Master Degree Project in Knowledge-Based Entrepreneurship

Data sharing in the fire industry –
creating better and proactive safety
A qualitative case study

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Abstract

We are all familiar with the traditional job of a fireman: they receive news that a fire occurred, they rush into a fire truck, an alarm sounds and they race off to save and protect life and property (Schilling, 2014). While this approach will stay mostly the same, the aim of this research is to analyze factors that are likely to affect stakeholders and their decision to share fire-related data as it presumably enhances proactive fire safety. Sandbox is the name of the project which was initially introduced by the Svensk Brandskydds-föreningen (SBF). The idea is to develop a business model which connects different stakeholders in the fire-related industry. Subsequently, their data should be aggregated and analyzed in order to deduce new findings with the goal to enhance proactive fire safety. However, before someone can start to develop a business model, it is important to understand the viewpoints and concerns of each of the stakeholders as their data is a crucial variable, determining the feasibility of the whole project. This thesis employs a qualitative approach in form of a case study. The required data was collected throughout the conduction of semi-structured interviews, involving six different organizations that are currently engaged in the collection of fire-related data. The results indicate that the overall willingness to share fire-related data is well existent, nevertheless the findings also highlight that there are a number of motivational and discouraging factors that influence data owners and their decision to engage in data sharing. These factors mainly relate to the organization itself but also to aspects, identified by Elinor Ostrom and her perspective on the collective action theory. Further, the results show that related benefits and challenges of data sharing and data analytics are likely to affect data owners and their decision to engage in data sharing. Based on the empirical findings and reviewed theory, a new model was developed which incorporates the previously mentioned factors and concurrently summarizes the thesis. Further, it outlines the prerequisites for future research, which should aim towards the development of a business model related to the Sandbox idea.

Keywords – data sharing, data analytics, fire safety, data-driven innovation, data silos, collective action, Sandbox, Brandskyddsföreningen

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Personal Refection

Writing this thesis was challenging and rewarding at the same time. As this research has a practical background, it was in particular challenging to merge the piratical situation with the academia. Also being a single author does not leave room for fruitful and stimulating discussions which on the other hand creates independence and flexibility in the process of researching and writing. Having a close collaboration with SBF and First to Know helped me to stay focused, but also regular meetings with my supervisor which often resulted in inspiring discussions, helped me to overcome the flaws of being a single author. The chosen field of study did not arise from my own personal interest, rather it was an opportunity which I embarked upon. Nonetheless, my interest for this field rapidly grew throughout conducting this research and hopefully resulted in a study which not only adds value for SBF but also lays the foundation for future research.

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List of Abbreviations

CPR	Common-Pool Resource
DDI	Data Driven Innovation
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
IoT	Internet of Things
SBF	Svensk Brandskyddsföreningen
UN	United Nations

1. Introduction

1.1 Background

In Sweden and throughout the rest of the world, increasing population numbers and resources are concentrated around cities. To this day, more than 50 percent of the world population lives in urban areas and especially Sweden has a high degree of urbanization, which according to Statistiska centralbyrån (2018) was 87 percent in 2017. The UN forecasts, that the urbanization will rise up to 66 percent by the year 2050 and therefore the promotion of safe, resilient and sustainable urban environments is one of the 17 new UN sustainability goals (Hedeklint, 2016).

Alongside the increasing level of urbanization, the emergence of digitization and big data affects our lives. Today, major advances in information and communication technologies (ICT), the increasing use of electronic devices and networks and the digitalization of processes mean that enormous amounts of data are generated 24/7 by social and economic activities. This so-called big data can be transmitted, collected, aggregated and analyzed to provide valuable insights into processes and human behaviors (Davies, 2016). It is said that the explosion of data enables the creation of new, innovative products, services and business models, while also stimulating greater competitiveness and economic growth (Schalenkamp, 2014). According to the OECD (2015), this so-called Data-Driven Innovation (DDI) will be a key pillar in 21st century sources of growth. In businesses, the exploitation of data promises the creation of additional value in a variety of operations, ranging from the optimization of value chains to a more efficient use of labor and improved customer relationships (OECD, 2015). But also the public sector is a key profiteer, as it is both, a key source and user of data, which creates the opportunity to generate benefits across the economy.

By taking a closer look at these developments we can identify an opportunity which relates to fire safety. On one hand, the increase of urbanizations demands for improved fire safety as last year's happening in West London points out, where 71 people died in a 24-story housing complex due to a fire which was accelerated by the building's exterior cladding and significant fire safety failures (Bowcott, 2018). On the other hand, advances in ICT create the possibility to collect and share data in an unprecedented way amongst different stakeholders. These stakeholders, such as insurance companies, private safety firms and governmental agencies collect fire-related data and by aggregating and analyzing this data, predictions can be made where the likelihood of a fire is increased. Predictive policing is a similar, already existing framework in law enforcement, which applies mathematical, predictive and analytical techniques to identify potential criminal activity (Rienks, 2005). In Santa Cruz, California, the implementation of predictive policing for a period of 6-months resulted in a 19 percent drop in the number of housebreakings and the overall situation consistently improved (Friend, 2013). The example demonstrates the current state of technological developments and indicates the possibilities for future projects.

1.2 Problem Setting

Although many scholars have touched upon the benefits and challenges of data sharing and data analytics in general, there has so far been little research on suitable areas of application. Especially when turning the focus on fire safety, there is almost non-exiting research which relates to data sharing and fire safety. This however presents an important research area, particularly with respect to increase of urbanization, as it has the potential to save people's lives but also to reduce fire-related damages. Every year approximately 90 persons die in domestic fires in Sweden (Winberg, 2016) and major insurance companies state that the expenses for fire insurance claims by far exceed the expenses for any other insured loss (Svensk Försäkring, 2017). Having this in mind, this study will help to highlight today's advances in technology but also the potential impact of data sharing and data analytics tools in regards to fire safety. Further, it will be a first step to get in touch with fire-related stakeholders, bringing them closer together in a framework, which in the upcoming study will be referred to as *Sandbox*.

1.3 Research Question

As Charles Darwin once said: "In the long history of humankind (and animal kind, too), those who learned to collaborate and improvise most effectively prevailed" (Clarke, 2017). And even though, this study does not focus on the competitive corporate world, the before mentioned quote might help us explain one major obstacle within this research, namely the circumstance that data is sensitive. In today's sea of data, little can be done if data exists in separate "silos", caused by reluctance or the data owners fear of sharing data (Lin, 2016). Therefore, the main objective of this study is to identify factors that are influencing data owners and their decision to engage in data sharing, as it is a determining aspect to turn the Sandbox model into practice. Elinor Ostrom, an American political economist, who won the Nobel Memorial Prize in Economic Sciences for her analysis of economic governance (Grandin, 2010), developed an applicable framework, which is based on *the logic of collective action*. Ostrom (2009) argues, that individuals who face a social dilemma, chose interdependent actions that maximize their short-term benefits. However, a better optimal outcome could have been achieved if those involved cooperated. Ostrom (2009) developed a framework with a set of variables, that are predicted to affect the likelihood of collective action and will subsequently be applied throughout this study.

Based on the previous considerations, the following research question and relevant subordinate research question will guide this study:

Guiding Research Question:
- *What factors influence stakeholders, making them willing to share their data for the mutual benefit in terms of fire safety in Sweden?*
  .

Relevant Sub-question:
- *What are potential benefits and obstacles that affect data sharing and data analytics?*

1.4 Disposition

This research study is structured as follows: The thesis will proceed with an explanatory framework of collective action, rooted in literature. This will cover a description of relevant variables that are related to the concept. Thereafter, the paper will continue with an elaboration on data sharing and data analytics including related benefits and challenges. Subsequently the applied methodology to answer the research question will be elucidated. The findings are then presented, followed by an analysis. The study ends by presenting the conclusions including recommendations and future research. Figure 1.1 below summarizes the outline and the relevant content for each of the sections.

Introduction	• Background: Urbanization & New technologies • Problem Setting & Research Question
Theoretical Framework	• The logic of collective action • Data sharing & data analytics – Benefits & Challenges
Methodology	• Research Strategy & Design • Research Methods
Empirical Findings	• Presentation of 5 identified topic areas • Summary of main findings
Analysis	• Analysis of the empirical findings • Presenting a new data sharing model
Conclusion	• Conclusion & Future Research

Figure 1.1 Outline of the Thesis

2. Theoretical Background

2.1 Settings

2.1.1 Research Areas

In order to be able to create a theoretical framework for this research, a literature review was conducted. The literature review was broken down into two research areas, namely: *collective action theory* and *big data sharing and data analytics*. The review of these two research areas resulted in the identification of two main blocks, which shall subsequently help to answer the research question.

2.2. The logic of collective action	2.3 Big data sharing & data analytics
2.2.1 Elinor Ostroms approach	2.3.1 The benefits
2.2.2 Ostroms collective action framework	2.3.2 The challenges

Figure 2.1 Outline of the Theoretical Background

2.1.2   Scope of the Theoretical Background

The first research area relates to the concept of collective action. Elinor Ostrom and her book *Governing the Commons: The evolution of Institutions for Collective Action (1990)* was an important contributor to this logic (Little, 2012). Ostroms book (1990) presents a new theoretical framework which describes, how human communities accomplish to handle common property resources like forests, fishing grounds and water supplies. Although this research does not focus on one of the before mentioned common property resources per se, the same framework shall be applied in the area of data sharing, as data is a valuable resource which becomes even more precious when it is shared and combined with other sources and therefore relates to the collective action theory. Thus, this approach might give considerable new insights and shall serve as a fundament 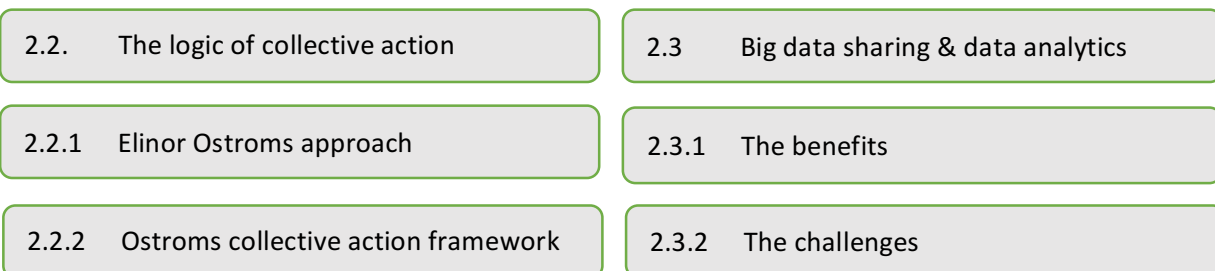for the Sandbox model. The second research area relates to big data sharing and data analytics as it is central to the whole case study. In particular, the benefits and challenges of data sharing will be highlighted, which will most likely affect stakeholders and their decision to engage in a data sharing network.

2.2 The logic of collective action

The logic of collective action was initially addressed by Mancur Olson in his same name book which was published in 1965. Olson describes how groups are formed and explores the economic incentives and disincentives for group formation. In conclusion, Olson states that individuals are tempted to act in their own interest which consequently restrains individuals to work towards a collective good (Congleton, 2015).

The logic of collective action can be defined as a formal organizational alignment, which involves actions, that are carried out by a group of people who are trying to obtain a common good (Bennett & Segerberg, 2012). Those actions often require a stronger commitment by the individual and result in a collective structure, which is based on a set of values that relate to the group (Lim, 2013). Collective action typically evolves, when two or more individuals face a social dilemma, which is a situation in which the involved individuals receive a higher payoff for a competitive choice than for a cooperative choice. However, all members would be better off, if those involved cooperated (Komorita & Hilty, 1991). Behavior in a social dilemma is an important topic, as it reflects many real-life problems, that we are facing in society, such as environmental pollution or resource fading (Komorita & Hilty, 1991). Networks that reflect this logic, are generally characterized by explicit groups that are continuously networking to bring committed participants into action and keep them there (Bennet & Segerberg, 2012).

Related to the logic of collective action, there is an often discussed issue, namely the rational, self-interest habit of individuals. In many cases, individuals will not act to achieve a common group interest, and rather "free ride" on the contributions of others. Olson (1965) describes this phenomenon by using the example of collective bargaining. Factory workers usually have an interest in unionizing to negotiate higher wages and force better working conditions. However, joining the union requires the use of resources. On the other hand, non-joiners would benefit from the same agreement. Consequently, each individual worker would have an interest in not joining while still obtaining the benefits of being a "free rider". As most of the people would attempt to "free-ride", the number of joining members wouldn't be significant enough

to achieve the end goal (Sabin, 2003). This example describes a social dilemma which involves a conflict between the individual rationality and optimal outcome for a group.

But the assumption that human communities are continuously stuck in a social dilemma has increasingly been replaced with a recognition that individuals face the possibility to achieve results that circumvent the worst possible outcome, and in some cases even turn out optimal (Ostrom, 2007). Today, the predictions of earlier theories have been replaced by far more optimistic ones. As opposed to Olson's theory, Ostrom (1999) argues, that human communities voluntary organize themselves and contribute with the mindset of gaining collective benefits, as the willingness to conduct is strongly correlating with the expected behaviors of others. Ostroms approach will be further elaborated in the following part.

