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Innovation diffusion of a regulated technology - a cross-sectional study of emerging drone application on the organizational level

Master thesis in Knowledge-Based Entrepreneurship

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Abstract

This study has focused on the theory of innovation diffusion in organizational contexts, using the emerging drone technology as its core product innovation in order to analyze the phenomenon. The study has been of a qualitative cross-sectional character, by which eleven different organizations in different industries using drone technology were interviewed during March 2020, from both the governmental and private sector. This in order to thoroughly understand the perception of hindrances and enablers for organizations regarding new technology implementation. As the study used an hermeneutic approach, the goal of the study was merely to gain an understanding of how the perception of organizational hindrances and enabler for innovation diffusion could be perceived, without acknowledging it as an absolute truth but instead one of many possible explanations.

To analyze the organizational innovation diffusion, the theoretical framework of Diffusion of Innovation (DOI) presented by Rogers (2010) was used in combination with the Technological-Organizational-Environmental-framework (TOE) presented by Tornatzky and Fleischer (1990). Both are well-respected and thoroughly empirically tested in previous research. The findings of the study concluded that eight main themes could be extracted from the thematic analysis conducted on the interviews. These themes were: 1) Drone technology democratizes airborne data gathering and increases data accuracy, 2) Drone technology proves unique in the sense of the broad spectrum of application areas and is fairly easy to match against a real need, 3) Rules and regulations prevents new innovation and influence the adoption of it, 4) Operation of drones is not an isolated activity, 5) The implementation process is i) organization specific ii)) has been characterized by "lack of track record", 6) Individual innovation champions are key drivers in the incorporation of new technology, 7) The competence of the user and the organization determines the potential of the technology and 8) The data gathered is broad and demands complementary assets and supporting functions.

Overall, the finding and analysis showed special emphasis on influencing determinants regarding the power of surrounding regulatory systems, the power of innovation champions, the power or organizational collaboration with governmental entities and the power of organizational complementary technology systems. Conclusively, the contributions of the study entail both academic and practical characteristics. Its academic contribution is an enhanced awareness and understanding of the application of drone technology whilst also validating the theoretical frameworks TOE and DOI due the shortage of an organizational perspective. Its practical contribution consists of recommendations to organizations that are beneficial to be aware of when implementing drone technology, or similar new innovations, in their operations.

Keywords: DOI, TOE, drone technology, UAS, innovation diffusion, technology adoption, innovation champion, rules and regulations, collaboration, complementary technology

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Oscar Hanson and Marcus Olsson

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1. Introduction

This section provides a first insight in the topic to be studied. The background to the innovation of drone technology is accounted for in combination with current trends and key aspects. The term "drone" is defined. In addition, the purpose of the study and its research question is stated.

1.1 Background

Just like the technology of internet and the GPS, the drone technology originally evolved from the military field, before entering into the civil sector of application. The pace of technological development has been unmistakable in recent years and the private consumer markets have embraced the new technology worldwide with open arms. Commercial applications of drones have also increased and is believed to continuously grow immensely moving forward. The OECD placed drone technologies in the same "box" as autonomous vehicles and blockchain in their respectable STI outlook, referring to the disruptive consequences and changes they will impose (OECD, 2018). Nonetheless, the innovation diffusion of drones has already accelerated at a pace that regulatory authorities have had difficulties to keep up with. Policy makers and top management are describing scenarios of future societies where drones have a given place in the infrastructure, for instance autonomously delivering packages and efficiently transporting people around. A new ecosystem of drones is arising which will offer new opportunities for businesses as well as new hindrances to be overcome in order to reach its full potential.

Sweden is commonly known as one of the most technology-friendly countries in the world, much supported by the well-established infrastructure of internet connection and applications combined with consumers curious attitude towards new innovation (Internetstiftelsen, 2019). In terms of drones, this is supported by the fact that the Swedish Transport Agency estimates the number of drones for hobby usage in Sweden to be around 800 000 (Transportstyrelsen, 2019). This can be put in relation to Sweden's population which is around 10 million. In other words, the innovation diffusion of drones in the consumer market seems to be in full swing. However, the commercial setting, that is organizations of different kinds implementing drones in their operations, seems to have been more cautious. There might be numerous explanations behind this, such as regulatory hindrances and lack of implementation expertise. Still, the trend is clear that drones will be integrated into society, infrastructure and continuously implemented by organizations in the future.

Innovation, such as new technology, is increasingly recognized as a mean of gaining competitive advantage for organizations. This is especially true in the globalized world and its competition that makes up the business arena. Tremendous amount of resources is spent on research and development in new promising fields which is why new innovation as drones have emerged lately. The digital transformation has further pushed the limits of what is possible, broadening the areas of application, enabling new innovations. Organizations prioritizing innovation are in a constant search for new promising technologies that can be adopted in order increase their efficiency, safety or sustainability (Fagerberg and Mowery, 2006). But what does actually explain why an innovation diffuses in a social system or not? There are countless examples of promising innovations that did not manage to attract more than early adopters. Will drones reach the full potential in commercial application or fail to do so?

