UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Innovation in firefighting equipment diffusion
A qualitative study about new technology adoption in Swedish fire brigades

Author: Khalil Nidal Khalil
Supervisor: Ethan Gifford
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INNOVATION WITHIN SWEDISH FIRE BRIGADES
By Khalil Nidal Khalil

Abstract

The continuous innovation and diffusion of fire fighting technologies has always been improving the speed and efficiency of fire fighting. The users of these technologies are qualified and passionate men and women who are dedicated to the well being of others. As for all technologies, their diffusion process isn't smooth, and the new products can't easily find their way into its users hands, there are always problems preventing the adoption of these technologies. Sweden suffered from one of the worst cases of forest fires in 2018 and the need for innovation to better fight these fires was imminent. In addition it was noticed that the diffusion time of fire fighting innovations is taking long periods of time for complete adoption by brigades and the adoption decision making process is not smooth or similar between all the fire brigades in Sweden.

This study does a qualitative analysis of the diffusion process in Swedish fire brigades by interviewing product vendors and fire fighters in different positions and expertise. The collected data is analyzed while maintaining a theoretical guideline of diffusion theories by Everett M. Rogers and Geoffrey A. Moore. The study concluded that the process of innovation diffusion is subjective to most of the fire brigade since most fire brigades in Sweden operate and take innovation adoption decisions independently unless they were not involved in larger organization. The issue of communication between brigades was the most prominent when it comes to spreading the word about successful innovation and their compatibility to existing training and procedures. Others issues such as funding new equipment and decision makers preferences were emphasized as hinders for innovation adoption.

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1. Introduction

This chapter will provide an explanation of the topic, the need for innovation and general statistics about the organizational environment of fire departments in Sweden. Further explanation of how the study came about and interview examples from other case studies are included.

1.1 introduction

This paper will study the process of decision making regarding the adoption of new technology within the fire brigades in Sweden. It will explore the difficulties surrounding the adoption of new ideas and the challenges that needs to be overcome in order to fully adopt innovations, further more the paper will give recommendation for future improvements of the adoption decision making process.

According to the Swedish Civil Contingencies Agency, Sweden has been averaging nearly ten thousand reported fire incidents per year since 1998, in addition to that recently Sweden has also been suffering from devastating forest fires which had a devastating impact on nature in the summer of 2018. Electrical vehicles are increasing in number rapidly and they require updated fire fighting procedures and equipment in order for fire fighter to be able to deal correctly with their accidents. Forest fires on the other hand also requires a constant adaptation with the rapidly evolving technological solutions.

As for fire brigades, the responsibilities are ultimately vested in Sweden's two hundred and ninety municipalities, they cooperate with each other to varying degrees. By the definition used by the Swedish Civil Contingencies Agency as well as the Swedish Association of Local Authorities and Regions (SKL), there are currently one hundred and fifty four fire brigades. Of these, thirty eight are local federations governed by a direction consisting of politicians elected by the municipal assemblies of its member municipalities. Eight are administered as part of a single municipality but governed and funded by a common committee with politicians elected by the municipal assemblies of several municipalities, typically the brigade has operations/stations in each municipality, but all personnel are employed by the host municipality. The rest are single municipalities having their own committee for civil protection, which may or may not cooperate

with other municipalities, sometimes to the point of having the same fire chief or purchasing the service entirely from another municipality.

 The brigades operate a total number of fire stations which is roughly two hundred with full-time staff, roughly five hundred with only part-time staff and roughly two hundred with only volunteers. These numbers are not very exact or up to date and MSB is constantly working on getting a better overview. Apart from the political governance as outlined above, MSB has no information to share about the organizational structure of the fire brigades.

The below three interviews are from a case study about the preparedness of municipal officials and firefighters for electrical vehicle accident preparedness in Sweden's three largest cities Stockholm, Gothenburg and Malmo. The study sheds light on the organizational attitude towards innovation adoption. (Annelie Carlson, May 2017)

Stockholm, interview with the official in charge of the national electrical vehicle procurement contract. *"There is knowledge of how to deal with electrical cars in many different places. In some areas, however, for example, when charging indoors, there is a lack of knowledge, routines, and rules. The knowledge is not widely disseminated"*
The official knew about the scope of the problem but they did not know or have a specific strategy on how to spread the knowledge required nor who should be responsible for sharing the knowledge. *"We feel responsible because we are promoting electrical vehicles and installing charging stations in the city, so of course we think about this"*.

Gothenburg, interview with a green vehicle project leader in the traffic department claimed that the ongoing progress of environmentally friendly vehicles is driven by the technology. Engineers discuss types of different cables that should be used but it is not of interest of the city of Gothenburg to care about. She was also a little discouraged to say if electrical vehicles should be treated in a different way from other green solution. She thinks electrical vehicles are a better and safer in case of accidents, problems arise when charging is not done properly, problems occur when the battery is overheating, but she does not think it will be a problem here in Sweden because it is a cold country *"We have no cooperation with the rescue services, but they have not*

come to me either. I wonder if they have been contacted regarding the new electrical bus, in case something should happen, I mean"

Malmo, interview with an official at the cities environmental office for overarching environmental goals states that the responsibility to inform the public about the risks associated with charging in the responsibility of the energy companies and not the municipalities or the rescue services *"We do not think about safety when it comes to electrical vehicles or the environment. I*
don't think that anyone in Malmö thinks about these issues. I fully trust that electric vehicles are safe – we have to trust that the car manufacturers produce safe products. But you never know, it's like with everything else, like, for example, mobile phones and radiation. It is not something that I ever think about".

1.2 Problem discussion

Although the need for constant innovation is prominent in all industries, the need was especially visible within the fire brigades in Sweden after discussions with PerOla Malmquist founder of Utkiken, since it was noticed that there are long waiting times for fire brigades to adopt new products offered by the vendors. It was difficult to get an overview of the issue since there was no recent specialized reports that specify the nature of organizational attitudes and regulations connecting Swedish fire brigades with companies that are selling new innovations in fire fighting technologies.

Furthermore new technologies are transforming the landscape of different industries and it is ok to argue that those who don't cope with innovation are obligated to suffer the effects of being laggards in technological adoption, this is a major issue to investigate because rescue missions and peoples well being are dependent on the efficiency and updated services of the fire departments.

After discussing the issue with vendors and fire data analysts, it turned out that vendors of fire equipment are experiencing a long time until a purchase is made, the waiting time could take up to two years or more. These long times were apparent in every fire brigade they contact, and

there wasn't an obvious easy route to take in order to accelerate the adoption between all departments in Sweden except contacting each brigade individually.

1.3 Research Question

The purpose of this study is to get a deeper explanation of the relationship between the fire brigades and their innovation adoption strategies by doing an exploratory study, doing so will include interviewing people from both the fire departments as well as companies who are trying to sell to them. By combining both data it is predicted to bridge the gap between the suppliers and the user.

"What are the challenges that are preventing fire brigades in Sweden from adopting new technologies"

2. Theory

This chapter will provide a thorough representation of Everett Rogers and Geoffrey Moore theories of innovation diffusion and crossing the chasm techniques. Relative topics of the general theories were selected in order to correspond with the purpose of the study.