2.2.1 Elinor Ostroms approach

In contrast to Mancur Olsons work (1965), Ostrom presents a new, more positive theoretical framework, in which human communities can handle common property resources. In her book *Governing the Commons: The evolution of Institutions for collective action* (1990), Ostrom demonstrates that human communities have actually created a number of informal agreements through which a community of users is able to manage resources collectively and control violators (free-riders) in such a way that the resource is preserved over time.

Although Ostroms (1990) work mainly focuses on individuals and common property regimes in the agricultural sector, her way of framing problems leaves substantial room for the study of social systems, such as the behavior of people as individuals but also as actors in a market setting or in a public economy (Laerhoven, 2011). A common-property regime can for instance also be thought of as a setting of firms in which representatives agree to enter a long-term contract to economize on certain transaction costs, and therefore engage in the interests of others in the joint use of common-pool resources (Bromley, 1993). The same approach applies to this research as this study does not focus on the behavior of individuals but rather different organizations that collect fire-related data.

2.2.2 Ostrom collective action framework

Throughout the years a growing and extensive theoretical literature proposed that a number of structural variables are presumed to affect the likelihood of participants to achieve collective action and overcome social dilemmas. In her work *collective action and local development process*, Ostrom (2007) presents a number of structural variables and will be further exemplified in the following table 2.1.

Structural Variable	Effect on collective action
1. The number of participant involved	There is a two sided opinion regarding the group size and its effect on collective action. In his book *The logic of collective action*, Mancur Olson (1965) argues that an increasing group size negatively affects the probability of achieving a public good, as he argues that an increased group size leads to an increase of the "free rider" effect and thus negatively affects the likelihood that the common good will be achieved. On the other hand, other scholars such as Bates and Shepsle (1995) developed the opposite prediction, saying that the provision of public goods is positively correlated with the group size.

2.	Whether benefits are subtractive or fully shared	Sharing or subtracting benefits, relates to the problem of "free-riding". Public goods generally have the characteristic of non-subtractability, whereas common-pool resources (CPRs) are subtractable. According to Ostrom, Walker and Gardner (1992), in a CPR environment, an increase in the number of participants, while holding other variables constant, is generally negatively related to achieving social benefits.
3.	The heterogeneity of participants	Olson (1965) argues that a number of individuals with a strong interest in achieving a public good, has an increased probability to achieve a public good. Other scholars such as Hardin (1982) however speculate that heterogeneity is negatively related to gaining cooperation, as for instance heterogeneity in information increases the conflict that would exist over the distribution of benefits.
4.	Face-to-face communication	Communication is used for conviction and by being able to look others directly in the eye while discussing issues. The effectiveness of communication is higher than relying on written communication (Frohlich and Oppenheimer, 1998) in Ostrom (2007).
5.	The shape of the production function	In order to solve a social dilemma, it requires individuals to take actions that produce benefits for others and themselves at a cost they must bear themselves. It can be argued, that when the shape of a production function is step (high involvement of individuals), solving a social dilemma is facilitated.
6.	Information about past action	Knowing about earlier actions of others can have a substantial impact on the individuals chosen strategy and is highly related to the participant's reputation. However it requires a repetition of interactions.
7.	How individuals are linked	Having direct links between between individuals e.g. actors A contributes resources to actor B increases the likelihood that individuals contribute to each other's welfare, rather than everyone's contribution goes to a generalized pool.
8.	Whether individuals can enter or exit voluntarily	Hauk and Nagel (2001) argue that when individuals have a choice whether to cooperate with others in a situation of a social dilemma and they can identify the individuals with whom they have cooperated before, individuals will choose partners so as to increase the frequency with which cooperative outcomes are achieved.

Table 2.1 Structural variables predicted to affect the likelihood of collective action

In addition to the above listed structural variables, Ostrom (2007) further highlights the importance of three core relationships that are presumed to affect the level of cooperation when facing a social dilemma, namely - *trust, reputation* and *reciprocity*.

Trust

Trust is the central theoretical variable within Ostroms collective action theory, as it is a cornerstone of collaboration. Cooperative behavior requires leaving one's own self-interest in order to advance the interest of the group. This however carries the risk that others will not cooperate, leaving the cooperator paying all the costs of cooperation without receiving benefits (Henry & Dietz, 2011). Thus, one must assume that some degree of trust exists between one and the others to establish a level of cooperation. The ability to work collaboratively is a core competency for a learning organization, and building trust lays the foundation for collaborative practices (Hattori & Lapidus, 2007). Trust develops through repeated and

meaningful interaction, where the involved learn to feel comfortable and open in sharing their individual insights and concerns (Holton, 2001). It helps you to understand the other parties position and sensing whether there is a truthful opportunity for give-and-take (Cisco, 2007). Especially in today's digitalized economy with a growing trend in data sharing, the meaning of trust becomes even more important as data breaches and identity theft are common incidents. Therefore, a network of trusted data, that provides secure and safe access to everyone involved, must be established (Hardjono et. al., 2016). The role of trust is an important variable amongst those that emerge data-sharing practices (Merson & Phong, 2015) and therefore a relevant factor in this study.

Reputation

"Reputation is the opinion that people in general have about someone or something, or how much respect or admiration someone or something receives, based on past behavior or character" (Cambridge Dictionary). There has been a lot of research on reputation and its impact on cooperative behavior and recent experiments with human subjects revealed, that it requires knowledge of the partners' reputation in order to work as a cooperation driver. Individuals do not only base their decisions based on payoffs but behave conditionally on the number of cooperative acts they receive, as well as on their own previous actions (Cuesta, et. al., 2015).

Reciprocity

"Reciprocity is the behavior in which two people or groups of people give each other help and advantages" (Cambridge Dictionary). According to Gouldner (1960), reciprocity is the basis of stable relationships and explains the origins of trust and trustworthy behavior. The norm prescribes, that people should help those who have helped them. Concurrently the norm prescribes that people should counter those who violate the interests and that exploitation of cooperation should not be tolerated (Komorotia & Hilty, 1991).

Illustration 2.2 below projects the relation between reputation, trust and reciprocity and highlights that a good reputation, a high level of trust and reciprocity are positively reinforcing themselves.

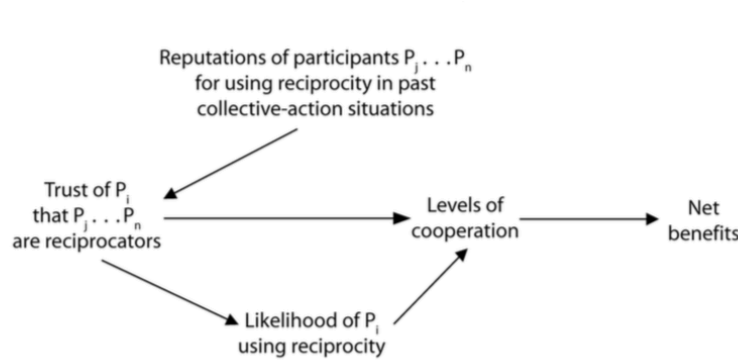Figure 2.2 The core relationships at the individual level affecting level of cooperation (Ostrom 2007)

Ostrom (2007) states, that when individuals initiate cooperation in a repeated situation, others learn to trust them and are more willing to adopt reciprocity themselves, leading to higher level of cooperation. Following this, Ostrom (2007) links the before mentioned external structural variables to the individual

core variables – reputation, trust and reciprocity, which in turn affect the level of cooperation and net benefits achieved.
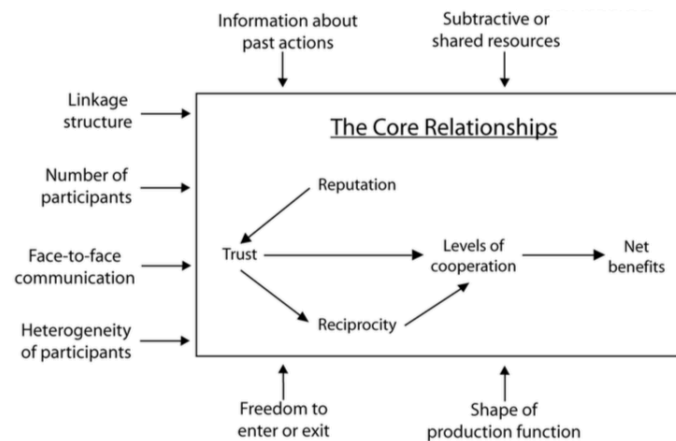

Figure 2.3 Ostroms (2007) collective action framework

Figure 2.3 illustrates the overall framework which links the external structural variables and the inner core variables. However, it should be noted, that it is not possible to link all the identified structural variables in one definitive causal model, due to the large number of variables and that many of them are depended on the value of other variables (Ostrom, 2009). Also, the figure above does not represent the whole set of structural variables, that are likely to affect collective action. Other scholars such as Agrawal (2000) identified over 30 additional variables that are posited to affect collective action. However, an important next step is to explore how the structural variables interact with one other. One cannot argue that for instance, the number of participants alone makes a difference, rather it is a combination of multiple variables that evoke norms and help to build trust, reputation and reciprocity (Ostrom, 2009).

Ostrom (2009) further states that research on collective action is a challenge both in terms of acquiring consistent and accurate data but also because of the large number of variables that might affect collective action. She suggests that instead of looking at all of the potential variables, one should focus on a distinct and precise chain of relationships. In regards to this research, the focus will therefore be on the inner core variable –, *trust*, as trust is a central element within Ostroms collective action framework and lays the foundation for collaborative behavior but also because it was emphasized upon by previous scholars, throughout the emergence of data-sharing practices. Besides the importance of trust, this research will focus on the external variables; *number of participants* and *heterogeneity of participants.* The two external variables were chosen because this research constitutes first advances with relevant stakeholders. As the interviewed stakeholders had no or little previous knowledge about the Sandbox idea in general, it seemed reasonable not to focus on other structural variables such as *how individuals/organizations are linked*, which under certain circumstances requires previous in-depth knowledge. By rather focusing on variables that are straightforward to answer, a better quality of received answers was assured.

2.3 Big data & Data analytics

In today's digital economy data has become increasingly valuable. Not only to businesses but also to the public sector, as it realizes enormous potential, that can be unlocked by data sharing and data analytics (Schalenkamp, 2014). It is argued that big data stimulates innovation, productivity and growth, improve clinical medicine, policing but also to revolutionize science (Hand, 2016). In the sphere of big data, theory, which is based on assumptions becomes less important, as we can simply look at what the data says (Hand, 2016). The driver behind this is a combination of spectacular advances in ICTs, coupled with a routine of data collection. According to some estimates, the amount of data produced worldwide is doubling every two years and the sources for this enormous amount of data are amongst others interactions on the web, social media, mobile apps, biometric wearables and sensors in objects that are linked to the internet of things (IoT) (Davies, 2016).
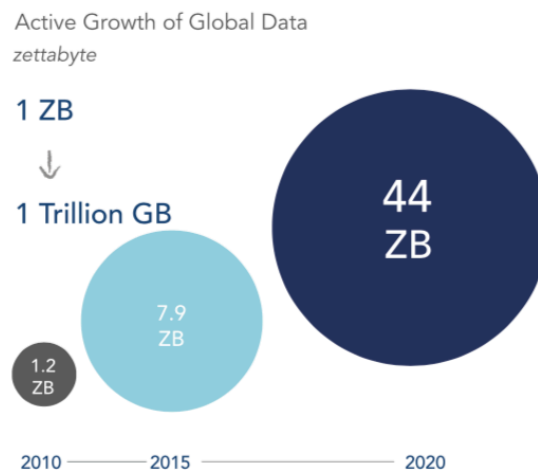
Figure 2.4 Active Growth of Global Data (Schalenkamp, 2014)

The dramatic growth of data is induced by a variety of factors, starting with new and cheaper solutions to store, manage and process data (e.g. cloud solutions), enormous advances in computing power, but also due to a decline of related costs and the omnipresence of the internet and the sprawl of online devices (Silverberg, 2016). These advances created the possibility to store, transmit and process a large amount of data much quicker and effectively and at the same time much cheaper than before (Davies, 2016). The global big-data technology and services market is expected to increase at a compound annual growth rate of approximately 23% between 2014 and 2019, while the worldwide revenue for big data and business analytics is expected to increase more than 50% from almost US$122 billion in 2015 to more than US$187 billion in 2019 (Davies, 2016). The largest sectors within this market include manufacturing, banking, insurance, government, professional services, telecommunications, health, transport and retail (Davies, 2016).

Sharing and linking data holds tremendous promise and there is a wide variety of potential uses for big data and data analytics. However, it also raises crucial questions whether our legal, ethical and social norms are sufficient to protect privacy and other values in a big data world (Executive Office of the US President, 2014). Big data, creates the possibility to promote innovation while also improving the quality

of our life, nevertheless most of these capabilities are not visible or available to the average consumer and might also create an imbalance of power between those who hold the data and those who supply it (Executive Office of the US President, 2014). Therefore, it's quite naturally that there are also big concerns related to the era of big data and data sharing. The related benefits and challenges will be further discussed in the subsequent part.

2.3.1 The benefits of data sharing and data analytics

There is a wide variety of stimulating opportunities connected to an ever increasing capacity to collect, store and analyze data. Even though there hasn't been a big bang moment at which entire sectors completely transformed due to the increased use of data, there is a trend that businesses undergo a significant and gradual transition towards a more data-driven landscape (Schroeder, 2016). The following part will highlight a number of identified benefits of data sharing and data analytics.