The innovation diffusion model by Rogers, originally introduced back in the 1960s, has been continuously updated and is still today acknowledged as one of the most powerful theories when conducting research on innovation and technology adoption (Oliveira and Martins, 2011). However, its main emphasis has been on how innovation diffuses among end consumers, the broad masses, rather than among organizations. Furthermore, the theory focuses mainly on innovation characteristics and not contextual factors. In terms of drone technology, our literature review found almost no concrete studies where the innovation diffusion model had been applied. The research that do exist for instance focus on the technology's military origin, being used in warfare (Gilli, 2016). Since drone is increasingly recognized as an important innovation for organizations, and the fact that is has diffused rapidly in commercial application lately, makes it an interesting topic to study.

1.1.1 Trends of drone technology

As stated, businesses around the world have increasingly realized the innovation potential that drone technology offers. Exploiting the potential advantages is a driving force for the development. For instance, deliveries by autonomous drones is today one of the hottest topics discussed, similarly to self-driving cars in the automotive industry. Amazon, being one of the leading actors in global ecommerce, declared their belief in using drones for package deliveries already back in 2013, concepted as Amazon Prime Air. In 2016 Amazon did their first fully autonomous drone delivery to a customer in Cambridgeshire, UK, taking only 13 minutes from order to delivery. Amazon Prime air is disclosed as the backbone in their future delivery system, designed to safely deliver packages to customers within 30 minutes or less (Amazon, 2020). Amazon expects that around 80 % of their future deliveries will be possible to perform by drones, which of course could offer great advantages such as increased sustainability and efficiency compared to the present traditional delivery methods. This would have implications on for instance business models and supply chain management. The implementation of drones in Amazon's delivery system has been delayed but in June 2019 their executive Jeff Wilke demonstrated their latest edition of the drone to be used for deliveries to customers in "a matter of months" (Forbes, 2019). We are still awaiting the final launch.

The case of Amazon captures one of the motives for organizations to implement drone technology into their operation if that provides advantages compared to present solutions. Other actors are using drones for surveillance or inspection of an area of interest, without putting their employees in harm's way, improving both safety and work environment. For instance, governmental entities such as fire services and police forces have successfully implemented the drone technology into their respective operations (CBC, 2018). Furthermore, flying beyond visual line of sight, in short BVLOS, is believed to be a cornerstone in order to achieve the full potential of drone usage. However, this is one of the drone operations that has been highly regulated in the regulatory framework. Nonetheless, start-ups are launched to address different problems with their autonomous drone solutions, for instance Everdrone which in July 2019 completed the first autonomous deliveries of blood samples between hospitals in Sweden (Everdrone, 2019). On a similar note, the leading world drone manufacturer DJI helped to battle the COVID-19 outbreak in China by using drone to spray disinfectants in the city of Shenzhen, reportedly covering 3 million square meters. This was claimed to be up to 50 times more efficient than traditional methods used

(DJI, 2020). Altogether, this demonstrates the some of the key drivers and broad application areas of the drone technology, making it an interesting innovation for organizations to adopt.

1.1.2 Regulatory landscape

Regulations often interplay with the diffusion of new innovation and technology (Andersen et al, 2018). Regulations are expected to have a particularly important influence on the applications of drones in all settings moving forward, from public to private sector, considering its inevitable heritage and connection to aviation which is known to be one of the most regulated industries there are. As in traditional aviation, safety is the main objective for implementing regulations on drone operations. This can be reflected by the fact that the European Union Aviation Safety Agency (EASA) in June 2019 announced new common harmonized regulatory framework to ensure safe drone operations across Europe by July 2020 when it enters into force. The executive director of EASA, Patrick Ky, commented the publication in the following way: *"Europe will be the first region in the world to have a comprehensive set of rules ensuring safe, secure and sustainable operations of drones both, for commercial and leisure activities. Common rules will help foster investment, innovation and growth in this promising sector"* (EASA, 2019).

The goal is that drone operators, regardless of which EU country they are registered in and received approval from, should be able to seamlessly fly their drones regardless of which EU country they are in. This in line with the principle of EU to provide people and goods the freedom to move within the union. Furthermore, manufacturer and other stakeholders should also be able to continuously innovate the technology. This is likely to have consequences on how the technology of drones, and innovations based on the same, diffuses moving forward. For instance, a drone business today operating in one EU country under their national regulations will have the option to expand their operation into another country once the regulations and drone laws are harmonized. Logically, this should accelerate the innovation diffusion. Nonetheless, new rules impose new requirements of both technical and operational character such as a minimum pilot training requirement (EASA, 2019). Therefore, rules and regulations will most likely be perceived as a hindrance to drone adoption by organization even after the coming regulation update.