2.1 The diffusion of innovation

Diffusion is the process of communicating different innovations within specific channels over a period of time and among different segments of the social system.

Diffusion is a different type of communication because the messages that are transmitted are related to new ideas to the receivers.

Communication is the creation and exchange of ideas between different segments of a social system, thus it is a process of convergence or divergence as opposite ideas clash with each other between individual of a social system, this exchange of ideas aims to move people closer of further away from each other.

Communication should be thought of as a two way communication process in which ideas are exchange and affected by each other, it shouldn't be thought of as a linear process of one way communication when an individual only wants to send one message to the other part (Rogers and Kincaid, 1981).

But when a deeper look at the exchange of ideas is taken, we realize that it is actually a small part within a larger ongoing process. Consider a simple exchange when a seller of a certain product going to different potential buyers with a set of problems, the innovation in this case will appear as a solution. When this exchange is studied in a broader sense it is shown that their exchange of ideas is a small part of the beginning of an ongoing cycle.

Diffusion is a unique form of communication, were messages are connected to new ideas. The special characters of the diffusion process comes from the newness of the exchanged ideas and to the degree of their acceptance by the other side. Newness is the amount of uncertainty that is involved.

Uncertainty is the lack of structure, predictability and information, it is the point in which many alternatives are related to the occurrence of an event. In order to reduce uncertainty it is important to supply as much information as necessary, information affects uncertainty by

providing a choice between the different given set of alternatives (Rogers and Kincaid, 1981, p.64).

2.2 Four main element of innovation diffusion

The innovation diffusion process is categorized in four main categories which are the innovation, communication channels, time, members of the social system. *Figure 1. Innovation adoption process.*
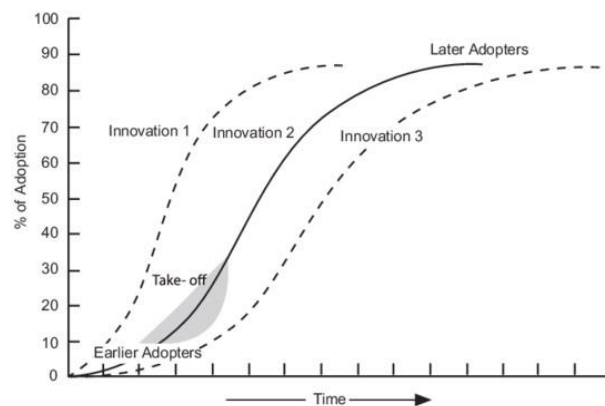
The innovation

Any new practice, object or idea that is considered to something new to the receivers or adopters. It is the degree of newness that is perceived by the adopter that determines the type of reactions they will have. If the idea is perceived as something new and the adopter can't take the adoption decision easily, the idea is considered an innovation.

In order to predict the rate of adoption of an innovation there are certain categories from research data that should be measured.

Relative advantage: is the degree of perception by the end user whether the new innovation is better than the idea that precedes it. This degree of difference is measured in an increased advantage of economic profitability, in status or any other value perception that fits within the users environment. Potential users always want to know the degree of relative advantage of the new idea, and scholars have found the relative advantage as one of the ultimate predictors of the innovation rate of adoption. Measuring relative advantage requires measuring the immediacy of

the reward, efficiency in time and energy, lowering rates of discomfort, lowering initial costs, profitability.(Generalization, Rogers, p. 220)

Compatibility: it is the degree to which any new innovation whether a product or service is fitting consistently within the existing past experiences, vales and the needs of the end users. The degree of compatibility can either slow or speed up the rate of adoption, every new idea is judged by its preceding old ideas.

Complexity: is the degree of perception that the new innovation is considered easy to use in comparison to the old training and processes previously adopted by the end users. *"The complexity of an innovation, as perceived by members of social systems, is negatively related to its rate of adoption"* (Generalization 6-3 Rogers p.231)

Trialability: is the degree and feasibility of experimentation of an innovation by the end user on a limited basis before its final adoption. New innovations that can be tried will be easily adopted in a more rapid way than other innovations that does not allow experimentation before final adoption.

Observability: the visibility of innovation user results to be visible to others. *" The Observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption"* (Generalization 6-5 Rogers p.232)

Communication channels

As discussed earlier that innovation is a unique type of communication that is related to the exchange of new ideas, It's essence lies within the information exchange between a social network. This process involves the following
The innovation
An individual or a group that has an experience with the innovation
Another individual or groups that does not have any previous knowledge with the innovation
Efficient communication channels connecting group two and three

Mass media channels are the most effective tool to convey messages to adopters, whether it's television, radio, newspapers, social media etc. on the other hand interpersonal channels has proven to be more effective in persuading the adoption of new ideas, especially if the social channel is linking people who are colleagues within a similar field, this type of communication involves a face to face interaction.

Results of various diffusion investigation indicate mostly that people don't evaluate innovation based on scientific studies, but they mostly depend on subjective evaluations that is delivered to them via other colleagues who previously adopted the new ideas, which is more describe in the theory of Heterophily and Diffusion

Time

Time is a very important element within diffusion adoption, perhaps it is so fundamental that it not possible to explain it in comparison to other things more fundamental (Whitrow, 1980, p.372) The innovation decision process is the process when an actor or the decision making group pass the knowledge introduction stage to the decision making stage to adopt or reject. There are five conceptual elements to this processes: knowledge, persuasion, decision, implementation and confirmation. Rate of adoption and innovative categories will be further discusses in pages 10&11 in this study

Social system

The collection of individuals, groups, organizations or subsystems that are interrelated and engaged in joint problem solving in order to achieve a mutual goal. Because these groups within a social system are not identical in their opinions, separate structures start to exist within the system. Structure is the arrangement of units within a system, this form of structuring gives stability and regularity to the human behavior, this structuring also allows the ability to predict certain behaviors.

We can see this type of structuring within bureaucratic system such as governments and organizations were everyone follows certain commands and adoption of new ideas usually happens in a centralized way. Another very important structure for adoption is the informal structure that exists within interpersonal networks, were people are much more influenced from

their other peers, as mentioned in the homophile principle when individuals prefer to be influenced by others who look and talk like them.

2.3 The innovation decision process

The decision making process that consists of the first knowledge, attitude formation, adoption or rejection decision, implementation of new innovation and later on the confirmation of the decision; consists of a series of choices and actions over a specific period of time when the decision maker or makers evaluate whether to incorporate it or not, final decision making is usually accompanied with a certain degree of uncertainty and newness, and it is this uncertainty and newness that contributes to distinctive aspect of innovation decision making.

Types of innovation decision

There are three types of innovation decision:

Optional innovation decision: adoption decisions that are made on an individual level regardless of the collective norm of the social structure, example would be someone deciding to use or not a flat screen TV rather than an old black and white TV.

Collective innovation decision: adoption decisions that are made in a collective authoritative or representative organization and it is always made by consensus among all members of the social structure, example is a representative government voting for a certain issue.

