| Gap Analysis of Interorganizational Learning in SPSC

6.2.1| Introduction

Since this study follows a pre-structured method as explained in chapter 2, part of the gap analysis for each interviewed actor has already been done when structuring the interview answers in chapter 5 and appendix C in accordance with the predefined theory. This chapter will further add a gap analysis for each theoretically identified interorganizational learning method and discuss the trends of interorganizational learning in the SPSC.

Each section in the chapter starts with an overview of if and how the specific interorganizational learning method and its sub-methods are used in the SPSC. For each learning method, an overview of the sub-methods used by the interviewed actors is presented in a table, followed by a discussion about the general use of the method based on the findings from the interviews presented in chapter 5 and appendix C. Further, some interesting aspects are highlighted, aspects that are considered important for how interorganizational learning can be developed in the SPSC within each method. Lastly, the goals and prerequisites for the specific learning method are discussed. Each section concludes with a summary of suggestions for improvement. The learning methods are presented in the same order as in chapter 4 and 5. In the end of the chapter, a summarizing analysis of interorganizational learning in the SPSC is provided.

6.2.2| Vertical Information Sharing

As can be seen in table 6.1, vertical information sharing is a widely used interorganizational learning method by all interviewed actors. All interviewed actors share information for dynamics knowledge and almost all actors involved in the material flow share information for resource knowledge. It can further be seen that some actors know how they share information during a crisis, while others have not been in a critical situation where it has been necessary to involve other actors alternatively do not know how they would communicate with other actors in such a situation. Based on the data in Appendix C, it can be seen that actors overall paying a lot of attention to crisis preparedness are the ones that have a better idea of how to communicate externally during a crisis and also state in their interviews that they do systematically share information with relevant actors during crises. Almost all actors regularly share their opinions regarding improvement of regulations and laws. A common trend among the interview answers is, however, that the actors involved in the material flow believe that the governmental agencies do not change the regulations often enough and that they do often not understand the extent of problems that inadequate regulations are causing.

Table 6.1: Overview of Vertical Information Sharing in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Information sharing for resource knowledge	X	X	X	X	X	X	X				
Information sharing for dynamics knowledge	X	X	X	X	X	X	X	X	X	X	X
Information sharing for managing a crisis	X	X					X			X	X
Information sharing for improving regulations	X	X	X		X	X	X	X	X		X

Different opinions regarding the optimal extent of resource knowledge sharing

Resource knowledge is said to be shared by all actors participating in the material flow except hospitals only receiving resource information, being the last actors in its part of the SPSC. However, although information is being shared between the actors, several of the interviewed actors believe that the information quality is poor and that a lot of information is shared when a supply issue has already occurred, preventing the actors from working proactively with planning and forecasting. The two large distributors have access to a lot of information about usage, inventory levels and distribution in the SPSC, because of the single channel distribution system and since one of the distributors is responsible for destroying all unused pharmaceuticals. This information often enables the distributors to foresee potential shortages before the other actors in the SPSC and thus, sharing this information clearly have the potential to facilitate for actors further down in the SPSC. However, due to contractual agreements with the pharmaceuticals producers, the distributors are not allowed to share information such as exact inventory levels. The rationale behind not sharing this information is that sharing detailed inventory levels would only push potential disruptions to occur earlier and possibly make them worse than necessary, this due to the risk of overexaggerated stockpiling in cases of low inventory levels. The interviewed distributor instead believes historical data on pharmaceuticals use, held by the county councils, could improve the ordering quantities and forecasts in this part of the supply chain. To summarize, the opinion of weather a sharing of more detailed resource knowledge would minimize shortages in the SPSC or not, differs between the actors. Clear is that the actors view the need for and usefulness of resource knowledge sharing from different angles and that a shared understanding of necessary information sharing is lacking. A discussion between the distributors and actors further down the material flow about the optimal extent of resource knowledge sharing for minimizing shortages in the SPSC, could possibly lead to a better understanding of the needs and rationales for everyone involved.

No distinction of discussions regarding regulatory changes versus changes of routines

Both public and private actors in the SPSC regularly share opinions regarding laws and regulations with concerned governmental agencies as well as give comment letters to referrals. The opinions and feedback are in most cases shared through the actors' respective trade organizations, giving a more gathered view as well as the possibility to have a greater impact than if every organization tried to influence separately. The system for sharing opinions concerning laws and regulations is clearly defined and most actors believes that the system works well. However, a common belief among the interviewed actors is that the governmental agencies do not consider the opinions or suggestions from the practitioners to a sufficiently high degree and that they are too slow and afraid to change the regulations. The interviewed governmental agencies on the other hand, believe they are flexible and always find solutions to the brought-up issues within the limits of the law. Thus, while one part tries to find solutions by pointing out things to *change in the law* the other part tries to find solutions by *new routines within the limits of the law*, naturally leading to miscommunication and difficulty in learning from each other. A better distinction of when the interorganizational discussions concentrate on regulatory changes versus changes of routines may thus possible minimize the frustration and increase the joint learning.

Looking at the learning prerequisites and learning goals for the specific interorganizational learning method, most learning goals are said to be meet by more than half of the interviewees, which is not surprisingly given the widespread use of the learning method. All but one actor uses vertical information sharing to *understand interdependencies and dynamics* and seven actors to *understand resources in the supply chain* as well as *understand risks and external threats.* Five actors further use the learning method to *enable high situational awareness in a crisis* and five actors also state that the learning method is used to *understand how to improve regulations*. Given the interview answers, there seem to be a clear *vertical communication structure* as well as a *vertical communication committee*, enabling the information interchange. What may be missing to some degree in terms of learning prerequisites, given the previous discussion on resource knowledge sharing, is *trust* between the vertical actors, especially between the pharmaceuticals producer and distributor in relation to later actors in the material flow.

The improvement suggestions from this section are summarized in Table 6.2

Table 6.2: Summary of Improvement Suggestions, Vertical Information Sharing

Improvement suggestion	Rationale
Have a discussion between the distributors and actors further down the material flow about the optimal extent of *resource knowledge sharing* for minimizing shortages in the SPSC.	Increase the understanding of the information needs and rationales for everyone involved in the material flow, to allow for a joint view of the most effective way to minimize shortages in the SPSC.
Specify when comment letters on referrals and other *vertical information exchanges* with governmental agencies are meant to focus on regulatory changes versus changes of routines.	Minimize the misunderstandings and feelings of not being listened to in regulatory discussions between practitioners and governmental agencies, hopefully leading to more efficient and constructive discussions.

6.2.3| Vertical Joint Assessment

Vertical joint assessments are not used at all by five of the eleven interviewed actors in the SPSC as illustrated in Table 6.3. Most of the interviewed actors describe how they mainly conduct assessments internally, even though they sometimes share these assessments with other actors in the SPSC. *Joint assessment of current status* is used by both the inpatient and the outpatient care, by four actors involved in the operational planning. Four actors in the SPSC further use *joint risk analysis,* but two of these actors though highlights that the risk analyzes are not conducted often enough to be valuable for the daily risk management. *Joint forecasting* is only said to be used by one of the interviewed actors, the distributor, who though believes it to be a very helpful method to improve forecasts and a method that could potentially minimize problems with back-orders if used more extensively.

Table 6.3: Overview of Vertical Joint Assessment in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Joint assessment of current status			X	X	X		X				
Joint risk analysis		X		X			X	X			
Joint forecasting		X									

A willingness to increase the use of joint assessments

In general, joint assessments is not an as widely used interorganizational learning method as could be expected, given the benefit of making assessments based on multiple perspectives and inputs. Several of the interviewed actors though state that they see potential in using the learning method more. One county council using the method describes a need to conduct joint risk assessments more often to be able to use it on a regular basis while another county council awaits governmental instructions for how to work with the method in the future, believing that it has the potential to be helpful. The distributor point towards possible improvement of risk analyzes and forecasts if more joint assessments would be made with the outpatient pharmacies and further believes that backorder problems within the inpatient care partly could be minimized if increasing the use of joint forecasting together with the county councils. Thus, it seems to be a willingness to increase the use of joint assessments in the SPSC. Why the method is not more extensively used is not clear, but one potential reason may be lack of knowledge about how to conduct joint assessments effectively and regularly. The authors believe that an increased use could increase the preparedness in the SPSC and enable the actors better understand the supply chain from a bigger perspective.

Looking at learning prerequisites and learning goals, it can be seen that all actors conducting joint risk analysis has the learning goals of *understanding risks and external threats* as well as *minimize vulnerability in the supply chain* and often also *understand interdependencies and dynamics*. Only two of the six actors using vertical joint assessment make it with the goal of *understanding resources in the supply chain*. A lack of one or several of the necessary learning prerequisites, *supply chain management team, trust* and *supply chain map*, may be one explanation for the little use of vertical joint assessment in the SPSC. Data from the interviews indicate that no overall supply chain management team govern the SPSC and that an overall supply chain map is missing, hence the objective of this thesis. It might further be that the actors in the SPSC do not trust each other enough to reveal weaknesses and fears during joint assessments of current status and joint risk analysis or reveal information about the market in joint forecasts. This might be due to the actors being afraid of being exploited if they reveal such information. However, this is just one possible explanation that though is not explicitly clear given the interview answers.

The improvement suggestion from this section is summarized in Table 6.4 below.

Table 6.4: Summary of Improvement Suggestion, Vertical Joint Assessment

Improvement suggestion	Rationale
All actors should focus more on making *vertical joint assessments*, e.g., *joint risk analysis* and *joint forecasting*, in the SPSC.	There is a willingness and believed benefit of using the learning method by practitioners in the SPSC.

6.2.4| Vertical Collaborative Planning

As can be seen in Table 6.5, *vertical collaborative planning* is a learning method used by all interviewed actors except one, who though expresses an ambition to start using it in the near future. The extent of collaborations and used learning sub-methods varies between the interviewed actors. *Coordinated prevention of disruption* is used extensively by most actors on both a strategic and an operational level. One noteworthy exception is the interviewed pharmaceuticals producer, who primarily takes action for prevention of disruptions internally. Numerous of the mentioned preventive efforts are jointly developed within NLS. *Coordinated contingency plans* are used by roughly half of the interviewed actors, often conducted in pairs. The development of coordinated contingency plans does not include any actors working with pharmaceuticals supply on a strategic level, in other words governmental agencies and trade- and professions associations. *Coordinated crisis management procedures* are developed by the same actors that develop coordinated contingency plans, except the distributor. One governmental agency also develops coordinated crisis management procedures for strategic or structural problems with other actors in the SPSC. Once again, roughly half of the interviewed actors regularly use *coordinated response efforts*. This method is continuously used during, e.g., back-orders and shortages situations, to jointly learn from each other to improve the response and ability to recover.

Table 6.5: Overview of Vertical Collaborative Planning in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Coordinated prevention of disruption		X	X	X	X		X	X	X	X	X
Coordinated contingency plans	X	X		X	X		X	X			
Coordinated crisis management procedures	X			X	X		X	X			X
Coordinated response effort	X		X	X	X			X		X	

Go from collaborative planning to collaborative action taking within NLS

Vertical collaborative planning continuously take place within the NLS. This forum enables actors to highlight problems needed to be discussed by the whole supply chain and develop sector wide preventive measures and response efforts. However, NLS is not a decision-taking body, why the developed solutions need to be decided upon, financed and implemented outside this forum. This can be done for example by internal decisions in the actors' organizations, by the parliament changing the laws or SD assigning its governmental agencies to conduct investigations or authorizing them to change regulations. Still, while many of the interviewed actors agree that NLS have improved the overall collaboration and interorganizational learning between the actors in SPSC, many also stress that the collaboration forum is still not ideal. Not

all actors in the SPSC are represented in NLS, why discussions held there do not include the entire SPSC's perspectives. On the other hand, the actors being represented in NLS have different tasks and focus and it is thus hard to always keep the discussions relevant to everyone involved. Further, NLS is a collaborative forum for *pharmaceuticals issues*, not *pharmaceuticals supply issues*, why the supply-related topics only get a limited focus. In total, NLS currently is more of an information sharing forum than a forum for joint action taking, and thus yet has to find a structure to enable actors to go from information sharing and collaborative planning to action and implementation. If to many efforts end already in the planning phase, the actors might lose their interest in the forum.

Distance between the actors prevents meaningful collaboration
Multiple actors, both public and private, highlight a desire to make more collaborative plans together with the pharmaceuticals producers' global units. Especially coordinated contingency plans are mentioned as a specific method that would improve the actors' ability to recover after a crisis. However, almost all contact between the pharmaceuticals producers and the other actors in the SPSC is done through the pharmaceuticals producers' subsidiaries, preventing collaboration and mutual learning between the parties that mainly can impact the pharmaceuticals supply. The pharmaceuticals producers, however, often have this organizational structure to simplify their operations and in accordance with one pharmaceuticals producer's subsidiary, the subsidiaries' have the expert knowledge of the Swedish market why the contact should go through them. Weather the global unit would be willing to collaborate more directly with the Swedish actors is, however, not known, since no interview was conducted with them and few of the interviewed actors have been in contact with them despite the expressed desire. It is though worth investigating if there is an interest from global pharmaceuticals producers to increase the collaborative planning via, e.g., coordinated contingency plans, as this is believed to be helpful for many of the Swedish actors.

All nine actors using the learning sub-method coordinated prevention of disruption, does so with the learning goal of *minimizing vulnerability in the supply chain*. Less than half of the interview actors use vertical collaborative planning explicitly to *enable high situational awareness in a crisis* and *avoid holes and duplication in response effort*. Regarding the learning prerequisites, *supply chain management team, trust* and *supply chain map*, being the same as for vertical joint assessment, a lack of one or several of them may obstruct the collaborative planning in the SPSC. As indicated in the earlier discussion about NLS, no clear supply chain management team with decision-making mandate govern the SPSC. Of course, the parliament govern the SPSC by writing the laws and SD are responsible for all governmental agencies within the pharmaceuticals supply areas, but these functions have very broad roles, not only focusing of pharmaceuticals supply issues, why they hold the decision-mandate but not the expertise knowledge expected of a supply chain management team. An overall supply chain map of the SPSC is further missing, which may obstruct the discussions in NLS and other collaborative forums. Looking at trust, that might once again be a prerequisite missing for vertical collaborative planning, but this is not stated explicitly in the given interview answers in this section.

The improvement suggestions from this section are summarized in Table 6.6 below.

Table 6.6: Summary of Improvement Suggestions, Vertical Collaborative Planning

Improvement suggestion	Rationale
Find a structure within NLS to enable actors to go from *information sharing* and *collaborative planning* to action and implementation.	NLS currently is more of an information sharing forum than a forum for joint action taking. This, since developed solutions need to be decided upon, financed and implemented outside NLS. If to many efforts end already in the planning phase, the actors might lose their interest in the forum.
Investigate if there is an interest from global pharmaceuticals producers to increase the collaborative planning with the Swedish actors via, e.g., coordinated contingency plans.	Coordinated contingency plans with the global pharmaceuticals producers are believed to improve the Swedish actors' ability to recover after a crisis, as the global units and not the Swedish subsidiaries are the ones that mainly can impact the pharmaceuticals supply to Sweden.

6.2.5| Horizontal Information Sharing

All interviewed actors conduct some form of *horizontal information sharing* as can be seen in Table 6.7, but the degree of information sharing differs a lot depending on the competitive climate between the actors. Between public actors, e.g., county councils, the collaboration is extensive while between private actors, e.g., the outpatient pharmacies, the use of horizontal information sharing as a learning method is limited due to competitive reasons. Through their trade- and professions organizations, a lot of actors *share information for industry coordination* while only the public non-competing actors use *horizontal benchmarking*. All public actors believe horizontal benchmarking is a very valuable interorganizational learning method, but in a competitive market, critical success factors are not worth revealing for competitors.

Table 6.7: Overview of Horizontal Information Sharing in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Information sharing for industry coordination	X	X	X	X	X	X	X	X	X	X	X
Horizontal benchmarking					X	X	X	X	X	X	X

Potential for more horizontal information sharing between non-competing actors

Despite the apparent benefits of horizontal collaboration with regards to pharmaceuticals supply between non-competing actors, horizontal information sharing is not as extensively used as could be expected. Four of the interviewed actors state that the information exchange and collaboration between both different governmental agencies and between hospitals within the same county, is not using horizontal information sharing as widely as believed to be beneficial. Lack of coordination between the governmental agencies has led to some overlapping regulations and grey areas, creating unclarities for the operational actors, that do not feel like they have enough coordinated support from the governmental agencies to resolve the unclarities. Due to the lack of overview, governmentally assigned investigations are believed to often only solve the specifically defined issue instead of the underlying problem. The governmental agencies have started to increase their coordination and benchmarking but still have improvements to do. One county council has seen a need to increase the county's hospitals' horizontal benchmarking, since different hospitals currently find new solutions to the same problem, requiring unnecessary resources. Thus, industry coordination and horizontal benchmarking between both governmental agencies and between hospitals in the same county, has potential to be further developed and an ambition to do so appears to exist.

Looking at learning goals, all actors using horizontal benchmarking do so to *learn successful strategies*. Many actors, eight out of eleven, further use horizontal information sharing to *understand interdependences and dynamics* as well as *understand risks and external threats*. Other stated learning goals are, e.g., to develop a joint front toward governmental agencies for maximal impact, to develop a safety network for emergencies as well as to achieve synergies by close collaboration with similar public actors. Regarding learning prerequisites, most actors have a stated *horizontal collaboration committee*, often organized via a trade- or professions association, for their horizontal information sharing. However, in the examples mentioned above, the hospitals within a country as well as collaboration between governmental agencies, no such clear horizontal collaboration committee exists, which may be a reason for the lacking horizontal collaboration. Looking at the interview answers, the level of *trust* can be seen to differ between the actors. For non-competing actors it is generally high while it is naturally lower for competing actors.

The improvement suggestion from this section is summarized in Table 6.8 below.

Table 6.8: Summary of Improvement Suggestion, Horizontal Information Sharing

Improvement suggestion	Rationale
Increase *horizontal information sharing*, both *information sharing for industry coordination* and *horizontal benchmarking*, between non-competing actors in the SPSC, e.g., governmental agencies and hospitals within a country.	Avoid using unnecessary resources by repeatedly reinventing the wheel, as well as avoid using unnecessary resources to resolve situations caused by a lack of coordination and overview in the first place.

6.2.6| Interorganizational Education

Most interview actors describe that they rarely use *interorganizational educations*, but primarily work with internal educations. However, the given answers may be influences by how the method interorganizational education is interpreted. While some actors for example have interpreted information seminars conducted by NLS as interorganizational educations, other actors have seen this more as *vertical or horizontal information sharing*. Thus, some overlap between these learning methods exist.

However, *interorganizational education* is somewhat used in the SPSC as seen in Table 6.9, but to a limited extent and on a shallow level. *Education in appropriate response* is conducted mainly through workshops focusing on current and upcoming pharmaceutical supply issues. These educations help the actors understand the issues better and therefore adapt better if a disruption occurs. *Education in supply chain structure* is the most commonly used sub-method within interorganizational educations, as it is used by roughly half of the interviewed actors. This method enables the actors to understand the structure of the SPSC and, thereby, better understand how disruptions in the supply chain may affect themselves as well as other actors and it is primarily used when changes in the SPSC and its regulations need to be spread to the practitioners. Even if many actors do not view these information seminars and workshops as educations, all actors in the SPSC are often invited and participate occasionally. Still, the fact that many actors do not mention these seminars as chances for interorganizational learning indicates that the actors might not be learning as much as suggested by theory. *Education in security procedures* is not used by any actor in the SPSC. Whether this is because most actors in the supply chain do not have normal supplier-customer relationships is hard to determine, but it might be a contribution factor.

Table 6.9: Overview of Interorganizational Education in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Education in appropriate response	X	X				X				X	
Education in supply chain structure	X	X	X			X				X	
Education in security procedures											

General education about SPSC's structure is believed to be missing

One interviewed governmental agency describes a large need to conduct a more general education about the SPSC's structure to create a fundamental understanding and better overview of the SPSC. Given that a general structural map over the SPSC currently is missing. Hence the objective of this thesis, this seems to be an accurate claim. One reason that it has not been created before might be that each county council has its own structure for the healthcare system within its geographical area of responsibility and that no map can show all these exceptions without losing the overview. However, it is believed that a generalized picture would improve the broad understanding of the interdependencies in the SPSC and, thereby, facilitate the interorganizational discussions.

All actors conducting educations in supply chain structure has *understanding interdependencies and dynamics* as a learning goal and all actors conducting education in appropriate response has *learning successful strategies* as a learning goal. Regarding the learning prerequisites, *vertical and horizontal collaboration committees*, no signs that they are missing is seen in the interview answers. However, given the discussion above regarding the need for an interorganizational education about the SPSC's structure, a *supply chain map* is believed to be a prerequisite not fulfilled in the SPSC. Even though a supply chain map is not a prerequisite for interorganizational education in general, it is though necessary to be able to arrange general and overall educations in supply chain structure. Further, if it is missing, it makes is harder to use many of the other interorganizational learning methods, namely vertical joint assessment, vertical collaborative planning, simulation, analyzing experiences and stimulate flexibility. In this thesis, a general map of the SPSC is provided which the actors are encouraged to use and further refine as needed.

The improvement suggestions from this section are summarized in Table 6.10 below.

Table 6.10: Summary of Improvement Suggestions, Horizontal Information Sharing

Improvement suggestion	Rationale
Conduct a general *interorganizational education* about SPSC's structure and interdependencies.	Allow for all actors to create a fundamental understanding and better overview of the SPSC, which probably will facilitate interorganizational discussions.

6.2.7| Simulation

Only four of the eleven interviewed actors are using *simulation* as an interorganizational learning method for resilience, as can be seen in Table 6.11. However, among those actors using it, simulation is believed to be an irreplaceable method to understand interdependencies, avoid holes and overlaps in response efforts as well as learn successful strategies. Even by the actors not using the method, or actors only conducting internal simulations, many see a potential value to start using it on an interorganizational level. Noteworthy is that none of the actors working on a strategic level use the method of simulation. The most commonly used simulation sub-method is *practicing exercises*, used by four of the interviewed actors, where actors jointly practice shared routines. Some actors have further created *scenario-based trainings*. These trainings are the ones that, in accordance with the interviewed actors, creates valuable learning opportunity to improve adaptability. *Role-playing* is currently not used by any actor in the SPSC. However, according to theory, this method could be valuable when trying to find new and unexpected threats.

Table 6.11: Overview of Simulation in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Scenario-based learning		X		X			X				
Practice exercises	X	X		X			X				
Role-playing											

Of the actors using simulation as an interorganizational learning method, all but one actor believe that simulation is used with the learning goals of *understanding interdependencies and dynamics, understanding risks and external threats* as well as *avoid holes and duplication in response efforts*. Looking at learning prerequisites, the lack of an overall *supply chain map* might be one reason for the limited use of the learning method, as it is hard to conduct simulations without knowing about the actors' connections and interdependences. The fact that none of the strategic actors use the method of simulation, a *supply chain management team* organizing overall simulations is further missing.

The improvement suggestion from this section is summarized in Table 6.12 below.

Table 6.12: Summary of Improvement Suggestion, Simulation

Improvement suggestion	Rationale
Start using *simulations*, e.g., *scenario-based trainings*, both on an operational and a strategic level.	Among those actors using *scenario-based trainings*, it is believed to be an irreplaceable learning method to improve adaptability and efficiently understand interdependencies, avoid holes and overlaps in response efforts as well as learn successful strategies.

6.2.8| Analyzing Experiences

Nine of the interviewed actors use interorganizational *experience analysis* as a learning method, as illustrated in Table 6.13. The analyzed events primarily concern deviations, as many of the actors in the SPSC by law are required to conduct such deviation analyzes. Experience analysis is only to a limited extent done on a more strategic level. The most commonly used sub-method is *post-disruption analysis*, used by all interviewed actors except the interviewed trade- and professions association and one governmental agency. By reviewing disruptions that have occurred, actors using the method have found that they are able to learn from their mistakes and develop new better strategies. Most post-disruption analyzes involve the specific actors in an event and in cases of larger, sector wide, disruptions they also include LV as they are a supervising governmental agency. Actors in the later parts of the inpatient care, i.e., the interviewed pharmacy contractor, county councils and hospital, additionally *share experiences and lessons learned* with each other in a structured way. This method is used to follow up on their tight collaborative planning. *Near misses analysis* is only conducted by the interviewed county councils as well as the distributor, where near misses are analyzed the same way as normal disruptions. Near misses analysis is viewed as an opportunity to learn before a real disruption occurs. In general, near misses as well as successful events are not thoroughly analyzed in the SPSC, but some of the interviewed actors sees a potential in more systematically analyzing these types of event in the future as well.

Table 6.13: Overview of Analyzing Experiences in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Post-disruption analysis	X	X	X	X	X	X	X	X			X
Share experiences and lessons learned				X	X	X	X	X			
Near misses analysis		X			X	X	X				

Lack of structure to analyze on a strategic level

Although the method of interorganizational experience analysis is widely used by the actors in the SPSC, the experiences analyzed are most times linked to direct disruptions in the material flow that are not analyzed on a more strategic level. Thus, to improve the learning ability with regards to experience analysis, methods and structures for how to analyze experiences on a more strategic level would be beneficial. One example of a more strategic analysis area that need to be developed according to several of the interviewed actor, are interorganizational post-disruption analyzes of IT disruptions on a strategic level, as IT disruptions are a widespread problem in the SPSC. One interviewed governmental agency further highlights that it would be beneficial to involve external actors earlier in the analysis process, why again a better structure for the analysis process is needed. Therefore, an increased use of all types of experience analysis on a more strategic level are believed to be more beneficial and would allow actors on a strategic level to be more involved in this learning method.