1.2 Defining drones (UAS)

Drone is a general term used in both military and civilian communication nowadays for explaining flying aircrafts without an onboard pilot, either remotely controlled or fully/partly autonomous (Webster's dictionary, 2020). They can be of multirotor or fixed wing type. The size of a drone can range from a couple of hundred grams to several tons. A more accurate term for drones is the acronym UAS, which stands for Unmanned Aerial System (or UAV, Unmanned Aerial Vehicle). As the name implies, an UAS is basically several components and technologies interacting forming the system, consisting of both hardware and software. Suraj et al. (2013) captures this definition in their literature review by describing UAS as the entire system that includes aircraft, control stations and data link. In other words, innovating the UAS itself was made possible partly by combining previous already existing technologies and innovations, such as sensor and microprocessor technologies. However, for simplicity, the term drone will be used for the remainder of this study. The technical aspect of drones lies outside the scope of this study, wherefore it will not be further elaborated on.

1.3 Justifying drone technology as a research subject

Rogers (2010), the originator of innovation diffusion theory, defines how adoption of new innovations often are accompanied with other innovations simultaneously and are dependent on each other, something he refers to as "technology clusters", and exemplified by Suraj et al (2013) under previous section "1.2 Defining drone". In a way, several innovations simultaneously generate positive feedback loops, where innovations further foster new innovations, and innovations build on each other and creates a dependency within its cluster. As a result of this, the innovations extend its cluster, making it possible for more and new populations of potential customers to take part of the innovation.

Dorf (1998) explains how the microprocessor is a good example of how innovation and technology have spread from being used in only computers to now be a part of automobile engines and medical devices. Thus, Dorf (1998) uses the microprocessor as an illustrative example for innovation diffusion. Just as described by Dorf (1998), drones are also reliant on microprocessors. Suraj et al (2013) explains how microprocessors are used to construct autonomous flights, as they control the navigation systems and generate mission achievement, making the drone an extension to the innovation of microprocessors according to the logic outlined above. Building on Rogers (2010) and Dorf (1998), there is a high reliance on microprocessors for drones, whereas without them, drone technology would not function properly.

Looking at the diffusion of microprocessors to other areas like the automobile engine or medical devices, drone technology is now part of that technology cluster. Similar to microprocessors, there seems to be an innovation diffusion characteristic to drone technology, whereas the technology has found its way to the retail industry, the medical industry and more, with even more industries soon following. As such, drone technology both consist of parts that has been subject to innovation diffusion, whilst also demonstrating similarities to the innovation diffusion of microprocessors, continuously spreading to more different industries with different purposes. Based on this, it can thus be argued that drones can be used as a suitable subject of study in regards to innovation diffusion.

1.4 Purpose

The purpose of this thesis is to investigate the technology adoption regarding drones on organizational level, shedding light on the innovation diffusion process. Since innovations based on drone technology is a relatively new and emerging phenomenon, limited research has been carried out to our knowledge. There is some research on the technological aspect of drones, its military origin or on niche application areas such as agricultural usage (Frankelius et al, 2019; Gilli, 2016). However, research on business aspect in terms of why organizations decide to adopt it and what challenges this implies seems limited. Thus, to study the innovation diffusion of drone technology on organization level, it makes sense to identify the variables that explain the motives and decision to implement drones in their operation. By interviewing different actors within industries and across sectors, and various professionals such as drone pilots, decision makers and administrators, our aim is to gain a better understanding of innovation diffusion from the organizational perspective and the key people that drive it. Gaining a deeper understanding could also help to indicate how the diffusion of it will continue, and what can be expected in the future.

1.5 Research question

Based on what has been discussed above, this paper aims to study technology adoption of drones and what affects the innovation diffusion process among different stakeholders on organizational level. To shed light on this a qualitative approach will be applied, interviewing different key actors within the industry. The academic research questions we aim to answer are the following:

What are the perceived hindrances and enablers regarding innovation diffusion of drones in an organizational context?

To clarify, hindrances refer to challenges, internal resistance, external contexts and other similar determinants that prohibits organizations from adopting drones, in turn slowing down the innovation diffusion process. Subsequently, enablers refer to determinants that explains why organizations choose to adopt drones, such as motives, resources and ability to test an innovation before implementing it. These are determinants that accelerates the innovation diffusion process.

1.6 Contribution

The contribution made is twofold. Firstly, the academic contribution of this thesis is an increased understanding and awareness of the field of drone technology and its business application in terms of how the technology diffuses, seeing that the technology of drones and the implementation of it is still an emerging field. Based on Oliveira and Martins (2011) conclusions in their comprehensive literature review of the theories and models on innovation diffusion, previous research has been mainly consumer-centered, by which this study aims to elaborate on the theory of innovation diffusion on an organizational level. Thus, it contributes to the shortage of research in this field. Additionally, the aim is to shed light on explanatory factors, such as regulations, and see patterns and themes in regard of what affects the companies operating drones the most. By and large, the contribution is valuable conclusions regarding the status of the innovation diffusion, common hindrances and enablers guiding what to expect in the future for drone technology. Secondly, practical contribution is provided by concluding on practical recommendations based on the findings of the study. These can be seen as guidelines or objectives to take into consideration for organizations and practitioners who plan to adopt drone technology in their operations.