Authority innovation decisions: a final decision that is usually taken by a few members in a social system that usually posses power, technical expertise or status.

Model of innovation decision making process:

The innovation adoption decision making process goes through five stages.

Knowledge: happens when a decision making individual or group is exposed to the presence of a new innovative product or service and begin understanding its functionalities

Persuasion: happens when a decision making individual or group begins to form a liking or disliking towards the innovation

Decision: happens when a decision making individual or group gets involved in activities that contributes to the decision making process of adopting or rejecting

Implementation: happens when a decision making individual or group starts using the innovation

Confirmation: happens when a decision making individual or group searches for additional supporting processes that will elevate the use of the innovation, it is at this stage when the decision makers decide to keep using the innovation for reject it completely

The individuals role in innovation discovery is passive, the exposure to new innovation happens by accident because a person cannot actively be looking for new innovations (Coleman et al 1966, p. 599) suggests that discovery of new innovation occurs within its relative communication channels.

> *"Cosmopolite channels are relatively more important at the knowledge stage, and localite channels are relatively more important at the persuasion stage in the innovation decision process"* (Generalization 5-13 Rogers p.200)

2.4 Rate of adoption variables

As mentioned in section 2.2 the five attributes to an innovation are relative advantage, compatibility, complexity, trialability, observability. Mentioned below more variables that contribute to the speed of adoption of any innovation

Type of innovation decision: generally innovation that require an individual decision are easier and faster adopted than innovations that require an organizational decision for adoption. The more there are individuals taking part in the decision making process the more time for the adoption it will take, one way of speeding the decision making process is to try to reduce the number of people who are taking the decision, an example when in the USA the decision for adopting fluoridation of water was made by a mayor or a city manager, the speed of decision making was quicker than when made by a public referendum

Communication channels: channels must be used to spread awareness and diffuse the innovation, example (Petrini et al, 1968) discovered differences within the communication channel usage depending on the perceived simplicity of complexity of the innovation among Swedish farmers. Mass media; agricultural magazines were efficient for less complex innovations, while interpersonal channels with outside change agents were better for innovation that farmers thought were more complex.

Nature of the social system: the norms of the system and the degree of interconnectedness between the structure of a social network determines the rate of knowledge sharing and innovation adoption, until the decision maker has the minimum degree of knowledge and social peer influence they are unlikely to adopt, but once this threshold is overcome and the necessary amount of influence and knowledge is reached, it is more likely for the rate of adoption within other network to increase with each influencer.

Change agents: rate of adoption is influenced by the change agents promotional efforts, this relationship is not necessary a linear relationship, however a great payoff is always related to change agents activities. (Stone, 1952, Petrini, 1966) determined that the ultimate response from the efforts of the change agents happens when opinion leaders start adopting.

2.5 Innovation and adopter categories

Individuals in a social system adopted innovations at different times, studies has shown a sequence that individuals fits within certain categories of adoption. It is true to any innovation that the adopter will always fall in one of these categories. Change agents becomes practical if they could identify the category in which an adopter fits in and use different strategies accordingly. *Figure 2. Adoption stages curve.*
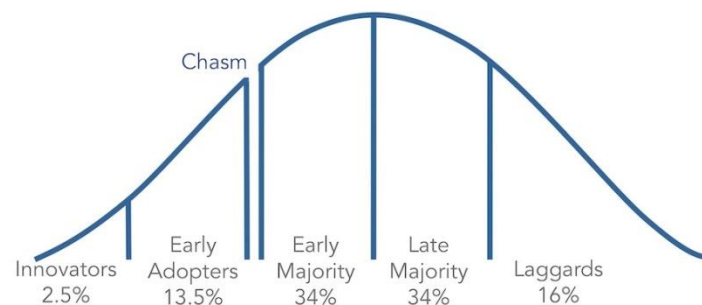
Innovators: small category of individuals who are eager to be the first ones to try new ideas. This niche type of interest pushes them out of normal communication patterns and puts them into a cosmopolite social network. Friendships and communication channels remains active between them even though the geographical distances between them may be huge. They handle a high degree of uncertainty, they are prepared to handle some setbacks when the innovation proves unsuccessful. they play an important role in launching the product because they import the idea within their social structure which could be called a gatekeeper role.

Early adopters: they are a more connected section within the social structure than the innovators, they are more localites when innovators are more cosmopolite. They hold the most opinion leadership between the other groups. Change agents focus on this group and try to make them local missionaries to speed the diffusion. Once they adopt the innovation they become as a role model for the other adopter categories. They are respected by other members of their social system, their overall role is to reduce the uncertainty that is always there with new ideas and present a subjective opinion.

Early majority: they adopt the innovation just before the regular member of the social system, they interact a lot with their colleges and influencers but they don't hold any decision making power, the obtain an interconnectedness for the entire group of adopters because of their unique position between the early adopter and the rest of the groups. Although they may take longer to adopt, they adopt by seldom decision of willingness to adopt after the product has been tested.

Late majority: they adopt after the regular people has adopted and tested the technology, the delay in adoption decision can be either due to social pressure of economic reasons, they can be motivated by the uniqueness and newness of the innovation but the weight of their peers is important to motivate them. It is very important to remove all their uncertainties before they adopt.

Laggards: they are the last group in the social system to adopt, they don't hold any opinion leadership, they are localite, almost close to being isolated from the social system. Their decision making is based on previous generations trials and especially with those who hold traditional values.

2.6 Crossing the chasm

The chasm is the area between early adopters and early majority, it is the point which explains why most product take off into the market and become main stream, and why other innovations die within a couple of months after the initial release and doesn't make it beyond the early adopters stage.
Early adopters are highly influential and can affect the decision making of the next group the early majority, while the early majority comprises of the main stream market were all the profits and customers are.
Rogers suggested the innovation diffusion model IDM, and illustrated how diffusion starts with the innovators creating a new product, and how it is first adopted by early adopters, then early majority gets inspired by them and then late majority follows and so on, each adoption category gets inspired by the previous one, the research shows that if the early adopters accepts the innovation the early majority will also accept it easily and so on for the other groups. The

transition between early adopters and early majority is the difference between an innovation going viral or dying.

Rogers suggested that it is easier to cross the chasm when suitable information is given to the early majority, so finding the suitable information to give for the early majority is key for successful adoption transition.

The extensive use of the innovation by the early adopters is a key factor for crossing the chasm, the perceived usefulness focuses on how people believes by using a certain innovation it will enhance their job.

In the study Opportunities for crossing the chasm (Mu-Hua LIN, Chao-Fu Hong) It was concluded that for a successful transition from early adopters to early majority, there should be a wide use of the innovation by the early adopters because early majority will follow by confirmation. In order for a wide usage between the early adopters to happen, the key factor was to present suitable information such as advertising scenario based on the innovative uses of the innovation.

Crossing the chasm difficulties

According to Geoffrey Moore, there are four major characteristics of visionaries that prevent the transition of innovations to the pragmatists stage, the early adopter.