Increased productivity
Studies suggest that companies that adopt big data practices can increase productivity by 5%- 10% more than companies that do not, and that big data practices in Europe could add 1.9% to the GDP between 2014 and 2020. Today's large amount of data, either on its own or in combination with data from other sources can be used to identify patterns and meaningful relationships. These gained insights can then be used to design new products and services, improve production processes, optimize marketing or enable better decision making (Davies, 2016).

New factor of production
According to a study which was conducted amongst global business leaders in 2012, data has become a new factor of production, as the analysis of large quantities of data can lead to new insights and therefore act as a competitive advantage amongst firms. Data is therefore mentioned as a fundamental asset to businesses besides physical assets, labor or capital (Davies, 2016). Worlds famous economist, Michael Porter even stated, that data is most likely becoming a core asset for many businesses in the future (Porter, 2014).

Larger scale analytics
Being able to analyze enormous amounts of data from different sources are especially valuable for science. In medicine, for instance, researchers analyzed terabytes of brain image data, which was collected over thirty years by several institutions. Due to the large scale of data, the researchers were able to make progress in understanding the Alzheimer disease, by being able to map five critical factors in distinct regions of the brain (Davies, 2016). Briefly speaking, the more data we have, the more we will understand.

Encouraging collaboration
As previously implied, big data encourages the level of collaboration amongst different stakeholders. One example of a fruitful collaboration in the Pharma industry and big data includes the French company Sanofi, who posted its prostate cancer trials on a website, where companies can share data with the aim to develop cancer cures. By promoting cooperation within the industry they hope to get breakthrough treatment to the patient more quickly (Total Biopharma, 2014).

Promote innovation

Big data and data analytics does not only improve productivity, it is also referred to Data-Driven Innovation (DDI), which entails the exploitation of any kind of data in the innovation process to create value (Stone & Wang, 2014). The manufacturing industry can be mentioned as a good example, as it is undergoing radical changes with the introduction of IT technology on a large scale. With the upspring of "Industry 4.0" sensors and connectivity becomes more important. Smart machinery such as truck engines can benefit from this development, as data-based predictive maintenance is applied, where sensors are used with machine learning algorithms to avoid unnecessary maintenance jobs and to schedule protective repairs when failures are predicted (Zillner, et. al., 2016). According to the OECD report (2015) on data-driven innovation, governments must encourage more on investments in big data and data sharing as countries could get much more out of data analytics in term of social and economic gains.

Benefits for society

Big data and data analytics does not only benefit the industry; on a large scale it also positively affects the society. The U.S. Chamber of Commerce Foundation (2016) highlights seven areas, where properly accessed data can pay off in social benefits:

1. Public health	Understanding and defeating diseases and injury
2. Public safety	Anticipating and preventing crime
3. National security	Preventing instability through grater knowledge about its forerunners and dynamics
4. Development and poverty reduction	Developing empirically-proven techniques and technologies for fostering human development and poverty reduction
5. Governance	Putting knowledge about the dynamics of social and economic problems in the hands of lawmakers, along with options and likely consequences of policy actions
6. Education	Improving pedagogical arts and sciences to enhance student performance
7. Environmental protection	Protect our natural heritage and sustain life-critical natural systems and resources

Table 2.2 7 great ways that data can benefit society (Raidt, 2016)

The list of above mentioned benefits of data sharing and data analytics is just the thin end of the wedge of several other advantages and it will most likely take several more years until a broader adoption of big data practices is applied. However, the focus will now be turned to arising challenges that are related to data sharing and data analytics.

2.3.2 The challenges of data sharing & data analytics

Despite a considerable amount of advantages, data sharing and analytic practices also hold a number of arising challenges, that are in particular related to legal, ethical and social norms. Yet, it is a gray area, containing amongst others unclear and varying regulations but also the greater extent of its impact on businesses and society is not yet visible. The following part will highlight a number of identified challenges, that are related to data sharing and data analytics.

Data security and privacy

One of the main issues related to data sharing and data analytics are privacy and personal data protection. Even though, a large proportion of big data is not personal (e.g. weather information or satellite imaging), parts of big data potentially include elements that are directly linked to a person (e.g. name, address) and hence this data is considered to be personal data (Davies, 2016). There are techniques to pseudonymize and remove explicit identifiers, however it is technically also possible to re-identify this data and therefore the danger exists, that personal data can lead to unwanted disclosure of private information (Davies, 2016). To increase privacy and personal data protection, the EU General Data Protection Regulation (GDPR) has reinforced EU data protection standards, which are considered to be the highest in the world. (Davies, 2016). The European Commission argues, that these high standards will act as a competitive advantage, as they foster trust and will consequently lead to an increased willingness of sharing data. Other opinions however believe that European companies are losing out in the application of big data as stricter regulations may in fact prevent the realization of the potential benefits from big data, as costs will outweigh efficiency gains (Ciriani,2015). In Sweden, various laws govern the use of personal data. Those laws apply to the data controllers, which is defined as the person or legal entity who alone, or together with others decides on the purpose and means of personal data processing (Svensson, 2018).

Data ownership

Another concern relates to data ownership. Generally, data does not only have one owner but typically comes with a complex set of rights, associated with different stakeholders. To mention an example; smart cars typically generate a large quantity of technical data, but then the question arises what rights to that data are assigned to the owner of the car, the driver, the dealer who sold the car or the car manufacturer? As stated previously, providing guidelines could increase legal certainty but on the other hand, complex regulations might once again hinder data exchange (Davies, 2016).

Data capture and cleaning

In general, data sharing practices involve different stakeholders that are contributing their data in order to generate valuable output. However, one often related issue is the compatibility of the gathered data. The captured data needs to be clean, complete, accurate, consistent and formatted correctly in order to be able to utilize in a collective network. Up until now, it is an often ongoing battle for organizations to fulfill these requirements, as many of them use different systems (Bresnick, 2017). Also and even more important, the quality of the captured data is of importance as a low quality of data can lead to misleading or misguided conclusions and should be circumvented by all means.

Data storage

Data storage is an important issue when it comes to costs, security and performance. As the volume of data grows exponentially it is an often observed challenge to manage the costs and impacts of data centers. Whereas on-premise data storage promises control over security and access, an on-site network can be expansive to scale, difficult to maintain and challenging to produce and share data amongst different stakeholders. Cloud storage, on the other hand, becomes increasingly cheap and reliable (Siddiqa, et.al., 2017). Still, organizations must be cautious whom they share their data with.

Security

As it was previously mentioned, security is one of the most important factors in terms of data sharing and data analytics. In the healthcare sector, where data sharing is an already established practice, a number of technical safeguards for organizations were developed. These safeguards include amongst others procedures such as using up to date anti-virus software, setting up firewalls and the encryption of sensitive data (Bresnick, 2017).

Administratorship

Ongoing administratorship and curation of the data is an important concern. For the data owners and analysts, it is important to understand, when and by whom the data was created and for what purpose. Also, it should be known, who used the data previously, why and how. Therefore, having a trustworthy data administrator, who handles the development and curation of the data to ensure that all elements have defined formats and remain useful for its purpose, is very important (Dunning & Friedman, 2015).

Updating

In most cases, data is not static, especially in relation to this case study. Think of smart homes with constant room temperature control. These data updates may occur every few seconds, whereas other information such a home address might only change once in several years. Understanding the volatility of data is therefore of major concern and operators should know, which datasets need manual updates, whereas other datasets can be automated (Bresnick, 2017).

Sharing

Sharing data amongst external partners is essential for projects such as the Sandbox. However, the reluctance between data owners is considerably high. Distrust, the possibility to lose valued customers to competitors, or revealing a unique competitive advantage are just a few examples to mention that are influencing data owners and their willingness to share data. In order to establish a data-sharing network, it therefore requires clear guidelines and strategies, making it easier to share data securely (Olson & Downey, 2001).

The above-mentioned challenges just present a partial overview of factors to keep in mind when developing a big data exchange ecosystem. In order to function, participants must be able to overcome each of the before mentioned factors and doing so takes time, commitment and communication. The subsequent part of this research will focus on the viewpoints and concerns of potential stakeholders within the Sandbox project and will hopefully deliver new, additional insights related to data sharing and data analytics.

2.4 Summary of literature review

The previous literature review was broken down into two main areas. The first section focuses on the theory behind the logic of collective action and will in the upcoming study be of main interest, as the guiding research question focuses on factors that influence potential stakeholders and their decision to engage in a data sharing network. In this particular case, the idea is to connect different stakeholders that collect fire-related data in order to improve fire safety in Sweden. This approach relates to the collective action theory, as it involves actions that are carried out by a group of organizations that are trying to obtain a common goal, namely to enhance proactive fire safety. The subsequent mentioned benefits and challenges, related to data sharing and data analytics shall then give additional insights and help to clarify the viewpoints and concerns of potential stakeholders. Highlighting the benefits and challenges is of importance as they might have a crucial impact on the stakeholder's decision to engage in collective action. Therefore, both theoretical areas are highly related to each other as they reinforce themselves.

3. Methodology

3.1 Research Strategy

The aim of this research is to identify factors that are likely to affect stakeholders and their decision to share fire-related data. Therefore, to get a better understanding of how involved organizations operate, including how and what data they collect but also to understand their concerns and terms, it is suitable to conduct an external analysis amongst different organizations. The applied methodology is of qualitative nature, not only to obtain rich data and information about processes, strategies and approaches but also to be able to understand the big picture. Looking into the epistemological considerations, the focus of this study is on interpretivism as the anticipated type of information is most likely to be found in the personal views and perspectives of the people and therefore requires a close involvement with the investigated people. Such personal viewpoints are rather unobtainable through the use of quantitative analyses such as surveys (Bryman & Bell, 2011) and therefore a quantitative analysis is not applicable for this research. Moreover, a qualitative methodology allows for a certain degree of flexibility, as for example to adjust interview questions, or to dive deeper in certain areas in alignment with newly made discoveries (Bryman & Bell, 2011). Also, an inductive view of the relationship between theory and research is applied, whereby the former is generated out of the latter (Bryman & Bell, 2011). In contrast to testing an established theory, the scope of this research is to develop new valuable insights, as there has been no to little research on this specific set of data sharing related to fire safety before.

At this point it should be noted, that a qualitative research strategy is highly vulnerable to subjectivism and generalization, based on the researcher's subjective observations and interpretations (Bryman & Bell, 2011). This obstacle cannot be fully avoided, however by frequently biasing the observations on a theoretical framework, affecting personal interpretations and generalizations shall be minimized.

3.2 Research Design

In the process of data collection and analysis, a case study design has been chosen. Conducting a single case study is motivated by various aspects, both in relation to the expected outcome of the research as well as of practical implications. Primarily, the case study design entails the detailed and intensive analysis of a single case (Bryman & Bell, 2007). As emphasized in the research question, the focus of this research is to identify factors that affect data owners and their decisions to share data amongst different stakeholders. One would argue that the examination of different stakeholders can be classified as a multiple case study, however in relation to the research question, this study is treated as a single case, as the goal is to provide an in-depth elucidation of Sandbox idea. By further looking into the specific type of case, Yin (2003) generally distinguishes five types of cases. Considering the different classifications, this research can be considered as a revelatory case, as the focus is on a phenomenon that was previously not investigated scientifically and therefore goes in line with an inductive approach.

Shifting the focus on the practical situation, a single in-depth case study is suitable for this research, as it is conducted in cooperation with SBF. Having a close relationship with the initiator of the Sandbox project is beneficial, as it provides access to detailed background information about the project but also not to drift too far away and stay focused.

3.3 Research Methods and Data Collection

Due to the explorative nature of this study, which focuses on the experiences and perceptions of relevant stakeholders, qualitative data collection methods are applied in this research as preferred method of obtaining data. Specifically, semi-structured interviews with a chosen sample of stakeholders that collect fire-related data were conducted. Semi-structured interviews have the advantage that they are flexible in their process and therefore create the possibility to adapt and rephrase questions according to the situational circumstances (Bryman & Bell, 2011). The degree of flexibility and adjustability is the main motivation behind choosing this method, as the chosen research area was previously not investigated scientifically but also with the intention to explore the interviewees own perspectives. Also, by having the opportunity to adjust interview questions, richer and more valuable information from the respondents can be gathered, which provides a more complete picture and increases the validity of the study (Bryman & Bell, 2011). Further, semi-structured interviews assure a certain level of focus and guidance, which is especially helpful for researchers that are relatively inexperienced in the field of interviewing (Bryman & Bell, 2011).

3.3.1 Selection of Organizations and Respondents

The selection of part-taking organizations and respondents evolved throughout the close cooperation with SBF. A list of potential stakeholders and contact persons was provided by SBF as they have previously been in contact with a number of potential stakeholders. The criteria for being a relevant stakeholder and therefore being a potential interviewee were mainly related to the organizations connection to fire-related data and its geographical location in Sweden.

Potential interviewees were contacted via email, which included a brief information about the research area but also an overview of other potential part-taking organizations. Also it was clearly stated, that the research has an academic background in form of a Master thesis. In total, eight emails to seven different organizations were sent out. In case that no response was received within a week, a friendly reminder was sent out to the organization, to emphasize the interest as them being part of the research. Overall eight responses were received, out of these, six respondents agreed to be interviewed as part of the research.