1.7 Disposition

The thesis continues as follows. First, the theoretical section is outlined where relevant theories and frameworks within innovation diffusion and technology adoption are presented in detail. Thereafter, the research methods applied in the study are accounted for, clearly motivating the choices made and corresponding delimitations. Then, a section of combined empirical findings and analysis follows, putting the findings in context and in relation to the theoretical framework discussed. Finally, the study and its main takeaways in terms of academic and practical contribution is disclosed in the conclusion, answering the research question together with suggested future research.

2. Theoretical framework

This section outlines the main theories, models and concepts that have been chosen. In combination, they constitute the theoretical framework in this research. Before accounting for them individually, a brief explanation is provided regarding the selection made.

2.1 Selection of theories

Innovations, such as new technology, spread differently depending on a range of factors and not seldom it takes many years before the broad mass fully embrace them. In the literature on technology adoption there are several theories and frameworks that has been used for studying this phenomenon. Among the most well-known are the Diffusion of innovation (DOI), Technology-Organization-Environment framework (TOE). Both have proved themselves to explain innovation diffusion and technology adoption on organizational level (Oliveira and Martins, 2011). Typically, these models have been used to research adoption of information technology (IT) and information system (IS) (Zhu et al, 2006). The drone technology, to a great extent builds on these technologies as outlined in section 1.3, which is why these two models are relevant to use.

In this thesis, the theory of Diffusion of innovation (DOI) combined with the TOE framework have been chosen to act as the foundation for the theoretical framework. The main reason is that both have been thoroughly tested and gained empirical support for studying adoption and innovation diffusion of technology (Oliveira and Martins, 2011). Moreover, there is an overlap and correlation between the two, by which they complement each other, providing a better understanding of the innovation diffusion process (Zhu et al., 2006; Wang et al., 2010). Concretely, the DOI theory mainly captures innovation characteristics while the TOE framework takes the external contextual factors into consideration. By incorporating the TOE contextual perspective, the specific technological and organizational setting of the adopters and their industry are better accounted for, which would have been partly neglected if only applying the DOI theory.

2.2 Diffusion of innovation (DOI)

Innovation diffusion is a theory originally introduced by Rogers in 1962. Since then, it has been continuously updated in different editions, still being widely used and respected in research on the topic. The theory is used for understanding how, why, and at what rate new ideas and technology, such as drones, are spread and implemented over time. In that sense, it can be described as the process by which an innovation is communicated, thereby diffused, among actors in a social system. Rogers (2010) states that *"It is a special type of communication, in that the messages are concerned with new ideas."* (p. 5), referring to the innovation (often being a new technology). In that sense, it is a social process where information is generated and exchanged between the stakeholders in order to reach a mutual understanding of the innovation. Four elements are proposed as the main explanatory factors of the diffusion process, which Rogers (2010) claims can be found in any studied innovation diffusion, being the Innovation itself, Communication channels, Time and Social system.

2.2.1 The elements

The innovation

Defined as *"An idea, practice, or object that is perceived as new by an individual or other unit of adoption."* (Rogers, 2010, p. 12). However, the newness factor is not limited to the time aspect only and can be captured by knowledge, persuasion, or a decision to adopt. A technological innovation is defined as a "design for instrumental action" that decreases uncertainty in terms of cause-effect relationships in a context of problem solving. Often, the technology consists of two components according to Rogers (2010). First, the hardware materializing the technology as a physical object. Second, the software referring to the information base typically coded as commands and instructions using computer power. This definition of technology captures the definition of drone well: as a system of different technologies materialized in an airborne vehicle as outlined in section 1.2.

As expected, for potential adopters to embrace a new technological innovation, it should have some degree of perceived benefit compared to existing alternatives. In some cases, the intended adopters can struggle with realizing the benefit if it is not clear. The adopters need to gather information and learn about the new information before any decision making can be performed. More on the innovation-decision process later. Thus, when studying innovation diffusion, the characteristics of the specific innovation help to explain the expected technology adoption and the speed it is likely to occur in. Rogers (2010) proposes the following innovation attributes:

i) Relative advantage: *"The degree to which an innovation is perceived as better than the idea it supersedes."* (Rogers, 2010, p. 15). It can be measured through several factors, such as in economic terms, overall satisfaction, social factors or convenience. The focus lies on the subjective advantage, that is whether the adopter perceives the innovation as advantageous or not. As expected, the larger the perceived relative advantage is, the more rapidly the innovation will diffuse.

ii) Compatibility: *"The degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters."* (Rogers, 2010, p. 15). In that sense, compatibility than be described as the fit between the innovation and the adopting organization or individual. As expected, the more compatible an innovation is, the more rapidly it will be spread in a social system.

iii) Complexity: *"The degree to which an innovation is perceived as difficult to understand and use."* (Rogers, 2010, p. 16). Some innovations are more complex than others and demand the adopter to spend more time in the innovation-decision process, learning the required skills and knowledges needed. Thus, the more complex an innovation is, the bigger the hurdle for adopting it is which will be reflected in a lower rate of adoption.

iv) Trialability: *"The degree to which an innovation may be experimented with on a limited basis."* (Rogers, 2010, p. 16). It is concluded that an innovation that is trialable offers less uncertainty than an innovation that is not triable before adoption. That enables the decision-maker to evaluate if the innovation is suitable in the specific problem-solving context. Thus, as expected, new innovation that can be tried out early in the process are more likely to be adopted and diffused in a system.

v) Observability: *"The degree to which the results of an innovation are visible to others."* (Rogers, 2010, p. 16). Greater transparency offers exchange of experience between adopters which in turn enables increased innovation diffusion. If the results can be visualized, it stimulates peer discussion of a new idea, which is often an important aspect of deciding to implement an innovation. The power of word of mouth should not be neglected.