Lack in respect for the industry experience
Being more focused on the technology rather than focusing on the industry
Not recognizing the importance of current product infrastructure
Innovation disruptiveness

Early majority needs reference from people around them who they trust, but not from enthusiastic early adopters. Visionaries and early adopters want innovations, customizations and they accept inconvenience and risk, on the other hand the early majority wants stable, generic and proven ideas.

Moore suggests that crossing your way into the mainstream market is an act of aggression, he suggests the D-day analogy, were the mainstream market is Europe, the strategic market is Normandy and the chasm is the English channel.

Niche marketing helps leveraging the word of mouth, the niche position within early adopters will provide the base for takeoff in the main stream afterwards.

Point of attack, market segment: early majority only wants to deal with market leaders, therefore chose your initial market segment who will use the product initially. While choosing this group considerations of potential influence for the next segment should be taken in consideration

Prepare for invasion, product offering: Moore describes Theodore Levitt's theory The Marketing Imagination, the gap between what is being advertised and actual product delivery is important for early majority. Early majority only buys complete products, by solving a need and having a small gap between product promise and reality.

Define the war, the market: early majority requires competition because it allows them to compare offerings, so they have a fall on option in case the innovation fails, so find some competition and position yourself between them. Positioning is a one of the largest influences of buying decisions because it is based on perception, Moore suggests that the positioning process contains four parts:

    Product attributes in two sentences that sell.

    Evidence of leadership.

    Targeted communication towards the right audience at the right time.

    Calculated response and modification based on competitors attacks.

Leaving the chasm: Moore says that the post chasm activities are to make money, however all the post chasm activities are a direct and bounded result to the pre chasm, so the promises made in the pre chasm should be delivered.

3. Methodology

This chapter will detail the strategy, design and methods used to conduct the process of data collection, furthermore the final part will explain how the collected data has been analyzed.

3.1 Research Strategy

For the study to be able to answer the research question, it was decided to do a qualitative study by collecting and examining both primary and secondary data. The advantage of doing a qualitative study is that it allows the research to obtain deeper explanations about the issue of slow technology adoption within the fire departments in Sweden. This use of data collection is very suitable when trying to answer research questions that begins with "how" or "what" (Bryman & Bell, 2005). Researching subjects that contain a high level of novelty also requires the study of multiple qualitative case studies (Yin, 2003).

The study is constructed via a deductive approach, an focuses on testing (Everett Rogers) theory of innovation diffusion within fire departments in Sweden. Primary data collection involved interviewing key representatives within fire fighting as well as interviewing representative of the private companies who sell innovative products. Companies and personal qualified for the interviews was determined by the recommendation of data collection company within their field, furthermore most of the questions for the companies revolved around the specific product they sold and what qualified it to be innovative.

Possible drawbacks of the selected research strategy is the possibility of subjectivity in the results. But when retrospective studies are made it is necessary to keep in mind that the interviewees might not remember the complete answer or might change some of their answers based on their personal experiences. This personal experience bias should be taken in consideration when analyzing the final data.

3.2 Research Design

This study aims to research in what ways the innovations in fire fighting techniques finds their way into the practical use of the fire departments and how it gets permanently adopted. The first step of understanding this issue; a literature review was made about the business side of adopting new ideas, the main purpose of this is to understand the business environment surrounding the difficulties of creating, testing and adopting new ideas. In order to reach a relevant degree of understanding of the business side of the adoption phenomena, the initial section of the thesis includes summarizing theories and documents published in the area of the problems and solution of new ideas adoption.

Furthermore several interviews with professionals in the area of firefighting and firefighting equipment suppliers were made, the interviews were split into two sections, primary interviews and secondary interviews. The purpose of doing two different phases o f interviews was to get an initial feel for the topic and then develop a more structured interviews.
The style for the first phase of the interviews was unstructured in order to allow the interviewee to express individual struggles that they might have been going through, irrelevant to the industry norms, and all the primary interviews were done by phone. Accordingly the interviewees who shared their insights on the current procedures and difficulties within the fire safety sector in Sweden, all their answers were accordingly to their current of previous roles they might have held between different organizations.
On the other hand the second phase of interviews was more structured, all the data from the first interviews combined with the theory from the literature review was combined in order to develop a more in depth data mining technique. The second interviews were more structured and were done via E-mail, the interview consisted of eleven questions.

3.3 Research Methods

Secondary data collection

The literature has been collected by searching for literature topics in different techniques in order to find suitable theories that corresponds with the intentions of the study. The innovation theories and literature connected to the topic of the study could be seen as general or broad, since it covers different areas of innovation within different sectors. The purpose of the initial search was to find a general theory that is broad enough and can cover all aspects of innovation diffusion problems within the fire fighting sector.

The initial search took place by using the super search option through the Gothenburg University library website. The amount of literature available by searching this way about innovation is immense, so in order to narrow the theory down certain criteria's were determined such as the number of citations, relevance to topic, connection to other literature and review with university professors and previous program literature.

After this narrowing down of literature topics was determined, they were used in order to find additional material that build upon a solid base of practical theory. The determinations were innovations within the public sector, finding a general theory that connected several relevant studies.

In order to understand the innovation process within the fire fighting industry, case studies towards innovation diffusion within that sector were studied, these case studies vary from being old to when fire departments started using steam engines to newer ones that dealt with current technological issues. Furthermore there was a lot of similarities between old innovation diffusion problems and current ongoing issues, which by itself encourage the fact to search for old innovation theories rather than searching for only contemporary theories. Furthermore searches within university library or search engines used the following key words to find relevant literature "innovation diffusion" "innovation adoption" "innovation diffusion theories" "firefighting technology adoption" "new technology challenges public sector" "grounded theories of innovation".

The table below shows the literature used in the theory and primary interview guide

Title	Author	Year of Publication
Diffusion of innovation	Everett M. Rogers	1971 / 1995
Crossing the chasm	Geoffrey A. Moore	1991
Adoption of new technologies	Bronwyn H. Hall, Beethika Khan	May 2003
Is the frontier shifting into the right direction	Julian Weidinger, Sebastian Schlauderer, Sven Overhage	Aug 2017
Case study exploring firefighters and municipal official preparedness for electrical vehicles	Christina stav, Annelie Carlson	May 2017

Primary data collection

The selection of interviewees was concluded after discussions with The Space, Gothenburg, who has close collaboration with SBF, and PerOla Malmquist founder of Utkiken. Both have an intensive knowledge in the fire frightening ecosystem through networking, data mining and mutual interest. After reviewing the fire brigades situation it turned out that there is a slow adoption rate in implementing the use of new technologies within fire brigades in Sweden. The reasons weren't quite obvious but there was an obvious outcry from both fire fighters who would like to use new technologies but are unable to obtain them, and from companies who supply new technologies who are having huge difficulties getting fire brigades to adopt the new technologies they are offering.

Since the problem was obvious and the availability of its causes were unclear, it was decided to do unstructured interviews with different segments of informed respondents within that field. For the purposes of the study, the initial step for understanding the slow adoption phenomena was to not exclude anyone who could provide any type of input towards finding a cause and effect relationships between suppliers and adopters.

For the first phase of interviews it was managed to get in contact with eight contacts but for the timeline purposes of the study it was managed to do interviews with four respondents, who

agreed to do a phone interviews and share insightful data about their industry, allowing the study to get an initial grasp of the problems facing them.