Table 3.1 below provides an overview of the conducted interviews, followed by a brief background information about the organization and interviewee.

Organization	Position of the Interviewee	Date (2018)	Length	Channel
SBF	Consultant/Data Expert	4th of April	50 min	F2F
SOS Alarm	Fire Specialist	12th of April	31 min	F2F
Länsförsäkringar	Innovation Manager	12th of April	28 min	F2F
MSB	Statistician	17th of April	52 min	Skype
Karlstad University	Professor in Natural disaster theory	18th of April	30 min	Skype
Göta Lejon	Risk Manager	24th of April	34 min	F2F

Table 3.1 Overview of the conducted interviews and organizations

SBF is an over 100 years old Swedish organization with about 150 employees and 100 consultants that work with fire and safety inspection, writes rules and regulations and through their research, support researchers on fire safety. SBF is an association that has both commercial and social goals. Their mission is to make sure that nobody in Sweden dies or gets hurt in fires and that no property is destroyed. The interview within SBF was conducted with an IT consultant who works for SBF since 1 year. The interviewee has a lot of experience in the realm of big data and databases and supports SBF with the Sandbox project. He currently develops a prototype to establish a proof of concept.

SOS Alarm is the Swedish hub that creates safety and security. For more than 60 years they handle the national emergency hotline *112* and make sure that the ambulance, emergency services and police can do their job. SOS Alarm is an organization that has a unique access to information, which they continuously convert into knowledge and services. The organization is partly owned by the state and all of Sweden's municipalities and county councils. The organization employed 947 people in 2016 while generating an operating profit of 57.8 million SEK at the same time. The interviewee works for SOS Alarm for more than 12 years and has an in-depth knowledge regarding information handling and policies within the organization.

Länsförsäkringar is a unique alliance of 23 customer-owned regional insurance companies in Sweden. All companies have a strong local base in their home market and have no ownership interest other than those of their customers. Their mission is to develop products, concepts and system support, exclusively on their customer needs. In addition to the parent company, Länsförsäkringar AB, the group includes Länsförsäkringar Sak, Länsförsäkringar Bank, Länsförsäkringar Fondliv and Länsförsäkringar Liv. The group employs more than 2000 people and the operating profit exceeded 2.8 billion SEK in 2017. The interviewee works as Chief Innovation Manager at Länsförsäkringar and has extensive experience in innovation and technology. As he introduced himself: "I am doing stuff that we don't do today."

MSB, also known as the Swedish Civil Contingencies Agency is the responsible actor for issues concerning civil protection, public safety, emergency management and civil defense as long as no other authority has responsibility. MSB has a close cooperation with the municipalities, county councils, the private sector and other organizations and works with knowledge enhancement, training, supports regulation and supervision. Their goal is to achieve greater security and safety at all levels in society. MSB is steered by the Swedish Government, specifying objectives and reporting requirements, while also allocating resources for MSB administration and activities. The interviewee works as a statistics producer for MSB in the knowledge development section. His role is to supervise the fire brigades in Sweden by taking in and analyzing data from the incident reports, which are provided by the fire brigades.

Karlstad University
The contacted interviewee is a professor in the field of risk and environmental studies at Karlstad University, Sweden. With a background in natural- and geoscience, the interviewee works amongst others with risk management and is currently involved in a catastrophe modeling project with the Swedish KK-Foundation. Similar to the Sandbox project, the idea is to develop new types of data collection to get a better understanding of how large a damage is after there was a rainstorm. The consulted scientist has previously been in contact with SBF and was roughly familiar with the Sandbox project.

Göta Lejon is an insurance company that works with loss prevention and is responsible for all municipal owned administrations and companies in Gothenburg. Their mission is to offer insurance solutions that benefit the entire city, while also being an important catalyst to reduce the cities risks and responsibilities for efficient claims management. Göta Lejon acts as a non-profit organization and currently employs 12 people. The interviewee works within the organization´s loss prevention and risk management and has several years of work experience in the related field.

3.3.2 Practicalities

Before conducting the interviews, an interview guide was constructed (Appendix 1). The guide was structured in accordance to the building blocks that were identified in the theoretical framework and therefore included two main fields of interest: questions in relation to the collective action theory and questions related to data sharing and data analytics. Overall, the interview guide combined six topic areas: *personal background information, challenges and future, current data collection practices, data sharing and data analytics, benefits & challenges of data sharing* and *project Sandbox.* For each topic area, specific interview questions were formulated, from which the interviewer could choose from but also being able

to adapt questions in a given situation, as the interview went along. Preparing an interview guide assured both, asking the right questions in relevant areas, while also keeping an adequate level of flexibility. The first interview was conducted with SBF, who picked up the idea of the Sandbox project, while also being a stakeholder within the framework. The information obtained from the interview with SBF were crucial for all subsequent interviews as they provided initial in-depth information about the Sandbox idea and can therefore be considered as background information.

Even though, SBF was in the previous contact with relevant stakeholders, not every interviewee was profound familiar with the Sandbox approach. Therefore, relevant information obtained from the interview with SBF were shared with all subsequent interviewees prior conducting the interview itself. Also, the phrasing of certain interview questions was slightly changed after the interview with SBF as it became apparent that the interviewee did not grasp the full intention of the interview question. In particular, the phrasing of interview questions related to Ostroms collective action theory were changed (Topic area 5, see appendix 1) to assure a better quality throughout conducting the interviews.

Most of the interviews were conducted on a face-face (F2F) level, as they have a series of advantages as opposed to telephone interviews. This includes amongst others the length of an interview, which is usually limited to 20-25 minutes via the phone, whereas personal interviews can be much longer than this (Bryman & Bell, 2011). Also, it is implied that the derived quality of data from telephone interviews is inferior to that of comparable (F2F) interviews (Bryman & Bell, 2011). However, due to geographical distances, two of the interviews were conducted via Skype.

In order to maintain, aggregate and analyze the gathered data, the interviews were with the permission of the interviewee voice recorded and later transcribed. Thereby the mobile application "Wrappup" was used, which records and transcribes simultaneously. The tool was helpful to backtrack important sections of the interview and was of major importance for the analysis part. Besides using a recording tool, important handwritten notes were taken throughout the interview.

3.4 Data Analysis

Miles (1979) once described qualitative data as an "attractive nuisance" due to the attractiveness of its richness but also the difficulty to find analytical lanes through that abundance. Bryman & Bell (2011) therefore state that the researcher must protect himself from being flooded by the richness of the collected data, to prevent failing to give no wider significance to the data. In order to prevent this failure, a thematic analysis was performed which focuses on the identification of patterned meaning across datasets to answer the research question (Braun & Clarke, 2006). One of the advantages of a thematic analysis is, that it is relatively flexible, but also it suits questions that are related to people's experiences, views and perceptions which is of special interest in this research. The process of a thematic analysis starts with data familiarization, followed by coding, searching for themes, revision of the themes and a subsequently defining and naming of themes (Braun & Clarke, 2006). The intended aim of a thematic analysis is to detect patterns throughout the gathered data, in order to gain new insights, that ideally help to answer the research question. By applying a thematic approach, it was possible to structure the plenitude of gathered data into themes which subsequently simplified the analysis.

3.5 Quality of the study

In order to reduce uncertainties, the quality of the research is very important. This includes a high level of reliability and validity. There is an often discussed issue regarding the validity and reliability of qualitative research, as certain researchers question their relevance for qualitative research (Bryman & Bell, 2011). However, one stance is to assimilate reliability and validity into qualitative research as LeCompte and Goetz (1982) do.

3.5.1   Reliability

The reliability refers to the degree to which a study can be replicated (*external reliability*). In qualitative research, this is in particular difficult, as creating the same environmental setting throughout the investigation is difficult (Bryman & Bell, 2011). This thesis however employs high transparency by providing a detailed explanation of undertaken decisions and procedures, which hopefully affects the replicability and therefore increases the reliability of this study. The internal reliability can be affected by the number of observers involved. As this research was conducted by a single person, it is difficult to exchange opinions and find consistencies, however by having a close collaboration with SBF and a frequent reporting, the lack of internal reliability has been reduced. Further, a good preparation prior the interviews was of importance. In order to assure a good quality of the interviews within this study, the researcher familiarized himself with the interviewee prior conducting the interview while also performing interview pilots to get familiar with the questioning and how to react on given answers.

3.5.2   Validity

The internal validity of a study refers to the consensus between the researchers' observations and the theoretical ideas they develop (Bryman & Bell, 2011). In qualitative research, it is in most cases difficult to measure such validity however the validity of this research was increased by a frequent comparison of theories and empirical observations throughout the research process. The level of external validity is another often concerned problem within qualitative research. To increase the external validity of a study it is important to make the results generalizable so they can be applied to other social settings (Bryman & Bell, 2011). By formulating a clear and well-structured research question, the level of validity was tried to increase. Also by choosing an appropriate sample for the topic of interest, the validity was affected positively. As it was stated earlier, the interviewees were carefully chosen in cooperation with SBF and the interviews resulted in rich insightful findings. The validity was further increased by following a good research practice, which included the importance to keep track of the research phases, supported by frequent auditions from others (regular meetings with the supervisor and SBF) and a good level of self-reflection.

4. Empirical Findings

In this section, the results of the empirical data collection are outlined. As mentioned in the previous methodology part, six different interviewees, each representing a different organization were interviewed. The following chapter highlights relevant empirical findings, resulted from the interview guide. Overall, five topic areas were identified which are successively presented. Subsequently, the main findings are summarized in table 4.1.

4.1 Topic areas

4.1.1   Topic area 1: Challenges and Future

The first topic area is primarily concerned with challenges that the interviewed organization is facing today, but also anticipated challenges for the future. The interviewee was asked to describe the current situation within the organization and if applicable, elaborate on initiated actions in order to embrace the future. While talking about present challenges and the future, the interviewee was also asked to relate his answers to data sharing and data analytics (if possible).

SBF
SBF is an organization which works towards the goal that no one in Sweden dies or gets hurt within a fire. For more than 20 years they collect fire-related data but so far they didn't effectively use that data. It was more recently that SBF started to look into areas where this data could be utilized – not only internally but also externally. Generally speaking, SBF is the middleman between the fire brigades and the insurance companies and invoices the insurance companies for the fire brigades salvage services. Within this process they collect a multitude of fire-related data, however this data only represents a subset of the overall data. SBFs goal is to connect to other entities such as insurance companies and property owners, in order to get access to the other subset of the data. However, the mentioned challenge related to this idea is that most entities are not willing to share their data, due to their fear of giving away valuable and sensitive information.

SOS Alarm
SOS Alarm is the organization that handles all 112 calls and therefore collects an enormous amount of data from all fires in which the fire brigade is involved in. They are currently looking into new ways on how to use this data. Specifically, they are interested in being able to see what might happen next. SOS Alarm is just at the very beginning of this process but they understood that they can do a lot more with their data. Presently, SOS Alarm is sharing their data with other organizations such as MSB, however their main challenge is to give other entities only the right amount of access to their data, as it contains under certain circumstances, private and therefore confidential information.

Länsförsäkringar
Länsförsäkringar has a very innovate way of thinking, with a high customer-focus in mind. Their idea is to change their business model, away from selling insurances as a product towards being proactive and preventing insurance cases. They want to focus on services that help to eliminate the risks that people have for their homes, property and health. Therefore, they want to move all their resources and money

from being reactive towards being proactive and see how they can provide safety for their customers in the future. Within this approach, one major challenge is to gather a sufficient amount of data, but also to be able to understand how to connect and use this data in order to help their customers and eliminate risks.

MSB

MSB collects fire-related data from the fire brigades, however up until now this process is voluntary. Therefore, their future goal is to make this procedure obligatory, meaning that the fire brigades are obliged by law to provide MSB with fire-related data. The driving reason relates to the fact that MSB is having problems with under-reporting but also because of a varying quality of the data which likewise affects the reliability and usability of the data. Also, MSB would be further interest in having access to additional data-sets such as information regarding fire-related costs. To date, MSB only receives instant reports from the fire brigades which includes information about the cause of a fire, when it started and which action was taken by the fire brigade. However, they don't know the actual costs of a fire which would be an additional reasonable proxy. MSB states that it would give them much more power to their analyses if they would cooperate with insurance companies and get an actual number of losses in Krona.

Karlstad University

The researcher from the university states that the main challenges within a data sharing framework are related to regulations on data handling. Organizations are obliged to keep personal information confidential not only by law but also to maintain legitimacy towards their customers, by not revealing private information about who is insured and in what way. Further, competitive reasons are mentioned as data is considered as a valuable resource and therefore sustains the firms' competitive advantage.

Göta Lejon

Göta Lejon just recently introduced a new data storage and handling system, but the main challenge, mentioned by the interviewee relates to the functionality of the system itself. The system needs to be filled with parameters, in order to store the data correspondingly. However, in many cases, collected data doesn't fit into the system and later system design changes are costly and difficult to implement. The interviewee mentions that it takes a lot of resources and time to develop a system which fits the organizations purposes as each system is unique.

4.1.2   Topic area 2: Data collection practices

This section is concerned with current data collection practices. In particular, the interviewees were asked to specify what kind of data their organization is collecting, which techniques they apply to collect the data and how they use their data. As this area is quite sensible and potentially involves confidential information but also because of the required technical expertise and knowledge, not all respondents answered with an in-depth explanation.