All actors but the governmental agency, use experience analysis with the goal of *learning successful strategies*. The governmental agency as well as the distributor and one country council further believe that experience analysis has the learning goal of *avoiding holes and duplication in response effort*. Looking at learning prerequisites in the given interview answers, *vertical collaboration committees* seems to be in place even though methods for analyzing the experiences in these committees are sometimes missing. Once again, a *supply chain map* is missing. Having that would probably facilitate the experiences analyses because the actors would better be able to discuss and understand the interdependencies and dynamics between them. Looking at the interview answers, lack of *trust* does not seem to be a reason for the limited experience analysis on a strategic level in the SPSC.

The improvement suggestion from this section is summarized in Table 6.14 below.

Table 6.14: Summary of Improvement Suggestions, Analyzing Experiences

Improvement suggestion	Rationale
Develop routines and structures to be able to increase the use of *experience analysis* on an overall strategic level, especially for IT-disruptions.	Currently, the experiences analyzed are most times linked to direct disruptions in the pharmaceuticals flow but are not overall analyzed on a more strategic level. IT disruptions are a widespread problem in the SPSC and thus need to be analyzed on a strategic level.

6.2.9| Stimulate Flexibility

The method of learning from different attempts to *stimulate flexibility* is used to a limited extent in the SPSC, as only six of the interviewed actors describe that they use the method as illustrated in Table 6.15. This is by the interviewed actors explained to be primarily due to the fact that the pharmaceuticals market is heavily regulated, why it is difficult to be flexible. Especially the regulations constraining movement of pharmaceuticals between healthcare provider makes it hard for healthcare providers to be flexible. The regulations are overall concerned with ensuring pharmaceuticals safety and quality, why any changes must be assured not to decrease either of them, making changes difficult and time consuming. *Continuous reorganization* on a large scale is to improve flexibility and absorption is therefore rare, even though three interviewed actors try to be flexible within the law on a small scale, i.e., by reorganizing local inventories or making temporary exceptions from the regulations. *Continuous improvement of crisis management* procedures can more easily be practiced but since many improvements need to be approved by a governmental agency, the method is also used to a limited extent. Given the regulatory environment in the SPSC, most attempt to stimulate the flexibility have concerned impacting the governmental agencies to change the regulations or impacting other actors to take certain actions for preparedness, e.g., refine their crisis management procedures. In total however, the methods to stimulate flexibility presented in the theory are hard to apply on the heavily regulated pharmaceuticals market, and methods to stimulate the adaptive capacity thus have to be conducted in another ways that does not require continuous changes of the laws and regulations.

Table 6.15: Overview of Stimulate Flexibility in SPSC

Learning sub-methods	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Continuous reorganization				X	X					X	
Continuous improvement of crisis mgmt. procedures							X	X	X		

Looking at the learning goals and learning prerequisites for the actors using methods to stimulate flexibility, all use it with the learning goal of *minimizing vulnerability in the supply chain*. Three actors further use it to *learn successful strategies* and only one actor use it to *avoid holes and duplication in response effort*. For the learning prerequisites, *supply chain map* and *trust*, they are believed to be missing in the SPSC according to the interview answers and earlier held discussions. However, the authors believe that it is not the lack of these prerequisites as much as the heavily regulated pharmaceuticals market and the regulations constraining movement of pharmaceuticals between healthcare providers, that make it hard for the actors in the SPSC to use this learning method.

6.2.10| Summarizing Analysis of Interorganizational Learning in the SPSC

In this section, some observations spanning several interorganizational learning methods as well as an overall analysis of interorganizational learning in the SPSC are presented. Further, suggestions for how these observations can be used to develop interorganizational learning for resilience in the SPSC will be proposed.

Vast information sharing, but little joint assessments

The interorganizational learning in the SPSC is characterized by a relatively high degree of vertical and horizontal information sharing between the actors. This comes in many different forms in different learning methods, e.g., automatic integration of sales data and transferal of finished risk-analyzes in *vertical information sharing*, information sessions about new regulations in *interorganizational educations*, best practice sharing during industry seminars in *horizontal information sharing* and the reporting of conducted deviation analyzes in *experience analysis*. However, less joint sense-making, interpretation, and assessment of the information is done between the actors during *vertical joint assessments* and *experience analysis*. Most times, basic information is shared with the other actor to interpret internally, alternatively is an interpretation done by one actor to then be shared. The actors in the SPSC rarely sit down together to interpret and assess the available information. Thus, this is a substantial improvement area for interorganizational learning in the SPSC.

Returning to the theoretical perspectives on interorganizational learning as discussed in chapter 3.2, Rajala (2018) presents that interorganizational learning begins with information sharing, is followed by information interpretation and finally ends in application to practice. What differs between the perspectives discussed by Rajala (2018), is the belief of how and where in the interorganizational process that the learning occurs, whether it is in the knowledge transfer being a catalyst for internalized learning or in the joint sense-making process between two parties. In this thesis, the definition of interorganizational learning includes both these views. However, it is worth noticing that in one of the perspectives, interorganizational learning does not occur until the information is jointly interpreted, why most of the activities conducted in the SPSC would not be classified as interorganizational learning.

Methods for simulation and strategic experience analysis are needed

Another summarizing observation of the methods used for interorganizational learning in the SPSC, is the lack of simulation and experience analysis conducted on a more strategic or national level as discussed in sections 6.2.7 and 6.2.8. It is more straightforward to conduct both simulations and experience analysis for operational activities, than doing it for strategic activities. The operational actors further practice a lot of their routines almost daily, which is some sense works as simulations and further makes it easier to understand which areas that might be problematic by conducting near misses analysis. A reason why few strategic simulations and strategic experience analysis are conducted, may be that there are no clear methods, routines, or measures for how to conduct larger and more strategic simulations and experience analysis. Luckily, major national problems or crises rarely happen in the SPSC. However, this makes it hard for actors not directly involved in the material flow that still have

important coordinating roles during large-scale crisis to naturally practice their routines and skills. Simulations and experience analysis thus have potential to increase the interorganizational learning on a strategic level, influencing actors on all levels in the SPSC.

If once again looking at the theoretical perspectives of interorganizational learning discussed in chapter 3.2, Rajala (2018) stresses that information sharing per se does not lead to interorganizational learning. Instead, learning does not occur until the relationship or respective actors interpret and utilize the knowledge acquired, why simulation and experience analysis can be considered a critical last stage for interorganizational learning to occur. Hence, the actors in the SPSC should focus on using and developing these interorganizational learning methods to ensure that the learning truly occurs, on an operational as well as a strategic level.

The summarizing analysis will now further be extended using the description models in Figure 6.1 and Figure 6.2 as a basis for explanations. In Figure 6.1 and Figure 6.2, the learning methods and learning sub-methods have been colored in three different shades of grey depending on their extent of use among the interviewed practitioners. The black text symbolizes a high degree of usage (8-11 actors), the medium grey symbolized a medium degree of usage (4-7 actors) and the light grey symbolizes a low degree of usage (0-3 actors).

Preparedness
Information sharing for improving regulations
Joint assessment of current status
Joint risk analysis
Joint forecasting
Horizontal benchmarking
Education in security procedures
Post-disruption analysis
Share experiences and lessons learned
Near misses analysis
Role-playing
Practice exercises

Absorption
Information sharing for resource knowledge
Coordinated prevention of disruptions
Information sharing for industry coordination
Education in supply chain structure
Continuous reorganization
Continuous improvement of crisis management procedures

Recovering
Coordinated contingency plans
Coordinated response effort

Adaptability
Information sharing for dynamics knowledge
Information sharing for managing a crisis
Coordinated crisis management procedures
Education in appropriate response
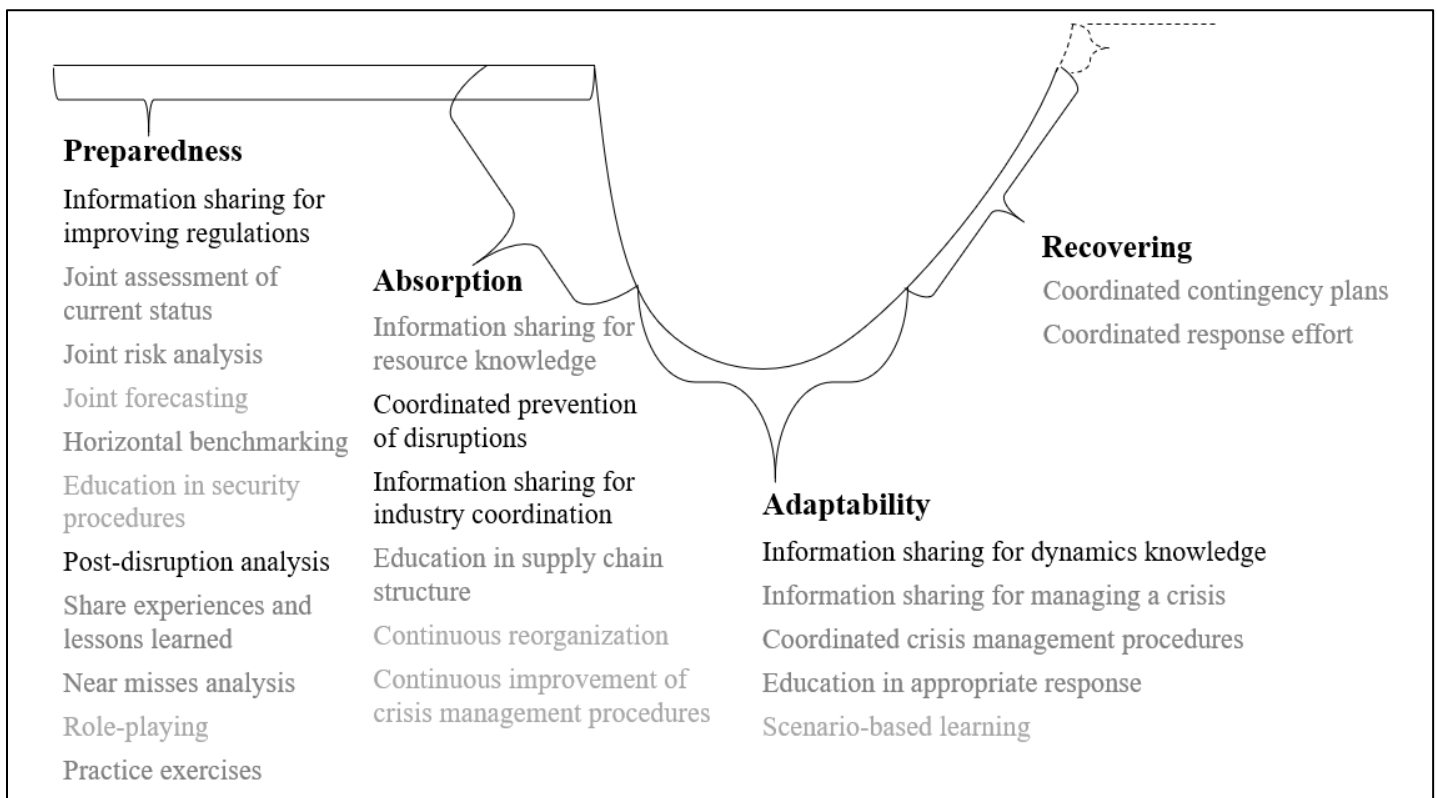Scenario-based learning

Figure 6.1: Summary of Interorganizational Learning Methods
Influencing the Different Components of Resilience in the SPSC

Interorganizational learning is used in all components of resilience

When looking at the interorganizational learning sub-methods' main influence on the different components of resilience in the SPSC, it can be seen that the learning sub-methods used in the SPSC target all stages of the resilience model in Figure 6.1. From Figure 6.1, it can be seen that the majority of the learning sub-methods, 13 out of 24, are used to a moderate degree in the SPSC and well spread across the four components of resilience. Five learning sub-methods are used to a high degree in the SPSC, spanning over three different components of resilience. Six learning sub-methods, once again spread over three components of resilience, are used by few actors in the SPSC: Thus, given this data, no component of resilience can be said to be stronger or weaker than any other, as the focus in rather dispersed.
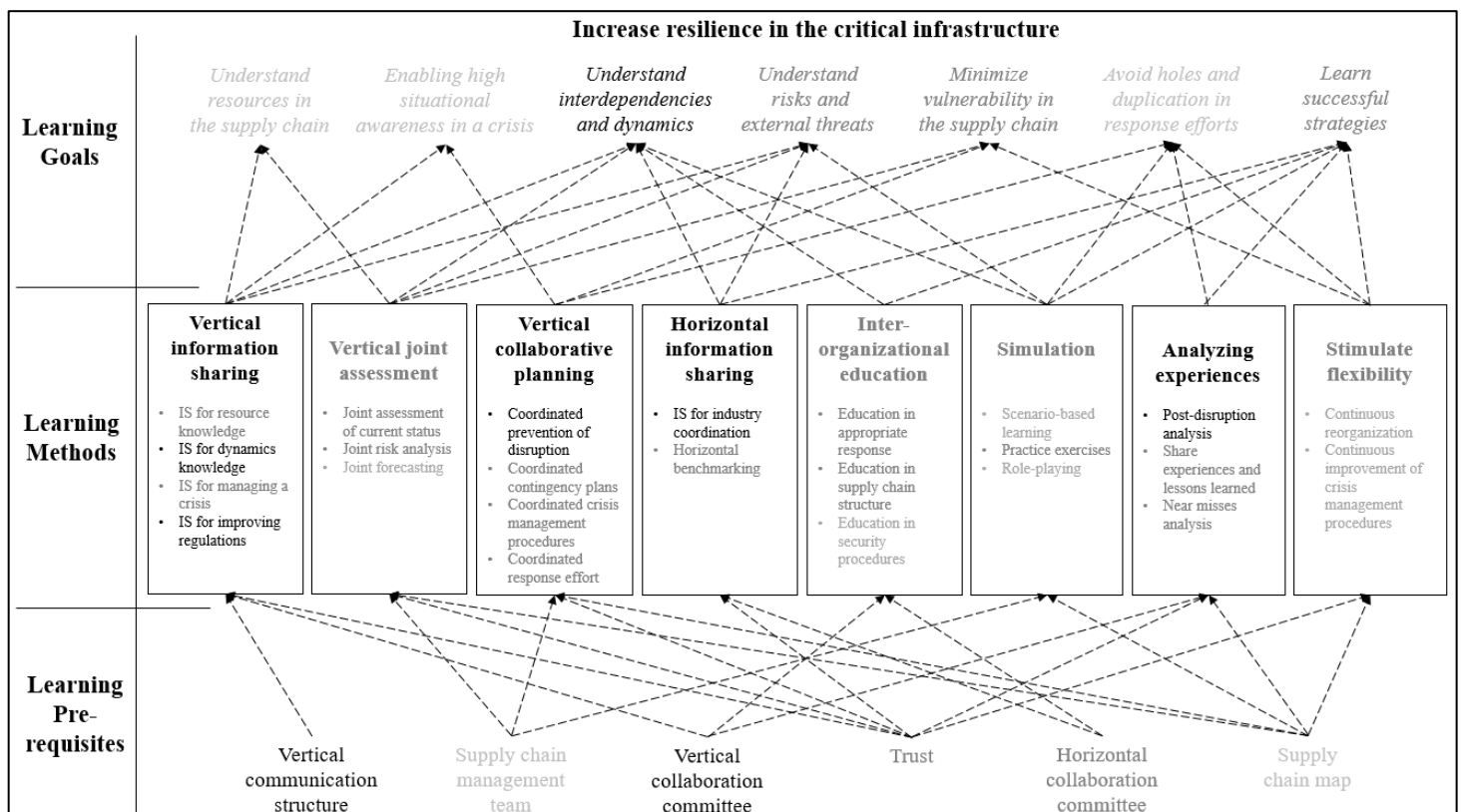
Figure 6.2: Summary of Interorganizational Learning Methods and their Connections to Learning Prerequisites and Learning Goals in SPSC

Not all learning prerequisites are in place in the SPSC

One potential reason for some of the interorganizational learning methods not being well implemented in the SPSC, might be that important underlying learning prerequisites are missing, obstructing the learning methods from being used efficiently in the SPSC. Based on the discussions during the gap analysis per learning method in chapters 6.2.2-6.2.9, some major trends with regards to the learning prerequisites can be seen in the SPSC. These trends are further illustrated in Figure 6.2, where the learning prerequisites are colored in three shades of grey depending on if they are well, moderately or not in place in the SPSC. The black text symbolizes learning prerequisites well in place, the medium grey symbolizes learning prerequisites moderately in place and the light grey symbolizes learning prerequisites not in place.

According to the interview answers, *vertical communication structures* and *vertical collaboration committees* seems to be learning perquisites well in place in the SPSC, at least in normal circumstances. However, for some actors, these prerequisites are not as clear during crises situations.

Further, *horizontal collaboration committees* and *trust* seems to be learning prerequisites moderately in place in the SPSC. In some parts of the SPSC, they are well implemented, while they are missing in other parts of the SPSC. Most actors have a stated *horizontal collaboration committee*, often organized via a trade- or professions association, but for, e.g., the hospitals within a country as well as between governmental agencies, no such clear horizontal collaboration committees exist which may be a reason for lacking horizontal collaboration. The horizontal level of trust differs depending on if the actors are directly competing or not. For non-competing actors it is generally high while trust is naturally lower for competing actors Looking at vertical trust, it is primarily lacking between the pharmaceuticals producer and distributor in relation to later actors in the material flow. If these actors do not trust each other enough to reveal weaknesses and fears, they probably will not conduct joint assessments or experience analyses, which can be seen in the interview answers.

Two learning prerequisites, a *supply chain management team* and a *supply chain map* are believed to be missing in the SPSC according to the interview answers. No clear supply chain management team with decision-making mandate and expertise knowledge govern the SPSC, making the SPSC dependent on initiatives from individual organizations as well as being heavily governed by laws and regulations. Further, an overall supply chain map of the SPSC is lacking, hence the objective of this thesis. Without a supply chain map, it is hard to use many of the interorganizational learning methods. For example, it is hard to conduct simulations as well as experiences analyses without knowing about the actors' connections and interdependences. In this thesis, a general map of the SPSC is provided which the actors are encouraged to use and further refine as needed.

Most learning goals are currently focused in the SPSC
When looking at the learning goals that are focused in the SPSC, based on the interview answers about interorganizational learning, it can be seen that the actors target a large variety of learning goals, but that all but one actor has at least one learning goal not targeted by any of its used interorganizational learning methods. In Table 6.16, the total number of used interorganizational learning methods targeting a specific learning goal has been counted for each actor and compared to the total number of possible learning methods targeting the learning goal based on the description model. The numbers stated in Table 6.16 are based on the learning goal columns in the tables in chapter 5, i.e., if the specific learning goals are said to be targeted by the actor, and thus not just assumed to be targeted by all actors using the overall linked learning method. If an actor targets a specific learning goal zero or one time, it has been colored light grey in the table.

Table 6.16: Overview of Focused Learning Goals in SPSC

Learning Goals	PP	D	O-Ph	H-Ph	CC1	CC2	CC3	H	SKL	TLV	LV
Understand resources in the supply chain	1/2	1/2	1/2	2/2	2/2	1/2	1/2	0/2	0/2	0/2	0/2
Enabling high situational awareness in a crisis	2/2	0/2	1/2	1/2	1/2	0/2	2/2	0/2	0/2	1/2	2/2
Understand interdependencies and dynamics	4/5	4/5	3/5	4/5	1/5	3/5	4/5	2/5	2/5	3/5	1/5
Understand risks and external threats	1/4	4/4	0/4	3/4	1/4	2/4	4/4	2/4	2/4	2/4	1/4
Minimize vulnerability in the supply chain	0/3	2/3	1/3	3/3	2/3	0/3	3/3	3/3	2/3	2/3	1/3
Avoid holes and duplication in response efforts	1/4	3/4	0/4	0/4	0/4	0/4	4/4	0/4	1/4	1/4	2/4
Learn successful strategies	3/5	3/5	1/5	1/5	3/5	3/5	4/5	2/5	1/5	3/5	1/5

Based on the total numbers of actors clearly striving towards a learning goal by using two or more learning methods striving at it, a discussion about the learning goals focused in the SPSC is presented below. This discussion is further illustrated in Figure 6.2, where the learning goals have been colored in three different shades of grey depending on the number of actors targeting the learning goals in two or more learning methods. The black text symbolizes a high degree of targeting (8-11 actors), the medium grey symbolized a medium degree of targeting (4-7 actors) and the light grey symbolizes a low degree of targeting (0-3 actors).

According to the interview answers, *understanding interdependencies and dynamics* is a learning goal targeted by most of the actors in the SPSC. Nine out of eleven interviewed actors target it by at least two interorganizational learning methods, and all actors by at least one such method.

For *understanding risks and external threats, minimizing vulnerability in supply* chain as well as *learning successful strategies*, these learning goals are targeted with at least two interorganizational learning methods by seven of the interviewed actors.

The learning goals though not receiving so much attention in the SPSC, are *understanding resources in the supply chain, enabling high situational awareness in a crisis* and *avoid holes and duplication in response effort*, that only have two, three respectively three actors targeting them with at least two interorganizational learning methods The two first mentioned learning

goals only have two learning methods each targeting them, which naturally contributes to low numbers, but though makes it more important to use those specific learning methods to be able to achieve the learning goals. The goal of avoiding holes and duplication in response efforts only is targeted by surprisingly few actors, given that totally four interorganizational learning method targeting this goal.

Lastly, all improvement suggestions from this section are summarized in Table 6.17 below

Table 6.17: Summary of Improvement Suggestions, Summarizing Analysis

Improvement suggestion	Rationale
Conduct more joint-sense-making, interpretation and assessment of information during *vertical joint assessments* and *experience analysis*, in addition to the vast amount of *vertical and horizontal information sharing* done in the SPSC.	Most times, basic information is shared between actors to interpret internally, alternatively is an interpretation done by one actor to then be shared. The actors in the SPSC rarely sit down together to interpret and assess the available information. According to theory, there believes differ of how and where in the interorganizational process that the learning occurs, whether it is in the knowledge transfer being a catalyst for internalized learning or in the joint sense-making process between two parties. In one of the perspectives, interorganizational learning does not occur until the information is jointly interpreted, why most of the activities conducted in the SPSC would actually not classify as interorganizational learning.
Make sure that all actors have a stated *horizontal collaboration committee* to enable the use of *horizontal information sharing*.	For, e.g., the hospitals within a country as well as between governmental agencies, often no clear *horizontal collaboration committees* exist, which may cause lacking horizontal collaboration.
More explicitly state an overall *supply chain management team* for pharmaceuticals supply issues in the SPSC, with the task of coordinating the overall joint actions and ensure crisis preparedness.	No clear *supply chain management* team with decision-making mandate and expertise knowledge currently govern the SPSC, making the SPSC dependent on initiatives from individual organizations as well as being heavily governed by laws and regulations.
Use and refine *the supply chain maps* of the SPSC presented in this thesis	To enable the usage of interorganizational learning methods like *vertical joint assessment, vertical collaborative planning, simulation, analyzing experiences* and *stimulate flexibility* and further be able to hold general *interorganizational educations* about SPSC's structure.

7| Conclusions

This chapter concludes with the main findings for each research question. This is followed by a discussion of the theoretical and practical implications, the delimitations of the study and the researchers' suggestions for further research.

7.1| Key Findings

7.1.1| Answering RQ1: How is the Swedish Pharmaceuticals Supply Chain (SPSC) Structured Under Normal Circumstances and in a Crisis?

Three key processes, material flow, legal frames, and collaboration, to show how the SPSC is structured under normal circumstances and in a crisis, is mapped in the report. A summary of the main findings related to each key process as well as overall is presented below.