Furthermore the focus of this study was not to discover new firefighting innovations but rather to discover the hidden issues that were preventing those innovations from being adopted.

After the criteria's for respondents were made, initial contact was made by (Utkiken) and then after showing interest in participating a second contact was made either through E-mail of social media. And then it was up for the respondents to decide whether they wanted to do a face to face interview or an email or phone.

It was convenient letting Utkiken do the initial contact and selection of respondents since their main mission is data mining within the field of fire fighting, they have a large data base and experience in networking and connecting people in that field.

The table below shows the participants in the primary interviews

Organization	Interviewee	Job title	Date	Time
Nordic Fire & Rescue Service AS	Daniel Apeland	Manager / International Master Instructor One Seven	13th March	40minutes
kalmar Airport / MSB	Leif Leke´n	Airport firefighter	18th March	50minutes
S ö vestad fire department	Mattias Cederblad	Fire fighter	12th March	30minutes
RSYD / MSB	Stefan Svensson	Crew commander/ Instructor	14th March	30minutes

After the first phase of primary unstructured interviews were finished, the study followed by conducting two structured interviews based on the data acquired from the first phase. Secondary interviews were done via E-mail and maintained a structured interviewing method, the interview consisted of eleven questions connected to the primary interviewing phase and selected theory.

The table below shows the participants in the secondary interviews

Organization	Interviewee	Job title	Date	Method
Self employed currently selling Pulverlansen	Daniel Abrahamsson	Product designer/engineer with 20years experience Part time firefighter in Mullsjö	12th April	E-mail
Greater Stockholm FD HazMat Unit	Sven Johnson	highly commended professional Fire Officer, ex Coordinator for the Greater Stockholm FD HazMat Unit/ Fire fighter	28th April	E-mail

3.4 Analysis

In order to analyze the data properly and in a structured way, thematic analysis was used to identify common themes in both stages of interviews. Comparison analysis was made between the similarities and differences between the data collected from both stages of interviews. The coding of the interviews was based on the repetition and emphasis from the interviewee, while theme identification was more related to the theoretical framework. Coding and theme table found in the appendix.

3.5 Validity and reliability

When qualitative studies are compared with quantitative studies, it is often determined that qualitative studies are not as reliable as quantitative studies (Bryman & Bell, 2005). This determination is due to the fact that qualitative studies provide point of views of the interviewees and analyze them based of common themes between them. The data mainly stays within the context and perspective of the interviewee.

On the other hand the quantitative studies relies more on numbers and precise measurements of different variables and how they interact with each other based on numerical findings.

Never the less the validity of this study was improved by focusing on a narrow research question from the beginning that is very relevant to a current situational problem that Sweden is currently experiencing.

Regarding the study reliability it is not likely to replicate the study in Sweden and get the same results, the reason behind that is because the data collected from the interviewees is connected to current social, economical and organizational behaviors and attitudes that could easily change within a period of one to two years. The data collected in this study can be used as a reflection point for future innovation diffusion advisory strategies in Swedish fire brigades.

3.6 Limitations

Although the study relied on Rogers theory of innovation diffusion, the practical data was restricted to the Swedish ecosystem, so based on that it will be difficult to generalize the findings to other countries around the world. The reason behind that is that there are several factors contributing to the innovation adoption decision such as financial reasons, educational, governmental or societal reasons. And these factors differ from country to country and their applicability will vary depending on the different interactions between the innovation decision making and how it interact with these factors in a different country.

4. Findings

This chapter provides the findings from the primary and secondary interviews. The provided text is a summary of each individual interview, furthermore the important quotations from the interviewee is highlighted in italics.

4.1 Primary interviews

Interview one: *Daniel Apeland, manager and international master instructor at One Seven Nordic*

Daniel is originally a fire fighter and an instructor. Currently he is managing Sven Nordic, a company that sells fire fighting products. There most important products is a compressed air foam system. A device that compresses foam and mixes it with water to increase the efficiency in fighting fires.

The initial step when introducing a new product to fire brigades is to get the approval of the MSB, and to do it is highly important to provide for them as much information and reliability testing because they evaluate any new product based on their current procedures.

After organizational approvals vendors are faced with long waiting times until fire brigades decides to buy their products because of several reasons such as the tender buying system, committees based decision making, availability of funding for the brigade, training and procedural compatibility of the product. The entire adoption process could take up to three years.

Fire departments should believe in the product first in order to get the money, best way to sell for them is direct selling because they need individual training and eventually the sale happens individually. Regular advertising didn't work but driving there and asking for a demo was the most effective. It is believed that twenty percent are early adopters but unfortunately most of the others are late majority

Interview two: *Leif leke´n, airport firefighter, twenty years of experience, MSB Skydd Mot Olyckor, part of volunteer firefighter*

For the most part the biggest problem in fire services innovation adoption is the need to wait for something wrong to happen in order to take action. It is hard for services to ask for help and get funding if the problem isn't big enough.

In the future more problems with forest fires or whatever we have a problem with will occur because of the waiting times of procedures. An example is when a lot of people are asked to leave their homes is the case of a forest fire when instead some of them are capable in helping the fire fighter in fighting the fire. People who live around the incident can actually innovate and help contain the fire. Regular fire fighter are training for twenty weeks, why don't we do training programs for people who live in rural areas so they can help out when fires break out.

"The problem is like having a library where you can't borrow a book, we have a lot of fire stations, some of them work together and some not, if one fire station is ordering one thing it's not sure that other fire station know that this product exists"

Social media groups exists but they are not used properly. An example some stations are using fire foams while in some communities its criminal to use foam because it's bad for the environment.

"Two fire department could be fighting the same forest fire and they might not know they were fighting the same one"

Interview three: *Mattias Cederblad, fireman six years of experience firefighter*

Older generations of fire fighters are controlling the decision making within the brigade which makes it difficult to introduce new ideas. Older generation are accustomed to their procedures and are hesitantly to change it.

The numbers of older generations are much higher than the younger generations in the department, making it more difficult to implement innovations in equipment or procedures.

Firefighting is a good job, most people are interested in the job and the relaxed environment. People are more interested in the environment rather than helping the industry develop.

"*some people could be motivated, but some people are not motivated to be fighter fighters they are lazy*"

Fire brigades are having difficulties in filling places because of recruitment problem, so they end up having to take anyone even if the person is not motivated because there is no other choice.

Another problem comes from the school SMO, graduating about one hundred twenty firefighters every year, good grades but don't know how to work with their bodies. It was more efficient some years ago because fire brigades first choose the people then sent them to the school.

Just because a big forest fires was big in the media, it is not efficient to spend money on new equipment because forest fires happen so rarely so it is better to rent the equipment from others, a lot of training and maintenance goes with it.

Fire brigades in Sweden are mostly late majority. New things are expensive to buy and takes time to learn, most fire brigades wait until someone else buys and tries the new product then evaluate the new equipment before they even think about buying it themselves.