SBF

SBF collects fire-related data for more than 20 years. The data is amongst others gathered from public organizations such as MSB, however up until now they didn't make use of this data in the sense of

proactive fire safety. In year the 2015 SBF started to develop a new prototype for data collection, which currently involves one insurance company. The data is stored in a simple structured database with the attempt to generate new insightful findings.

SOS Alarm

SOS Alarm currently records all *112* calls as well as every communication with the fire brigades and ambulances. Further, they have access to every fire report which includes all relevant information about what, when and where something happened. Therefore, this package of information is extremely valuable for SOS Alarm. The gathered data is stored in a data warehouse for 10 years unless it contains personal information such as names or telephone numbers which needs to be erased within 13 months due to legislation reasons. To date, SOS Alarm has no daily use for this data, rather it is used for specific research projects and the generation of statistics as for instance regarding the number of fires in Sweden. These statistics are then compared with separate statics from other organizations such as the fire brigades and insurance companies. However, the interviewee stated that they never correspond. Therefore, the interviewee expressed the need to merge this data with other sources as it would most likely provide results that are closer to the truth.

Länsförsäkringar

The interviewee wasn't too familiar with the current data collection practices within the organization, however he mentioned a collaboration with a startup that currently developed an Internet of Things (IoT) platform for Länsförsäkringar. The project focuses on moisture sensors that are installed in homes and sends out information in real time. Novel about their idea is, that a notification is sent out to a neighbor or any other chosen person, in case the apartment owner is not at home. Around 400 houses are involved in this pilot project and one bigger damage due to a water leakage was already prevented.

MSB

MSB uses a three-staged system in order to handle their data. The first stage is known as a receiving system through which all fire instant reports in Sweden are compiled. As previously mentioned, the fire bridges are the provider of these instant reports. The second stage is the data warehouse, where all the data is aggregated and stored. The environment is much more user-friendly and allows for easier analyses and analytical work. The third stage is a web-based system, which allows external organizations to access the data. MSB currently uses the data for comparison reasons e.g. analyzing different regional areas but also to provide the data to the general public such as journalists or organizations like SBF that use the data for research purposes.

Göta Lejon

Göta Lejon just recently introduced a new data collecting and data storage system based on excel sheets. The system is primarily used to store information about insured buildings but also for loss prevention projects, which includes risk surveys and risk assessment results. The results of these surveys and assessments are stored in the data system and provide information regarding the date of the assessment, identified flaws and undertaken actions. Further, the system is used to compile annual statistics about originated losses due to fires and other occurring incidents. The statistics are indented to be used for comparison reasons but also to be able to make recommendations for future improvements.

4.1.3 Topic area 3: Data sharing & data analytics

This section revolves around the terms; data sharing and data analytics. In particular, the interviewees were asked to express their personal association with these terms and if there is a relation to data sharing and data analytics within their organization.

SBF

As an IT expert, the interviewee has many years of experience in the field of big data and data-based analyses. As he develops the prototype for SBF, he mentioned the Sandbox project as a concrete example to demonstrate his association with data sharing and data analytics. There is a high relation between SBF and the two terms as they currently try to initiate a new framework, known as the Sandbox which involves data sharing and data analytics practices.

SOS Alarm

The interviewee mentioned the wider spectrum of data sharing and that every individual has its own view in regards to these terms. However, for SOS Alarm it means the collection of data from many different sources. SOS Alarm considers data as a valuable source for innovation, due to its extensive applicability. For the moment SOS Alarm tries to connect data from open sources in order to be able to predict what will happen in the next hour.

Länsförsäkringar

Before the interviewee started to work for Länsförsäkringar, he thought that insurance companies would be much more mature in the way they are using their data, however at the present stage it doesn't seem to be the case. The interviewees idea behind data sharing and data analytics is to develop and build new predictive models to eliminate risks. In his role as innovation manager, it is important for him to show his organization what they can do with data. The interviewee imitated several pilot projects related to data sharing, indicating a general interest in this field.

MSB

As a governmental owned organization, MSB is obliged to share data with individuals and organizations that ask for specific data, unless it contains personal information and reveals privacy. Based on their data, MSB produces statistics and performs basic analyses for customers such as the fire brigades. The interviewee itself is unaware of all the possibilities related to data sharing and data analytics, however he would like to know more about its potential.

Karlstad University

The interviewee is not very familiar with the terms; data sharing and data analytics, however he started to follow general discussion related to this field. So far he can only see a fraction of its potential use but mentions a catastrophe modeling project, he is currently involved in, to demonstrate his understanding. The project is similar to the Sandbox idea, which involves the advanced use of data collection practices to generate new findings.

Göta Lejon

The interviewees main association with the terms data sharing and data analytics relates to the broader availability of information and increased simplicity to access data. Also, the interviewee mentions the feasibility of better analyses, as access to a broader data-set, allows for the identification of connections within the data. As a governmental owned organization, Göta Lejon has to act according to the principle of public access to official records and shares their data with other organizations and individuals upon request. Also, they request information from other organizations such as the rescue services and store this data in their systems for reporting purposes.

4.1.4   Topic area 4: Benefits & challenges of data sharing and data analytics

This section revolves around the benefits and challenges related to data sharing and data analytics. The interviewee was asked to state his personal opinion regarding those two terms.

SBF

The interviewee mentioned the example of a fire in a multi-family home building with 10 different families. In the worst case, it could be that each family has a different insurance company and therefore its own view of the fire and what happened. All this data needs to be collected in order to make cost-predictions. However, if insurance companies would routinely share their data in a system as it is the approach within the Sandbox, it would be much easier to track the actual costs of a fire. In contrast to his example, the interviewee mentions regulations by law, the difficulty to share personal data, competitive reasons for private companies and the general reluctance of organizations to share their data as occurring challenges related to data sharing. Also, the interviewee mentions, that different scandals in the news affect people's sentiment regarding big data and data sharing. However, he is positively convinced that the benefits of data sharing outweigh related challenges.

SOS Alarm

As one of the biggest challenge, the interviewee mentioned privacy concerns. Sharing and analyzing personal data creates the possibility to develop a picture of every citizen in the country and the question is if we really want that? As one of the main benefits, the interviewee mentions the possibility to connect things with happenings from the past which might also create the possibility to be able to predict things in the future. Overall the interviewee considers the benefits as being more determining than the challenges.

Länsförsäkringar

Regarding the benefits and challenges of data sharing and data analytics the interviewee once again mentioned the intention to change the organizational business model from being reactive towards being more proactive. This however requires the advanced use of data in order to deliver personal services. The interviewee specifically clarifies that the use of personal data is no mean to punish their customers, if anything they want to reduce the risks of an accident. As major challenges, the interviewee mentions regulations by law and the fact that individuals and organizations are still too afraid of data and how it will be used against them. The interviewee suggests to give the people the power of their own data back and mentions blockchain as a possible technology.

MSB

The interviewee stated that he is unaware of all the potential benefits and challenges related to data sharing and data analytics, however he mentions the legal side and the quality of the data as major challenges.

Göta Lejon

As one of the main benefits related to data sharing and data analytics, the interviewee mentions the ability to be more proactive, as the access to a larger database provides more information to initiate proactive steps. Also, the increased level of reliability in relation to a larger database was mentioned as an advantage. As major challenges, the interviewee mentioned integrity and trust, due to the often occurring misuse of data and uncertainty how the shared data is used in the end.

4.1.5 Topic area 5: Project Sandbox

The last section revolves around the interviewees general opinion regarding the Sandbox project. In particular, questions were asked to identify main incentives and concerns for organizations to be part of the project. But also perceptions regarding the overall size of the project, the constellation of partaking organizations and the importance of trust were reviewed.

SBF

As being the initiator of the Sandbox project, SBF has a very positive attitude towards the project. Their goal is to connect all entities that collect fire-related data as they see it as an important task to use fire-related data for more profound purposes. The potential benefits that would arise throughout the implementation of the Sandbox project would not just benefit all involved organizations and the society, but also strengthen SBFs role. Regarding the size of the project, the interviewee mentions, that a larger and more diversified number of stakeholders would benefit the overall project, as a greater and more diverse amount of data would provide more insights. However, he also mentions that it would be no disappointment to start with only one additional stakeholder, to test and modify and build a proof of concept. Once other organizations see the potential of the Sandbox approach, the interviewee is confident that other organizations will follow. Also, the interviewee mentions personal trust as one of the most important pillars, especially in the early stage of the project. The interviewee stated: *"Someone needs to have a good personal relationship and therefore communication is a required key competence."*

SOS Alarm

SOS Alarm has a positive opinion regarding projects that involve data sharing and learning practices. Their main goal is to protect the life of the citizen by learning to predict things but also to make their work more efficiently while also saving money. Being involved in the Sandbox would certainly help SOS Alarm to work towards these goals. On the other hand, they have to be careful whom they share their data with and to what extent. In general, they have no doubts to share their data with an organization such as SBF, however the general set-up must be very secure to make sure that sensible data is not misused. Also, the interviewee mentions the importance of trust, as it lays the foundation for sharing sensitive data. The interviewee suggests to create some kind of independent organization, where each of the involved entities is part of, giving access and control to everyone involved. Regarding the size of the project, the interviewee

mentions that a greater number of participants would make it easier for SOS Alarm to reason for its participation in such as framework. Also the interviewee comments on the diversity of involved organizations, arguing that a blend of different organizations increases the legitimacy of the overall idea. Conclusively the interviewee states, that a project like the Sandbox could have already been implemented years ago, but back then everyone was even more afraid and unaware of the power of data.

Länsförsäkringar
Starting to collaborate with different kind of actors and seeing how we can combine fire-related data, is something Länsförsäkringar wants to be part of. Their goal is to focus on services that help to eliminate the risks that people have for their homes and therefore they try to move away from being reactive and paying out money when its already too late, towards being more proactive and support prevention. This certainly includes being part of a collaborative network. However, the interviewee also states that its already difficult to combine data within their own organization, therefore it's important for them to see how they can combine data in a project like the Sandbox. Further, the interviewee mentions the importance of clean and accurate data but also regulations related to data and the way data is stored, as it constitutes a complex problem. The interviewee stated: *"Once we start to combine data from different sources it becomes even more important to make sure that the quality of the data is adequate and good enough".* Time, resources and efforts also play an important role within this framework and the interviewee suggests to start this project in a chosen area, to see how it turns out and develops. Once it shows positive results, he suggests a wider roll-out. Regarding the diversity of involved organizations, the interviewee argues that a mix of different organizations is the way to go, however he also states, that it's a challenge when organizations within the same business area share their data due to competitive reason.

MSB
From the perspective of a researcher, the interviewee sees a lot of potential in the Sandbox idea, as it would create the possibility for MSB to compare insurance company data with operational data from the fire brigades. Subsequently, this data could be used for cost-benefit analyses, which would result in more effective fire protection. In relation to that, the interviewee mentions that up until now many decisions within the fire brigade service are not well grounded in science and primarily based on gut feeling. Having more data and a scientific background would most likely lead to a more objective decision-making. Nevertheless, the interviewee also mentions arising challenges, which relate to data protection regulations and the importance not to give away identifiable personal data. As the biggest challenge, the interviewee mentions the development of trust amongst the insurance companies, as there is the biggest conflict of interest. As a governmental owned organization, MSB is obliged to share their data. Insurance companies on the other hand are very reluctant to share their data as it is one of their most valuable assets.

Karlstad University
The interviewee envisions great potential in the Sandbox idea and is keen to see what organizations can do with this kind of approach. To his mind, it is important for organizations to turn into more knowledge-based organizations, as from a scientific point of view, data helps to understand a phenomenon, which likewise helps to understand the root-cause for any particular incident. The interviewee is however also concerned about arising challenges, including the amount of information organizations should/should not share amongst different stakeholders, but also how the use of information will affect certain groups in

society. Further, he mentions the importance of legal restrictions and trust amongst different stakeholders but also the necessity to establish long-term commitment and stable agreements among the involved stakeholders. Regarding the size of the Sandbox, the interviewee has a two-sided opinion. He argues that, involving organizations within the same industry e.g. insurance companies, increases the difficulty to establish trust and joint work. However, he also believes that a broader use of the Sandbox, requires the involvement of different companies within the same industry, as data is the key resource within this project.

Göta Lejon

The interviewees overall perception towards the Sandbox projects is very positive. Göta Lejon already cooperates with many different organizations, as they believe that sharing knowledge is a great advantage and by sharing opinions and different strengths, everyone can benefit from each other. Also due to its non-profit character, Göta Lejon is obliged to share their data with other organizations. However as one of the main challenges, the responded mentions the importance of trust and the concern that data might be used, not in line with the organizations core values, which would harm the organizations reputation. Therefore, the respondent suggests to start the project with a small core team on a local level, before expanding the project after a successful test-phase. Also the interviewee believes that a mixture of different organizations would be more beneficial for the overall project, as different organizations add different unique value and information.