Material flow

The overall material flow in the SPSC is presented in Figure 7.1.
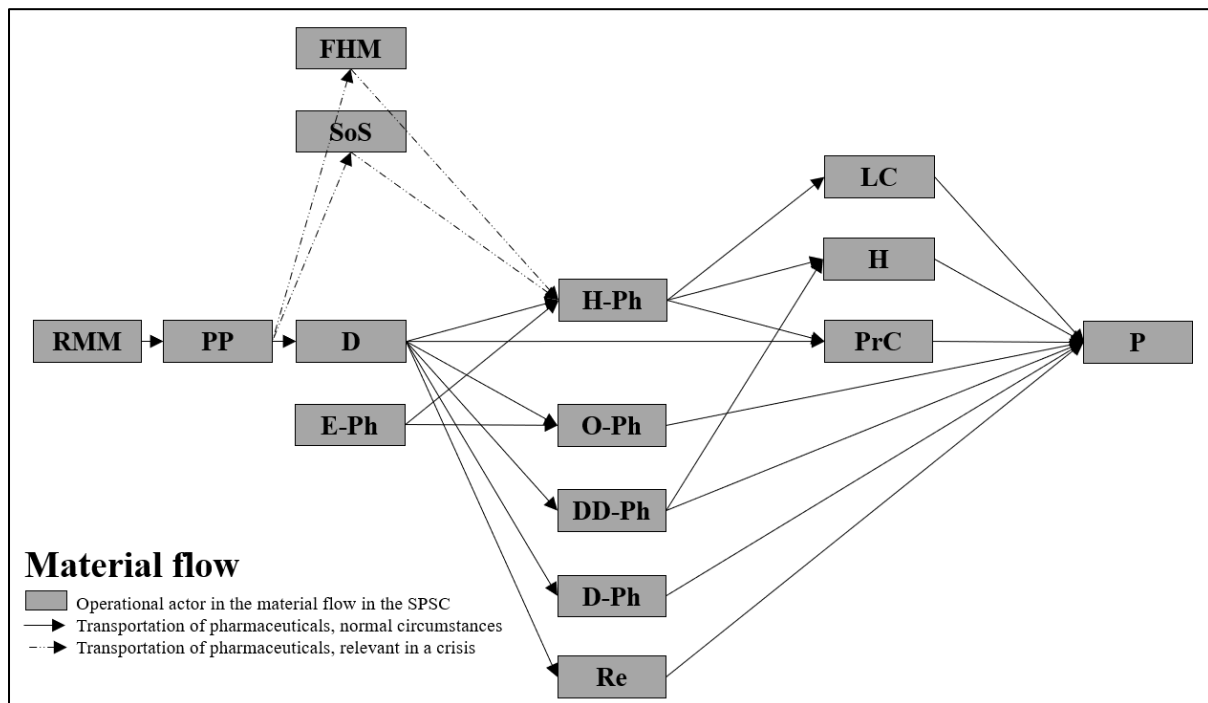
Figure 7.1: Material Flow in SPSC

In large, pharmaceuticals basic components are extracted at raw material manufacturers (RMM), distributed to pharmaceutical producers (PP) where defined and approved pharmaceuticals are produced. These pharmaceuticals are distributed via distributors (D) to the Swedish market, either to the inpatient or the outpatient care. Some pharmaceuticals are also produced at extemporaneous pharmacies (E-Ph). The inpatient care distribution is done via

hospital pharmacies (H-Ph) to hospitals (H) and lodging cares (LC) where the pharmaceuticals is given to a patient (P). In the outpatient care, pharmaceuticals are distributed to patients via different types of pharmacies; outpatient pharmacies (O-Ph), dose dispensing pharmacies (DD-Ph), distance- and e-pharmacies (D-Ph) and other retailers (Re). Regarding the primary care (PrC), some vaccines can be accessed directly via the distributor and other types of pharmaceuticals are distributed via the hospital pharmacies. The National Board of Health and Welfare (SoS) and the Public Health Agency of Sweden (FHM) are responsible for keeping small safety stocks of certain pharmaceuticals.

The material flow of the SPSC is characterized by streamlined operations and stocks according to the JIT philosophy. After the deregulation of the pharmacy market in 2009, no specific actor has a pronounced responsibility to keep safety stocks except for some small stocks held by FHM and SoS. Further, the actors in the SPSC have experienced an increase in the number of backordered pharmaceuticals during the latest years, risking pharmaceuticals shortages and inadequate healthcare to the patients. The opinions about the root cause behind the increasing number of backorders though differ between the actors in the SPSC.

The SPSC is clearly dependent on international trade since foreign raw material manufacturers and pharmaceuticals producers dominate the market. The distribution centers are also gradually moving away from Sweden to be placed more centrally in Europe. National guidelines for segmentation of pharmaceuticals needed both for crises and wars are missing today but would be advantageous when building up the preparedness for crises and wars.

Legal frames
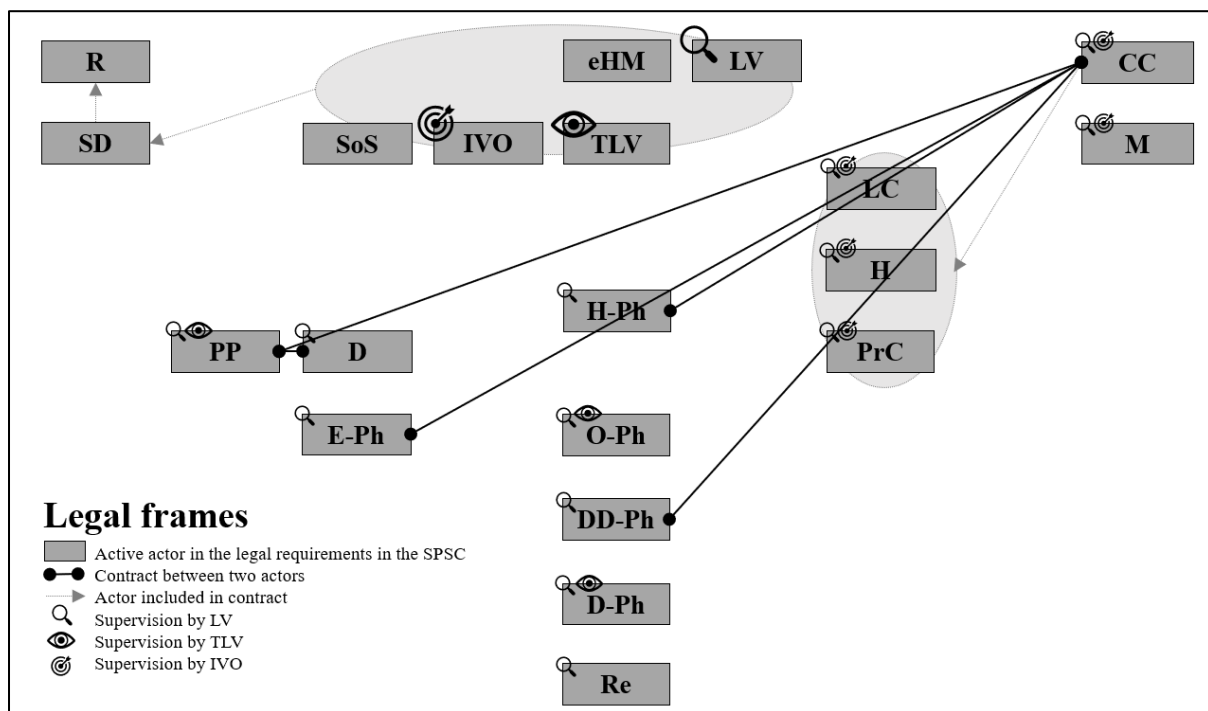The overall legal frames in the SPSC are presented in Figure 7.2.

Figure 7.2: Legal Frames in SPSC

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In large, the Swedish Medical Products Agency (LV) issues authorizations and permissions for marketing, distribution, extemporaneous production, dose dispensing, wholesaling and retail to the actors in the SPSC. LV further performs supervision over all actors with an issued authorization, IVO performs supervision for the healthcare actors and TLV performs supervision for pharmaceuticals sold within the Swedish pharmaceuticals benefits system.

In addition to laws and regulations, some actors in the SPSC have contracts with each other. The county councils (CC) have contracts with some pharmaceuticals producers (PP), with extemporaneous pharmacies (E-Ph), with dose dispensing pharmacies (DD-Ph) and often with a pharmacy contractor running their hospital pharmacies (H-Ph). The pharmaceuticals supply to hospitals (H), lodging cares (LC) and primary cares (PrC) in a country are included in the county council's above-mentioned contracts. Further, the pharmaceutical producers have contracts with a distributor (D) in Sweden. All mentioned authorities respond to the Ministry of Health and Social Affairs (SD) and their work is governed by laws regulated by the Swedish Parliament (R).

Most times, there are no direct contracts between the distributors and the actors in the downstream material flow in the SPSC, as can be seen in Figure 7.2. The pharmacy contractor and outpatient pharmacies find this problematic, as they have no lever towards the distributors. Instead, they have to try to influence the parliament and SD to make changes in the laws and regulations concerning the distributors.

One legal frame clearly limiting the possible strategies and operations within the SPSC, is the Medicinal Products Trading Act preventing healthcare providers from moving pharmaceuticals horizontally between their inventories. Practitioners believe this is suboptimal for the resilience of the overall system and further limits interorganizational collaboration and learning. With the current regulation, healthcare providers are forced to either have their own full-service stocks or trust that larger actors earlier in the SPSC have sufficient stocks for a well-functioning JIT system. Further, current regulations limit the county council's operational possibilities when it comes to advanced healthcare given in a patient's home, since the county council cannot deliver pharmaceuticals directly home to the patient but need them to be prescribed by a doctor and collected from a pharmacy by the patient.

Moreover, the responsibilities of the different actors in terms of crisis preparedness and crisis management are not clear in the SPSC. First of all, there are no overall law or regulation specifying the requirements on private actors in a crisis. Secondly, the county councils feel that they have been assigned a lot of responsibility for crisis preparedness and management while at the same time receiving minimal national support to be able to fulfill these requirements.

Collaboration

An overview of the main interorganizational collaboration links in SPSC found during the interviews is seen in Figure 7.3.
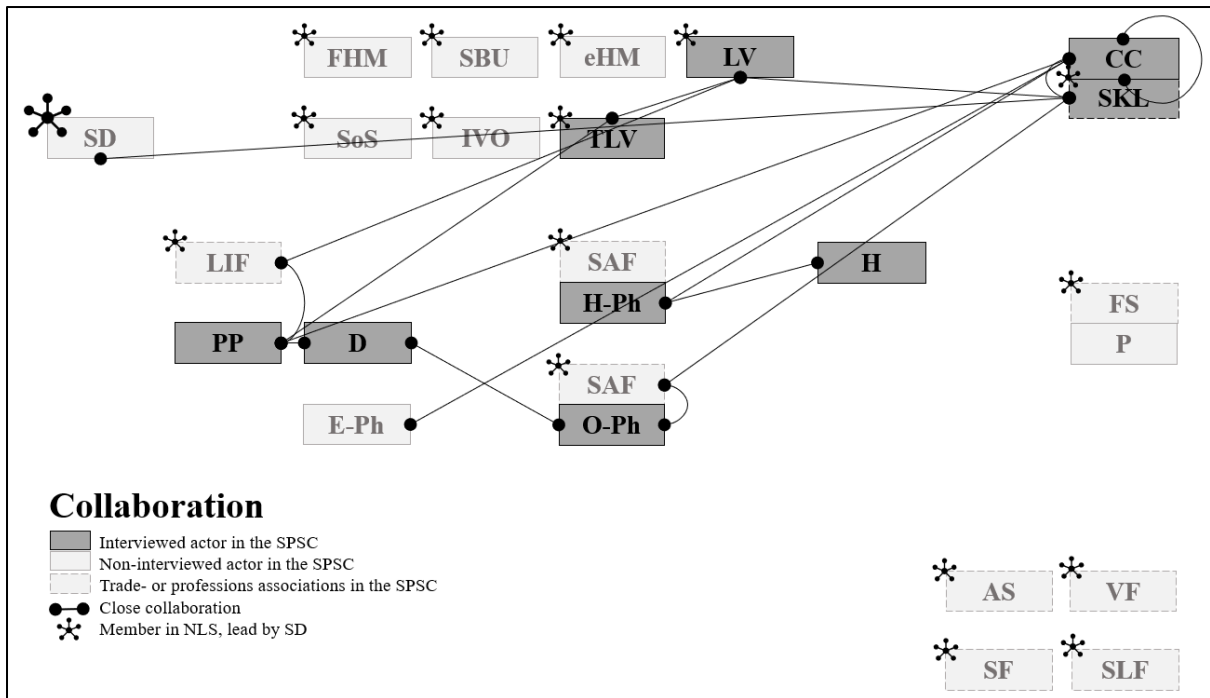
Figure 7.3: Collaboration in SPSC

From an overall perspective, a lot of the interorganizational collaboration in the SPSC is done between relevant authorities and relevant trade- and professions associations represented in the National Pharmaceuticals Strategy (NLS) which forms a natural collaborative forum. Naturally, there is also a close collaboration between the trade- and professions associations and their members. The county councils (CC) have close collaboration with their specific hospital pharmacy (H-Ph) and extemporaneous pharmacy (E-Ph), and the pharmaceuticals producers (PP) and the distributors (D) further have a very strong collaborative relationship.

Looking at the collaborative landscape, it can be seen that there is a strong link between the actors having contracts with each other and the actors having strong collaborative links. Further, most networks and collaboration forums in the SPSC are relatively new and have been developed within the last ten years. Lastly, the Competition Act regulates how much competing actors can collaborate and this law is believed to be strictly followed by most actors in the SPSC.

7.1.2| Answering RQ2: How can the Actors in the SPSC Work with Interorganizational Learning to Become more Resilient as a System?

Eight *interorganizational learning methods* to increase resilience in a critical infrastructure's supply chain have been identified in theory as thoroughly described in chapter 3.4. These finding have been summarized in two description models, Figure 7.4 giving an overview of the interorganizational learning methods and their corresponding *learning sub-methods, learning goals* and *learning prerequisites* and Figure 7.5 showing how the learning sub-methods influence the different components of *resilience*.

Figure 7.4: Description Model for Interorganizational Learning Methods and their Connections to Learning Prerequisites and Learning Goals.

. *Figure 7.5: Description Model for Interorganizational Learning*
Methods Influencing the Different Components of Resilience

An empirical investigation concerning how the actors in the SPSC currently use the identified interorganizational learning methods have been conducted to understand which methods that are valuable, and which has the potential to be developed to further increase the overall resilience of the SPSC. The analysis of the current status is illustrated in Figure 7.6 and Figure 7.7, using the two developed description models. *The learning prerequisites, learning methods, learning sub-methods* and *learning goals* have been colored in three different shades of grey in the figures, depending on the extent of usage of focus that they get in the SPSC.
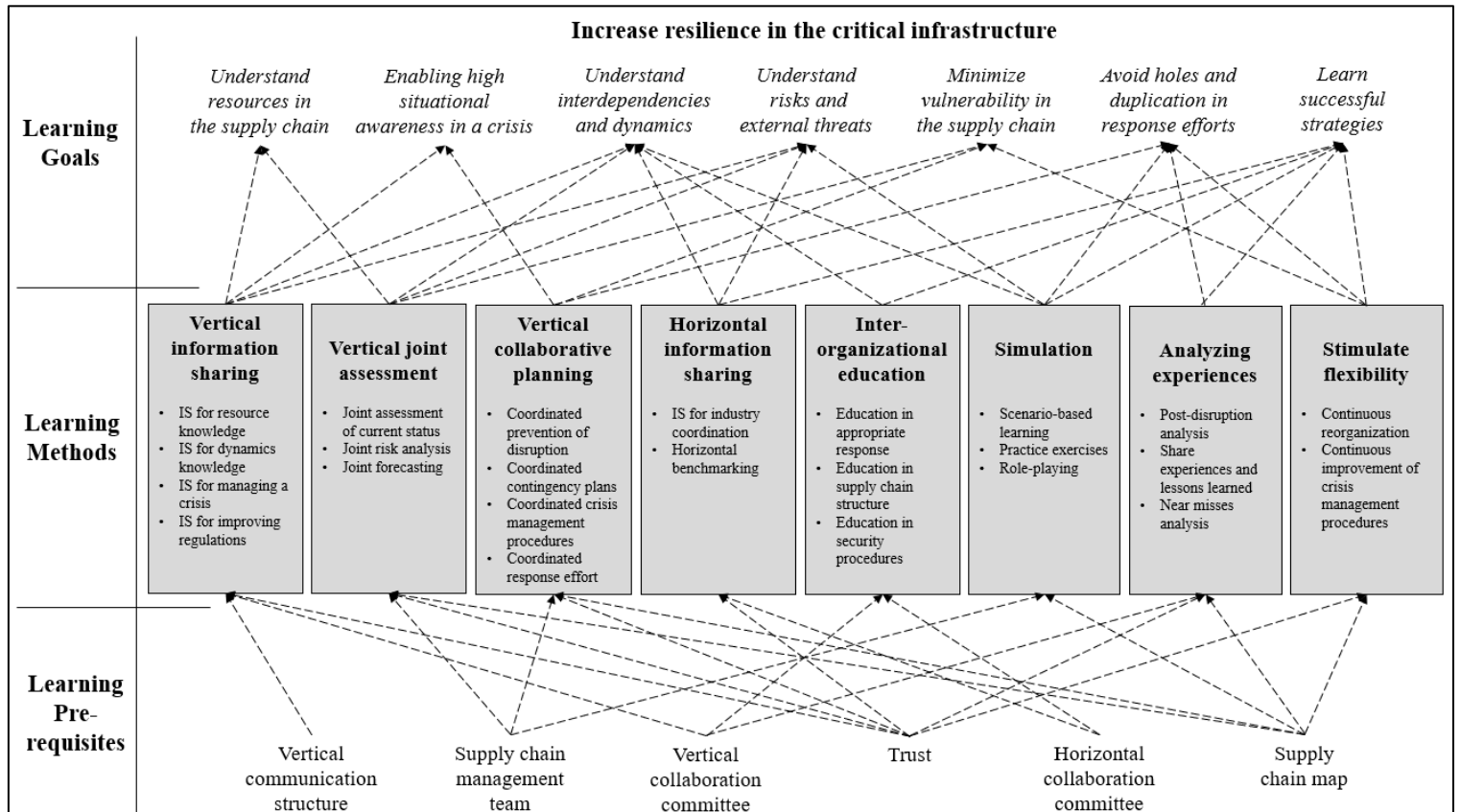
Figure 7.6: Summary of Interorganizational Learning Methods and their Connections to Learning Prerequisites and Learning Goals in SPSC

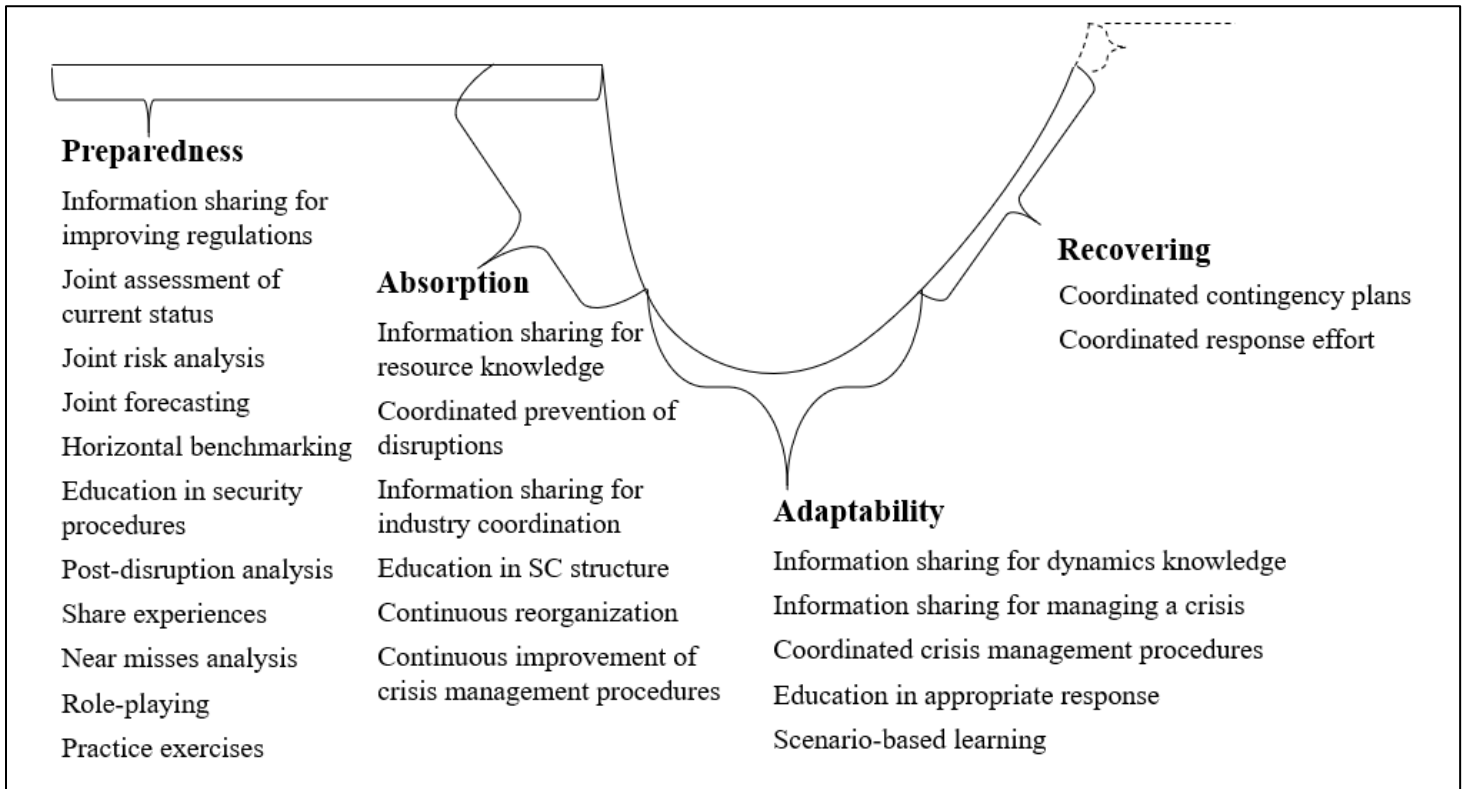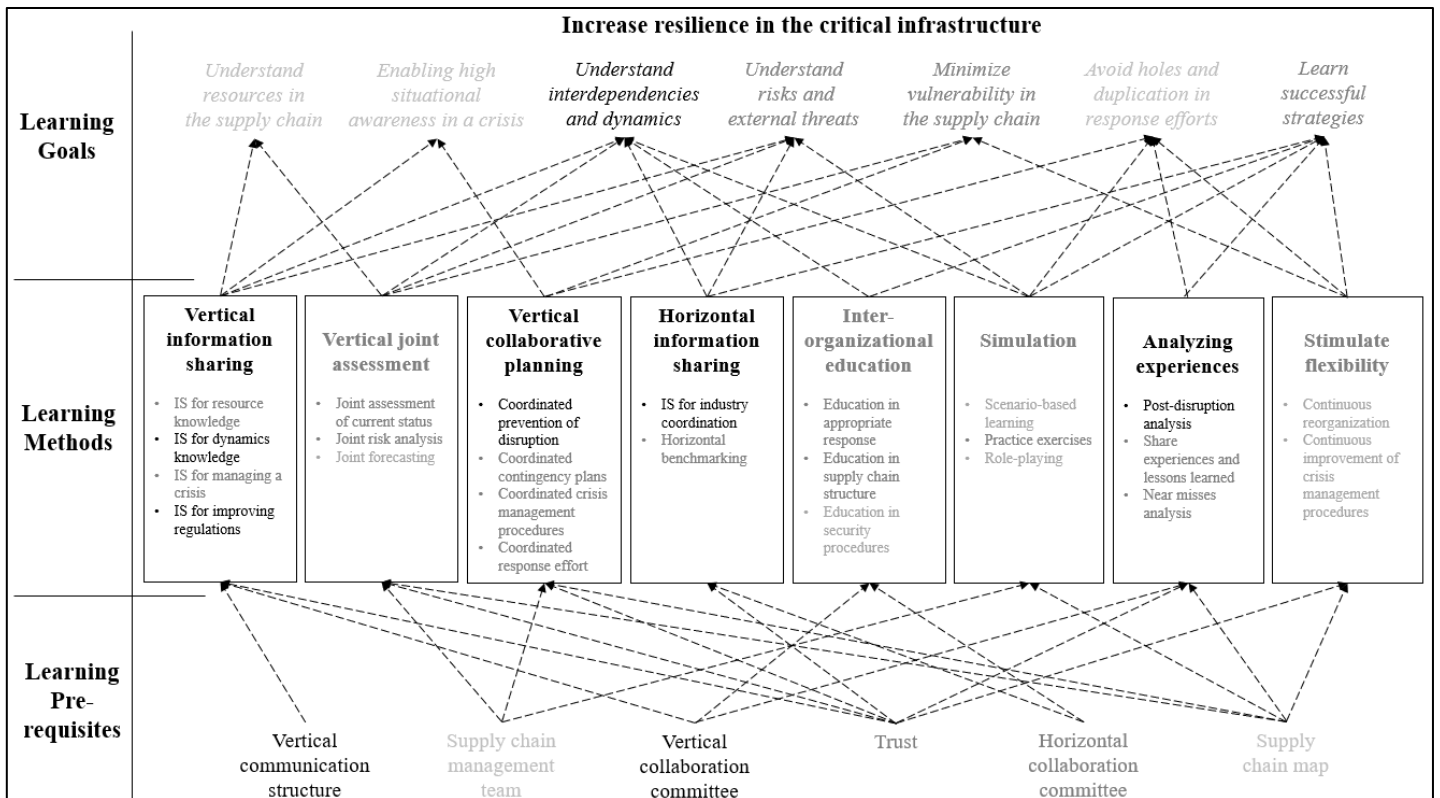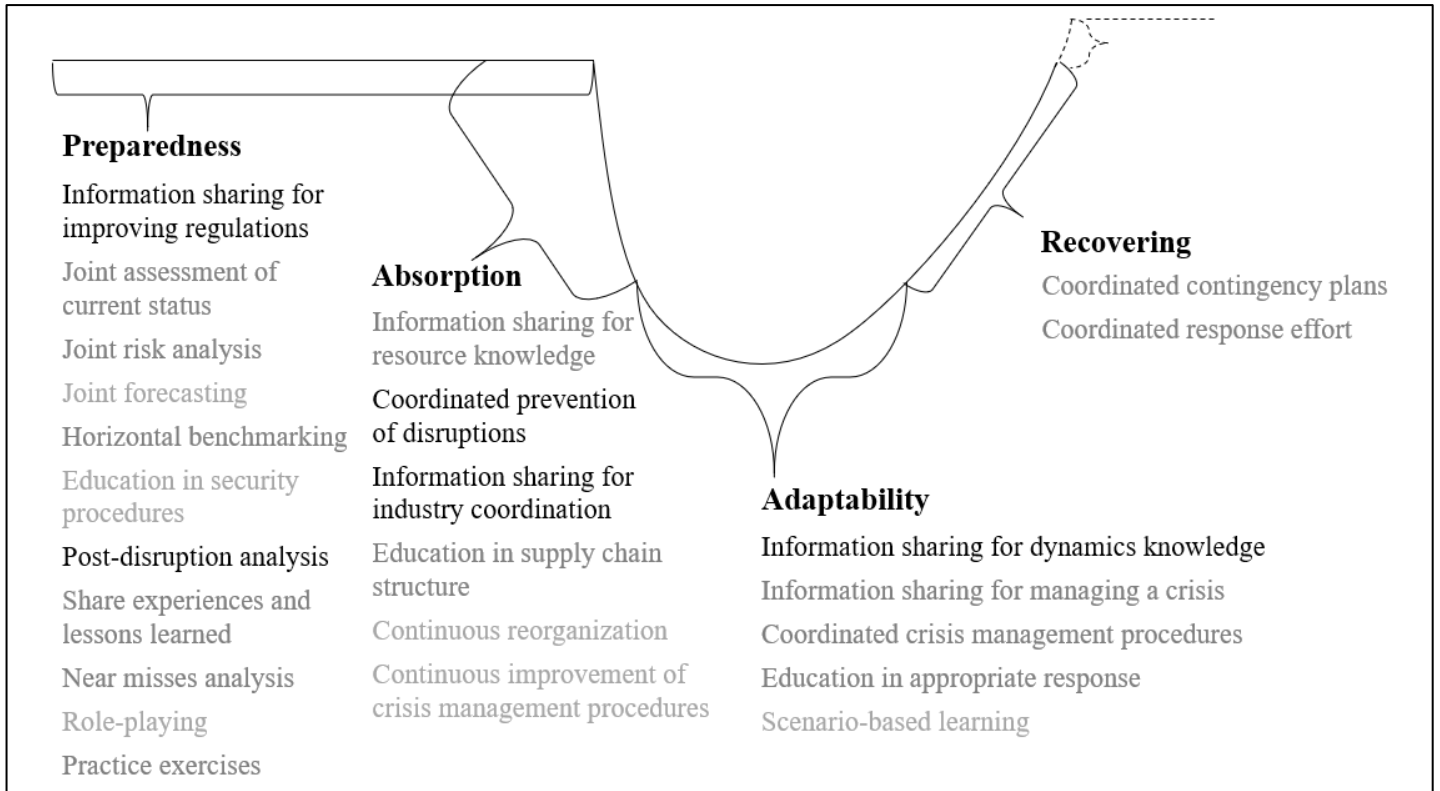*Figure 7.7: Summary of Interorganizational Learning Methods Influencing the Different Components of Resilience in the SPSC*

A summary of the suggestions for improvement is further presented in Table 7.1. They have been ordered from overall improvement suggestions to more specific suggestions for parts of the SPSC. For a more detailed analysis underlying these conclusions, see chapter 6.2 for a gap analysis per interorganizational learning method as well as a summarizing analysis.