A lot of fire brigades are behind in development because of financial issues. The few station who try new stuff are already early adopters but the big mass are hard to change. We are in need of more money and a stricter demands on our operative ability to make change.

Interview four: *Stefan Svensson, Instructor at MSB, Phd in fire safety engineering from Lund, Part time crew commander*

Fire services are different in different countries, in Sweden it is a local matter to the local department to make decisions, there are two hundred and eighty four municipalities in Sweden, some of them are connected in a way, approximately one hundred and seventy are connected on a local level.

"Not so sure if challenges of using new technologies is an actual problem, I wouldn't consider it a problem, If you are a vendor or a manufacturer or an inventor you have to talk to one hundred and seventy different organizations to sell your product, that is the basic problem"

Instead of using social media to communicate new technologies, conferences is the more adopted way in communication, still it is a very small group that meets at these conferences.

If new technologies are bought by the fire brigade it should fit within several layers of decision making criteria's such as tactics and procedures compatibility, funding approval, older generations acceptance. Younger people who have new training see new things with different perspective, a lot of people are interested in new products and new technologies but it's still a long process to use them, for legal, tactical and funding reasons

If a new product or procedure was introduced, it might not be known if it will make things more or less safe, if what is currently used has been working properly for many years, changing things might introduce uncertainty on the ground.

Most of the fire brigades are early majority or even early adopters, it depends on who is asked. A firefighter is fairly progressive. A chief sees more problems in terms of economy, training etc… adopting new things cannot be a means in itself, there has to be another purpose, adopting new ideas into a system is usually a lot more complex than one might think at first. Changing a new technology might as well create a need to change several procedures and tactics along the way to full adoption.

4.2 Secondary interviews

Interview five: Daniel Abrahamsson, product designer/engineer, twenty years experience, part time fire fighter in Mullsjö

Daniel is an entrepreneur who developed a new extinguishing equipment ,Pulverlansen - The Swedish Powder Lance, currently he is trying to introduce it to the Swedish fire brigades.

It takes time and training to develop a safe feeling of knowing what to do as a firefighter. This is the main reason why it is not so easily to change from old fashion gear, because their existing routines are well known and working properly.
Another big reason why it takes so long time to adopt is the economical situation. New technologies are usually expensive both to buy and to implement in the existing organization. Most of the Swedish fire brigades look on other Swedish fire brigades for new ideas and what is safe to use. Only a few big brigades have resources to look for new equipment and techniques from abroad through exchange programs with other counties or international fairs.

In the decision whether to use the new technology or not most fire brigades waits for another fire brigade to use it first. But someone has to be the first to try it, and with a genuine interest any of the fire brigades could do an individual test of any equipment. After this they take a decision and possibly make an order. If the price is higher than 50.000kr they have to go through certain procedures and if over 100.000kr they have to take in offers from more than one actor.

For a simple and less expensive product less than 20.000 the time to start using it from the point of hearing about it can be fast, but usually it still takes about four to six months from first initiative to the purchase. If the new tech are interesting but more advanced and expensive it can still take up to ten years until the smaller fire brigade is using it, most fire brigades in Sweden are small.

Younger fire fighters and fire engineers that are still enthusiastic and open for new learning, the older fire fighters and leaders that are less enthusiastic, that feels safe with the gears and the experience they have and don´t want too much changes and no expenses.

"For me as a part time on duty fire fighter I can only dream of having a new gear within a ten year period. Mostly because of economic reasons. Worth mentioning is that not all new tech is better. The old fashion ones are actually performing better many times"

Quite poor communication between fire brigades is common. Bigger fire brigades have meetings to discussion new products but mostly the discovery happens at conferences.

"There is no actual driving force to talk about a smaller internal innovation"

It is not an easy question to determine where fire brigades fit within the innovation adoption curve, it depend on many things. It is not a question whether the fire brigade itself is innovating or not, or have the right environment for innovation. Because I believe they have great possibilities, but too much organizational hinders to proceed.

"I believe the fire brigade can be in all these stages, but if you look to all two hundred and fifty fire brigades as a whole it takes a long time to spread out to all. Probably Late Majority in that case. The smallest fire brigades might even be lagers, mainly because of the cost to implement new equipment even though all the bigger brigades use it with success"

Crossing the chasm recommendations:

To get a faster adoption to new upcoming innovations the Swedish fire brigade has to unite to try out these innovations in a professional and broad manner so that all questions regarding the quality, safety, function and different manners of use can be answered by someone else than the seller.

Economical, For many smaller municipalities the fire brigade is seen as something that need to be there by law and will only get budget to remain what is needed to keep that law. New equipment will be bought first when the existing ones is warned out.

Lack of innovations itself, many things have to change to get the right qualifications for the Swedish fire brigade to become more successful with innovations. The main reason for the low innovation rate is that there is no money in it. The market is too small for external innovators and fire brigades are not allowed to earn any money on their own innovations.

"The best way I believe is to start uniting the Swedish fire brigade, together they can decide what problems need to be solved and put united efforts into innovative products that can solve these problems"

Interview six: *Sven Johnson a highly commended professional Fire Officer, ex Coordinator for the Greater Stockholm FD HazMat Unit, been in the fire service since 1977-2011 (volunteer) 1990 - fulltime fire fighter*

As HazMat Project Manager in the Greater Stockholm Fire Department and Chairman of the regional HazMat coordinating group responsible for four Hazardous Materials stations (covering 1.5 million people and 1,500 paid fire fighters), in addition to drafting standard operating procedures, he raised capacity, training effectiveness, procured needed equipment, ensured compliance to the WHS standards and regulations and recorded zero work related injuries. Doing so required a thorough understanding of all aspects of HazMat, detailed research, continuous risk management, high levels of organisation and time management, and rigorous training.
He designed a book and new national response tools for responding to HazMat incidents for the Swedish National Fire Protection Agency.

In order to introduce new technologies to fire brigades in Sweden It takes time to change existing procedures or SOP implementation in the organization (FD)
Hearing about new technologies happens through social media. From the point of hearing about the new technology to actually implementing it takes usually two years normally. And less than one year if there is only changes in procedures. For example changes of decompression rate for CPR or other procedures that are nationally accepted (arbetsmiljöverket). To have the senior officers approve a new technology, the process needs to go through the WHS committee for approval before implementing.

The major difficulties for adopting new technologies are training time, cost of training, procurement costs and cost for adapting fire trucks/ standard operating procedure/service cost/maintenance cost due to budget limitations.

It is believed that the communication between fire brigades is efficient to communicate new ideas, this is a way to convince other fire departments. There is a historic problem of that each fire department has its own standard operating procedure and don't on a general basis accept other departments routines/technology's in general.

There is now a more organized cooperation between the major fire departments in Sweden (Stockholm, Malmö, Göteborg) where information is shared, but this means that they don't on a general basis accept other fire departments new procedures/technology's etc.

5. Analysis

In this chapter, the theory will be cross compared with the data from the primary and secondary interviews in order to formulate a structured analysis, this will allow a coherent analysis of the findings and a corresponding conclusion for the research question.