4.2 Summary of the empirical findings

	Topic area 1: Challenges & Future
SBF	- SBF only has access to a subset of all fire related data - So far SBF didn't make use of that data - Develop a new data sharing framework
SOS Alarm	- Collects big amounts of fire related data and look into new ways how to use this data - Challenge: only give others the right amount of access to their data
Länsförsäkringar	- Most likely not selling insurances anymore - Shift from being reactive towards being proactive (prevent insurance cases) - Predicting what will happen next
MSB	- Data sharing for fire brigades is voluntary → change towards obligatory - MSB has problems of under-reporting + quality affects usability - Data needs to be more user friendly
Karlstad University	- Tougher regulations affect data sharing practices - Data sharing is limited due to competitive reasons
Göta Lejon	- Develop a data handling system, which allows for increased flexibility and the possibility to add/change parameters after its introduction
	Topic area 2: Data collection practices
SBF	- Collects fire related data for more than 20 yeas - So far a very simple structured data base
SOS Alarm	- Records all *112* calls and radio communication with the fire brigades and ambulances - Data is stored in a data warehouse for 10 years - No daily use for that data, rather for specific research projects
Länsförsäkringar	- Collaboration with a startup that develops an IoT platform (moisture sensors)
MSB	- 3-staged system for data collection and data handling (receiving, storage, analysis) - Data is used for comparison reasons and accessible to everyone
Karlstad University	- No answer

Göta Lejon	- Just introduced a new data handling system, used for reporting and compiling of statistics
	Topic area 3: Big data sharing & data analytics
SBF	- Sees enormous potential in data sharing and data analytics - Currently developing of a prototype for data sharing, involving one insurance company
SOS Alarm	- Enormous amounts of fire related data is collected, but they didn't uncover its full potential yet - Idea: connect data from open sources with their own data
Länsförsäkringar	- Many pilot projects within Länsförsäkringar related to big data and data sharing - Build new predictive models to eliminate risks
MSB	- MSB generates statistics and does basic analytics, based on fire related data - MSB is obliged to share their data
Karlstad University	- "I can only see a fraction of the potential use"
Göta Lejon	- More data allows for better analyses and the possibility to make connections amongst different data sources - Data is already shared with other organizations
	Topic area 4: Benefits & Challenges of big data sharing
SBF	- Data sharing would make it easier to track the actual costs of a fire - Challenges: regulations by law, GDPR, legal and competitive issues for companies
SOS Alarm	- Learn to predict things and make connections to the past - Challenge: Privacy concerns and surveillance; Do we really want that?
Länsförsäkringar	- Using data to initiate actions and reduce the risks of an accident - People are afraid of data and how it is used against them → need for change
MSB	- Challenges related to legal issues and the quality of the data
Karlstad University	- No answer
Göta Lejon	- Increased reliability and opportunity to be more proactive - Fear of data misuse and reputational damage
	Topic area 5: Project Sandbox
SBF	- Strong belief in the project, strengthen the role of SBF - Start to develop a proof of concept, engage in good personal relationships - Personal trust as one of the most important pillar
SOS Alarm	- Their main goal: protect the citizen, make their work more effective, try to predict what will happen next - Data storage and handling must be very secure (need for an organization that everyone can trust) - Suggests a mix of different organizations
Länsförsäkringar	- Moving from being reactive towards being proactive (requires collaboration) - Difficulty to combine data from different sources (quality, usability) - Time, resources, efforts and trust play an important role
MSB	- More effective fire protection due to cost-benefit-analysis - Data protection regulations and other legal arguments are very important - The biggest challenge is to develop trust among the insurance companies
Karlstad University	- Sees great potential in the idea, turning more into knowledge-based organizations - Without trust, long term commitment and stable agreements we won't achieve anything - Suggests to involve a variety of different organizations and scientists
Göta Lejon	- Sees it as a great advantage to share knowledge, opinions and strengths - Trust is important to assure that data is not misused - Testing the project with core team of mixed organizations on a local level

Table 4.1 Summary of the empirical findings

5   Analysis

The following section contains an analysis of the empirical findings in relation to the interviewed organizations and areas which were highlighted in the theoretical review. Thus, this section links the empirical findings from the previous chapter and the theoretical areas which were emphasized in the literature review. The five identified topic areas, as they were presented in the previous empirical findings part are once again outlined and analyzed successively.

5.1 Analysis of the topic areas

5.1.1   Topic area 1: Challenges and Future

The first topic area revolves around the current situation within the interviewed organization. In particular, questions were asked about current and upcoming challenges and how the organization is trying to embrace them. The idea was to get a better picture of the organization but also to identify If there is a relation to data sharing and data analytics within the organization.

By taking a closer look at the empirical findings, it becomes apparent that all interviewed organizations share one common goal – namely to improve fire safety and make sure that no one in Sweden dies or gets hurt within a fire. While most of the interviewed organizations are partly governmental owned, their primary goal seems plausible, interestingly however, Länsförsäkringar and SBF as privately held organizations indirectly follows the same mission. With a high customer-centric focus, Länsförsäkringar wants to change its business model, not focusing on selling insurances as a product/service anymore, but help to prevent insurance cases.

> *"We need to move all our resources and money from being reactive to be proactive and see how we can provide safety for our customers in the future."*
> (Länsförsäkringar)

This new way of doing business is rooted in Länsförsäkringars belief that a proactive approach is much more cost-effective, while also preventing their customers pain. Though, in order to achieve this goal, data as a resource becomes much more important to them, as it was also stated by Michael Porter (2014), who considers data as becoming a core asset for many businesses in the future. SBF as the initiator of the Sandbox idea acts according to the same principle. After years of collecting data without effectively using it, they recognized the potential that can be unlocked by sharing data. One of the drivers behind this change is as mentioned in the introductory theory related to advances in ICT coupled with a routine of data collection. As stated by Davies (2016), the amount of produced data is expected to double every two years and this growth is amongst others induced by new and cheaper solutions to store, manage and process data but also due to advances in computer power and the sprawl of data collection devices.

Besides the joint organizational mission, namely to save people's lives, also each of the organization collects fire-related data. Although, the amount of collected fire-related data amongst the organizations varies, one common obstacle remains, namely the fact that each of the organization only has access to a subset of the overall data. However, the empirical findings also indicate, that the interviewed organizations are starting to realize that there is an actual need to collaborate in order unify their data.

"Our data is just a little piece of the broader picture."
(SBF)
"If we can't see our customer's data or other organizations data, we cannot make predictions."
(Länsförsäkringar)

Most of the governmental owned organizations such as MSB, SOS Alarm and Göta Lejon are already obliged by law to share their data with other organizations, however at the same time, they face a problem of under-reporting. In order to compile advanced statistics and develop better analyses more data from different sources is required.

"We would be very interests in the data from insurances companies regarding fire related costs, as it would add a reasonable proxy to our cost-benefit analysis."
(MSB)

In order to be able to do so, closer collaboration is required. This challenge relates to Ostroms collective action theory, nonetheless in a slightly different form. Whereas Ostroms original theory relates to common pool resources such as fishery, which is usually scarce and therefore requires cautious treatment by the collective, data on the other hand grows exponentially. But it is also questionable if data can be considered as a common pool resource. Scholars such as Mauthner and Parry (2009) argue that research data, as it is the primary use case within the Sandbox idea, should be considered as a common pool resource due to scientific, moral, economic and political arguments. Throughout the years, this standpoint however changed as Mauthner (2012) started to question if data sharing is actually in the public interest and if it necessarily constitutes good science. Nevertheless, the discussion if data should be considered as a common pool resource is at this point negligible, as it is not the main focus of this researcher. Rather the idea is to apply Ostroms (2009) collective action theory in a new setting, in order identify factors, that influence data owners and their decision to share data and therefore engage in collective action. Ostroms common pool fishery example and the Sandbox idea are however to some extent connected as it requires in both cases collective action in order to gain collective benefits. Further, both examples share the challenge to treat the resources of interest cautiously, as it is their common goal to sustain it.

"The main challenge is to give the right amount of access to the data because the data is very sensible and classified. We have to make sure to handle the data in a good way".
(SOS Alarm)

Conclusively, all interviewed organizations stated that they would be willing to share their data, as it is their common goal to improve fire safety which conditionally requires to engage in data sharing practices. The above mentioned findings are crucial as they highlight that the nature of organization, the organizational mission, respectively the organizational business model are determining aspects that affect data owners and their decision to share fire-related data.

5.1.2   Topic area 2: Data collection practices

In this section, the interviewees were asked to specify what kind of data their organization is currently collecting, which techniques they apply to collect the data and how they make use of their data. The idea was to get a better overview of how the organizations operate but also to highlight how they differ and what consequences it might imply.

All interviewed organizations that were part of this research are currently collecting fire-related data. However, the technical implementation of these data collection and analyzing procedures differs profoundly. Whereas the recently introduced data collection system by Göta Lejon is based on Excel sheets, MSB on the other hand uses a 3-staged data handling system, including a receiving hub, data warehouse and web-based system. Those two examples highlight the extremes and it is important to shed light on the technical side, as this aspect will most likely present one major obstacle within the realization of the Sandbox project and therefore relates the sub-research question: *"What are potential obstacles and benefits that affect data sharing and data analytics?"* As previously mentioned by Bresnick (2017), data sharing practices often comprise issues related to the compatibility of the gathered data. The captured data needs to be clean, complete, accurate and formatted correctly in order to be able to utilize in a collective network. However, as the empirical findings indicate, this doesn't seem to be the case yet and it therefore requires a lot more communication and commitment by the collective in order to achieve compatibility. Due to the background of the researcher, further technical considerations are more or less neglected within this study, hence it is even more important for future research to look into technical consideration as they seem to portray one major challenge within data sharing and data analytics.

Besides the previously highlighted differences in data collection and data handling procedures, the interviewed organizations seem to have a common interest in how they use their data. Amongst all respondents, the main reason for data collection relates to the preparation of statistics and reporting. MSB for instance currently uses their data to analyze previous fires in different regional areas. Also, they provide their data to the general public for journalistic and research purposes. SOS Alarm and Göta Lejon collect fire-related data for similar purposes, interestingly however none of the interviewed organizations uses their data proactively to improve fire safety yet, which highlights the importance and need for projects such as the Sandbox.

"Today we don't have a daily use for this data, more for specific research projects or the generation of statistics about the number of fires in Sweden. Those statistics are then compared with separate statistics from the fire brigades and insurance companies but they never correspond."
(SOS Alarm)

Nevertheless, as it was mentioned in the previous section, most of the interviewed organizations are starting to realize that their data can be used for much more amplified purposes. Instead of collecting data without using it proactively the Sandbox idea demonstrates an innovative way to use data for more advanced purposes which will hopefully deliver new, valuable insights and improve the fire safety in Sweden.

5.1.3   Topic area 3: Data sharing and data analytics

In this section the interviewees were asked to express their opinion regarding the terms; data sharing and data analytics. The idea was to ascertain if the interviewees are familiar with these concepts and if there are similarities/differences in their perceptions.

The empirical findings highlight, that many of the interviewees are not yet truly familiar with the concepts of data sharing and data analytics. Even though they have a general idea what data sharing and data analytics involves, they cannot picture the greater potential yet. Nonetheless, most of the respondents have a similar association with the two terms and mention the possibility to connect different data sources and the increased availability of data-sets for better analyses as examples to demonstrate their association with those two terms.

"Instead of specifying what you would like to know, you just pull out the data you are interested in."
(Göta Lejon)

The fact that many of the interviewees don't see the greater potential of data sharing and data analytic practices yet, might also present another important factor that influences their decision to engage in a data sharing network. Being more familiar with related benefits might further increase their interest. Therefore, it is a crucial step to communicate the possibilities of the Sandbox idea in order to obtain greater attractiveness and encouragement. The importance of communication is also mentioned in Ostroms (2009) collective action framework, which is a key determinant for the development of long-lasting relationships and conviction. Beneficially, most of the interviewed organizations are already communicating with each other, but also all interviewees mentioned that they are interested in learning more about the concept of data sharing, as they would like to know more about its potential implications.

An additional interesting finding relates to the statement, given by the interviewees from Länsförsäkringar and SOS Alarm. Instead of just being able to compare data from different data sources, they have an extended viewpoint on the terms data sharing and data analytics and mention the aspiration to be able to predict things in the future. This is an important finding, as the resulting objectives to engage in data sharing seem to differ amongst the interviewed organizations. Whereas SBF, MSB and Göta Lejon perceive data sharing as an opportunity to improve their analyses and statistics, Länsförsäkringar and SOS even further assume to be able to create new predictive models.

After conducting the interviews with the organizations representative, it is certainly not possible to generalize by drawing conclusions on the organizations overall knowledge and anticipation in regards to data sharing and data analytics. Future research should therefore further analyze to what extent the organizational knowledge in regards to data sharing and data analytics affects their decision to share fire-related data in a collective network.

5.1.4   Topic area 4: Benefits and challenges of data sharing and data analytics

This section revolves around the benefits and challenges of data sharing and data analytics. The idea was to identify if the respondents are familiar with the benefits and challenges of data sharing and data analytics but also and more importantly to understand their personal viewpoints and concerns.

Even though the interviewees were not truly familiar with the terms; data sharing and data analytics, all respondents had a personal opinion regarding related benefits and challenges. As the most common benefit, the interviewees mentioned the increased access to data and the ability to connect different dataset which presumably enhances proactive actions.

"The advantage of data sharing is that it's easier to be proactive because you have a larger database."
(Göta Lejon)

"The benefits are of course that we can learn to predict things."
(SOS Alarm)

In particular, the interviewees mentioned examples of how data sharing will most likely create the possibility to simpler track fire-related costs, but also the ability to make actual predictions of what might happen next, as it was stated in the above quote by SOS Alarm.