Table 7.1: Improvement Suggestions, Interorganizational Learning in SPSC

Improvement suggestion	Rationale	Discussed in chapter
Use and refine *the supply chain map* of the SPSC presented in this thesis	A *supply chain map* is needed to more efficiently use interorganizational learning methods like *vertical joint assessment, vertical collaborative planning, simulation, analyzing experiences* and *stimulate flexibility* and further be able to hold general *interorganizational educations* about SPSC's structure.	6.2.10
More explicitly state an overall *supply chain management team* for pharmaceuticals supply issues in the SPSC, with the task of coordinating the overall joint actions and ensure crisis preparedness.	No clear *supply chain management* team with decision-making mandate and expertise knowledge currently govern the SPSC, making the SPSC dependent on initiatives from individual organizations as well as being heavily governed by laws and regulations.	6.2.10
Make sure that all actors have a stated *horizontal collaboration committee* to enable the use of *horizontal information sharing*.	For, e.g., the hospitals within a country as well as between governmental agencies, often no clear *horizontal collaboration committees* exist, which may cause lacking horizontal collaboration.	6.2.10
Conduct more joint-sense-making, interpretation and assessment of information during *vertical joint assessments* and *experience analysis*.	The actors in the SPSC rarely sit down together to interpret and assess the available information, but there is a willingness and believed benefit to do so by practitioners in the SPSC. Most times, basic information is shared between actors to interpret internally, alternatively is an interpretation done by one actor to then be shared. According to theory, interorganizational learning may not occur until the information is jointly interpreted.	6.2.3 6.2.10
Start using *simulations*, e.g., *scenario-based trainings*, both on an operational and a strategic level.	Among those actors using *scenario-based trainings*, it is believed to be an irreplaceable learning method to improve adaptability and understand interdependencies, avoid holes and overlaps in response efforts and learn successful strategies.	6.2.7

Develop routines and structures to be able to increase the use of *experience analysis* on an overall strategic level, especially for IT-disruptions.	Currently, the experiences analyzed are most times linked to direct disruptions in the pharmaceuticals flow but are not overall analyzed on a more strategic level. IT-disruptions are a widespread problem in the SPSC and need to be strategically analyzed.	6.2.8
Conduct a general *interorganizational education* about SPSC's structure and interdependencies.	Allow for all actors to create a fundamental understanding and get a better overview of the SPSC, which probably will facilitate interorganizational discussions.	6.2.6
Find a structure within NLS to enable actors to go from *information sharing* and *collaborative planning* to action and implementation.	NLS currently is more of an information sharing forum than a forum for joint action taking. This, since developed solutions need to be decided upon, financed and implemented outside NLS. If to many efforts end already in the planning phase, the actors might lose their interest in the forum.	6.2.4
Increase *horizontal information sharing*, both *information sharing for industry coordination* and *horizontal benchmarking*, between non-competing actors in the SPSC, e.g., governmental agencies and hospitals within a country.	Avoid using unnecessary resources by repeatedly reinventing the wheel, as well as avoid using unnecessary resources to resolve situations caused by a lack of coordination and overview in the first place.	6.2.5
Specify when comment letters on referrals and other *vertical information exchanges* with governmental agencies are meant to focus on regulatory changes versus changes of routines.	Minimize the misunderstandings and feelings of not being listened to in regulatory discussions between practitioners and governmental agencies, hopefully leading to more efficient and constructive discussions.	6.2.2
Have a discussion between the distributors and actors further down the material flow about the optimal extent of *resource knowledge sharing* for minimizing shortages in SPSC.	There is a need to increase the understanding of the information needs and rationales for everyone involved in the material flow, to allow for a joint view of the most effective way to minimize shortages in the SPSC.	6.2.2
Investigate if there is an interest from global pharmaceuticals producers to increase the collaborative planning with the Swedish actors via, e.g., *coordinated contingency plans*.	*Coordinated contingency plans* with the global pharmaceuticals producers are believed to improve the Swedish actors' ability to recover after a crisis, as the global units and not the Swedish subsidiaries are the ones that mainly impact the production and pharmaceuticals supply to Sweden.	6.2.4

7.2| Theoretical Implications

This study has contributed to research by mapping the SPSC in a structured way as presented in chapter 4 and 6.1 and summarized in Figures 7.1-7.3 in chapter 7.1.1. The thesis has thus partly filled the earlier presented gap within the research area as requested by researchers (e.g., Johansson et al., 2017). The study will thus enable and facilitate further research studies within the area of the SPSC and critical infrastructures.

Moreover, the thesis contains a comprehensive method for mapping and analyzing a critical infrastructure as presented in chapter 2. This method can further be used by other researchers and practitioners to map and analyze critical infrastructures in other sectors. Knowledge about how to systematically describe a critical infrastructure in an easy way that still catches its complexity can further be used when building scenarios for training and simulations.

The study has further contributed to research by providing a comprehensive theoretical framework for how to work with interorganizational learning for resilience in a critical infrastructure, as presented in chapter 3.4 and summarized in Figures 7.4-7.5 in chapter 7.1.2. The theoretical framework for interorganizational learning to increase resilience can further be used for analyzing and improving the resilience in critical infrastructures in other sectors.

7.3| Practical Implications

This study has contributed to practitioners by mapping the SPSC in a structured way as presented in chapter 4 and 6.1 and summarized in Figures 7.1-7.3 in chapter 7.1.1. The thesis has thus partly filled the earlier presented gap within the area as requested by practitioners (e.g., Gårdmark Östh, 2018). For practitioners within the SPSC, the maps and structured description of the SPSC provide a communication tool for facilitated coordination and collaboration.

In the study, the developed framework for how to work with interorganizational learning for resilience in a critical infrastructure, has been applied to the SPSC. Based on a gap analysis in chapter 5 and chapter 6.2, which is summarized in figure 7.4 and 7.5 in chapter 7.1.2, the practitioners in the SPSC has been provided with suggestions for improvements in the work with interorganizational learning to strengthen the resilience of the overall system. These improvement suggestions as summarized in Table 7.1 in chapter 7.1.2. The interviews conducted during the study have hopefully directly given the practitioners new ideas about how to work with interorganizational learning for resilience in the SPSC. By describing their work and getting to know about the eight methods of interorganizational learning, the interviewees have directly gotten an intuitive understanding of the potential improvement areas.

Lastly, the study has contributed to the authors by providing a deep understanding of an area and sector of interest to them, a better understanding of how research is done in an efficient way, as well as the possibility to develop relationships with several practitioners within the field. Above all, the study has given the authors the chance to use their gained academic knowledge to contribute to academia and practice in a meaningful way.

7.4| Limitations of the Study

Some limitations that may have influenced the result of the study will now be presented and discussed. These limitations mainly showed up during the interviews and were mostly based on the structure of the interviews.

First of all, no consistent definition of core concepts was given to the interviewees. During some interviews, definitions were given if requested, but in other cases the researchers just assumed that the interviewees had the same understanding of the concepts as the researchers. The quality of and the consistency among the interviews could thus have been improved if all respondents used the same definition of important core concepts, primarily *resilience, interorganizational learning* and *crisis.* For example, whether the interviewee thought of internal or external crises when talking about crisis preparedness and crisis management, may clearly have influenced their answers.

Further, the classification of horizontal versus vertical actors in the SPSC was somewhat confusing during the course of the interviews. Vertical actors were defined as actors with different tasks in the supply chain, while the material flow in the map though was illustrated as a horizontal flow, causing confusion during some of the interviews. Also, the definition of what to include as horizontal actors was changed halfway through the interviews. Initially, only actors with the exact corresponding role in the SPSC was included, but this was extended to also include trade- and professions associations where this was relevant and other governmental agencies if the interviewed actor was a governmental agency. Thus, the distinction between horizontal and vertical collaboration in the interviews is not always sharp. Another definition that became confusing for some interviewed actors, was the distinction of what was considered to be internal learning versus interorganizational learning. Some large organizations with other actors closely linked to them, e.g., county councils and hospitals, saw the two actors as one actor while the meaning was to look at them separately and study the interorganizational learning between them.

Questions regarding *learning prerequisites* and *learning goals* were not consistently asked during the interviews, even though they sometimes surfaced and were discussed when talking about the interorganizational learning methods. By asking about this in a more structured way, the links between learning prerequisites, learning methods and learning goals could have been more deeply analyzed and compared to the theory.

Moreover, the professional roles and characteristics of the specific interviewed persons, naturally have a large influence over the result of the study. As it is hard for one person to have the full overview of all collaborative areas that an organization takes part in, details and collaborations may be missing in the interviews. The professional roles of the interviewees varied from roles focusing on legal requirements to logistics or external collaboration, which clearly influenced the given answers. For a more comprehensive understanding of each actors role and activities, interviews with several representatives from the same organization could have been conducted. Additionally, only twelve actors were interviewed and only eleven of

these interviews were used for the empirical study of the practical use of interorganizational learning methods. To gain a complete understanding of how the actors in the SPSC use the eight interorganizational learning methods, all actors would have to be interviewed. This was, however, not possible within the scope of the thesis. Also, the time frame for the interviews clearly limited the areas and details that could be covered.

Some limitations also concern the developed theoretical framework, as some problems with the interorganizational learning methods for resilience were discovered during the interviews and analysis. First of all, the methods of *Vertical/Horizontal Information Sharing* and *Interorganizational Education* were quite similar, and different actors interpreted the methods differently during the interviews. In a future research, these learning methods can be deeper defined to provide a better distinction. Moreover, both the interorganizational learning methods and developed interview structure were better customized for the operational actors than the strategic actors, which meant that some of the learning sub-methods were not relevant to the more strategic actors.

Lastly, since both critical infrastructure, pharmaceuticals and preparedness for crisis and state of alert are areas surrounded by a lot of regulations concerning professional secrecy, chances are high that the interviewed actors know more about crisis preparedness than they are allowed to tell. Since most of the interviewed practitioners have high positions within their respective organizations, as well as in the overall planning for the Swedish pharmaceuticals supply and crisis preparedness, regulations concerning professional secrecy as well as business secrets were assessed to be more influential over the lack of details in the given answers rather than lack of knowledge.

7.5| Further Research

Several potential areas for further research were discovered during the study as presented below.

As this thesis focus on the SPSC's structure under normal circumstances and in a crisis, but not in a war, this is an area that could further be investigated and was deemed necessary by most of the interviewed actors. Luckily, Region Skåne is currently leading a two-year long project in collaboration with SoS with the aim of investigating how to organize the Swedish pharmaceuticals supply to prepare for crisis, state of alert, and war. The project will be finished in 2019 and hopefully thoroughly guide the involved actors in how to structure the SPSC.

Another important aspect of the SPSC structure and interorganizational learning, are the integrated information systems used. These technical systems bond the different parts of the SPSC and are fundamental tools for the interorganizational learning. This key dimension was not mapped during the project, since it was estimated to be too time consuming, exceeding the scope of the thesis. Practitioners in the SPSC though stress that the integrated technical systems need to be mapped and overlooked since problems often happen in the interfaces, which may have severe consequences for the overall system. IT and information flow are also areas where

more consequence analyzes need to be conducted according to the practitioners. A more detailed study of how to theoretically and practically conduct such consequence analyzes would therefore further be valuable to the practitioners.

The pharmaceuticals supply chain is not isolated, but closely interconnected with and dependent on other critical infrastructures, e.g., energy, transportation and information systems. An extension of the thesis would therefore be to map more critical infrastructures as well as the dependencies between them. In such a research, interorganizational learning with actors outside one supply network can further be studied. Fortunately, in 2019 a five-year research project will start, aiming to understand how different types of crises in critical sectors and supply chains in Sweden can be avoided and handled, thus mapping the critical supply chain and their interdependencies. This research project will be conducted by researchers from Lund University, Luleå University and FOI and will hopefully fill the missing gaps with regards to mapping critical infrastructures in Sweden.

Moreover, the found interorganizational learning methods for resilience can and should be refined and empirically tested in future research studies. It would further be valuable to find ways to measure the effectiveness of the learning methods and their impact on the resilience of the overall system, to better guide the practitioners in how to prioritize the learning methods in their operations. It would further be valuable to systematically investigate the connections between learning prerequisites, learning methods, learning sub-methods and learning goals in a critical infrastructure.

As the pharmaceuticals market is heavily regulated and the authors have no legal educational background, it would be valuable with another and more detailed overview of the legal frames in the SPSC. A lot of actors in the SPSC believe that some laws and regulations do not fulfil their intended purpose, and it would therefore be valuable for both practitioners and the government to pinpoint exactly where the contradictory or non-regulated areas are.

Lastly, the study looks at the SPSC and the interorganizational learning methods used between Swedish actors. However, the Nordics and Europe is increasingly seen as one market when it comes to pharmaceuticals supply, and a lot of collaboration occurs between Swedish actors and actors in other Nordic or European countries, hence making it interesting to study interorganizational learning from a larger perspective including these interconnections.

Appendix A: Swedish Interview Guide, Contextual Interview

Information till intervjuobjekt

- Godkännande av inspelning av intervju
- Våra forskningsfrågor
  - How is the SPSC structured under normal circumstances and in a crisis?
  - How can the actors in the SPSC work with interorganizational learning to become more resilient as a system?
- Intervjun fokuserar på den första forskningsfrågan.
- Frågor kommer att ställas både om SPSC och din organizations specifika roll i SPSC. Vi vill att du specificerar när du vet säkert respektive när du är osäker på ditt svar.
- Du kommer att få godkänna dina svar innan de publiceras.

Inledande information

Detta för att få en allmän bakgrund till intervjuobjektet.

Generellt

- Namn:
- Utbildning:
- Tidigare jobb:

Specifikt

- Nuvarande roll i organization:
- Uppgifter och ansvarsområden:
- Antal anställningsår i organizationen:
- Antal anställningsår i SPSC:

Intervjufrågor

Materialflöde
- Hur skulle ni beskriva det övergripande fysiska flödet i läkemedelskedjan?
- Hur ser det fysiska flödet ut i Östergötland?
    - Hur skiljer det sig från andra landsting?
- Har ni någon gång nyttjat de beredskapslagar som finns i regi av SoS och FHM?

Visa intervjuobjektet kartan över materialflödet
- Vad i den här kartan skiljer sig från er uppfattning?
- Vad saknas i den här kartan? Vad är alltför förenklat?

Lagar och regler
- Vilka lagar, förordningar och regler är det som framförallt reglerar och sätter upp ramarna för er verksamhet?
- Hur har ni tolkat lagen angående ert ansvar för läkemedelsförsörjning i en krissituation?
- Vilka lagar är det som framförallt styr läkemedelskedjan i stort?
- Är det stor skillnad mellan privata och offentliga aktörer? Hur påverkar det?
- Tycker ni att det finns luckor i det som regleras i lag?
- Vilka andra aktörer rapporterar ni till? Vilka gör tillsyner hos er?

Visa intervjuobjektet den legala kartan
- Vad i den här kartan skiljer sig från er uppfattning?
- Vad saknas i den här kartan? Vad är alltför förenklat?

Samverkan
- Vilka samverkansforum har ni i läkemedelsförsörjningen?
- Vilka andra aktörer (SKL, Andra landsting, Myndigheter, etc) i läkemedelskedjan har ni kontakt med? Samarbete med?
    - Hur? Hur ofta? Hur använder ni kunskapen ni får?
- Vem i läkemedelskedjan anser ni har samordningsansvar för läkemedelskedjan? Vem samordnar i praktiken?
- Hur påverkas ni av arbetet med den nationella läkemedelsstrategin?
- Vi vill lära oss mer om hur man jobbar med lärande mellan organizationer i läkemedelskedjan. Vilka andra aktörer tycker ni att vi borde prata med för att få bäst insikt i detta?

Informationsflöde
- Hur integrerade är era system med andra aktörer i kedjan?
- Hur delar ni och får reda på information från andra aktörer?
- Vet ni hur det ser ut i övriga delar av värdekedjan?
- Hade det gått att rita upp en tydlig struktur för hur informationsflödet ser ut?

Avslutning
- Om vi verkligen vill förstå hur ni ser på läkemedelskedjan vad borde vi ha frågat om som vi inte har frågat om än?

Punkter att besvara efter intervjun

Intervjupersonerna skriver ner följande punkter direkt efter intervjun.

- Hur intervjun gick
- En beskrivning av miljön där intervjun ägde rum
- Känslor under eller efter intervjun

Appendix B: Swedish Interview Guide, Case Interviews

Information till intervjuobjekt
- Godkännande av inspelning av intervju
- Våra forskningsfrågor
  - How is the SPSC structured under normal circumstances and in a crisis?
  - How can the actors in the SPSC work with interorganizational learning to become more resilient as a system?
- Intervjun fokuserar på den andra forskningsfrågan.
- Frågor kommer att ställas både om SPSC och din organizations specifika roll i SPSC.
- Du kommer att få godkänna dina svar innan de publiceras.

Inledande information
Detta för att få en allmän bakgrund till intervjuobjektet.

Generellt
- Namn:
- Utbildning:
- Tidigare jobb:

Specifikt
- Nuvarande roll i organization:
- Uppgifter och ansvarsområden:
- Antal anställningsår i organizationen:
- Antal anställningsår i SPSC:

Intervjufrågor - Del 1

Materialflöde

Visa intervjuobjektet kartan över materialflödet
- Här är en övergripande bild av det fysiska flödet i den svenska läkemedelsförsörjningen.
  - Vad i den här kartan skiljer sig från din uppfattning?
  - Vad saknas i den här kartan? Vad är alltför förenklat?

Lagar och regler

- Vilka lagar, förordningar och regler är det som framförallt reglerar och sätter upp ramarna för er verksamhet?
- Tycker ni att det finns luckor i det som regleras i lag i svensk läkemedelsförsörjning?

Samverkan

- Vilka andra aktörer i läkemedelskedjan har ni kontakt eller samarbete med?
  - Hur ser detta samarbete ut?
  - Hur frekvent har ni kontakt?
  - Hur använder ni kunskapen ni får?

Intervjufrågor - Del 2

Vi kommer nu att introducera dig för åtta olika interorganisatoriska lärandemetoder för att skapa en mer resilient försörjningskedja och vill undersöka om och hur ni använder dessa lärandemetoder. Vi kommer att gå igenom och diskutera dem en efter en.

Vertical information sharing

- Arbetar ni med lärande genom att utbyta information med aktörer som har andra roller än er i försörjningskedjan - det som vi kallar vertikal informationsdelning?
  - Med vilka aktörer?
  - Vad är målet för detta lärande?
  - Vilken typ av information mottager ni? Hur använder ni den för att lära er?
  - Vilken typ av information delar ni? Hur använder andra aktörer den?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar den vertikala informationsdelningen om något av följande?
  - Att lära sig mer om de olika aktörernas resurser
  - Att lära sig mer om systemets dynamik, dvs att förstå interna beroenden och externa hot
  - Att lära sig för att bättre kunna hantera en pågående krissituation
  - Att lära regeringen något för att kunna påverka lagar och regler

Vertical joint assessment

- Arbetar ni med lärande genom att göra gemensamma bedömningar tillsammans med aktörer som har andra roller än er i försörjningskedjan - det som vi kallar vertikal gemensam bedömning?
  - Med vilka aktörer?
  - Vad är målet för detta lärande?
  - Vilken typ av bedömningar gör ni tillsammans? Hur använder ni bedömningarna för att lära er?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar det vertikala gemensamma bedömandet om något av följande?
  - Att gemensamt fastställa systemets aktuella status
  - Att gemensamt fastställa vad olika typer av avbrott skulle få för effekter, ex. kaskadeffekter och beroenden.
  - Att göra en gemensam prognostisering.

Vertical collaborative planning

- Arbetar ni med lärande genom att göra gemensamma planer tillsammans med aktörer som har andra roller än er i försörjningskedjan - det som vi kallar vertikal gemensam planering?
  - Med vilka aktörer?
  - Vad är målet för detta lärande?
  - Vilken typ av planer gör ni tillsammans? Hur använder ni planerna för att lära er?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar det vertikala gemensamma planerandet om något av följande?
  - Att planera för att förhindra att avbrott i kedjan uppstår
  - Att ta fram gemensamma beredskapsplaner för specifika händelser
  - Att ta fram övergripande krishanteringsrutiner och kommunikationsstrukturer
  - Att under en krissituation lära av varandra och planera nästa steg

Horizontal information sharing

- Arbetar ni med lärande genom att utbyta information med aktörer som har motsvarande roll i försörjningskedjan som er - det som vi kallar horisontell informationsdelning?
  - Vad är målet för detta lärande?
  - Vilken typ av information mottager ni? Hur använder ni den för att lära er?
  - Vilken typ av information delar ni? Hur använder andra aktörer den?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar den horisontella informationsdelningen om något av följande?
  - Att koordinera sig inom industrin, ex. lära sig om hot, beroenden, påverka myndigheter, sätta upp gemensamma standarder etc.
  - Att lära sig best practices från andra aktörers erfarenheter.

Interorganizational education

- Arbetar ni med lärande genom interorganisatoriska teoretiska utbildningar?
  - Vad är målet för detta lärande?
  - Vilka typer av interorganisatoriska utbildningar håller ni? Hur använder andra aktörer dessa utbildningar för att lära sig?
  - Vilka typer av interorganisatoriska utbildningar deltar ni i? Hur använder ni dessa utbildningar för att lära er?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar de interorganisatoriska teoretiska utbildningarna om något av följande?
  - Att lära ut säkerhetsrutiner
  - Att lära ut hur man agerar snabbt i en kris
  - Att ge en djupare förståelse för värdekedjans struktur

Simulation

- Arbetar ni med lärande genom interorganisatorisk praktiskt simulering och träning?
  - Vad är målet för detta lärande?
  - Vilken typ av saker simuleras och tränas interorganisatoriskt? Hur använder ni detta för att lära er?
  - Hur går ni tillväga när ni simulerar och tränar interorganisatoriskt?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar interorganisatorisk simulering och träning om något av följande?
  - Lärande baserat på scenariobaserade övningar?
  - Lärande genom praktiska övningar på krisplaner mm?
  - Lärande genom att genomföra rollspel?