In summary, Rogers (2010) proposes that innovations which offer greater perceived relative advantage, compatibility, trialability, and observability and less complexity compared to traditional or competing options will be adopted and diffused more extensively. This has been supported by research carried out on the topic. More specifically, it has been found that relative advantage and compatibility have particularly importance in explaining the rate of innovation diffusion.

Communication channels

Rogers (2010) defines this as *"A communication channel is the means by which messages gets from one individual to another."* (p. 18), referring to the process in which information is created and shared between actors in order to generate a mutual understanding. In terms of innovation diffusion, the message concerns the idea at hand. Typically, one actor has knowledge or experience of the innovation conveyed to another actor that lack the same. Rogers (2010) proposes that mass media has historically been an efficient way of reaching a broad audience with a new innovation, through channels such as television or radio. Simultaneously, he acknowledges that interpersonal channels, defined as face-to-face interactions, can be more efficient in convincing an individual to embrace a new idea innovation. It is concluded that diffusion investigations have demonstrated that adopters rely more on this kind of subjective evaluation aspects compared to scientific studies that might be more objective. This strengthens the standpoint that the process of innovation diffusion is social and to a great extent relies on potential adopters imitating peers and partners who already has adopted the innovation at hand.

In terms of communication channels, the researchers of this study acknowledge that the theory of innovation diffusion was introduced back in the 60s and that there have been significant changes since then in terms of communication and technology adoption in general. However, Rogers accounts for this in his latest fifth edition of the book from 2010 by acknowledging interactive internet communication as dominant aspect of innovation diffusion today. Thus, the theory is still up-to-date and has proved to add value in today's research on the topic why it is suitable to use. Nonetheless, Rogers identifies one of the most prominent hindrances to innovation diffusion in regards of communication, being that actors are often too heterophilous. The opposite is homophilous. As the notions implies, this refers to how similar or different they are in their attributes. If two actors communicating over an innovation are to heterophilous, their differences might result in ineffective communication and thus prohibited adoption. On the other hand, if they are too identical, diffusion is also hindered since there is no information to be exchanged. To conclude, diffusion of innovation is optimal between adopters that share both similarities and differences since this ease their communication (Rogers, 2010).

Time

This is a powerful element in the theory of innovation diffusion and Rogers acknowledges this by stating *"The inclusion of time as a variable in diffusion research is one of its strengths, but the measurement of the time dimension (often by means of the respondents' recall) can be criticized"* (2010, p.20). This element is heavily linked to the innovation-decision process in which a potential adopter moves from first apprehension of the innovation to either adoption or rejection. It is also used to categorize the different adopters, based on their innovativeness, which will be further elaborated on below in section 2.2.2. Moreover, time can be used to measure the rate of adoption of an innovation as the number of actors who has adopted it in a given time period.

The innovation-decision process is of great importance in explaining why individuals or units choose to adopt a new technological innovation. The process is conceptualized as a five steps journey, ranging from 1. Knowledge (gaining awareness and fundamental understanding), 2. Persuasion (forming a positive or negative attitude towards the innovation), 3. Decision (the process in which rejection or adoption is decided on), 4. Implementation (refers to when the innovation is adopted and put to usage) and 5. Confirmation (the activity in which the adoption decision is reinforced). In that sense, the process is twofold in that it consists of both information-seeking and information-processing in order to decrease the overall uncertainty and reach a point of adoption-rejection and following implementation. As expected, this process is related to the five innovation attributes outlined above. For instance, if the results of the innovation are observable this will ease the information-seeking process proceeding an adoption decision. As can be expected, different innovations impose different innovation-decision periods, that is the time required to undergo the innovation-decision process.

Social system

Rogers defines this element as *"… a set of interrelated units that are engaged in joint problem solving to accomplish a common goal."* (2010, p. 23). The notion units refer to members of the social system and consist of individuals, organizations, groups or other subsystems. In that sense, the social system is the context by which an innovation diffuses, given the boundaries it imposes. It can be said to compile of "patterned arrangements" of the units in the system that guides human behavior through offering stability. Norms is one of these arrangements. Rogers (2010) claim that this stability can predict behavior to a certain extent and decrease uncertainty accordingly. Bureaucracy in a public agency and hierarchical orders in organizations are used to exemplify structure based upon social relationships. This formal structure is contrasted to the informal, existing between interpersonal networks. As expected, social structure to a great extent affect innovation diffusion, either hindering of fostering the diffusion process.