In relation to the ability to connect datasets from different stakeholders, the interviewee from Göta Lejon also associates an increased reliability of their data sets. This assumption is however questionable as it was also mentioned as a potential challenge and will be further discussed in the subsequent part.

Interestingly, most of the benefits that were mentioned by the interviewees, also correspond with the benefits that were reviewed in the literature. Being able to conduct larger scale analytics, the encouragement of collaboration which presumably results in increased productivity, benefits for the society but also the promotion of innovation (changing the business model towards being more pro-active) are benefits, that were mentioned by both, the interviewees and in the literature.

Benefits of data sharing & data analytics	SBF	Länsförs.	SOS Alarm	MSB	Göta Lejon
Increased productivity	X		X	X	X
New factor of production		X			
Larger scale analytics	X		X	X	X
Encouraging collaboration	X	X	X		X
Promotion of Innovation		X	X		X
Benefits for society	X	X	X	X	X

Table 5.1 Mentioned benefits of data sharing & data analytics

Table 5.1 above illustrates the correspondence between benefits of data sharing and data analytics, mentioned in the literature compared with the responses throughout the conducted interviews. Even though the interviewees did not mention every benefit specifically by name, the overall interview itself indicates that the respondents are well aware of the above-listed benefits. Only the benefit: *new factor of*

production was solely mentioned by one interviewee (Länsförsäkringar) as he specifically talked about the organizational change of their business model towards being more proactive which concurrently implicates the importance of data as a new factor of production.

Shifting the focus towards mentioned challenges related to data sharing and data analytics, most respondents again had a strongly corresponding opinion. Legal restrictions and privacy concerns were addressed by all interviewees and most likely affects organizations and their decision to engage in data sharing practices.

"The challenges are of course concerning. We can get a picture of every citizen in the country and do we really want that? I don't think so."
(SOS Alarm)

"Today we are a little bit afraid of data and how it will be used against us."
(Länsförsäkringar)

Also, the interviewees mention that recent scandals in the news such as the example of Facebook and its big data business affect people's sentiment. Further, as it was already addressed previously, most of the fire-related data contains personal information and is therefore highly confidential. Davies (2016) emphasizes on the same personal data protection concerns, arguing that there are techniques to pseudonymize personal data, but he also stresses that there are techniques to re-identify this data, which might lead to an unwanted disclosure of private information. Therefore, organizations have to make sure that their data is only shared in an appropriate way. Affective from the 25th of May 2018, the European Commission released new regulations with regard to the processing of personal data (eugdpr.org, 2018). These regulations are considered to be the highest standards in the world, with the intention to foster trust and consequently lead to an increased willingness to share data. Critical voices are however expecting a contradictory development as stricter regulations might outweigh efficiency gains and therefore lead to a decrease in data sharing (Ciriani, 2015). Time will tell if tougher regulations will lead to an increase in data sharing, but for now, it can be stated that privacy and personal data concerns are clearly affecting data owners and their decision to engage in data sharing.

Further, competitive reasons were mentioned as a major challenge. Especially non-governmental organizations such as insurance companies have to be careful whom they share their data with, as other insurance companies can easily calculate their competitor's insurance plans, which in reverse affects their competitive advantage. In relation to that, trust was mentioned as a crucial factor, which is also mentioned as a central variable within Ostroms collective action theory, as it is a cornerstone of collaboration. According to Holton (2001), trust helps to understand the other parties position and sensing whether there is a truthful opportunity for give and take. Before someone starts to engage in data sharing, it is therefore important to establish trust which is in particular of importance for the realization of the Sandbox project.

Besides challenges that are rather relate to the human sphere, the respondents also mentioned concerns related to technological considerations and were also addressed in a previous section. Especially in terms of data sharing amongst several stakeholders with differences in the organizational size, and data collecting practices, the way data is captured, cleaned and stored is very important.

"In order to combine data from different sources, you need to wash and clean it, because otherwise it doesn't make sense."
(Länsförsäkringar)

But also the quality of the data was mentioned as an important factor, as a low quality of data can lead to misleading conclusions, which especially in regards to fire safety should be circumvented by all means. The amount and diversity of data from different stakeholders can therefore have a two-sided effect. In case that shared data is accurate, complete and formatted correctly, it will most likely add value and increase the validity and reliability of fire-related statistics and proactive-actions. If data on the other hand is lacking accuracy, consistency and a standardized format, it will most likely not add value and rather harm the collective network. Bresnick (2017) therefore suggests an ongoing curation of the collected data, involving a trustworthy data administrator who handles the development of the data to ensure that data is kept in defined formats and remains useful for its purpose.

Table 5.2 below illustrates the correspondence between challenges of data sharing and data analytics mentioned in the literature compared with collected responses throughout the interviews. It becomes apparent that the interviewees are well aware of potential challenges, nevertheless the table also indicates that certain challenges are not yet taken into consideration. This underlines the importance that organizations need to be further familiarized with related challenges. Once they are more knowledgeable, they will most likely be less afraid to engage in data sharing.

Challenges of data sharing & data analytics	SBF	Länsförs.	SOS Alarm	MSB	Göta Lejon
Data security & privacy and legal requirements	X	X	X	X	X
Data ownership					
Data storage	X	X	X		X
Security					
Administratorship	X		X		
Updating					
Sharing	X	X	X	X	X
Trust	X	X	X	X	X

Table 5.2 Mentioned challenges of data sharing & data analytics

Overall, it shall however be stated that most of the interviewees consider the benefits of data sharing and data analytics as more determining than anticipated challenges. This indicates that even though the respondents are aware of related challenges, the benefits are more impactful on their decision to engage in data sharing than the challenges.

5.1.5   Topic area 6: Project Sandbox

The last section revolves around the interviewees general opinion regarding the Sandbox project. In particular, questions were asked to identify main incentives and concerns that affect the organizations and their decision to engage in a data sharing network such as the Sandbox. Also, perceptions regarding the overall size of the project, the structure of participants and the importance of trust were reviewed.

After analyzing the empirical findings, it can be stated that the overall opinion regarding the Sandbox project and therefore the acceptance to engage in a data sharing network, is very positive amongst all interviewees. The respondents showed a high level of interest and were to some extent excited to see, what the Sandbox approach might facilitate in the future.

"I think the Sandbox idea has great potential and I am really keen to see what we can do with this kind of approach."
(Karlstad University)

Primary incentives, affecting stakeholders and their decision to engage in projects such as the Sandbox, mainly relate to the *nature of the organization* but also to their business model and organizational mission. As it was previously mentioned, four of the interviewed organizations (SOS Alarm, MSB, Göta Lejon, Karlstad University) are partly owned by the government and therefore obliged by law to share their data with other organizations. Further, the organizational business model appears to have an impact on the decision to share data amongst different stakeholders. Länsförsäkringar as a non-governmental organization has a strong customer-centric focus with the defined mission to make sure that none of their customers gets involved in an accident. By changing their business model from being reactive towards being proactive and circumventing accidents, they attempt to achieve this goal. They are therefore committed to engage in a data sharing network, as having access to a broader data network fosters the initiation of proactive actions. Other interviewed organizations such as SBF follow a similar approach and therefore the organizational mission and business model are driving factors to engage in a data sharing network. The findings further indicate that the interviewed organizations start to recognize the benefit of knowledge, rooted in data and therefore intend to turn into more knowledge-based organizations. Up until now many decisions within the fire brigade service are not very well grounded in science and many decisions are based on gut feeling. However, with an extended scientific background, decisions could be made more objectively, which potentially also results in a more effective fire protection.

As main concerns, the interviewees mentioned the importance of a secure set-up of the Sandbox to make sure that no data is misused. This is a considerable factor as most of the involved organizations rely on their reputation. In case of a data-misuse, the overall project will most-likely collapse, as the reputational damage would be too gravely. Also, as it was previously mentioned and reviewed in the literature; the quality, compatibility and neatness of the data were stated as important factors to assure the feasibility of the project. Further, considerations regarding personal data protection regulations and the importance of trust amongst involved stakeholders were mentioned as key pillars which most-likely affect the success of the Sandbox project. This consideration goes in line with Merson (2015) who refers to trust as an important variable amongst those that engage in data sharing practices. Most of the interviewed organizations already communicate and interact with each other, which is a fitting attitude in order to establish trust.

Concerning the overall size of the Sandbox project and the structure of involved participants, the interviewees altogether had a strongly corresponding opinion. It was suggested to test the Sandbox with a selected core team in a defined region to develop a proof of concept. After a successful test phase, the project should then be rolled-out on a larger scale. The interviewees further proposed to involve a greater number of participants, as a larger number of involved organizations would most likely result in more diverse data-sets. The interviewees however also mentioned related concerns regarding the number of involved organizations, arguing that an increased group size might negatively affect the project, due to arising challenges, such as the incompatibility of data-sets and the increased chance that data is misused. This concern coincides with Mancur Olson's (1965) notion regarding the group size and the collective action theory, arguing that an increased group size negatively affects the probability to achieve a collective benefit due to free-rider effects. Other scholars such as Bates and Shepsle (1995) on the other hand argue with the opposite prediction, stating that collective action is positively correlating with the group size and therefore results in a two-sided viewpoint. Regarding the structure of involved organizations, the interviewees suggest a diversified number of organizations, as each organization contributes with its unique dataset. At the same time, it is however also mentioned as an occurring challenge, especially when stakeholders within the same business area get together.

"I think a mixture of organizations is perfect but it's always a challenge when you have stakeholders in the same business area. The question is who is helping who here and who is gaining the most benefits?"
(Länsförsäkringar)

In the reviewed theory, scholars have a similar, two-sided opinion regarding the heterogeneity of involved participants, arguing with the same concerns and it is therefore difficult to reason for either side. It most likely requires some kind of testing in order to give a clear answer whether a heterogeneous or more diverse group is beneficial or not.

Conclusively it can be stated that all interviewees showed a high interest in the Sandbox project. Even though the interviewees mention relevant concerns, the overall sentiment regarding the project is more than positive and it became apparent that all interviewed organizations are currently trying to get more engaged in data sharing practices. As Schalenkamp (2014) put it: In today's digital economy, data has become increasingly valuable as it realizes enormous potential that can be unlocked by data sharing and data analytics and current developments, technological but also organizational, indicate that it is about time.

"The question is if we want to do this and the answer is yes. We could have done this years before but back then everyone was scared about it and not knowing if we can do it. But now we see the possibilities to do this (….) Today every grocery store has more knowledge about their customer's future buying behavior but we don't have the knowledge to predict what might happen next. But we should have."
(SOS Alarm)

5.2   Results

After analyzing the empirical findings, the following research question and relevant subordinate research question which were guiding this study shall now be answered:

Guiding Research Question:
- *What factors influence stakeholders, making them willing to share their data for the mutual benefit in terms of fire safety in Sweden?*

Subordinate Research Question:
- *What are potential benefits and obstacles that affect data sharing and data analytics?*

In order to answer the research questions, a new model derived from the introductory literature review and the subsequent analysis of the empirical findings was developed. The model distinguishes between motivational and discouraging factors that are likely to affect data sharing and will be further discussed in the subsequent part.

The motivational factors are mainly related to the organization itself but also to the identified benefits of data sharing and data analytics. Throughout this research, different organizations were interviewed and the findings indicate, that the *nature of the organization* is presumed to be an important factor which is likely to affect data sharing. Out of six interviewed organizations, four (MSB, SOS Alarm, Göta Lejon, Karlstad University) are partly owned by the government, which directly affects their obligation to share their data according to the principal of public access to official records. Three out of these four governmental owned organizations are currently collecting fire-related data and act according to the principle by sharing their data with other organizations. The remaining two interviewed organizations; SBF and Länsförsäkringar are not governmental owned and therefore not obliged to share their data, however the findings indicate that their *organizational mission and business model* are likely to affect their decision to engage in data sharing practices. As an over 100-year-old organization, SBF has the defined mission to make sure that nobody in Sweden dies or gets hurt in fires. Also as being the initiator of the Sandbox project SBF shows high commitment and willingness to share their data amongst different stakeholders and is therefore strongly driven by its organizational mission. Länsförsäkringar on the other hand has a very customer-centric focus and is currently changing their business model from being reactive towards being more proactive and trying to reduce the number of insurance cases. In order to achieve this change, Länsförsäkringar expressed the need to engage in data sharing practices, as data is a key prerequisite to initiate proactive actions and hence directly affected by its organizational business model.

Further motivational factors relate to the identified benefits of data sharing and data analytics. Reviewed in the literature but also confirmed throughout the interviews, respondents mentioned the ability to conduct *larger scale analytics* due to the broader access to data-sets, *increased productivity* gains; as newly gained insights are likely leading to the design of new products and services, and the improvement of current processes which is concurrently linked to the *promotion of innovation*. Further, as it was indirectly mentioned by the interviewee from Länsförsäkringar, data acts as *a new factor of production* and is especially of importance throughout the transformation towards a more proactive business model. Lastly,

the *encouragement of collaboration* was mentioned, which is directly reflected by SBFs initiated Sandbox project. Besides the previous expressed benefits, the research further indicates that the following two variables according to Ostroms collective action theory are presumed to affect data sharing; The *number,* as well as the *heterogeneity of involved participants,* were mentioned as important factors throughout the interviews, arguing that a greater and more diversified number of participants will result in more varied and insightful data. At the same time however, the respondents also mentioned concerns due to the fact that a greater number of participants might also negatively affect data sharing. It is therefore not possible to clearly state whether the number and heterogeneity of participants are truly motivational or discouraging factors, nevertheless, the conducted interviews leave the impression that the number and heterogeneity of participants should rather be considered as motivational than discouraging factors.