Analyzing experiences

- Arbetar ni med lärande genom att analyzera interorganisatoriska erfarenheter?
  - Vad är målet för detta lärande?
  - Vilken typ av erfarenheter analyzeras? Hur använder ni dessa analyzer för att lära er?
  - Hur går ni tillväga när ni analyzerar erfarenheter?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.
- Handlar det interorganisatoriska erfarenhets analyzerandet om något av följande?
  - Lära sig att undvika avbrott genom att analyzera near misses
  - Dela best practices och erfarenheter
  - Utvärdera gemensamma lyckade eller misslyckade erfarenheter

Stimulate flexibility

- Jobbar ni med metoder för att göra organizationen mer flexibel och anpassningsbar?
  - Vad är målet för detta lärande?
  - Vilken typ av metoder använder ni? Hur gör ni för att lära er anpassningsförmåga?
  - Hur går ni tillväga när ni skapar flexibilitet?

Eventuella vägledande frågor ifall det inte framgår av svaren på ovanstående frågor.

- Handlar interorganisatorisk simulering och träning om något av följande?
  - Förmåga att snabbt omorganisera försörjningskedjan
  - Metoder för kontinuerlig utveckling av krishanterings rutiner

Avslutningsvis

- Jobbar ni med någon ytterligare lärandemetod än de som diskuterats?
- Känner ni att det är något som inte framkommit under intervjun om hur ni arbetar med interorganisatoriskt lärande?
- Vad tycker du är de största utmaningarna i dagsläget i fråga om läkemedelsförsörjning?

Punkter att besvara efter intervjun

Intervjupersonerna skriver ner följande punkter direkt efter intervjun.

- Hur intervjun gick
- En beskrivning av miljön där intervjun ägde rum
- Känslor under eller efter intervjun

Appendix C: Interviews about Interorganizational Learning in SPSC

C.1| Overview of Interorganizational Learning in SPSC

The interorganizational learning methods used by each interviewed actor is explained in depth below. These should be read as expansions to the matrices in chapter 5 above and explain in depth how the actors work with the eight interorganizational learning methods. To facilitate the reading, the numerical sequence used in appendix C follows the sequence used in chapter 5, where C.2 corresponds to 5.2 and so on.

C.2| Pharmaceuticals Producer

All information in chapter C.2 was received during a conducted interview with the *Head of Regulatory Affairs and Product Quality at a global pharmaceuticals producing company* (2018).

C.2.1| Vertical Information Sharing

The pharmaceuticals producer has close contact with their distributor due to their role of storing and distributing the pharmaceuticals producer's pharmaceuticals in accordance with contractual agreements. The logistics department at the pharmaceuticals producer's subsidiary has daily contact with their distributor through a warehouse management system that sends information concerning the current inventory and positions of the producer's products. This include information about how their products are allocated between the distributor's central warehouses and distribution centers. Additionally, regular contact with the distributor is had since the pharmaceutical producer's subsidiary have to manually approve all pharmaceuticals delivered into Sweden, which happens when the pharmaceuticals are transferred to the distributor's Swedish warehouses. Further, regular phone meetings are held with the distributors.

The county councils also have contact with the pharmaceuticals producer in times of public procurements and contractings of certain pharmaceuticals for the inpatient care. These contracts are also signed through the Swedish subsidiary and are made separately with each county council. Through a method called *horizon scanning*, the pharmaceuticals producer has started to share information with the county councils regarding new pharmaceuticals that are expected to be introduced to the Swedish market as well as changes the pharmaceuticals producer is planning. This information sharing aims to prepare the county councils of upcoming changes and allow them to plan for it in advance.

The pharmaceuticals producer also has regular contact with TLV concerning price negotiations of the pharmaceuticals sold in Sweden.

Information concerning laws and regulations is shared with governmental agencies, for example with LV, through the trade association LIF and different expert groups within LIF. One example is an expert group in LIF focusing on the European regulation regarding *good distribution practice* (GDP). This group has lately looked at the how the pharmaceuticals producers should handle backorder situations. Further, suggestions for new regulations are often sent out from governmental agencies for referral through LIF, allowing the pharmaceuticals producers to share their opinions regarding a proposal.

If a pharmaceuticals producer experiences a large disruption, as for example a significant product defect or backorder situation, the situation is continuously shared directly with LV. Thus, the normal communication path through LIF is then bypassed to share information rapidly with the right people. To ensure rapid communication, there is always an inspector on standby-duty if something happens.

Given that many pharmaceuticals producers are global companies selling pharmaceuticals in multiple countries, the producers have internal rules ensuring compliance with all applicable laws and regulations. Thus, in many cases, the internal rules are stricter than the Swedish requirements.

C.2.2| Vertical Joint Assessment

Risk analyzes and assessments of current status is developed internally and not shared with other actors. However, the pharmaceuticals producer could ask the distributor to show their internally developed risk analyzes during the pharmaceuticals producers regular inspections to secure that a satisfactory risk analysis in conducted by the distributor and that preventive measurements have been taken through contingency plans and risk management procedures.

Forecasts are also done internally and not shared or developed in collaboration with other actors.

C.2.3| Vertical Collaborative Planning

As described above concerning the information sharing during disruptions, the pharmaceuticals producer has together with LV developed a crisis communication structure and routines for who to contact when large disruptions occur.

The pharmaceuticals producer does not develop contingency plans or similar with other actors, these are only done internally. This because it is regulated in the contracts with the county councils that the pharmaceuticals producer has to deliver 100%, with penalties if they do not. Thus, the responsibility to prevent disruption and ensure delivery reliability is considered to be the pharmaceuticals producer's alone.

C.2.4| Horizontal Information Sharing

The pharmaceuticals producer has contact with other researching pharmaceuticals producers through LIF. Within this forum, joint pharmaceuticals trade issues are discussed. One example could be discussions concerning a potential problem with a new regulation affecting the ability to deliver pharmaceuticals. Another example is discussions concerning the 2D codes on the pharmaceutical packages that will be implemented in 2019, where the pharmaceuticals producers in LIF work jointly to find systems and routines for how this should be managed. Additionally, within the collaboration in LIF, a joint system for how to manage reclamations and a joint system for how to manage withdrawals of pharmaceuticals have been developed. To ensure that the pharmaceuticals companies follow the Competition Act when discussing industry wide solutions, a representative from LIF is always present during discussions and interrupts all collaborations that could potentially break the law.

The pharmaceuticals producer is represented by LIF in NLS and gets information from their discussions via LIF but is not actively involved in the collaboration.

The pharmaceuticals producers in LIF does also collaborate concerning referrals and comment letters to governmental agencies, for example LV.

C.2.5| Interorganizational Education

The pharmaceuticals producer participates in regular interorganizational educations held by their distributor together with the distributor's other pharmaceuticals producers. This takes the form of information days arranged two times per year, where the pharmaceuticals producers are, e.g., educated in the Swedish healthcare system and pharmaceuticals market.

Additionally, one-time educations informing all actors in the SPSC of upcoming changes are sometimes held. This could be information concerning the 2D coding on the pharmaceutical packages as well as information concerning Brexit and how it will affect the actors in Sweden. In these two examples the educations were primarily arrange by LV, but it may differ from time to time.

C.2.6| Simulation

Simulations and practicing exercises are regularly conducted, but primarily internally. However, when it comes to crises that involves getting information from the distributor, the distributor is contacted and asked for the specific information during the exercise and afterwards informed that it was only an exercise. An example of such exercise would be simulation of a withdrawal. Thus, the pharmaceuticals producer tests if their information exchange and communication routines with the distributor works, even if they are not involved in the planning or aware of the simulation in advance.

C.2.7| Analyzing Experiences

The pharmaceuticals producer has extensive routines for how to analyze incidents and disruptions. If an incident happens, the pharmaceuticals producer looks at corrective and preventive actions: the first step is to correct the deviation or failure and the second is to prevent it from happen again. After that, an effectiveness check on these preventive actions is made to see that the preventive action found is effective. This process is, however, primarily done internally by the pharmaceuticals producer.

However, the pharmaceuticals producer also visits the distributor to perform inspections and control the inventory as well as secure proper crisis management procedures and contingency plans are in place. If an incident occurs at the distributor, the pharmaceuticals producer wants the distributor to go through the analysis process described above and share the results with the pharmaceuticals producer. They pharmaceuticals producer may then be a part of deciding about correcting and preventive actions for the distributor.

Near misses and success factors concerning the pharmaceutical supply are not analyzed by the pharmaceuticals producer, not internally nor interorganizational.

C.2.8|Stimulate Flexibility

The production of pharmaceuticals is a time-consuming process. The lead time from the production plan is decided by the Swedish subsidiary until the pharmaceuticals can be delivered is 3-4 months. Thus, if changes are made during that time, it creates problems. Thus, to increase the flexibility in the ordering process, the minimal ordering volume has recently been reduced to allow for more regular deliveries with smaller volumes. One recurring change that cause problems due to the long lead times, is the Swedish leaflets that continuously are updated and thus has to be updated in the sold packages as well. Thus, another method to increase flexibility would be to remove the physical leaflets and work with electronic leaflets. This is a suggestion that has been discussed together with other pharmaceuticals producers in LIF. To be able to implement this, a regulatory change would have to be made and governmental agencies would have to be convinced through discussions with LIF.

Methods to be able to fast reorganize the supply chain if something happens with for example the distribution are not used. Instead the pharmaceuticals producer rely on their contingency plans as well as their distributors contingency plans.

A big challenge for the pharmaceuticals producer's flexibility concerns parallel import and parallel distribution. If they supply 60% of the total number of a pharmaceutical to the Swedish market and a parallel distributor supply the other 40 % of the market, but the parallel distributor for some reason decides that it is not profitable to continue to supply the Swedish market, then the pharmaceuticals producer suddenly is left to supply the entire Swedish market. They then have to increase their sales with 67% to satisfy the demand, often without any warning. Another difficulty with parallel distributors is that they do not have to report potential backorders to LV as strictly at the pharmaceuticals producers have.

The product of the period is another regulation that affects the pharmaceuticals sales and creates problems, however, forcing the generics producing pharmaceuticals producers to be more flexible in their operations.

C.3| Distributor

All information in chapter C.3 was received during a conducted interview with Brammersjö (2018).

C.3.1| Vertical Information Sharing

One of the distributor's largest sources of income, comes from selling sales statistics, prices and other types of transactions to other actors in the SPSC, often to the pharmaceuticals producers or European or international statistical agencies. As an example, the pharmaceuticals producers sell pharmaceuticals in bulk to the distributors, why they need information from the distributors if they want to know the daily demand, the demand in different geographical areas or the demand categorized by different types of actors. The pharmaceuticals producer can buy this data from the distributor and also get further help with logistics analysis and strategy via the distributor's business intelligence function.

The distributors have a unique position in the SPSC as they provide 100% of both the inpatient and outpatient care with their specific assortment of pharmaceuticals, hence making it interesting for both upstream and downstream actors as well as governmental agencies to get access to the distributors' data. The distributor works a lot internally with their available data to develop new solutions for the market. In accordance with the distributor, other actors in the supply chain, e.g., the county councils, could make better use of their available data and transaction information to plan their operations. One such area where the county councils are struggling and where the distributor is currently developing future solutions and offerings based on their data, is healthcare provided at patients' homes.

Some data concerning availability of the distributor's products is shared with outpatient pharmacies and hospital pharmacies, but on a general level showing three different states: *in stock*, *few left* and *out of stock*. The given reason for not sharing more detailed information is because the distributor is not allowed to share exact details due to contractual agreements with the pharmaceutical producers. If a disruption that may affect the delivery reliability occurs in the supply chain, the distributor contacts the hospital pharmacies or outpatient pharmacies depending on which actors the disruption impacts. When the disruption concerns the outpatient pharmacies an immediate contact is even more critical, given that the distributor has agreed to deliver within a timespan of plus/minus 30 minutes of the decided time. The disruptions reported to the different types of pharmacies include everything from small traffic disruptions to a breakdown in the distributor's business system.

The distributor has contact with approximately 150 pharmaceuticals producers with which they have contracts for distribution to the Swedish market. These types of distribution contracts are currently made on a national or Nordic level, why the contracts often are signed through the pharmaceuticals producers' local subsidiaries. However, there is currently a tendency towards centralization of the distributor service and the signing of European contracts instead of separate contracts for each country, due to savings potential. This is believed to potentially lead to fewer local distribution hubs and warehouses, potentially closing the ones in Sweden,

leading to lower priority of the Swedish and Nordic market as well as longer distances to the patients. This would be especially problematic if Sweden went into a situation where the borders had to close, since it would be impossible to get new pharmaceuticals, even if the central inventory only were moved from Sweden to Denmark. A solution to this would be to have a war inventory, were the pharmaceuticals producers have to have a defined extra inventory accessible in Sweden as a requirement if they want to be approved to sell in the country. This solution is currently used in Finland. Another strategy to handle the situation is that the Swedish governmental agencies engage in activities to prevent the closing of Swedish hubs. This by trying to impact the distributor's global units through lobbying.

The distributor does not support parallel export of pharmaceuticals from Sweden, believing that products produced for the Swedish market should stay on the Swedish market. Thus, their ordering system is programmed to detect abnormalities. If an abnormal order is detected, the order is immediately stopped, and the hospital pharmacy's or outpatient pharmacy's order has to be manually approved or declined by the pharmaceuticals producer before proceeding. The distributor cannot itself decide to decline the order, only inform the pharmaceutical producer about the abnormality before processing it.

The distributor further has regular contact with multiple governmental agencies. TLV regulates prices for a lot of prescriptive pharmaceuticals sold at the outpatient pharmacies and the distributor thus need regular updates of the prices for its distribution pharmaceuticals to correctly invoice the outpatient pharmacies. The distributor also has regular contact with LV concerning regulations, where it tries to impact LV to improve the regulations to facilitate the Swedish pharmaceutical supply. Finally, the distributor has regular contact with eHM regarding integration of product information etc. Since the distributors are required to share some sales statistics with eHM, their IT-systems are somewhat integrated with automated information exchange.

C.3.2| Vertical Joint Assessment

The distributor develops joint risk analyzes regularly with some of the pharmaceuticals producers due to their strong interdependence and interlinked goals. It is important for both parties that the other actor has satisfactory risk analyzes and procedures, why risk analysis and assessment of current status are naturally developed jointly. These types of risk analyzes are often done via the pharmaceuticals producers' Swedish subsidiaries.

The distributor has a newly formed partnerships with one large pharmacy contractor who runs the hospital pharmacies in several counties. The partnership means that the pharmacy contractor recently moved the location of their regional cycle stock to one of the distributor's warehouses, since the distributor already keeps a cycle stock of 2-3 weeks for 35% of the Swedish population in the specific distribution warehouse, why one of the cycle stocks hence could be removed. The goal with this change is to minimize costs and provide the hospitals with better service, since unnecessary handling and time can be removed in the ordering

process. This arrangement requires a joint view of potential risks, why the distributor develops joint risk analyzes with this specific pharmacy contractor.

Risk analyzes are not made together with the outpatient pharmacies, since the distributor has the sole responsibility of delivering the pharmaceuticals in that collaboration and thus only develops potential risk analyzes themselves. Some joint forecasts are, however, developed with the outpatient pharmacies. Once a month, the distributor meets with the central unit of each outpatient pharmacy chain to discuss forecasts. Forecasts are generally very important to the distributor, as they form the basis for all the distributor's planning and operations. It has though become more difficult to forecast the pharmaceuticals demand due to changes in the outpatient pharmacies promotions and similar sales tactics on non-pharmaceutical products. This attracts people to specific outpatient pharmacies during certain periods, increasing prescriptive pharmaceuticals sales in those outpatient pharmacies as well. Thus, to facilitate the forecasting, the distributor uses AI to enhance their forecasts of the Swedish demand, and in combination with the monthly discussions with each outpatient pharmacy chain, an improvement has been noticed in their forecasts. These forecasts form the foundation for how the distributor structure their inventory to be able to fulfill the "24 hour rule", where the distributor has to deliver an ordered pharmaceutical to the outpatient pharmacies within 24 hours. However, the distributor believes that their forecast for each outpatient pharmacy store could be improved if not only the central units but also each store shared information of their current stock and their internal ordering rules. This would enable the distributor to be better prepared for when a specific store is about to order something and help the distributor plan its inventory even better.

Based on the joint forecasts of each outpatient pharmacy chain as well as each country and its hospital pharmacies, the distributor develops forecasts over the yearly Swedish demand for the pharmaceuticals they stock and distribute. These prognoses are then sold, together with other information mentioned above, to the pharmaceuticals producers that use them for planning the following year's production.

The fundamental problem to the backorder situations in the inpatient care, in accordance with the distributor, is the buffers embedded in most county councils' pharmaceuticals ordering. The distributor both distribute 100% of the Swedish consumption of the pharmaceuticals they have signed for with the pharmaceuticals producers and destroy 100% of all pharmaceuticals not used in the Swedish market. Thus, the distributor knows the exact consumption of their assigned pharmaceuticals each year. Based on those numbers, the distributor stresses that most backorders do not occur due to shortages in production, but rather due to stockpiling at the hospital pharmacies or in the caregivers' facilities. Given this, the solution to the backorder situation is not to produce more but to distribute the pharmaceuticals more evenly to where they are needed. This problem is amplified by the law, preventing hospitals from reallocating pharmaceuticals between them.

The problems with backorders are not widespread in the outpatient care according to the distributor. The outpatient care is built on direct service where the patients most times get their prescribed pharmaceutical at their first visit to the pharmacy. The service level for that is

currently 95%. In the remaining 5% of the times, the pharmacies order the pharmaceutical from the distributor, who then has 24 hours to deliver it to the pharmacy, the so called 24-hour rule. The distributor is able to deliver those missing pharmaceuticals within 24 hours in 99,5% of the times. Thus, backorder caused shortages occurs in the outpatient care in less than 1 ‰ of the cases.

C.3.3| Vertical Collaborative Planning

The distributor conducts collaborative planning with multiple actors in the SPSC. When it comes to crises affecting a large part of Sweden, LV has contingency plans where the distributor is involved. This can be anything from a sudden need for vaccines or a disruptive event in Europe. If a crisis occurs somewhere in Sweden, the distributor has employees on-call twenty-four hours a day that can come in and pack pharmaceuticals to send out as soon as possible. These routines are additionally practiced with LV on a regular basis.

Contingency plans are also developed specifically for backorder situations together with the pharmaceuticals producers' subsidiaries and LV. If a pharmaceutical has a risk of being backordered or suddenly becomes backordered, the parties follow a certain routine to avoid serious shortages and medical impact on the patients. This routine involves investigating if the product is available with another county's package, primarily Norwegian as these often are stored at the same places as the Swedish boxes. If foreign packages are available, LV can issue an exemption to the pharmaceutical producer to use these boxes, preferably by the dose dispensing pharmacies that repackage the pharmaceuticals in either case. If needed, foreign packages can also be used by the rest of the supply chain. For this to be possible, the pharmaceuticals producer's subsidiary has to have a discussion with LV who needs to allow the foreign package. In these cases, LV often requires the packages to include a Swedish leaflet, why the distributor may repack all boxes before distributing them from their facilities. This process thus demands a close collaboration between the pharmaceutical producer, LV and the distributor, a routine that is pre-defined and naturally practiced almost every week. In an urgent backorder situation where the pharmaceutical is finished and urgently needed, the county council may also get involved in the discussion though their contact with LV. However, in a lot of cases, the backorder situations can be solved early in the supply chain with minimal impact on the healthcare given to patients.

C.3.4| Horizontal Information Sharing

The distributor belongs to an European concern with multiple local units in 27 European countries. Thus, two different types of horizontal collaborations will be discussed. One is the collaboration between the local units belonging to the same concern and one is the collaboration between the interviewed distributor and the local competitor in the Swedish market.

Within the concern, best practices are shared extensively. All local units report their current and upcoming operations and projects to the central unit, where after the central unit connects them with units that have already done or is currently doing the same project. An example

could be when the distributor is doing an automation: before starting, the global unit connects the distributor with all other units that have gone through with that automation. By learning from their mistakes and success factors, the distributor can avoid the same disruptions or problems, hence making the distributors process more efficient. The opposite roles are taken if the distributor is the first unit to conduct a project.

The distributor has no information exchange directly with their main competitor. However, the two competitors have a joint pharmaceutical distribution association, LDF. Due to competition laws, only collaboration to enable a unified front against for example governmental agencies are allowed and no best practices or similar is shared through the association. To ensure this, the two companies' lawyers are present in the meetings. A joint area where the distributors do collaborate to have a unified front in discussions with other actors, is for example the backorder discussions. In that case, they jointly chose a representative for the two distributors. Similarly, a joint representative is chosen when discussing regulatory issues with, e.g., LIF and LV.

C.3.5| Interorganizational Education
The distributor holds theoretical educations for the pharmaceuticals producers and pharmaceuticals producers' subsidiaries continuously. The educations include both information about the EU regulation *Good Distribution Practice* as well as updates about the Swedish pharmaceuticals market and new local regulations etc. The latter is primarily for pharmaceuticals producers without a Swedish subsidiary, to keep them updated on important information and upcoming changes in the market.

The distributor is sometimes part of one-time educations about various upcoming changes and how to handle them appropriately. These are often organized by governmental agencies and held for all actors in the SPSC to inform and educate all involved parties. One example of such education, that is conducted at the moment, is an education about a new system for 2D codes on the pharmaceutical packages that is soon to be implemented.

C.3.6| Simulation
The distributor regularly practices its safety procedures together with some of their global pharmaceuticals producers, who may have global safety operational procedures regulating that these types of practices have to be conducted. These types of simulations are though only conducted if initiated by a specific pharmacy producer.

The distributor has further occasionally participated in scenario-based exercises about severe crises or war situations, arranged by the Defence Agency.

C.3.7| Analyzing Experiences
The distributor conducts extensive deviation and incident analyzes. Given the large amounts of pharmaceuticals they have, it is necessary to have extreme safety procedures to protect the central warehouses and distribution centers. Therefore, both near misses and actual incidents are thoroughly analyzed and addressed by the distributor. This is mainly done internally but

due to the value of the pharmaceuticals and the consequences if something would happen to the inventory, governmental agencies and the police are sometimes involved in the incidents and following analyzes.

C.3.8 | Stimulate Flexibility

Given the size of the distributors operations, it is not easy to quickly reorganize or be flexible in its distribution logistics. The distributor sees potential to increase the internal flexibility and to optimize the management of emergency orders. However, due to their system where the same truck drives the same route every day it is difficult to add a flexible dimension into the logistical system without disrupting the regular deliveries.

At the same time, the distributor's size enables them to absorb other types of disruptions. One example is the situation where the other large distributor shuts down completely during a period, when the distributor would be able to take over the distribution of their critical pharmaceuticals to prevent a serious disruption. This exact situation happened last spring in Finland and the distributor's local unit there were able to handle the situation by taking over the distribution of all critical pharmaceuticals and avoid any consequences affecting the patients.

C.4| Outpatient Pharmacy

All information in chapter C.4 was received during a conducted interview with Boström (2018).

C.4.1| Vertical Information Sharing

The outpatient pharmacy shares and receives information from a number of vertical actors in the SPSC. When ordering pharmaceuticals from the distributors, the outpatient pharmacy can see information about if the product is in stock or not. This information is saved internally until the next day by the outpatient pharmacy. The available inventory information is shared by the distributor through a page showing if the item is in stock or not, and if not, an approximation of when it is expected to be back in stock. However, information regarding how long a pharmaceutical inventory is expected to last or similar, is not shared by the distributors. The outpatient pharmacy shares information about their needs through direct ordering to the distributors.

Information exchange with the pharmaceuticals producers is only done reactively if a pharmaceutical is not delivered and not available at the distributor. This communication is handled via the pharmaceuticals producer's local subsidiary if such exists. The information exchange focus on understanding why the product is not delivered and when it will be available again. For the outpatient pharmacy this is important information that they in turn share with their customers. On rare occasions, the pharmaceuticals producer's subsidiary share information proactively regarding potential or expected backorders with the outpatient pharmacy. Usually this information is shared when another substituting pharmaceutical can be offered by the pharmaceuticals producer instead. Moreover, the outpatient pharmacy can find information about backorders on LV's webpage, as they provide a compiled list of current and expected backorders together with recommendations for how to handle the specific situations. In cases of more severe backorder situations, information is provided as a separate news from LV in addition to the compiled list. Pharmaceuticals producers are required to inform LV about potential and current backorders, but since LV currently lacks sanctions if this is not done, the list provided is not always complete.

The problem concerning backorders is widely known in the SPSC, but in contrast to the institutional care, the process of changing pharmaceutical and pharmaceutical producer is easier in the outpatient care. The process is facilitated by the constant changing of recommended pharmaceuticals within an interchangeable group through the system of *the product of the period*. This often result in situations where substitutes are available in the large volumes to, at the latest, the following month. However, when backorders affect pharmaceuticals without any substitutes, the situation is equally problematic as it is in the institutional care.

The pharmacy share information with TLV as they are the authority that mainly oversees the non-institutional care. The information to TLV is partly shared through the individual outpatient pharmacies and partly shared via SAF. The individual contact occurs when TLV has a supervisory matter concerning a specific outpatient pharmacy and the outpatient pharmacy

explains what they think of TLV's application of laws and regulations in the specific situation. In these contexts, a more general discussion about how the legislations work in practice is often held. Moreover, the outpatient pharmacy may also contact TLV directly if a *product of the period* is being backordered. Then, TLV can supervise the pharmaceuticals producer's capacity to fulfill the *product of the period* contract, since a breach of contract may lead to sanctions. TLV will further decide about and inform the outpatient pharmacy about a new substituting product of the period. Beside this, regular contact with TLV is managed via SAF. One example is when the regulations are about to change and TLV sends out a proposal for referral. Then all pharmacies write a joint comment letter through SAF in which they share their thoughts and opinions. As an industry, the opinion is generally that TLV often is too cautious and slow when it comes to regulatory changes in the SPSC.