In relation to this element, Rogers (2010) proposes that opinion leaders and change agents within the social system could have particular influence on the diffusion of an innovation. Opinion leaders take on the role of fostering the diffusion by sharing knowledge and information in a more credible way. According to Rogers (2010), the success of the opinion leader is determined by their technical competence, accessibility, and adaptation to the social system. Their style is often adapted according to the state of the social system, that can range from being oppose or keen to change (in the direction of the innovation). It is noted that the opinions expressed by these leaders can contrast within the same social system. Regardless, they are typically found in the center of interpersonal communication networks. A change agent on the other hand is someone who influences innovation diffusion through their clients in a direction deemed desirable by the underlying change agency.

There are numerous ways in which a new innovation can be either rejected or accepted by members in the system. Rogers (2010) outlines three main options being 1. Optional innovation-decisions, referring to choices made independent of ones made by other members in the system. 2. Collective innovation-decisions, where choices are made in consensus among all system. 3. Authority innovation-decisions, referring to authoritarian choices made by relatively few individuals in the social system. As expected, authority-made decision often leads to the fastest rate of adoption followed by optional innovation-decisions. Regardless of type, when innovation decisions are made, consequences will follow. Three pairs of consequences are proposed: i) desirable versus undesirable, ii) direct versus indirect and iii) anticipated versus unanticipated.

2.2.2 Categorization of adopters

Considering the four elements, a categorization of the members in a social system can be made based upon their level of innovativeness, which is a relative measure of technology and idea adoption compared to other actors in the system (Rogers, 2010). Innovativeness is described as *"… the bottom-line behavior in the diffusion process"* (p. 268). In total, five types of adopters are proposed: Innovators, Early adopters, Early majority, Late majority and Laggards. The notion of innovativeness and adopter classification is made in the context of the relative time in which an innovation is adopted, referring to the fact that adoption does not occur simultaneous by all members of the system. Members that shares certain characteristics in their adoption falls into the same category. Rogers (2010) claims that the adoption of a new innovation entails a normally distributed bell-curve, divided accordingly over these five categories where each are given a percentage share (Figure 2.1.2). This implies that the majority of the adopters will be categorized as early or late majority. This is reinforced by the fact that many human traits and behaviors are normally distributed. The five adopter categories and their respective characteristics are now accounted for more in detail.

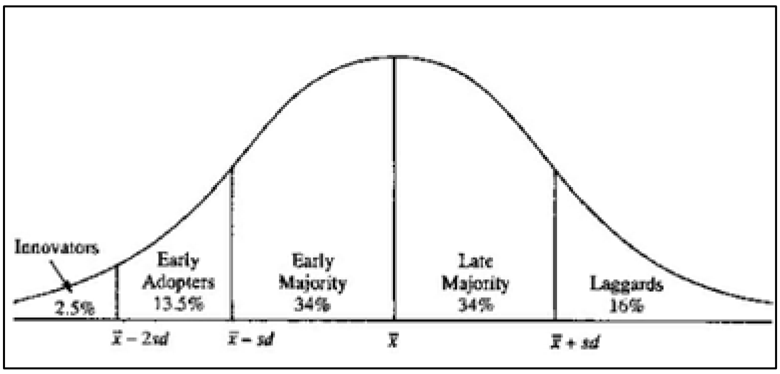

Figure 2.1.2 Illustration of the innovation diffusion curve (Rogers, 2010, p. 281)

Innovators
Innovators are defined as *"active information seekers about new ideas."* (Rogers, 2010, p. 22). This category embraces uncertainty rather than avoiding it, being the most venturesome adopters and are more forgiving to setback and liability of newness of new technology. They are known for leaving local networks and peers in search for new innovation outside their present settings. Financial resources and technical knowledge are typically possessed making this search possible. Furthermore, risk-takers and visionaries are terms often used to describe the group. Considering these characteristics, innovators plays an important role in diffusion process by bringing innovations into a system by stepping outside its boundaries in search for new ideas.

Early adopters
Early adopters are defined as *"a more integrated part of the local social system than innovators."* (Rogers, 2010, p. 283), yet having an optimistic attitude towards new innovation. Considering their position as early in the adoption but still anchored in their local context and network, this category represents the majority of opinion leadership in most systems. Thus, aspiring adopters often tend to consult this category in their network regarding new innovation, as a part of their innovation-decision process. In that sense, their proximity to the majority group that will potentially embrace the innovation, early adopters often act as a benchmark for the rest of the system's adopters. They are viewed as respectful and their opinions are valid, a position the early adopter must care of according to Rogers (2010). In conclusion, this category of adopters decreases uncertainty by adopting new innovation after which providing a subjective evaluation fosters the diffusion process.