5.1 Theoretical analysis

After the primary interviews were done, an overview of the challenges that are facing the fire departments were established, further upon that the major corresponding theory topics within Everett Rogers and Geoffrey Moore innovation theories were identified.

The participants in the interviews contributed to the theory in different ways, the theory described in the previous sections will be used here to analyze and structure the findings.

5.1.1 Elements of an innovation

As described by Rogers theory the elements of an innovation are the innovation, communication channels, time and the social system.

The innovation: Innovation within fire brigades as described by the interviewees are not much due to the fact that there is a lack in the innovation itself, the technology currently being used is working and there is not much of a need for new innovations if the new innovation is only going to help reduce the fire fighting time for ten minutes. The innovation should have an incremental improvement on current procedure for adoption to take place.

Communication channels: There was a noticeable pattern of discomfort with the type of communication happening between fire departments. The issue was highly emphasized for two main reason. First the communication channels were important for sharing success stories of innovation adoption and funding obtaining efficiency. Second the organized cooperation between fire brigades was lacking the necessary tools and behaviors for effective transfer of ideas and experiences. Social media is available but not used efficiently enough.

Time: was not an important factors for the fire brigades as much as it was an important factor for new innovation vendors. Fire departments seems reluctant to try new products and would rather wait as much as possible to prove the technology, while innovation vendors were more demanding of faster adoption times because they were faced by the challenge of having to touch each fire brigade by itself and direct sell their products because there was no one organization to go to that is responsible for innovation adoption within all the fire brigades

Social system: the main issue with the social system comprised of having an age gap between the users of the innovation and the decision makers of innovation adoption. Younger generations of fire fighters are demanding to have more decision making power in order to implement new innovations. The resistance for adoption was not necessarily due to other elements such as funding or efficiency but rather to the procedural preferences of a certain demographic within different brigades.

5.1.2 Attributes of innovation

As the describe by (Everett Rogers) the five attributes of an innovation are relative advantage, compatibility, complexity, trialability, observability. The interviews describe their interaction with innovation in the fire departments as follows.

Relative advantage: the innovation should outperform what is currently being used to a relatively high degree in order to be able to obtain relevance financing for it. The ability to stop a fire ten minutes faster will not be sufficient enough to convince funders to invest in such a product, the relative advantage should be sufficiently high.

Compatibility: fire departments are performing based on a set system of strict training and procedures, and these procedures are integrated with the equipment they are using, so introducing new innovations has to be compatible within their existing procedures, otherwise they would endure a training and changing costs that they might not have the money for

Complexity: was adding a huge effort on the vendor of the innovation to provide training that fits for the individual brigade that uses it, the fact that vendors had to spend so much time explaining for each individual brigade how to use the product increased the diffusion time.

Trialability: fire brigades waits until another fire brigades uses the product first and then think about implementing it themselves, they wait until another brigade tests it and proves its affectivity and its compatibility within their procedures. Having a success story of another brigade when adopted the product fully will make it easier for the new brigade to obtain funding or convince decision makers to test the product.

Observability: one of the most important factors in diffusion adoption as pointed out by all interviewees, is that no one was willing to adopt a new product before it was proven and tested by other brigades and organization. Fire brigades would rather maintain using their current procedures before implementing any change that might be risky towards completing their missions, they take their jobs very seriously because it's a life and death issue for the victims. Old technologies being used are used for a reason and changing to new products should have observable incremental advantages before adopted.

5.1.3 Type of decision making

Rogers describes three types of decision making, optional, collective and authoritative. Based on the six interviews it is clear that the decision making in Swedish fire brigades is definitely non optional, thus no one individual thinks by himself. The decision making is balancing between collective and authoritative but mostly authoritative.

Authoritative decision making could be one individual deciding for the entire brigade or a group of committee members with authoritative power.

Adoption decision requires initial testing approval thus all decision makers wait for technology approval as their primary important aspect in their adoption decision.

All new proposed innovation has to go through a tender system and then the best one gets approved. The tender time is a constant complain since it could take up to two years for an innovation to be fully adopted just at one fire brigade.

In smaller fire brigades the decision making is made more locally and usually the older generation that are more experienced are taking those decisions.

5.1.4 Rate of adoption variables

Decision making rate is affected by several factors, based on our interviews the factors that most affect the adoption rate are the amount of capital needed for adoption, if it is less than twenty thousand krona the decision is usually fast less than one year or about four to six months, this is usually the case for big brigades. On the other hand smaller brigades that are late to hear about the innovation or can't acquire the funding needed for it, the adoption process could take up to ten years.

The degree of new procedures required to use the innovation is a big factor in the speed of adoption since each new product requires an adjustment to be made for the fire fighters to be able to implement it correctly and efficiently.

The fire brigades doesn't have one big organization that communicates and helps implementing the innovations within all of them, MSB gives recommendations and tests products but can't push innovations into fire brigades if the adoption decision didn't happen from the inside. Hearing about new products is the first step in the adoption process and that usually happens through word of mouth, social media or communication between several brigades

5.1.5 Stages of adoption

The majority of the interviewees categorized fire departments as being early majority or late majority. This question was especially difficult to answer because different fire departments are unique in their own way and they adopt innovation differently from each other.

Different types of products require different types of adoption since it depends very much on the trialability of the product, the more complicated the product the more time it took for the department to adopt it. In the case of the smallest fire brigades, it was mentioned that they could be qualified as being laggards because they are not able to obtain funding as easily as bigger department, they are late to hear about new products and they are not allowed to create their own profit.

5.1.6 Crossing the chasm

In order to cross the chasm the interviewees managed to share similar results, mainly the two most important reasons were economical; exploring new ways to provide income for fire departments either by allowing them to earn their own income or by helping them obtain external funds. The second main reason was communication; it is very important for adoption decision makers to know that some other brigade has been using the innovation and it is performing efficiently, but unfortunately fire brigades are not communicating between each other effectively in a way that would spread word of mouth about successful new products.

 Additional suggestions for crossing the chasm were changing laws, low innovation rate in the entire industry, uniting fire brigades and centralizing innovation decision adoption.

5.2 Summary of analysis

The need for the acceptance of innovations was apparent mainly because of three reasons, first the enthusiasm from the younger generations to change old approaches in fire fighting, second the lack of efficiency in communicating innovations as expressed by the vendors of innovative products, and finally the lack of efficiency in fighting certain types of fires.

Once the real need was established the size of that problem needed to be addressed and it was determined that in most fire brigades the need for innovation wasn't that prominent because what they are using is already working and fighting fires efficiently. It was obvious that the problems facing fire brigades differ from one brigade to another based on the region they are in.

The more isolated fire brigades are the smaller they are, and they are the ones who are suffering from the lack of innovation adoption because they lack the resources and networks to do so. Usually the decision making is done by older generations who tends to get used to their current equipment and procedures and prefer to not change it. In addition the proof of functionality from other fire brigades that the technology is working properly before they adopt it.

Bigger fire brigades are open to more technologies and innovation testing because they are more exposed and participate more in networking and conferencing and they have the capital to test

technologies and spend time and money updating their current training and procedures into new versions that can manage the use of new technologies.