C.4.2| Vertical Joint Assessment

Joint assessments are done together with the main distributor in retrospect regarding the current status of the delivery reliability. Jointly they look at products that did not arrive, disruptions or similar issues and assess how widespread these issues are

C.4.3| Vertical Collaborative Planning

Based on the joint assessment of product reliability with the main distributor, a plan is sometimes made for how to improve delivery reliability and better prioritize supply during disruptions or high demand. These assessments and plans are only sporadically conducted, and often varies depending on the role of the specific distributor as the outpatient pharmacy has more business and collaboration with one of the actors in the market. Apart from these discussion with the distributor, no contingency plans are made upward in the supply chain. The reason for not having much collaboration with the pharmaceuticals producers and distributors, is believed to partly be due to these actor's old view of outpatient pharmacies solely as a distribution channel and not as a customer. This view of the outpatient pharmacies has though changed somewhat among some of the large distributors and pharmaceuticals producers, but many actors still see them as a function that should work automatically. It is also hard to change this view since none of the upstream actors have incentive to collaborate with them, as LV decides what prescriptive pharmaceutical that should be available in the Swedish market and TLV decides what generic pharmaceuticals to sell within interchangeable pharmaceuticals categories. The distributors have contracts with the pharmacies because of the material flow, but their main customer is the pharmaceuticals producers why continuous collaboration is limited there as well.

However, when it comes to dose dispensing pharmacies, continuity plans are often required by the county councils as part of their contractual agreement. These contingency plans often involve the outpatient pharmacies temporarily helping with the distribution of pharmaceuticals to patients with prescribed dose dispensed pharmaceuticals, as well as getting aid from other dose dispensing pharmacies. To be able to transfer this type of production by the actors, eHM has to be involved to temporarily transfer the patient registers between the pharmacy actors.

When a supply disruption does occur, communication and collaboration with primarily the distributor takes place in order to solve the issue. Additionally, communication with the patients takes place through the stores belonging to the outpatient pharmacy. Usually, the same problem does not occur twice why the communication and collaboration structures and routines depend on the context. However, the outpatient pharmacy has noticed that communication and problem-solving abilities are improved the second time when a similar problem repeat itself.

C.4.4|Horizontal Information Sharing

Given the competitive outpatient pharmacy market, the information shared between the outpatient pharmacies is limited and all information regarded as business secrets is well kept.

Information shared with other outpatient pharmacies through the SAF mainly concerns joint comment letters to TLV. In such joint comment letters, all outpatient pharmacies share the same opinion and collaborate to better be able to influence TLV. Another collaboration area handled though SAF is the topics connected to NLS, as SAF is representing the outpatient pharmacies in this forum SAF's task is thus to convey the joint view of all members. In, e.g., the NLS workshops concerning the problems with backorders, one or two of the outpatient pharmacies were also allowed to attend the workshops to bring the somewhat more operational perspective to the Table.

Another example of industry coordination through SAF, is the work conducted in ARI. In an attempt to increase industry coordination, actors including SAF, LV and LIF have though ARI developed a structure and communication paths for how information should be distributed in cases of withdrawals. The decision for how to communicate a withdrawal still lies with the withdrawer, but support for understanding which media to use in which cases is provided to facilitate the choice.

Information regarding stock status at different outpatient pharmacies is shared and publicly available through FASS. Thus, any outpatient pharmacy can see whether a pharmaceutical, if not classified as narcotics, is in stock in all other outpatient pharmacies in Sweden. Given this, there is an industry wide agreement, that if an outpatient pharmacy does not have a certain pharmaceutical, the pharmacist should call or go into FASS to find the closest outpatient pharmacy, including competing outpatient pharmacies, where this item is available.

C.4.5|Interorganizational Education

Interorganizational theoretical educations concerning how to secure pharmaceuticals supply are not conducted regular with other actors in SPSC. However, when changes that may affect the delivery reliability are enforced, education regarding the changes and how to work with them are sometimes conducted. E.g. SAF recently held an E.g. SAF recently held an education for the outpatient pharmacies regarding the new 2D codes on pharmaceuticals packages that will be implemented in SPSC in 2019 and what incidents that are expected during this implementation process.

C.4.6| Simulation

The outpatient pharmacy has no simulation exercises with other actors in the supply chain. It is though known that for example the dose dispensing pharmacies are a part of large scenario-based exercises with among others the county councils.

C.4.7| Analyzing Experiences

Experiences are analyzed if a disruption or an incident occurs, as this is required by law. This analysis is done through a predefined quality management system. For larger incidents, a more extensive quality management analysis is conducted. If needed, information is requested by the outpatient pharmacy from involved actors, in most cases D or PP, to understand what went wrong in an incident. It is though rare that these actors sit down together and discuss the incident, instead the collaboration is more about sharing standardized information. The incidents can be various things, e.g., a risk for or an actual situation when a pharmaceutical is not delivered. If a systematic error happens, changes are made in the routines.

C.4.8| Stimulate Flexibility

The outpatient pharmacy's ability to reorganize if a disruption occurs is increased by the distributors choice to have several distribution warehouses, each witch roughly the same range as the others. Thus, if something happens at one location, it would be possible to use the other facilities owned by the distributors. However, this flexibility is not due to any interorganizational collaboration with outpatient pharmacies but lies within the distributors' operations.

A limitation to the possibilities to be flexible for the outpatient pharmacies, is the regulations prohibiting outpatient pharmacies to send pharmaceuticals between different stores, if it is not a requested pharmaceutical for a specific patient. The only transfer that may be possible is to return the pharmaceuticals to the distributor and then let them sell it to the other outpatient pharmacy. However, the possibility to return pharmaceuticals to the distributors depends on the characteristics of the item, as, e.g., a chilled product is not allowed to return.

The outpatient pharmacy stores have well adapted pharmaceuticals inventories for the local market and an outpatient pharmacy of normal size keeps around 3 000 – 4000 of the 15 000 available prescriptive pharmaceuticals in stock. The outpatient pharmacies are though largely dependent on daily deliveries by the distributors due to, e.g., low stocks of rare pharmaceuticals that need to be replaced immediately if someone buys the only available copy or request one that is not in stock. This is due to the fact that a lot of the 15 000 available prescriptive pharmaceuticals are rarely used but may be critical to get delivered very fast when actually needed.

In the case of a crisis, there are some inventory buffers at the central outpatient pharmacy warehouses, some at the outpatient pharmacy stores but primarily at home with the patients. The ability for patients to create less exposure to disruptions by storing their own buffer of prescriptive pharmaceuticals is, however, hindered, since pharmaceuticals benefits regulations

limits patients from collecting pharmaceuticals for more than three months use even if being under continuous medical treatment. The other side of this argument is that large patient buffers increase the risk for having to throw away pharmaceuticals due to change of medication resulting in resource destruction and environmental stress. It may also lead to a large illegal market for pharmaceuticals. However, the regulations clearly make the individual patients very dependent on a well-functioning SPSC

C.5| Hospital Pharmacy

All information in chapter C.5 was received during a conducted interview with Kjörling (2018).

C.5.1| Vertical Information Sharing

The pharmacy contractor shares a lot of information with the county councils regarding, e.g., deviations, consumption and risk of theft. This information is shared during administration meetings when the pharmacy contractor presents and explains the whole statistical package that they deliver to the county councils.

The county council also shares information with the pharmacy contractor. This information regards, e.g., holiday planning, that may mean that some departments are temporarily moving or closing down during a period which affects the hospital pharmacy. It may also be information concerning specific patients, e.g., that a patient with a rare treatment has been discharged or that another patient needs supply of pharmaceuticals for a specific number of days.

In summary, a lot of information is shared back and forth between the the pharmacy contractor and the county council, enabling them to understand resource allocation, system dynamics and potential threats. In the end the purpose is to free healthcare time and let the nurses focus on other tasks than organizing pharmaceuticals.

Given that extemporaneous pharmaceuticals are distributed by the pharmacy contractor, the pharmacy contractor has contact with the contracted extemporaneous pharmacy. This contact concerns the distribution of the pharmaceuticals to hospitals and to a very limited number of patients. The limited number of patients with home delivery of pharmaceuticals have regular contact directly with the pharmacy contractor, e.g., patients in need of dialysis. In this specific case the pharmacy contractor delivers the extemporaneous pharmaceutical, consisting of large volumes of liquid, directly to the patients in their homes, an arrangement requiring that the patient is home to receive it.

C.5.2| Vertical Joint Assessment

Given the information shared during the administrative meetings mentioned above, the representatives from the pharmacy contractor and county council tries to identify areas where they can improve jointly.

Joint assessments together with the county councils are also conducted, especially during and after signing a new contract. The assessments include both risk analyzes and joint assessments of efficient plans. The actors try to be as clear as possible about who is expected to do what and when.

The assessments are primarily done in the beginning after a new contract has been signed and after that, it is mostly adjustments when small disruptions occur. The adjustments focus on how to avoid or how to minimize the risk for a similar disruption in the future.

C.5.3| Vertical Collaborative Planning

Efforts and plans to avoid faulty deliveries are continuously conducted together with the county councils.

Another collaborative planning regards the management of disruptions concerning the e-business. If the electronic systems are not functioning, phones and faxes are the second options. This means that it is necessary to prioritize between different customers, i.e., county councils and their hospitals as well as between different pharmaceuticals. This prioritization done in such a situation is a type of coordinated response effort.

The collaborative planning with the county councils is conducted regularly given the difficulty in foreseeing these disruptions. Therefore, the crisis management is partly handled when a disruption occurs.

The communication structure between the pharmacy contractor and the county councils is very clear and, in a crisis, the communication structure switches directly to an "on call" solution. This solution looks different for every county council but is developed under close collaboration between the pharmacy contractor and each county council.

C.5.4| Horizontal Information Sharing

There are two main pharmacy contractors running hospital pharmacies in the SPSC. Given their competing positions of winning the supply contracts with the county councils they do not share any information with each other. This is due to a small and highly competitive market dynamic where all inventions and improvements are considered competitive advantages.

The only time direct horizontal information sharing occurs is when one pharmacy contractor wins a contract from the other pharmacy contractor. Then the two pharmacy contractors need to collaborate to be able to transfer the staff, inventory and tasks without disruption in the hospital pharmacy function. However, this collaboration is often forced and does not occur because the two parties want to collaborate.

The pharmacy contractors further have contact with the other pharmacy contractor through SAP, however, this contact is limited and in the presence of all pharmacies in the SPSC including outpatient pharmacies. Questions brought up at discussions held by SAP are mainly concerning upstream issues in the SPSC, e.g., how pharmaceuticals are distributed between the distributor's warehouses, or recently, how the new 2D coding will work in practice. The trade organization further represents the pharmacy contractor in NLS but this representation is also limited. The pharmacy contractor does not see SAP as a strong trade organization due to the low number of members and the competitive climate between them, preventing a more extensive collaboration.

C.5.5| Interorganizational Education

The pharmacy contractor creates and sells educations about pharmacy knowledge to other actors in the SPSC. This can as an example be an education in how nurses should handle pharmaceuticals. Education of employees at different county councils are common.

C.5.6| Simulation

The pharmacy contractor has scenario based exercises together with one county council, but not with the majority of the county councils that they have contracts with. When a simulation exercise is conducted, the pharmacy contractor and the county council jointly decide on a crisis scenario that they will practice. Then, they perform this scenario live, involving the hospitals in the county and physically sending pharmaceuticals etc. These kinds of exercises are performed at least once a year with the specific county council and involve different scenarios each time. The scenario-based exercises further give an opportunity to practice and test communication structures and crisis routines.

C.5.7| Analyzing Experiences

After the conducted scenario-based exercises with one CC, both actors go through the chain of events to change and improve routines and plans.

The pharmacy contractor further has a very effective and well-structured system for handling and following-up on deviations to secure that the deviation will not happen again. The conducted analysis and actions taken are widely shared and discussed with both the county councils and LV. The contact regarding deviation is more frequently recurring with the county councils than with the LV. The contact with LV is connected to LV's inspection of the pharmacy contractor.

The pharmacy contractor does not analyze near misses or successful projects and strategies.

5.5.8| Stimulate Flexibility

The pharmacy contractor tries to take different measures to make the SPSC more flexible to disruptive events, but find it hard since regulations prevent them from moving pharmaceuticals between different hospitals etc. They though provide aids to help hospitals move pharmaceuticals between their different departments using inventory systems and communication apps. An obstacle to prevent efficient movement of pharmaceuticals, is that inventory levels of the pharmaceuticals stock are not up to date at all times since the nurses do not have time to register the checkout of every single pharmaceutical. This makes it more difficult to manage the movement of pharmaceuticals between departments.

C.6| County Council 1

All information in chapter C.6 was received during a conducted interview with Thyberg (2018).

C.6.1| Vertical Information Sharing

For those pharmaceuticals that the county council have contracts for, the county council shares information with the pharmaceuticals producers regarding the county council's forecasts based on historical consumption as well as expected deviations in demand of considerable size.

The county council request information regarding supply issues, for example backorders, as early as possible from both pharmaceuticals producers, distributors and the pharmacy contractor managing the county's hospital pharmacies. The pharmacy contractor is also expected to directly share information regarding backorders with the healthcare providers within the county. This is done through a shared web page containing information of current and potential issues with backorders of specific pharmaceuticals.

However, the interorganizational information flow regarding backorders is currently not working that well due to low information quality. This is believed to partly be due to the fact that having a robust supply chain have previously not been a priority for the upstream actors in the supply chain. Given the inventory information provided by the distributor, it is often not possible to know when a product is coming. The county councils have learned to interpret certain vague formulations provided by the distributors, for example "the product will be available in 999 days" which often means that the pharmaceutical is currently being transported between the distributor's central warehouses and their distribution centrals why it appears as it does not exist, but this formulation may also point towards a backorder situation. Thus, the county council find it hard to act upon the information provided by the distributors.

The information from the distributors is accessed through the pharmacy contractor. The pharmacy contractor has a transparent system towards the county council and takes the information that they get from the distributor, adds some information regarding, e.g., additional handling times and provides the combined information package to the county councils and its healthcare providers. The information flow from the pharmacy contractor to the county council is considered to be important and have been developed jointly by the two parties.

If there is a local emergency situation a communication structure exists where all county councils have an Official on Standby (TiB) that takes care of all disruptions occurring locally like power shortages or fires. If the event escalates to a regional emergency, there are special divisions taking over both communication and decision making.

The county council shares information with LV concerning regulations that they believe do not work as well as intended. This can, as an example, be regarding the regulations preventing hospitals from moving inventories between each other, partly preventing county council to work with healthcare from a countywide perspective. Instead, the regulations favor hospital

specific inventories, which the county council believe is suboptimal for the system as a whole. This issue has been raised with LV.

C.6.2| Vertical Joint Assessment
Joint assessments are done daily together with the pharmacy contractor regarding issues in the pharmaceuticals deliveries and specifically regarding backorders. Occasionally LV is involved in the assessment of backorders as well.

Forecasting is only done internally.

C.6.3| Vertical Collaborative Planning
The county council develops contingency plans with the pharmacy contractor to secure supply and plan for how to act if there is a disruption in the supply chain. One such predefined contingency plan defines how to act if there is a disruption in the digital systems and the operations need to be managed manually. Coordinated crisis management procedures regarding pharmaceuticals supply are also developed together with the county council's contracted dose dispensing pharmacy. This is done on a relatively basic level, focusing on how to jointly handle failures in the operations or information loss.

This type of collaborative planning is not conducted together with the pharmaceuticals producer, as the pharmaceuticals producers contractually guarantees 100% delivery. However, this is an agreement both parties know will not be fulfilled, and the penalty clauses are not enough to prevent delivery issues. Part of the reason is that the Swedish market has low priority on a global level. Moreover, the contact with the pharmaceuticals producer is always handled through their Swedish subsidiary that acts as a local marketing function for the pharmaceuticals producers, but that is believed to have little influence over distribution or production. Contingency planning would thus preferably be done directly with the global pharmaceuticals producer if it should have any real impact for the county council. Direct contact with a global unit of the pharmaceuticals producer is though very rare and have for the specific county council only happened at one occasion when a large and important need for a specific pharmaceutical was known in advance. In that case, the global unit responded with an ensurance that they would guarantee no backorders.

When a local disruption in the supply occurs, it is natural to coordinate the management of how to handle the disruption with the distributors, the pharmacy contractor and involved hospitals. As an example, problems often occur when the county council change their contracted extemporaneous pharmacy and in these situations they form a group with representatives from hospitals, distributors and the new extemporaneous pharmacy that work and plan together until the issues are solved.

A current problem in the SPSC is that there are no incentives in any part of the supply chain to keep safety stocks, why the whole supply chain has been sub-optimized. Inventories held by different actors have gone from high to very low as all actors have started to pay attention to

their stock values and structure their operations according to JIT thinking. This is true for pharmaceuticals producers, distributors, all types of pharmacies as well as healthcare providers. With all actors working with JIT, the overall supply chain does not work as the service level is too low, which probably depends on the fact that the SPSC is not robust enough.

Other barrier for vertical collaborative planning is due to some actors being far away from the Swedish market and the Swedish actors. The global pharmaceuticals producers are located far away from the Swedish market and as a result, the communication between them and the county council is very rare. This increases the complexity since the two actors do not know how the other actor reason in these types of issues. The county council would truly like to work on these relationships as well as an interorganizational understanding.

When the county council plans for how to handle crises, certain pharmaceuticals and products are of special interest due to their wide application range and critical function during emergencies. These are products like infusion solutions, antibiotics, anesthetics and painkillers. Thus, the county council has a larger buffer of these products and are able to sustain operations a while without replenishment. Additionally, the county council is located in Stockholm and knows that the two main distributors have warehouses in Stockholm which, even if the county council do not have specific information regarding their stocks, can be assumed to have a buffer of these types of products. An additional factor strengthening this assumption is that these types of products are regularly used even under normal circumstances and have relatively low prices and can therefore be assumed to be bought and stored in large quantities. The county council has started a project where this type of critical but common pharmaceuticals would be listed together with specifications of how much would be needed given maximal consumption for two whole days and compare that with the stocks kept today.

Still, the county council believes that there are a lot of unclarities in regard to their responsibility in a crisis situation. Currently, there are no laws or regulations that support how the county councils should work with preventing disruptions or response efforts and they are not given any support to be able to do it either. The efforts described above with security stocks and a critical pharmaceuticals list are initiatives driven by the county council. Therefore, there are a lot of questions about who is responsible for what and how to handle that responsibility. For example, if the county council would have a security stock enough to cover the pharmaceutical need in the county for 3 months, how would that be handled and stored to still make sure that they would be used before their expiry date? Another question is: who is responsible for keeping inventories for the outpatient care? Overall, the county council believes that the responsibility needs to be clarified and this includes a clarification of the responsibility of the governmental agencies.

The unclarities concerning the county councils responsibilities for the outpatient care is partly due to a very limited collaboration with the outpatient pharmacies. Before the deregulation, the inpatient and outpatient care collaborated continuously and the healthcare sector was viewed as one system. Today, the collaboration with the primarily outpatient pharmacies is almost non-existing and the system is divided between the outpatient and inpatient care. The reason for

this change is that the outpatient care, primarily the outpatient pharmacies, have a more commercial focus today. They have a very short-term perspective and focus on yearly profits. However, the inpatient care, including the pharmaceuticals producers and county councils have a long-term perspective when planning, focusing on securing profits over a 10 years period. These two contrasting views makes it hard to develop productive relationships and create joint crisis plans.

C.6.4| Horizontal Information Sharing

The county council works with benchmarking and shares best practices with other county councils. This is both done through yearly meetings where the Swedish county councils gather and discuss current issues and in smaller configurations looking at specific issues and questions. A lot of the larger discussions are held in forums or networks organized by SKL, such as the *contact person network* and the *pharmaceuticals supply network* where all county councils are represented. Furthermore, there are the *pharmaceuticals officers committee* and the *pharmaceuticals committee*, where regular meetings also are conducted. Smaller configurations for information sharing can be based on, e.g., county size, geographical proximity or contracted pharmacy contractor. The interviewed county council, e.g., has tight collaboration with the other three largest county councils in Sweden. Another example of such a collaboration forum is *Sjuklövern,* consisting of seven councils in the middle part of Sweden. During local emergencies when a lack of certain critical pharmaceuticals risk to occur, nearby county councils have close communication to see whether they can help in any way.

A lot of collaboration is also conducted on a more person specific level, where pharmacists and prescriptionists in different county councils personally know each other and each other's expertise areas, hence using these personal connections to share best practices and discuss problems. The hospital pharmacists, e.g., have an informal network where they ask and answer questions, hence continuously learning from each other.

C.6.5|Interorganizational Education

The county council has no theoretical educations with other actors in the SPSC. There are currently no clear motives to conduct such educations either, according to the county council.

C.6.6|Simulation

Interorganizational simulation exercises are not conducted on a regular basis in the county council. However, overall contingency plans and communication structures for pharmaceuticals are somewhat practiced when the regional healthcare crisis management practice their routines. Focus is then on which hierarchy level a certain type of problem should be handled by and who has the decision power over what. Given the difficulty in anticipating disruptions and crisis, these types of exercises are considered to be more relevant and helps build robustness in the system. These types of exercises are however, not done on a regular basis and mainly done internally in the county council.

C.6.7| Analyzing Experiences

The county council conduct analyzes on experiences with other actors. As an example, after the problems when changing contracted extemporaneous pharmacy, the county council will have a learning seminar together with the involved actors to jointly discuss what can be learned from the incident and what can be better in the future. The learning seminars often involve the pharmacy contractor, the extemporaneous pharmacy and/or hospitals. However, not only problematic projects are analyzed, but all projects are discussed after the implementation of it to find success factors and lessons to be learned. These analyzes are not advanced, but the information and lessons gained are taken home to each organization where they are used for future projects.

In the healthcare industry, deviation management systems are widely used and deviations thoroughly analyzed. Thus, deviations not fully becoming an incident or disruption are still reviewed, but it is not very often this system is used in the pharmaceutical supply area.

C.6.8| Stimulate Flexibility

As part of the normal work procedures, the county council test what would happen if a specific pharmaceutical would end and through the contingency plan exercises, reorganization is practiced to a limited extent.

Another way to constantly be flexible and minimize the risk for impact on the healthcare, is to work with several parallel strategies to ensure pharmaceuticals supply. This way, the county councils and the SPSC can stay flexible and uphold negotiation power in its relations. When it comes to interdependencies and external threats in the supply chain, e.g., backorders, the county council can take several parallel actions together with other actors in the supply chain. One method to use in such a situation, is to bring in pharmaceuticals available in other countries but not in Sweden, i.e., parallel distribution. Alternatively, the county councils expert organization can decide that the county council should change pharmaceutical or treatment, or ration it and, e.g., only allow it for diseases where no other treatment is available. Other alternatives are applying for production by license or exemption for foreign packages. All these methods are done jointly with putting pressure on the pharmaceuticals producer to prioritize the Swedish market regarding the original, approved, pharmaceutical. All these types of flexibility actions demand a vast amount of interorganizational collaboration to work.

An organizational advantage within the specific county council is that the pharmaceuticals and disaster medicine divisions are closely located organizationally as well as physically and thus naturally collaborate regularly. This makes the communication and collaboration when a disaster does occur smoother, a collaboration that is often not as flexible in other county councils where the two divisions usually are organizationally very far from each other.

C.7| County Council 2

All information in chapter C.7 was received during a conducted interview with Winner (2018).

C.7.1| Vertical Information Sharing

Information is shared extensively with the pharmacy contractor operating the county council's hospital pharmacies. This includes both information to facilitate the daily operations as well as information to find joint routines and information needed to jointly fulfill legally required demands. Both the county council and the pharmacy contractor are by law required to report to LV how they structure the pharmaceuticals supply to and within the county's hospitals as well as report significant deviations, problems and changes in their operations. The county council and pharmacy contractor thus need to have regular information sharing to ensure that these legal requirements are met. The county council has ensured information sharing and transparency from the pharmacy contractor by regulating delivery reliability demands in their agreement, including communication regarding inventories and backorder-substitutions. As a part of this, the county council automatically receives the pharmacy contractor's price list in their ordering system, where information regarding availability of pharmaceuticals is shown. This is shown on a high level only revealing whether a pharmaceutical is in stock or if it is an ordering item. Additionally, the county council has regular meetings with the pharmacy contractor to ensure the information sharing and that the agreements are satisfactory fulfilled.

The county council also has contact with a number of pharmaceuticals producers regarding contracts for certain chosen pharmaceuticals. The contracts primarily regulate prices but also include delivery commitments with penalty clauses for the pharmaceuticals producer. These contracts further give a forecast of the expected needed volume, based on the country's historical need of the specific pharmaceutical. The information sharing and learning is, however, very limited.

Information regarding potential risks and threats are shared by the county council with the public and thus, with the other actors in the SPSC through the county council's publicly available risk and vulnerability analysis, RSA. This is though a broad analysis, not only focusing on the pharmaceuticals supply.