Early majority
Early majority is defined as *"The early majority adopt new ideas just before the average member of a system."* (Rogers, 2010, p. 283). They are deeply embedded with their peers and networks in a system but do not typically participate in opinion leadership as early adopters. Considering this category's location between the early "embracers" on the one hand (innovators and early adopters) and the majority and late group on the other (late majority and laggards), they are a key link in the innovation diffusion process. This gap has been named "the chasm" by Moore (2014), referring to the phenomenon that innovation not seldom fail to make the leap between the early and late segments in the innovation diffusion curve. The importance of this category is illustrated by being a third of the members in a social system. As expected, their innovation-decision process is longer than those of previous early categories, thus making only deliberate adoption decisions. In that sense, they are positive to new innovation but seldom lead the adoption of it (Rogers, 2010).

Late majority
Described as "*The late majority adopt new ideas just after the average member of a system."* (Rogers, 2010, p. 284). Their size is equal to that of the early majority, meaning approximately a third of the social system's members. Economic necessity and pressure from their peers are typical key drivers of adoption for this conservative group. In general, these adopters have a skeptical attitude towards innovation and new ideas which is why the refrain from adoption until the majority has paved the way and proved to appreciate it. By then the late majority feel safe to commit to the innovation, which means that their direct influence on others are limited.

Laggards

Laggards is the final adoption category and defined as *"… the last in a social system to adopt an innovation."* (Rogers, 2010, p. 284). What first and foremost characterize this group of adopters is that their point of reference is the past, comparing to how things has been previously. They are local and isolated to their network of closest peers. Laggards are known as traditional types with, applying a passive and resistant attitude towards new innovation with no direct need of embracing it. Typically, they wait until there is no doubt that the innovation is "safe" and proved to be valuable among the rest of the members before adopting it themselves.

2.2.3 Innovation champions

New ideas and innovation typically find both proponents and opponents in an organization. An individual being proponent to the degree that they take action and fight for a particular innovation is often referred to as champion. Rogers (2010) concludes that research has shown that the innovation process is often dependent on innovation champions on an organizational level. The respected quotation by Schön (1963) captures this well *"The new idea either finds a champion or dies."* (p. 84). Thus, the champion has a key role in overcoming resistance and skepticism towards a new innovation and can be found at any level in the organization, not only in the top management. The common denominator is that these individuals use their charismatic side to influence others while being risk-takers, making them innovation minded. In that sense, innovation champions in organizations fulfill a similar role to that of an opinion leader in a community, discussed in section 2.2.1.

2.2.4 Innovation diffusion in organizations

The innovation diffusion theory by Rogers (2010) was initially developed to address the diffusion of innovation among individuals in a social system. However, as the theory has been tested and updated throughout its long lifetime, it has been adapted to also explain the matter on an organizational level. Similarly to individuals, Rogers (2010) states that organizations adopt new innovation based on their certain degrees of resistance towards it: *"… resistances to change exist in an organization, but we should not forget that innovation is one of the fundamental processes under way in all organizations"* (p. 405). In the end, organizations consist of individuals working towards a common goal. Thus, innovation diffuses similarly between companies in an industry as between individuals in a community or system. Therefore, many of the innovation characteristics discussed are equally relatable to organizations. The main difference between individuals and organization is that the innovation-decision process of the latter is typically more complex (Rogers, 2010). The implementation of a new innovation needs to unite the members of the organization, where both proponents and opponents usually are found. Collective and authority innovation-decisions, briefly discussed in previous sections, are most common in organizations as a result of the hierarchical order and routinized structure.

In relation to this, Rogers (2010) proposes independent variables specific for organizations that have proved to be related to their innovativeness. See figure 2.2.4 below. Three main categories are provided. First, individual leader characteristics, where attitude towards change has proved positive related to innovations. This means that if a decision maker in an organization is positive towards innovation, it is more likely it will be adopted than if the attitude towards change is negative. Second, the category internal characteristics of organizational structure follows. Complexity, interconnectedness, organizational slack and size has all been positively related to organizational innovativeness. On the other hand, centralization and formalization are variables that seems to inhibit organizations from being innovative. Lastly, external characteristics of the organization are captures by system openness which has shown to be positively related to the level of innovativeness of an organization (Rogers, 2010).

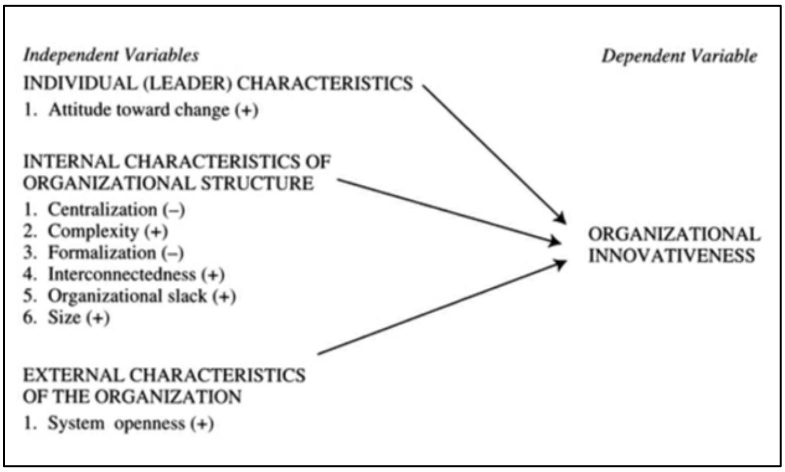

Figure 2.2.4 Illustrates variables affecting organizational innovativeness (Rogers, 2010, p. 411)

2.3 The Technology-Organizational-Environmental Framework (TOE)

The TOE framework, constructed by Tornatzky and Fleischer (1990), is described as a descriptive model of the process of technological innovation, by putting emphasis on influencing contexts for innovative technological adoption and implementation for organizations. The framework is put forth to explain the three most prominent influencing contextual elements affecting organizations in their adoption and implementation decision process: Technology context, Organizational context and Environmental context. Below the TOE framework is visualized in figure 2.2.