The identified discouraging factors are mainly related to the challenges of data sharing and data analytics but also to the concern of trust as a key variable within Elinor Ostroms collective action theory. The importance of *data security and privacy* which also includes *legal restrictions* were mentioned throughout each interview and are therefore considered as the most determining discouraging factors. Without clear guidelines on how collective data is used and clarification which data is shared, projects like the Sandbox will most likely not succeed in the long run. Also, it remains to be seen how the newly effective data regulations by the EU will impact data sharing in the future as it was appraised differently by various scholars.

Further, the *handling and storage of data* is a crucial factor as it was expressed as a major concern amongst the interviewees. Particularly in a framework where many different organizations combine their data, it is important to make sure that the *quality of the data* is appropriate and good enough. The current data collection and handling practices amongst the involved organizations vary greatly, ranging from basic excel sheets towards advanced data warehouses. It will therefore be a major challenge within the Sandbox project to aggregate and format the data correctly in order to ensure a good quality of the data. Related to the data collection practicalities, the relevance of *data administratorship* was identified as an additional factor which is likely to affect data sharing. The interviewees referred to the problem that data is often misused and in many cases, it prevails uncertain how the shared data is used in the end. Therefore, it was suggested to create an independent organization, acting as a data administrator, who handles the development and curation of the data to ensure that it has defined formats and remains useful for its purposes. Last but not least, trust was mentioned as an important variable throughout all conducted interviews while also representing a key variable within Ostroms collective action theory. Without trust, data owners won't be willing to share their data and it therefore requires a good level of collaboration with a great deal of communication in order to create an environment where others can learn to trust each other.
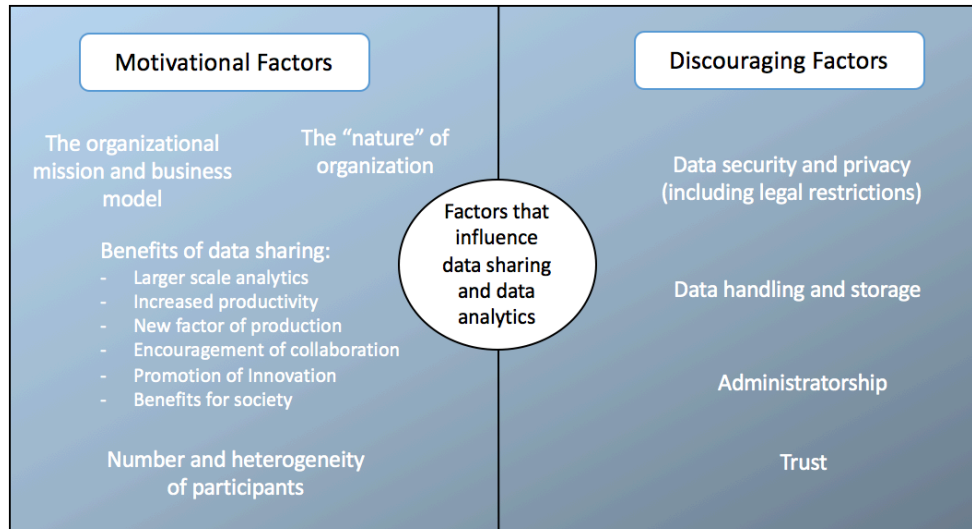
Figure 5.1 New data sharing model

The above-shown model summarizes and demonstrates the factors that are likely to affect data sharing and data analytics, in a collective network which involves different stakeholders that collect fire-related data. The model was developed in order to answer the guiding research questions of this study and highlights a number of motivational and discouraging factors while also incorporating related obstacles and benefits of data sharing which relates to the subordinate research question. Certain factors such as *the nature of the organization* and the importance of a secure set-up and trust seem to be more determining than other factors, however they conclusively act together as guiding elements for the realization of a collective data sharing network as it is the idea within the Sandbox project.

6   Conclusion & Future Research

6.1   Concluding discussion

This research presents new findings related to an innovative framework which focuses on data sharing and fire safety. Data-Driven innovation is the overarching term which is predicted to be a key pillar in the 21st century sources of growth, as the exploitation of data promises the creation of new, innovative products, services and business models, while also stimulating greater competitiveness. An incorporated project called Sandbox, emphasizes on this term, which's central idea is to connect different stakeholders that collect fire-related data. Subsequently, that data should be used in order to generate new findings with the goal to enhance proactive fire safety. The relevance of this research is determined by two major trends – namely the increase of urbanization which implies the need for proactive safety and significant advances in information technology, which enables the implementation of data sharing networks. Both trends were further discussed at the beginning of this research and deciding factors to commence this study. An introductory literature review refers to the later focus of this research and is broken down into two main areas: *the logic of collective action* and *the benefits and challenges of data sharing and data analytics*. Both subjects are closely related to each other and were further elaborated upon throughout this study.

The guiding research question: "*What factors influence stakeholders, making them willing to share their data for the mutual benefit in terms of fire safety in Sweden?*" and relevant subordinate research question "*What are potential benefits and obstacles affect data sharing and data analytics?*" were answered with the endorsement of a newly developed model which incorporates characteristics from existing theory, merged with the empirical findings that were identified throughout conducting this qualitative research. The developed model distinguishes between motivational and discouraging factors that are likely to affect data sharing. Identified motivational factors primarily relate to the organization itself; including the nature of organization e.g. if the organization is governmental owned and therefore obliged to share their data, the organizational mission and business model, anticipated benefits of data sharing which include amongst others the ability to conduct larger scale analytics due to the availability of larger data-sets, increased productivity due to the ability to combine data from different sources which can then be used to design new products and services, but also the encouragement of collaboration which is likely to enhance proactive fire safety and therefore constitutes a benefit for the society. Lastly the size of the overall data sharing network including the number and heterogeneity of involved participants were identified as motivational factors, as a greater and more diverse number of involved actors presumably result in more versatile data-sets.

The identified discouraging factors that influence data sharing and data analytics mainly relate to data security and privacy concerns, as fire-related data often includes confidential information and therefore points out the need that no data is misused, legal restrictions and the announcement of new laws, as they affect the overall sentiment and decision to engage in a data sharing network, but also technical considerations in terms of how data is handled, administrated and formatted correctly to ensure that data remains useful for its purposes. Last but not least, the importance of trust was identified as a determining factor as it is a central variable for the establishment of collaboration and therefore directly affecting data owners and their decision to engage in a data sharing network.
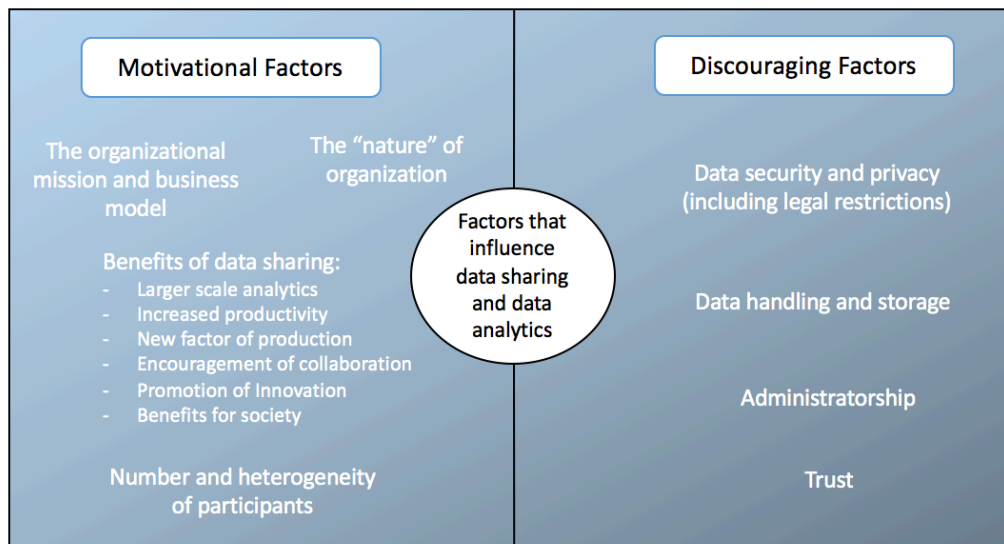

Figure 5.1 New data sharing model

The identified motivational and discouraging factors provide guidance to answer the main research question of this study by highlighting relevant determinants that influence stakeholders and their decision to share fire-related data. In conclusion it can be stated, that it is a combination of motivational and discouraging factors that affect data owners and their decision to engage in a data sharing network. The empirical findings however also indicate, that most of the interviewees consider the benefits (belonging to the motivational factors) of data sharing as being more determining than the discouraging factors, which likewise affects their decision to share their data. Also it should be mentioned that even though the identified discouraging factors represent major obstacles, they can outright be dealt with. Throughout the development of a data sharing network such as the Sandbox it is therefore suggested to pay particularly attention to a secure set-up, which incorporates latest data regulations and privacy concerns. Also, additional attention needs to be paid on technical considerations as the empirical findings indicate that data collecting-, handling- and storage-practices can vary tremendously. To assure an accurate flow of the collective data, clean, complete and formatted correctly data is a prerequisite. This further demands for a trustworthy administrative entity, to ensure a continuous curation of the collective data. Also, it needs to be emphasized on the establishment of trust amongst involved organizations, as it is a key element to establish long-term commitment and collaboration. Conclusively, it is suggested to explicitly communicate related benefits and challenges of data sharing and data analytics, as at this point many of the interviewed organizations are not yet thoroughly familiar with related benefits and challenges, which in turn might further strengthen their interest to engage in a data sharing network.

The subordinate research question, which revolves around potential benefits and obstacles that affect data sharing and data analytics is concurrently answered with the underpinned model, as the identified motivational and discouraging factors incorporate potential obstacles and benefits.

6.2 Future Research

The focus of this research was to provide new insights on factors that are likely to affect data sharing amongst different stakeholders that collect fire-related data. The aim of the study was not to provide in-depth information about each of the interviewed organizations but rather to identify and present the overall opinions and voices in relation to data sharing and fire safety. Nevertheless, one major limitation of this research constitutes the amount of examined interviewees and organizations, which was mainly limited due to time constraints. Someone should not neglect the fact that one interviewee does not represent the overall viewpoint of an organization. Also, not every interviewee was profoundly familiar with the concept of data sharing while also not being truly familiar with technical considerations. Future research should therefore focus on expanding the circle of interviewees in order to get a broader picture of the organization in study but also to emphasize on important technical consideration.

Future research should also further focus on the identified motivational and discouraging factors that are likely to affect data sharing, as this research does not measure to what extent each of the identified factors affect data owners and their decision to engage in data sharing. So far, it can only be stated that certain factors seem to be more determining than others, however it would be worthwhile to be able to rank the identified motivational and discouraging factors in order to determine their distant importance. Therefore, additional quantitative research is suggested, which rather focuses on numbers than on words.

Also, as it was stated in the beginning of this research, the underlying idea of the Sandbox model is to develop a viable business model, which involves different fire-related stakeholders and SBF, representing the backbone of the framework. The findings of this study are not directly akin with the requirements to develop a business model, indirectly however this study provides supportive information and lays the foundation for future research, related to the development of a business model.

Last but not least, the chosen area of study within this research is very unique. Not only because of the connection between data sharing and the fire safety, but also because of the previously mentioned combination of studied organizations. Future research is therefore suggested to test if the developed model as presented in the analysis and conclusion, can also be applied in other areas where data sharing and data analytics practices are presumed to be effective tools.

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8   Appendices

Appendix 1: Interview Guide

Personal background
- Could you please start and introduce yourself shortly? (name, position within the company, etc.)

Topic area 1: Challenges and Future
- What are the main challenges that your organization is facing today and in the future? (Is there a relation to big data, data sharing)
- What capabilities do you think will be of importance?

Topic area 2: Current data collection practices (sensible/optional)
- Are your currently collecting data which is related to fire safety? (e.g. data from previous fires, real-time data gathered through sensors as applied in smart homes) If yes, could you please be more specific?
- How do you collect this data?
- Where/How do you store this data?
- How do you analyze this data, what is your use for this data?

Topic area 3: Big data sharing & data analytics
- What do you associate with the term data sharing and data analytics?
- Is there a relation to data sharing & data analytics within your organization?

Topic area 4: Benefits & Challenges of big data sharing
- Are you familiar with the benefits and challenges of data sharing & data analytics?
- What benefits and challenges in regards to data sharing and data analytics do you consider as most important?
- Do you consider the benefits as being more determining than the challenges, or the other way round?

Topic area 5: Project Sandbox
- What is your general opinion regarding the Sandbox project? (consensus/rejection)
- What would be the main incentives for your organization to be part of this project?
- What would be your main expectations/concerns, when participating in this project?
- Would the size of the overall project affect your decision for being part of the Sandbox project?
- Would the heterogeneity of the involved organizations affect your decision to be part of the sandbox project? (e.g. only insurance companies or a mix of different organizations such as private safety firms, governmental agencies, insurance companies)
- In regards to the project and data sharing: How important is trust for your organization?
- Would you generally be interest in participating in the Sandbox project?