The county council has contact with multiple governmental agencies and shares information with them. The primary contact is with LV, with whom the county council shares information related to LV's role as supervisory authority for pharmaceutical regulations, including pharmaceutical supply. This includes sharing information if large deficiencies or delivery disruptions arise as previously described. Additionally, the county council has contact with SoS when in need of advice concerning pharmacy management. The county council also has some contact, although limited, with FHM and eHM.

Apart from the information sharing that is required and regulated in laws and regulations, the county council together with other county councils in SKL also shares information regarding how regulations work in practice with LV. This is primarily done in cases when the county

councils and SKL believe the regulation for some reason does not work optimally. An example could be regulations concerning prescriptions for patients given healthcare in their own homes, where the county council believes it would be beneficial if the county councils were allowed to deliver specific pharmaceuticals directly to the patients homes. Currently the county councils are not allowed to manage that function. Therefore, the county council has to contract a pharmacy contractor to deliver the pharmaceuticals or let the patients pick up their own medicines from an outpatient pharmacy. An example when this can cause problems for the patients is when the patients need dialysis and the medicine in that case is large volumes of liquid which is difficult to transport to their home.

When a law or regulation is overlooked and about to be changed, both SoS and LV sends out referrals to all county councils, who discuss the changes in SKL to come up with a joint view. Based on the discussions, the county councils then send back individual comment letters to the actual agency, sharing their opinions about the proposal.

C.7.4| Vertical Joint Assessment

Joint assessments or risk analyzes are currently not conducted together with other actors. However, the county council are waiting for an ongoing national evaluation where they are hoping to get more clear instructions including how to work with joint risk assessments and similar.

C.7.3|Vertical Collaborative Planning

Contingency plans are developed internally by the county council and not in collaboration with other actors in the SPSC. The same goes for crisis procedures and response efforts, where the county council communicates their plans to relevant actors when they are finished.

The county council would like to collaborate more concerning prevention of disruptions and response efforts together with other county councils but are heavily constrained from doing so by the current law about pharmaceuticals trade, preventing healthcare providers from moving pharmaceuticals between their stocks. The county council would therefore like to increase the information exchange and collaboration with concerned governmental agencies to develop an understanding for the county councils' situation as well as to receive more guidance of how the county council can increase the collaboration in prevention and response efforts to become more resilient as a system.

C.7.4|Horizontal Information Sharing

The county council conducts procurements of pharmaceuticals together with two other nearby county councils, thus having a vast information sharing between them. However, in this collaboration the pharmaceuticals are the sole focus and each of the three county councils have different solutions for the hospital pharmacy function, hence not collaborating at all in this area Another collaboration forum is instead developed between the county council and other county councils that use the same pharmacy contractor to manage the hospital pharmacies within their counties. These county councils have meetings every semester when they share experiences

from their collaboration with the pharmacy contractor, discuss established routines, what can be learned from each other and potential joint efforts. These discussions are only held between the county councils and the pharmacy contractor is not present in the meetings.

In addition to the collaboration regarding joint procurements and handling of the pharmacy contractor, the county council has extensive collaboration with all Swedish county councils through SKL. For example, SKL and the county councils have a specific network for questions concerning pharmaceuticals supply. This network was originally started in 2011 by the county councils, but SKL has also been involved since a few years back. Current issues with regards to pharmaceuticals supply are discussed by a leading committee that gets together three to four times per year. Once a year, the working committee assembles the whole network with representatives involved in supply questions from all county councils and SKL and have seminar days discussing experiences, best practices and knowledge concerning pharmaceutical supply. The seminar days are also valuable for establishing personal contacts and getting to know what project the other county councils have coming up. The tight collaboration with other county councils in the supply network is rewarding and the specific county council have very good experiences from it.

Apart from SKL, there are multiple other network between different functions in the county councils, often as a result of regulations demanding the county council to have certain specialists and roles. These specialists form networks between all specialist within an area, including both county council employees and, in the cases where a county council have procured the specialist function from their pharmacy contractor, the pharmacy contractor's employees.

An important thing to have in mind when looking at the different networks and collaborations in the SPSC, according to the county council, is that all of them are relatively new and have developed during the last eight or nine years. When the monopoly was deregulated in 2009, the existing networks were dissolved, and the knowledge were spread out between the private actors and the county councils. Corresponding networks and knowledge as well as the ability to learn from each other have therefore taken time to rebuild.

C.7.5| Interorganizational Education

The county councils have interorganizational theoretical educations within different disciplines on a yearly basis. Every fall, seminar days concerning pharmaceutical supply are organized by the leading committee of the county councils' and SKL's supply network, as described above. A more general two-day workshop with multiple specific and general disciplines is further held for the county councils every spring. Additionally, lectures within the specialist areas are held regularly as needed, often organized by either a county council or SKL.

The county council further have educations for and is educated by their specific pharmacy contractor. When new employees start at the pharmacy contractor, they are invited to the county council to see how the county council work and why the interorganizational procedures

and requirements look like they do. The county council likewise visited their pharmacy contractor's site before their contract signing to see how their procedures look in practice. The same type of visit was done shortly after the contract signing when the pharmacy contractor opened a new warehouse in connection to the county council's operations. However, the county council's visits at their pharmacy contractor are not conducted regularly. The visits at the other actors site increase the understanding of the other actors' routines and procedures, which is believed to have facilitated their collaboration.

C.7.6| Simulation

Simulations of crisis scenarios are not conducted with other actors. However, after a contract signing is made with a new pharmacy contractor and before this contract is implemented, practice exercises are made to control that the integrated technical systems work. A hypothetical scenario of orders is put through the system to see that the communication between different divisions works. The goal is to see that it is possible to send and receive orders. These exercises have turned out to be helpful in preventing disruptions in the start-up phase.

C.7.7| Analyzing Experiences

The county council has clear routines for Analyzing disruptions and deviations concerning the delivery reliability, as this is required by law. If a disruption occurs, the county council looks at why the disruption happened and how to avoid it in the future. This is then discussed with involved actors, usually the pharmacy contractor if it is an external problem. Large deviations are reported to LV as this is required by law.

Near misses, that could have led to serious consequences, are analyzed in the same way as real disruptions. By looking for lacking routines or routines that are not followed, improvements to avoid similar situations in the future are made.

C.7.8| Stimulate Flexibility

The county council does not systematically use methods to improve the adaptiveness of the organization. However, the county council has an upcoming project where they will create backup routines and system flexibility. The planning includes coming up with ways to manage very rare problems that still needs to be handled. The project is likely to include the pharmacy contractor, as they have a central role in the operations in the country.

C.8| County Council 3

All information in chapter C.8 was received during a conducted interview with Vondracek (2018).

C.8.1| Vertical Information Sharing

The county council has daily contact with their pharmacy contractor regarding how to solve problems with the availability of pharmaceuticals. This communication is based on information in a database with a register of all pharmaceuticals with marketing authorization in Sweden. This register shows availability and information concerning backorders of specific pharmaceuticals. This information is, however, not as accurate as preferred and often the information about backorders comes when the pharmaceutical is no longer possible to purchase, not proactively as is recommended by LV. To minimize this problem the county council have created an assortment council to monitor the availability and risks of back-orders for a defined assortment of approximately 3000 pharmaceuticals. When a back-order does occur the assortment council thus has contact with the pharmacy contractor to find alternative pharmaceuticals. To facilitate information exchange with the pharmacy contractor, a joint IT-tool is about to be implemented and will be used to share information more extensively. It will have, e.g., recommendations regarding alternative pharmaceuticals or expected availability of a backordered pharmaceutical. This IT-tool and the information to be included in it is developed jointly with the pharmacy contractor and is furthermore shared through the county's hospitals' ordering system to facilitate the ordering process for the nurses in the county.

The county council have regular information exchange with the pharmacy contractor and hospitals during a disruption or crisis to jointly manage the crisis. The routine for this will be described later. An ongoing project within the county council is assessing how large crises or disruptions should be managed. The hospital pharmacy function in the county council does currently not have a defined role in a large-scale crisis since they are expected to hand over the responsibility for communication with governmental agencies, e.g., MSB, to a temporary overall crisis organization within the county council.

The information sharing and contact with the extemporaneous pharmacies is similar to the contact established with the pharmacy contractor. However, there are not as many problems with the extemporaneous products as it is with pharmaceuticals produced by the pharmaceuticals producers, why the contact is less frequent.

The county council has a little contact with the pharmaceuticals producers trough their procurement division. This contact is, however, limited to official procurement of some specific pharmaceuticals and follow-up on these contracts. Most of this information exchange is conducted when something is not working. According to the county council, the contact with the pharmaceuticals producers needs to be improved. Since the only contact today goes through the purchasing division in the county council, medical specialist knowledge of the pharmaceuticals and the need for them and well as expertise regarding the SPSC is lacking when having discussions with the pharmaceutical producers. Thus, it is believed that the county

council needs to find a solution internally to improve the expertise in the contact with the pharmaceuticals producers to be able to share information of what a backorder situation looks like in reality and how it affects the patients.

The county council shares information and opinions regarding regulations and their applicability with governmental agencies, e.g., SD, SoS and LV. This is often done via SKL, via referral responses or via participation in investigation teams lead by one of the governmental agencies.

The interviewee is part of the SNÄL network together with, e.g., representants from SoS, FHM, eHM and LV, where information regarding the pharmaceuticals supply in crisis or state of alert and current issues are continuously shared.

C.8.2| Vertical Joint Assessment

The county council requires their pharmacy contractor and extemporaneous pharmacies to identify critical processes in their operations and additionally, create risk analyzes. The result is shared with, and if needed refined by, the county council. Thus, the risk analyzes are not really based on joint assessments but rather just shared between the actors. The analyzes though form the basis for contingency planning as described later. Forecasts over pharmaceuticals demand are made internally by the county council and not in collaboration with other actors.

C.8.3| Vertical Collaborative Planning

Based on the risk analyzes made by the pharmacy contractor or extemporaneous pharmacy and refined by the county council, contingency plans for the pharmaceuticals supply are developed, primarily by the pharmacy contractor and extemporaneous pharmacy but with some input from the county council.

A large and frequently recurring problem is disruptions in the ordering flow. To manage this, specific contingency plans and crisis management procedures are developed in close collaboration with the pharmacy contractor and extemporaneous pharmacy. The plans include, e.g., how decisions should be made and how different divisions within the hospitals should be prioritized if it is not possible to deliver a certain pharmaceutical to all divisions.

When a backorder problem or a disruption occurs, the county council further has a specified handling process including a communication routine to share and receive information regarding the situation. The above-mentioned assortment council is the foundation for this process and the communication. If not urgent, normal communication paths are used with the pharmacy contractor and hospitals within the county. This collected information is shared with the county council's knowledge organization, for example the pharmaceuticals committee and medical experts, to decide whether an alternative treatment should be given or if a prioritization of patients is necessary due to the disruption. The medical experts communicate the decisions and recommendations to all doctors in the county council.

The county council has further been part of multiple investigations lead by different governmental agencies with the purpose of overlooking and potentially change laws and regulations. The county council has, e.g., been involved in a project concerning vaccines with FHM, a project regarding pharmaceuticals supply during state of alert with SoS and several investigative project lead by LV.

Another collaboration forum is a Nordic network with Denmark, Norway, Finland and Iceland. This network gets together a couple of times per year and discuss backorder situations impacting the entire Nordics. Together they try to find high-level solutions for all five countries. Given this, each county then handles the details on a national level. Overall, the increasing problem with backorder situations and how to handle them is considered to be one of the main challenges in the SPSC.

Given the current structure of the SPSC where the distributors and country councils have no contracts, the county councils do not have much power to impact the upstream actors. The only way the county council can impact the distributors is by trying to impact the regulators to change what the county councils are allowed to do. The interviewee would like the county council to improve their collaboration with the distributors due to their control over large inventories of pharmaceuticals, owned by the pharmaceuticals producers, that the distributors are assigned to distribute. It is in the distributors' warehouses that the large volume of pharmaceuticals are located in Sweden, why it is from there the backorder situation needs to be handled and prevented. Additionally, if an emergency occurs, the distributors have the ability to help minimizing the impact by distributing pharmaceuticals from this inventory.

The county council further sees a possibility to collaborate more with the hospitals in the county, to coordinate their actions better. For example, as the care of patients in their own homes is becoming increasingly common, the hospitals have had to find solutions to transfer parts of the treatments and pharmaceuticals to their patients homes. The interviewee believes that the hospitals would have much to gain from learning from each other in this situation and jointly find best practices.

The county council sees an additional need to clarify the responsibilities of the actors in the SPSC during a larger crisis. A clarification of how governmental agencies, county councils and other actors should collaborate and work with methods to prevent disruptions as well as plan response efforts, is necessary for an overall secure system. According to the interviewee, there are currently holes in the response efforts and if a large crisis would happen at the moment, the system would probably not handle it well.

C.8.4 | Horizontal Information Sharing

The county council is the convening actor in a pharmaceuticals supply network within the SKL. This is a collaboration forum where all county councils share experiences and try to learn from each other regarding pharmaceuticals supply topics. An example is the question of how to organize the pharmaceutical supply within a county. For country councils having a contracted

pharmacy contractor fully or partly performing the hospital pharmacy function, experiences from negotiations and agreements are shared between the county councils as well as problems that showed up, success factors and opinions of different pharmacy contractors. The network has large meetings once or twice every year, during conferences or information days, arranged by a work team within the network. The work team consist of five to six persons and is led by the county council. This forum is a relatively large learning and experience exchange that is believed to contribute to each county councils daily work.

Within this pharmaceuticals supply network under SKL there are also discussions concerning laws and regulations. In the cases where the county councils find that a law does not reflect the intentional purpose of the law, the network of county councils try to impact, e.g., SD or LV through SKL. One example of when this has been done, is regarding the regulation of how to use prescription and requisition pharmaceuticals in different organizations, the legal scope of pharmacy hospitals and what permissions that are needed to conduct different activities in the SPSC. When aiming to change a law or regulation all county councils tries to present a joint opinion though SKL, as a joint interface. Referrals sent out by a governmental agency are though answered separately by each county council.

In addition to the SKL pharmaceuticals supply network, pharmacists and prescriptionists working on multiple divisions at all county councils, have an informal yet widely used joint mail group where they can ask specific questions to see if anyone else has experience of something similar. This enable the county councils to help each other with difficult situations and issues. It is believed by the interviewee that since the county councils are not profit-making companies, it is only beneficiary to share ideas and experiences between the county councils. By sharing ideas, the county councils also get suggestions for improvements, helping them to be better. This group is currently used on a daily basis.

These types of broad collaboration forums between the county councils is believed to be a response to the lack of communication and collaboration forum that existed when the monopoly was deregulated and the networks within Apoteket AB were dissolved. A lot of the people working with pharmaceuticals supply in the county councils have a background in Apoteket AB, where they were used to collaborate and help each other. It is believed that many county councils felt alone in their new responsibilities, why these new networks were developed as a replacement.

The county council has an especially tight collaboration with one other county council that has the same hospital pharmacy structure and uses the same regional warehouse. Thus, the two county councils discuss pharmaceuticals matters regularly.

The county council additionally highlights that the county council is a large organization, consisting of multiple divisions that in some cases functions more like different organizations than one. Therefore, the interorganizational learning methods are sometimes applicable not only on the officially separated organizations in the SPSC, but in some cases also between clearly separated divisions of large organizations.

C.8.5| Interorganizational Education

The county council does not conduct theoretical educations with other actors in the SPSC. The educations held are internal.

C.8.6| Simulation

The county council practice their contingency plans and crisis management procedures together with their pharmacy contractor. The practice exercises start with a discussion between the two actors, where they try to identify risks and currently critical situations that need to be practiced to see if the routines work. Given this, a fictive scenario is created where a disruption occurs, which the county council and pharmacy contractor jointly practice in reality together with different functions at the hospitals. During the simulation, more information is added to the scenario and some is changed. Everything that happens are written down and afterwards the involved actors have an evaluation where they go over the processes and ask themselves and each other if the routines work. Further they look into what decisions were made, how long it took and what consequences the disruption had. The actors also try to improve their routines and processes for managing that type of scenarios. These scenario-based exercises are conducted once every year.

What is noted by the county council is that these exercises have led to many improvements and identification of risks that only can be found during practices. Scenario-based exercises or similar types of stress tests have therefore become an irreplaceable method for risk management for the county council. The county council also recently started to involve their IT-functions as it has been identified as a vulnerable area.

The county council believe that it would be beneficial to include more actors by increasing the scope and time horizon of the exercises. However, the county council have not come that far in the development of their practices yet.

C.8.7| Analyzing Experiences

Every time a large incident occurs, or a disruption where a contingency plan or crisis management procedure is activated, the county council have made an internal decision to conduct an event analysis. The event analysis is conducted to understand the fundamental reason to why the disruption occurred and to find correcting and preventing actions to make sure that the same type of disruption does not happen again. The event analyzes are often conducted together with either the pharmacy contractor or the extemporaneous pharmacy. The county council have developed a standardized method for how to conduct these event analyzes.

The county council additionally looks at near misses during so called incident measurements. The incident measurements are mainly executed by the pharmacy contractor and the extemporaneous pharmacy. When neither the pharmacy contractor's employees or the county council are aware of it, the pharmacy contractor measures everything that did not go as expected but that was corrected or solved in the end. This is measured manually using pre-

designed protocols where they write down everything that is usually corrected right away and not viewed as a disruption. The measurement is presented to the county council and the incidents noticed are then analyzed jointly by the pharmacy contractor and the county council. The same procedure with incident measurements are conducted with the extemporaneous pharmacy.

Analyzes of IT-disruptions are currently not conducted in a satisfactory way, a weakness that the county council is clearly aware of.

The county council looks at success factors from projects or events when a large change has been made, but this is rarely done for smaller changes or events. The found success factors and best practices are often shared during network meetings and sometimes during congresses.

C.8.8| Stimulate Flexibility

The county council conducts methods to make the SPSC more flexible, by making the pharmacy contractor, the extemporaneous pharmacy and the hospitals practicing disruptive scenarios and prepare for reorganization. However, it is difficult to impact the early actors in the supply chain, since the supply chain is structured in a certain way and there currently are two large distributors, which the county council cannot impact. If the county council would like to impact this, they would have to go through governmental agencies to make them change the regulations and laws for what is allowed. However, it is believed that county councils do not have much power or ability to do that either, even if they try to go through SKL.

The main obstacle to increase flexibility in the SPSC, when it comes to regulations, is the law about pharmaceuticals trade which limits movement of pharmaceuticals between county councils as well as hospitals within county councils. Moreover, the regulations about the hospital's pharmaceuticals supply specify what a hospital pharmacy is allowed to do and what an outpatient pharmacy is allowed to do, e.g., preventing county councils from supplying the primary care with pharmaceuticals from a hospital pharmacy managed in-house by the county council. Many county councils agree that the laws and regulations surely fill a purpose but that they, as they are written today, clearly prevent efficiency in the pharmaceuticals supply. An increasing problem that the county council sees, concerning the laws regulating the pharmaceutical supply, is how the county councils will be able to handle the supply when patients to a higher degree will be treated at home. There are many laws and regulations preventing the county councils from organizing this efficiently. Another problem is the distribution itself, since the patients in this scenario are spread out.

C.9| Hospital

All information in chapter C.9 was received during a conducted interview with Heaton (2018).

C.9.1| Vertical Information Sharing

The hospital has vertical information sharing on a regular basis with the pharmacy contractor operating their hospital pharmacy. The pharmacy contractor shares statistics and quarterly reports, including delivery reliability and reported deviations regarding the logistics. This might for example be concerning delays or deliveries packed the wrong way. Another continuous information sharing between the pharmacy contractor and the hospital is regarding the status of the electronic ordering system which is the basic platform for the daily interorganizational activities. All of these aspects are further discussed at contract follow-up meetings where focus is to find recurring events and look into if it is possible to improve, e.g., shared information or education to avoid similar negative events in the future. Contract follow-up meetings are held in connection to new contract signings with pharmacy contractors, which are renewed every fourth to sixth year. The hospital is not aware of any information they share, on a regular basis, that is used by the pharmacy contractor to learn and improve. However, if the pharmacy contractor seeks specific information, the hospital is usually willing to share that information. Most of the daily contact with the pharmacy contractor is done via the county councils and not between the pharmacy contractor and the hospitals directly.

The hospital shares their opinions and improvement suggestions regarding LV's regulations on a regular basis. In most cases, this is done in collaboration with other hospitals belonging to the same county council.

One interorganizational learning sub-method that has potential to improve the vertical information sharing with the pharmacy contractor is to share information about available resources at the pharmacy contractor, i.e., more information about their warehousing and their current stock status. This information has been needed by the hospitals due to current problems with backorders and due to the fact that the stock status only is updated once per day. Thus, if the hospital looks into their order system and see that a specific drug is in stock and order it when that drug in fact ended earlier that day, the hospital will believe that the drug is arriving when it is not, which causes problem. To avoid this problem hospitals would need more insight into the pharmacy contractor's warehousing.

C.9.2| Vertical Joint Assessment

The hospital conduct risk analysis together with their pharmacy contractor. These analyzes are only done when entering a new contract with a pharmacy contractor. The risk analysis, only being created or updated in connection with contract signings, are not done as often as would be optimal. Preferably, the risk analysis would be updated continuously with the current pharmacy contractor to ensure it reflects the current structure.

C.9.3| Vertical Collaborative Planning

The hospital does make contingency plans together with their pharmacy contractor. However, it is considered to be difficult to make specific contingency plans other than for, e.g., the electronic system, since the needed and actual problem solving often vary by case to case. Therefore, the coordinated crisis management procedures and communication structure is key to make sure the right people get the right information as fast as possible. The most important function of these structures is to ensure a working routine for emergencies and how to make a group jointly handle the problem. The communication structure could though be better, since it currently is dependent on specific persons instead of being clearly connected to a function. If a certain person is not available, the system does not work that well and the function represented by a person not reached will not be included in the initial crisis discussions.

During an ongoing crisis the head of the pharmaceuticals unit at the county council calls the involved actors, e.g., hospitals, to a meeting. If people are out of town, a skype meeting is held. After the initial meeting there are continuous follow-up meeting until the crisis is solved.

Before specific and anticipated events, for example a state visit or large festival, the hospital does work proactively with their pharmacy contractor. In these cases, the hospital and their pharmacy contractor have planning meeting on how to minimize the probability for and scale of disruptions linked to the specific event.

The pharmacy contractor and the hospital jointly develop routines for logistics and deliveries and continuously develop them to prevent disruptions in the pharmaceuticals supply chain. Since a couple of years, the hospital has continuous meetings regarding backorders together with their pharmacy contractor, the assortment manager at the county council and representatives from other hospitals. This to discuss upcoming backorders that might cause problems in the future. The different actors collaboratively plan how to tackle and solve the situation, hopefully finding a solution before the drug actually runs out. It is important to get the information about potential backorders in time, given that the pharmacy contractor might need to apply for a new license to be able to order a substitute to the drug. Overall, this has shown to be a good collaboration method.

C.9.4| Horizontal Information Sharing

The hospital conducts continuous horizontal information sharing with other hospitals belonging to the same county council and therefore having the same contracted pharmacy contractor. This by for example sharing how they have solved specific problems in the past that other hospitals are currently facing or vice versa. This method enables them to, together, identify best practices for how to handle certain disruptions or problems.

Additionally, the county council presents a forum for the hospitals to discuss the joint contract with the county's pharmacy contractor as well as future planning. In this forum its discussed and decided what questions are better solved at a county wide level and what questions are best solved at each hospital. When decided that the central level is most appropriate, problems and

solutions are discussed and agreed upon in this forum. This could for example be that the hospitals develop a common technical solution for drug dispensers, instead of having one technical solution each. Lastly, the hospitals in the county discuss foreseeable upcoming threats. The council have meetings on a regular basis every fourth to every sixth week and is considered an important support by the individual hospitals.

One recurring obstacle is the fact that hospitals or care providers are not allowed to give or sell drugs to other hospitals or care providers if someone is short of a specific product that is not available at the pharmacy contractor. This due to LV's regulations concerning that a care provider is not allowed to sell pharmaceuticals. Thus, drugs cannot be transferred between care providers within the same county council or returned to the pharmacy contractor, which is problematic when one care provider lacks a critical drug and other care providers having this drug cannot help.

C.9.5|Interorganizational Education

There are currently no interorganizational educations in the SPSC involving hospitals and there is no obvious need for educations regarding the pharmaceutical supply.

C.9.6|Simulation

The hospitals are not currently involved in practical trainings or simulations together with other actors in the supply chain. However, the hospital has requested this recently due to an felt need for it. Routines and crisis plans are not practiced either. They are only created and read though when needed.

The hospital has observed that some county councils regularly have trainings and simulations including their hospitals for how to be able to handle the first 48 hours after a big incident. Something that is missing in the county council the interviewed hospital belongs to. The county council have some practical crisis management trainings but does not directly involve the pharmaceuticals supply to the hospitals in these trainings One example of a scenario needed to be practiced is the case when the pharmacy contractor is not reachable and pharmaceuticals owned by them but located at a hospital is needed by that hospital.

C.9.7|Analyzing Experiences

The hospital analyzes experiences from new contracts and agreements with for example a pharmacy contractor. After a new contract has been established or a new project has been launched, a follow up meeting is held to look at lessons learned as well as what went well respectively went wrong. Focus is on how all actors can improve in the future.