The use of new technologies by smaller fire brigades more or less happens as a spillover effect after the technology is being tested first by the bigger brigades. Never the less they are excited to use new innovations but the adoption process is risky, costly, accompanied with long waits and uncertainty about the results, so it is hard to convince the officials to shift their resources towards a new technology that would allow them to fight a fire ten minutes faster unless they see a prominent need.

When it comes to communicating successful innovation there seemed to be a major lack in communication both between the fire brigades and within the fire brigade itself. Since the new innovations are being tested first by the big brigades who can afford it, it was still a slow unsuccessful process of trickling down the innovations to the smaller brigades because there is no one reliable official centralized communication tool that communicates new better products.

Adoption time usually takes several years and has to go through a tender process, in comparison, it takes smaller fire brigades more time to adopt the innovation because they wait until the innovation is tested first by other fire departments and proven successful, after proof of technology they struggle with two issues one is finding funding for the new equipment and second is struggling with the decision makers within the fire department who are responsible for taking the adoption decision, the decision makers are usually older generations who are hesitant to change older procedures, they would rather continue using what they are used to.

Even though most young people within fire brigades see themselves as early adopters or even innovators in some cases, they still fight an uphill battle when it comes to adopting new innovations. Based on the interviews most fire brigades in Sweden turned out to be early majority or late majority and some small isolated brigades could be considered laggards.

More funding should be allocated for brigades who doesn't have the funding to do so since they continue using old equipment until it is warned out. This can only happen if the laws were

changed in support of innovation adoption and accelerating its testing period and tender period through centralized sales and communication channels.

6. Conclusion

The main challenges that are preventing innovation adoption within fire brigades in Sweden are the lack of communication between brigades, slow testing period of new ideas, changing old procedures to adapt with modern ideas, funding innovations, older generations controlling most of adoption decision making and the huge amount of effort facing innovation vendors when having to sell and train fire brigades individually.

It is also good to mention that old technologies doesn't necessary have to be bad, some old technologies work better than new ones and that's why they have been used for a long time. The slow adoption time might not necessarily be looked at as a bad thing since it allows the innovation to be tested thoroughly, after all the ability of these devices to function properly is a huge responsibility since it affects peoples well being.

Recommendations for accelerating the adoption time is by creating a governmental committee that has the centralized official power to do five things first problem identification, innovation testing, innovation communication, securing adoption funding, forcing innovation adoption. This committee will act as a catalyst for change and a fall back option whenever decision makers at fire brigades are searching for a reliable source of information about the efficiency and reliability of any new technology.

6.1 Further research

As a suggestion for further research based on the results of this study, two main issues requires further investigation:

First is the communication of successfully adopted innovations between fire brigades. The communicated data should include costs and compatibility with current procedures of the fire brigade. The knowledge transmission should occur between fire brigades on a local and a regional level. The purpose of the knowledge transmission is to inform and influence other brigade to adopt and not be afraid of failure or unsatisfactory results. The future research should figure out new efficient tools of communication between fire fighters an open discussion about innovative products but in a reliable and verified manner.

The second area that should be more investigated is the allocation of funding for rural fire brigades. The main problem rural fire brigades are dealing with is finding the necessary funds to buy new products and upgrade their systems. Currently fire brigades are not allowed to generate their own income, so the purpose of the future research is to determine new regulatory approved revenue streams for the local brigades.

7. References

A case study exploring firefighters and municipal officials preparedness for electrical vehicles, Christina Stave & Annelie Carlson, Published online: (3 May 2017)

Adoption of new technologies, Bronwyn H. Hall, Beethika Khan, (May 2003)

Case study research: design and methods 4. Ed., London: SAGE, Yin, R.K. (2009)

Communication Network: Towards a new Paradigm of Research Rogers, Everett M, and D. Lawrence Kincaid (1981), New York, Free Press. C(E)

Crossing the chasm, Geoffrey A. Moore,(1991)

Case study exploring firefighters and municipal official preparedness for electrical vehicles Christina stav, Annelie Carlson, (May 2017)

Foretagsekonomiska forskningsmetoder, Bryman, A. Bell, E. & Nilsson, B, Malmo: Liber ekonomi (2005)

How County Agricultural Agents Teach, East Lansing Stone, John T, Mimeo Bulletin, Michigan State University, Agricultural Extension Service, (1952)

Is the frontier shifting into the right direction, Julian Weidinger, Sebastian Schlauderer, Sven Overhage (Aug 2017)

Opportunities for Crossing the Chasm between Early Adopters and the Early Majority through New Uses of Innovative Products, Mu-Hua LinChao-Fu Hong,(December 2011), Volume 5, Issue 2

Swedish Work Environment Authority, https://www.av.se

Swedish Civil Contingencies Agency, Joakim Ekberg, Statistician, Knowledge Development Section Karlstad, (24th April)

The Natural, History of Time, Oxford, England, Clarendon, Whitrow, G. J. (1980)

The Diffusion of Hybrid Seed Corn in Two Iowa communities, Ryan, B. & Gross, N. C. Rural Sociology 8, 15 – 24 (1943)

The Diffusion of an Innovation among Physicians, Sociometry, 20:253-270. Coleman, James, et al (1957)

The Information Problem of an Agricultural College, Petrini, Frank, (1968)

The(   )Space : Process, Platform, Network & Hubs, Gothenburg Sweden

The Marketing Imagination , Theodore Levitt, Listen USA (May 1, 1985)

Utkiken Sverige and Public Safety Specialist, Per-Ola Malmquist, Helsingborg, Sweden

8. Appendix

Interviews coding:

Interviews coding		
Interviewee	**Codes**	**Common themes**
Daniel Apeland	Believe in innovation, safe with available products, time, funding, committee decision making, tender buying system, word of mouth, individual training	Time Funding Training
Leif leke´n	External help, reactive not proactive, time, funding, committee decision making, communication	Proof of functionality Communication
Mattias Cederblad	Older generations, resistance to change, procedures, lack of motivation for development, funding, regional politics	Changing procedures Generational decision making
Stefan Svensson	Local decision making, decentralized decision making, proof of functionality independent brigades, training, communication, funding, older generations, procedures, direct sales	Independent departments
Daniel Abrahamsson	Procedures, time, training, funding, proof of functionality, independent brigades, uniting decision making	
Sven Johnson	Time, procedures, social media, older generations, training, funding, proof of functionality	

Interviews questions:

1- Can you please give me a brief background about yourself.

2- How much do you believe fire brigades in Sweden are open to using the newest technologies for fighting fires

3- How do you usually hear about new technologies for fighting fires

4- How is the decision taken when a new technology is about to be used within a fire brigade

5- How much time does it take from the point of hearing about the new technology to starting to use it

6- Who mainly opposes and who mainly support the use of new ideas within your professional social network

7- In your opinion what are the major difficulties for adopting new technologies

8- Do you think that the communication channels between fire brigades are efficient for communicating new ideas.

9- What slows the decision making process of adopting a new technology

10- Where do you see fire brigades in Sweden fitting within this graph

11- What do you suggest should be done in order to cross the chasm, meaning how do we get fire brigades to become early majority