The hospital additionally has workshops about incident and crisis management after crises and large incidents. These workshops result in strengthening and improvement of crises management routines. One example could be improved routines on how to reach key personnel when out of office.

After large specific events or large project launches, the hospital is always Analyzing the experience regardless of the outcome. This to improve the managing of special events. Near misses and successful handling are rarely analyzed if not occurring in a special event.

C.9.8| Stimulate Flexibility

The hospital has been discussing the issue to create a more flexible organization, but it has turn out to be a complicated question given the hospitals large dependence on the pharmacy contractor. If something would happen to them, there is not enough employees at the hospital with the right training to take over the pharmacy contractors function. Also, the contracted pharmacy contractor is the only actor present in the market in the geographical area, so shifting to another pharmacy contractor would not be possible in a crisis.

This situation gets worse due to the fact that there are different pharmacy contractors in different county councils, why the pharmacy contractor in an adjacent county council not necessarily is able to help. That would only be possible if two adjacent county councils have the same pharmacy contractor and it is not certain even then. The pharmacy contractor has a responsibility to have a contingency plan for how to handle disruptions in one part of the delivery chain, but it is not considered to be detailed enough.

Another obstacle is the dependence on the electronic system containing all patient information, delivery addresses etc. Theoretically, the pharmaceuticals could in a crisis be transferred directly from the distributor to a pharmacy hospital without involving the pharmacy contractor, but since only the pharmacy contractor has the delivery data, this would be very hard to realize.

C.10| Swedish Association of Local Authorities and Regions (SKL)

All information in chapter C.10 was received during a conducted interview with Eklund and Ax (2018).

C.10.1| Vertical Information Sharing

SKL has information exchange with multiple actors in the SPSC and given their coordinating function for all county councils, all information shared and received is on a strategic rather than an operational level. Thus, information regarding resource allocation in the SPSC or similar is not shared or considered to be relevant to SKL. Instead, higher level questions like industry wide issues or problems with regulations are discussed with other actors in the SPSC. An example of this is the current problem with backorders. SKL is not part of the management of specific backordered pharmaceuticals but instead works on a national level to enable information sharing and finding strategic routines for what to do when a backorder situation occurs. SKL have discussions regarding this with LV and, e.g., looks at potential structural changes to facilitate the information flow between county councils and LV.

SKL has a well-established contact network with all twenty-one county councils and can fast and easily contact the county councils if needed. Therefore, SKL has close contact with SAF when general problems occur, enabling the use of efficient communication paths linked to the two organizations. In the cases SKL receives information, SAF need SKL to distribute the information to all county councils using their network communication channel. When instead SKL needs to distribute information to pharmacy contractors or outpatient pharmacies, SAF facilitates the distribution by sending it out through their communication channels. This contact only occurs when something specific has happened and does thus not occur on a regular basis.

SKL has no official role during a crisis situation, at least not as regulated by law. However, it is possible that SKL during a crisis could take a coordinating role for the account of all county councils, but this depends on the severity and geographical spread of the crisis. If the emergency laws enter into force, SoS takes the lead and has the coordinating responsibility for the county councils. SKL's role in such a situation is nowhere specified. SKL, however, believes they would be involved in the work with pharmaceuticals during a crisis or war situation, even if it currently is not clear what role they would take.

A lot of SKL's interorganizational information sharing and collaboration is conducted within NLS. NLS is not only a platform for joint action taking, but also a forum facilitating the contact between different actors. Through NLS the actors are able to find the right person to discuss a certain issue with, thus facilitating information sharing in the entire SPSC.

SKL works a lot with trying to influence SD on behalf of the county councils and municipalities, by pointing out areas or issues that need to be overlooked. When the county councils and SKL believe that a specific law or regulation needs to be changed or updated, they

turn to SD to try to convince them to launch an investigation of the specific issue. This may result in the parliament changing the law, or SD issuing an authorization to any of its governmental agencies to rewrite the regulations.

C.10.2| Vertical Joint Assessment

SKL does not conduct joint assessments with other actors in the supply chain.

C.10.3| Vertical Collaborative Planning

Collaboration with other actors is primarily conducted through NLS, where many of the actors in the SPSC are represented. One important function of NLS is that the forum enables the actors to highlight problems needed to be discussed by the whole supply chain. By highlighting topics in NLS, different perspectives are heard, giving the actors new angels and aspects of the topic. This makes it possible to learn from one another and get an overall view of the problem. The first step to change is that all actors in the SPSC are aware of the problem and its causes and this has been possible in some questions through NLS. One example is the problematic backorder situations. By highlighting the question during the NLS meetings, all actors are now aware that it is a problem and thus interorganizational projects to minimize the problem have been possible to initiate. However, NLS is not a decision-taking body, why solutions need to be decided upon, financed and implemented outside this forum. This can be done for example by internal decisions in the actors' organizations, by the parliament changing the laws or SD assigning its governmental agencies to conduct investigations or authorizing them to change regulations. Further, NLS is a collaborative forum for *pharmaceuticals issues*, not *pharmaceuticals supply issues*, why the supply-related topics only get a limited focus.

However, the NLS is not always working optimally since the actors sometimes have different views of the problem at hand even after joint discussions. Thus, problems discussed are not always solved in a way that works in practice for all members. To continue with the backorder situation as the example: A problem showed to be that the actors had not fully agreed on the main problem and the severances of it, why solutions suggested was deemed inadequate by some. To solve the situation, several actors in NLS have been working to create a shared view of the situation. One method used have been to invite relevant actors including actors not part of NLS, in this case distributors and FGL, to workshops focusing on this specific situation. The fact that there is no other forum for discussing this situation, where all relevant actors participate, shows that a better structure for these types of problem is needed. Currently a lot of the discussions are based on the actors voluntary participation, which is not always optimal. A strongly positive aspect of NLS is though that it enables members to find other actors working with similar issues or actors that can give advice regarding a specific topic. This leads to more dialog between the actors, both between governmental agencies and private actors, and between different governmental agencies. This has led to the formation of smaller collaboration forums, something that have turned out to be both efficient and helpful.

SKL sees a large need for interorganizational collaboration due to the fragmented nature of the sector. Today, the actors have different incentives and the roles are not as clearly defined. The

overlapping roles is primarily an issue between different governmental agencies, e.g., SoS and LV. The fact that these agencies have not thoroughly collaborated when writing regulations have led to a lot of gray areas and overlaps in the regulations. SoS and LV have in this case started working on this by reviewing these areas to try to improve them. Another obstacle is that governmental agencies, e.g., LV and FHM receive specific tasks to investigate and find solutions to problems within the pharmaceuticals and healthcare area. What often happens then is that the agency finds a solution to that specific issue. However, this solution does not necessarily fit into the big picture and sometimes it is not even compatible with current regulations in other areas. This makes the work inefficient and a closer collaboration between the governmental agencies and better overviewing perspective is thus wished for by SKL.

C.10.4| Horizontal Information Sharing

The county councils have extensive contact with SKL, being the employer- and interest association for all municipalities, county councils and regions in Sweden. If a county council experiences a general problem with for example a regulation concerning the pharmaceuticals supply, they often turn to SKL. SKL then compile the joint opinion of the issue from all county councils and then contact relevant governmental agencies on behalf of all county councils to discuss a potential change or investigation of the regulation in question.

SKL does also, together with some representatives from different county councils, manage a network specifically focused on pharmaceuticals supply. Personnel from all county councils are represented in this network, a network that was originally started by the county councils but later also included SKL. Once per year, a day is organized for the supply network where the county councils jointly discuss topics that are actual, problematic or that have received a lot of focus from one or multiple county councils during the last year. This enables experience-sharing and information from new perspectives.

SKL also has collaborations with corresponding groups on a European level. One example is the European Hospital and Healthcare Federation, HOPE, which SKL and equal European representatives are a part of. The discussions regarding healthcare issues and pharmaceutical supply is relatively limited given that a lot is regulated by national laws. Still, the approval of new pharmaceuticals is handled on an European level why pharmaceuticals supply is also somewhat discussed in this forum, even if it is on a limited scale. The group has meeting approximately twice a year.

C.10.5| Interorganizational Education

SKL does not attend or organize interorganizational educations within the pharmaceuticals supply area.

C.10.6| Simulation

Given SKL's strictly strategic position in the SPSC, they have no clear role during a crisis, why they are not part of practicing or simulation exercises.

C.10.7| Analyzing Experiences

Given SKL's strategic position in the supply chain, where they have little contact with the operational work, they are rarely a part of real crises. Therefore, deviation analyzes and post-disruption analyzes are primarily conducted by the county councils and not by SKL. SKL focuses on the entire system and works with long-term changes taking place over a number of years. Experience analysis are done after these efforts but to a limited degree and primarily internal. If a large national crisis would happen, affecting most county councils, SKL would probably be involved. In that situation SKL would probably be involved in the post-disruption analysis as well. However, a situation like that have never happened, why this is only a hypothesis.

C.10.8| Stimulate Flexibility

Because of the strategic position of SKL in the SPSC, methods to make them as an actor more flexible are irrelevant for the pharmaceuticals supply. Instead, SKL tries to facilitate for the county councils to increase their flexibility. The primary obstacle to increase flexibility in the SPSC is the current laws and regulations. Thus, SKL works with methods to influence the parliament and SD, to make them launch investigations and possibly change the regulations preventing the county councils from being flexible.

An example of an issue with the laws and regulations preventing the county councils from increasing the flexibility, is that they are written based on how the healthcare system used to look before, with heavy reliance on hospital care. Today, the healthcare is based on a system where the care is partly moved closer to the patients. However, this change in the system and the more important role of the healthcare given outside the hospital facilities is counteracted by the law about pharmaceuticals trade, regulating what is allowed to do with regards to pharmaceuticals supply. Thus, SKL believes that one important task for the parliament and SD is to launch investigations to rewrite the laws and regulations to suit a modern healthcare perspective.

C.11| Dental and Pharmaceutical Benefits Agency (TLV)

All information in chapter C.11 was received during a conducted interview with Hedberg (2018).

C.11.1| Vertical Information Sharing

TLV has regular contact with the pharmaceuticals producers. Since TLV decides what prescription pharmaceuticals that are included in the Swedish pharmaceuticals benefits system and well as sets the prices for these pharmaceuticals after an application process, the pharmaceuticals producers naturally establish a contact with TLV. The contact is most times handled via the pharmaceuticals producers' Swedish or Nordic subsidiaries. The subsidiaries' function is to be the pharmaceuticals producers' access point to the Swedish healthcare system and thus to understand how it is organized, how the legal structure works and to some degree also the culture and attitudes towards pharmaceuticals etc. However, the important decisions regarding pharmaceuticals production and supply are most times taken on a global level why TLV focuses on increasing their international presence. TLV has some contact with the global units of the pharmaceuticals producers during projects conducted at an European level.

TLV has a lot of contact and collaboration with LV. Together, the two governmental agencies have meetings with pharmaceuticals producers to give early advice of how to structure their product development plan and how to document the scientific evidence properly. This is to ensure that good products do not get disregarded or not approved due to a faulty documentation process or similar. This counseling is mainly a support to small pharmaceuticals producers that does not have vast experience within pharmaceuticals development and production.

TLV tries to have a proactive information exchange with all the county councils. Using the principle of *horizon scanning*, TLV tries to send signals to all county councils as early as possible regarding for example new regulations, new types of pharmaceuticals or new routines. This to make them prepared before the changes actually become effective. By preparing them, TLV enables the county councils to choose an appropriate reaction and prevent rash decisions, hence hopefully strengthening the operations in this part of the SPSC. The information sharing from TLV is currently done through a person at each county council, who have signed a specific confidentiality agreement and holds a decision mandate. This communication structure took a while to develop, since the *Public Access to Information and Secrecy Act* makes it hard for a governmental agency to only share information with a few chosen people. The developed system is though functioning very well, and information from TLV as well as other governmental agencies can be shared with these chosen county council employees, increasing all county councils preparedness and ability to adjust.

Information sharing concerning potential threats are done regularly with other actors in the SPSC. One example is the information sharing concerning the backorder situation done through the NLS. This newly implemented information sharing is the foundation to manage the problems and have turned out to be very valuable, since everyone from generic pharmaceuticals

producers to governmental agencies must share the information they have regarding backorders with the other actors.

During crises TLV has mainly a communicative role but are not often involved in solving operational problems. One example of a minor crisis was when LIF wrote an informative letter about the increasing use and regional recommendation about a treatment for which the pharmaceutical product in question was not licensed. Four governmental agencies, SoS, LV, IVO and TLV then wrote a joint comment in response to the LIF letter. Normal communication channels to arrange this was used, but more senior people than usual were involved.

C.11.2| Vertical Joint Assessment

TLV does not conduct joint assessments with other actors in the supply chain.

C.11.3| Vertical Collaborative Planning

TLV conducts collaborative planning through NLS. Roughly every second year, a market and external analysis is conducted jointly in NLS and, based on that analysis, an overall action plan is developed, decided upon and published. Thereafter the actors in NLS identify, formulate and implement solutions to the defined improvement areas and action plan. This is an ongoing work and each action plan often builds on the last one.

TLV additionally facilitates the negotiation process between county councils and pharmaceuticals producers concerning side agreements outside the pharmaceuticals benefits system. Further, as a service to all county councils, TLV facilitates and helps county councils to coordinate and create joint contracts and collaborations on a national level.

C.11.4| Horizontal Information Sharing

TLV believes that the governmental agencies involved in healthcare and pharmaceuticals supply have improved their collaboration due to working jointly in NLS and that they as a result have found areas of potential collaboration outside the direct scope of the NLS. One example is synergies for supervising the outpatient pharmacies, where TLV have exchange and collaboration with both LV and SKL.

TLV further has extensive collaboration with LV regarding approvals of new pharmaceuticals and discussions of follow-ups and usage. TLV often get help by and information from LV's experts concerning TLV's cases about both new and old pharmaceuticals, as LV proceeds TLV in the application process and thus often have access to relevant information. The two agencies' roles somewhat overlap, why the work requires and is helped by close collaboration.

Moreover, TLV has extensive contact with the eHM considering different types of data, for example how to get access to sales data and how to follow-up this data. Additionally, eHM built and maintain the digital system for the *product of the period*, which is managed by TLV and an important system for knowing which pharmaceuticals to be sold in the Swedish outpatient pharmacies.

TLV has extensive contact with SoS concerning national guidelines for and projects within healthcare and pharmaceuticals. SoS further have and gather important data extending the sales data collected by eHM, e.g., information about prescribers and patients, which is relevant to TLV when looking at statistical analyzes and trends. Additionally, SoS is responsible for the Council of Knowledge Management, which TLV is an active part of.

TLV also has occasional collaborations with FHM concerning, e.g., assignments from the government about antibiotics or vaccines, due to FHM's expertise within those areas.

As a part of the RSK, TLV conducts joint risk analysis and joint assessments of critical situations together with other governmental agencies on a high level. TLV also conducts collaborative planning concerning pharmaceuticals supply through RSK, however, only on a strategic level. TLV has previously been part of different governmental investigations regarding Swedish crisis preparedness. However, given that TLV only work on a non-operational level and has a different perspective of crisis management than actors managing the crisis directly, they are no longer part of the expert group in these investigations, which they find quite reasonable.

SoS is assigned by the government to regularly develop forecasts for the pharmaceuticals sales in Sweden and TLV together with eHM assist in this work.

Moreover, TLV has contact with other corresponding governmental agencies on an European level, especially since the interviewee, being Chief Pharmacist at TLV, recently was appointed to the Chair of the Executive Board at the European Network for Health Technology Assessment (EUnetHTA). From Sweden, TLV, LV and SBU are represented in the network. TLV also participates in Nordic collaborations concerning health economy, given the similarities between the Nordic systems for healthcare and pharmaceuticals. These Nordic collaborations are more extended and focused on pharmaceuticals supply than the European collaborations, that mainly focuses on clinical efficiency.

C.11.5| Interorganizational Education

Joint theoretical educations are held both on a national and an European level. On a national level, seminars and workshops are held on a regular basis with other actors in the supply chain. These educations are not always only concerning pharmaceutical supply but includes many topics and areas. One example is when FHM held educations concerning vaccines, an education involving both governmental agencies and pharmaceuticals producers. In other cases, it is the pharmaceuticals industry arranging the educations, inviting governmental agencies as well as county councils, to inform about broad themes in the market. These types of theoretical educations are held as deemed necessary by actors in the SPSC.

Within the area of NLS, there are also educational workshops. One example could be workshops concerning the backorder situation where LV presented their investigation of

possible solutions to the situation. These types on educations sometimes include scenario analysis and similar tools.

On an international level there are sometimes seminars concerning clinical efficiency where both European actors as well as county councils are represented. These are though not held regularly.

C.11.6| Simulation
Given their strategic, non-operational, position, TLV does not take part in simulation exercises with other actors in the SPSC.

C.11.7| Analyzing Experiences
TLV has routines for analyzing deviations or disruptions that occur within their business. If an IT-related deviation occurs, it is reported in accordance with GDPR to the data inspection. However, deviations are not analyzed on an interorganizational level due to their isolated function as a governmental agency.

C.11.8| Stimulate Flexibility
TLV works towards creating flexibility in the SPSC through multiple methods. One is the adjustment of regulation to allow temporarily subventions, i.e., temporary include pharmaceuticals in the Swedish pharmaceuticals benefits system, a measure to create more flexibility in the SPSC. This started as an evaluation assigned by the Government and resulted in a change of regulations. A similar measure is believed to be taken concerning the backorder situation. Similarly, adjustment has been made to clarify the distinction between TLV's and the county councils' roles in some areas and the actors have jointly decided upon interorganizational activities to facilitate flexibility in the SPSC. TLV constantly tries to find different ways to increase flexibility in the SPSC by making adjustment within the limits of the law.

C.12| Swedish Medical Products Agency (LV)

All information in chapter C.12 was received during a conducted interview with Gårdmark Östh (2018).

C.12.1| Vertical Information Sharing

Through LV's issuing of permissions licenses and surveillance of the development, manufacturing, distribution as well as sale of pharmaceuticals and other medicinal products, LV receives extensive information about actors and products in the SPSC. Some information is made available to the public though their website with the aim to enable re-utilization of information for actors in the healthcare sector. This is mainly information about the current status of pharmaceuticals, which for example can be information about if a new pharmaceutical is approved for the Swedish market or pending an approval as well as withdrawals and deregistrations of pharmaceuticals. LV also publishes information about current, previous and expected backordered pharmaceuticals. This information is published through a backorder list, which enables actors to look at detailed information related to specific backorders. LV knows that some of the information provided on the webpage is regularly used by, e.g., SKL's IT-department Inera. Additionally, it is possible to request further information about non-published but official decisions taken by LV, however, these are not shared actively.

LV has continuous contact with different trade- and professions associations, for example LIF, FGL and SKL. The reason for having the main contact and information sharing through the trade- and professions associations is to ensure that no unfair advantage is given to any pharmaceuticals producer or county council why almost all information from LV goes through one representative actor. Both the pharmaceuticals producers and county councils share most of their information to LV through their respectively trade- and professions associations as well. LV further has regular information exchange with the county councils' and SKL's collaborative network for pharmaceuticals supply.

When it comes to backorders, LV has contact and information exchange with pharmaceuticals producers. As an example, there was a shortage of TBE vaccines in Sweden during the summer of 2018. During this period, LV had extensive contact with all pharmaceuticals producers producing the vaccine since it was backordered at most pharmaceuticals producers. LV tried to facilitate the situation by first issuing exemptions for foreign packages to the pharmaceutical producers and secondly issuing licenses for substitutes via pharmacies after request from prescribing doctors. During this disruption LV additionally had contact with the FHM, given their expertise of vaccines.

Together with TLV, LV gives regulatory advice to pharmaceuticals producers to facilitate the obedience of regulations

C.12.2| Vertical Joint Assessment

LV is currently not making joint assessments regarding pharmaceuticals supply with other actors in SPSC.

C.12.3| Vertical Collaborative Planning

Collaborative planning with other actors is used in strategic questions, as new paths and methods often are developed jointly. Most of these activities are conducted in NLS. However, not all actors in the SPSC are involved in NLS, why NLS sometimes invite other actors to participate in workshops held by NLS when their perspectives are needed to ensure that all relevant viewpoints are included. An example of such workshop was arranged recently by LV. This workshop focused on the backorder situation and in addition to the actors in NLS, the distributors and FGL were invited. The expanded collaboration was received positively and, even if the results from the workshop are not yet finalized, the opinions and ideas discussed between the actors have potential to lead to valuable insights on how to continue to work with the backorder problems. LV believes that more inclusion of the distributors in the national discussions might be advantageous, since the distributors have an overviewing knowledge about stocks and demand in SPSC.

Coordinated crisis management procedures are jointly developed for example for withdrawals of pharmaceuticals. These procedures include a withdrawals communication chain per product and include actors like pharmaceuticals producers, distributors, outpatient pharmacies, hospital pharmacies and hospitals. These crisis management procedures are very mature and function well.

C.12.4| Horizontal Information Sharing

One of LV's closest horizontal collaboration is with eHM, since a lot of automatic information is shared between the two parties because of the shared IT-solution. Examples of information shared with eHM is updates of deregistrations and approval status of pharmaceuticals.

Further, information regarding what pharmaceuticals that LV has decided belong to the same interchangeable group, is shared with TLV. This information is updated every time a new pharmaceutical grant marketing authorization in Sweden and the information about interchangeable groups forms a base for TLV's work with the generic interchange, the product of the period etc. As mentioned above, LV and TLV additionally give joint regulatory advice to pharmaceuticals producers to facilitate the obedience of regulations.

Information is also shared between LV and other governmental agencies in Europe. Within EMA, there is a network where the different LV's help each other with quality assessments of each country's work. The assessments are conducted every second year and each agency is assessed every fourth year. As a part of this assessment, a benchmarking against the rest of Europe is done. This collaboration receives a lot of attention and the assessments and benchmarks are important for LV. A positive judgment is received with great pride and an inferior judgment is received as a driver to improve and solve the issues discovered. In addition to the European collaboration, several Nordic collaborations concerning pharmaceuticals issues also exist.

NLS does not only enable different types of actors to collaborate, but it does also enable closer collaboration between governmental agencies. Multiple investigations requested by the government are based on previous discussions held in the NLS. These investigations often involve multiple agencies, why it naturally increases the collaboration between them. The investigations further led to discussions about how different structures, laws and regulations affect different agencies, again increasing the understanding for each other.

C.12.5| Interorganizational Education
Few theoretical interorganizational educations with other actors in the SPSC are conducted. One interorganizational education believed to be missing, according to the interviewee, is an overview of how the SPSC is structured and how it fits together. The interviewee believes that an education about the SPSC structure would facilitate an understanding of the context when a person starts working for one of the involved actors. The interviewee suspects that the reason that such an education is missing, may be due to the fact that no actor in the supply chain has an overall responsibility for the entire SPSC.

C.12.6| Simulation
Executives at LV practice crisis management procedures regularly with focus on large-scale crises, for example what to do if there is a lengthy power shortage. Specific contingency plans, often associated with the Poisons Information Centre, are also regularly overlooked and practiced internally. However, LV does not take part in any interorganizational simulations. The interviewee believes that this holds true for large parts of the SPSC; that the individual actors take responsibility for and practice internal routines, but rarely practically test the overall system and its preparedness.

C.12.7| Analyzing Experiences
On a strategic level, some experience analyzes are conducted after disruptions. As an example, an analysis was made after multiple actors in the SPSC had different product status for a pharmaceutical, leading to that some information about prescriptions for that product was lost in the interface between the different IT-systems. The actors created a court of inquiry with representatives from all actors involved, which in this case were LV, eHM and SKL's Inera. The court of inquiry made an analysis of what had happened and as a result they decided that it is necessary to develop joint contingency plans for these types of events in the future. Both eHM and SKL are two actors that often take part in these types of interorganizational strategic experience analyzes together with LV.

In general, the SPSC is believed to be weak when it comes to courts of inquiries and incident analyzes. An area where more consequence analysis needs to be conducted, is the information flow in the SPSC. It would facilitate to have a clear picture over the entire information flow and to understand why errors frequently occur. An important part of this is the IT-infrastructure. A more structured and overall method for conducting strategic analysis after disruptions would be favorably since that would enable an overview of the disruption rather than multiple perspectives from small parts of the supply chain. Currently, the actors have no

joint understanding of the SPSC and its systems, why no actors take the overviewing responsibility in optimizing the interfaces between the actors. Hence, analyzes are often done separately to just be fused in the end.

However, on an operational level, deviation analyzes are conducted and the procedures for how to conduct them are well established. In this area, the SPSC is very thorough and actors like county councils, hospitals, hospital pharmacies and outpatient pharmacies follow the regulated procedure. Larger deviations are always reported to LV.

C.12.8| Stimulate Flexibility

As a governmental agency it is difficult for LV to be flexible, since they are largely governed by laws and regulations and it takes time to change laws, regulations and internal structures. Large parts of the SPSC are regulated in law, which naturally builds in a slowness and a security into the system. This security is believed to be very important to the patients, why applications and supervisions are such important parts of the quality and security system. However, LV tries to be flexible within the limits of the regulations and tries to collaborate to find solution that works for the actors in the SPSC without compromising the security of the pharmaceuticals. It is important for LV to do things in a smart way that makes it easy for the actors to collaborate with and learn from LV, while also ensuring correct and equal supervisions. The ability to be flexible is further believed to be more important to the actors involved in the physical flow in the SPSC than to the governmental agencies.

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