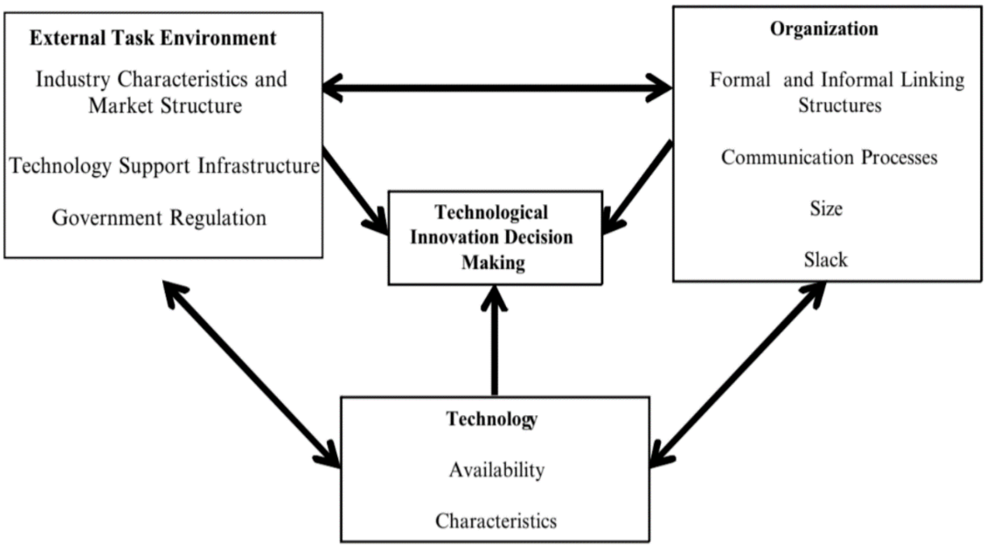

Figure2.3 Illustration of the TOE framework (Schneberger et al, 2012, p. 236)

2.3.1 Technological context

The technological context constitutes of all technological advancements and innovations that are of relevance for an organization. The technologies that are of relevance can be classified in two groups, one as currently in use within the organization, and the second as not currently in use within the organization but still accessible to obtain and implement. The technological context is a determining factor when implementing new technology, as the technological current status of the organization influences the speed of which implementation of new technology can occur (Collins et al. 1988). Moreover, seeing new technology in similar organizational contexts can further create recognition of possibilities for organizations, as technological advancements in similar contexts can demonstrate new ways for organizational evolution, growth and technological innovation (Schneberger et al, 2012).

Technologies and innovations are categorized by Tushman and Nadler (1986) into three different types: synthetic, discontinuous and incremental. By this, they mean that technology and innovation will, if implemented, affect the organization in those three ways. The least risk-taking technological innovation is said to be the incremental implementation, by which new technology builds upon already existing organizational technology, merely adding new features or updates. These kinds of new technology implementations are viewed as the easiest ones, requiring the least amount of effort and adaptation to the new technology whilst still adding more technological value. Further, synthetic innovation is, according to Tushman and Nadler (1986), to be viewed as something in between new radical innovation and current existing technology, where instead the innovation process lies in merging already existing technologies in novel ways. This middle way can be exemplified with online courses given by a university, where the university then utilizes already existing technology in order to provide education equal to the one given in class in a new orderly fashion. Lastly, Tushman and Nadler (1986) mentions discontinuous innovation, in which technology and innovation is to be viewed as radical, substituting current technology and processes for an organization in order to make room for new ones due to the technological influence. The discontinuous technology innovation can be compared to as to what Christensen et al (2015) coins as disruptive innovation, where disruptive technology and innovation find ways to generate market traction in markets that previously did not exist, turning previously not viable customer organizations into customers due to technology and innovation adaptation.

When implementing new discontinuous technology, Tushman and Anderson (1986) explains how organizations must consider the consequences of it, that being whether the technology innovation is ”competence-enhancing” or ”competence-destroying”. With that, innovations that are considered ”competence-enhancing” helps organizations elaborate on already existing qualifications and expertise, meaning that there is an added value of more expertise with implementing a new technology. A ”competence-destroying” innovation on the other hand substitutes existing knowledge and competence within the organization, outperforming and substituting current technology and processes. In short, adoption and implementation of new technology and innovation can thus provide an organization with more competence within certain areas, whereas in others technology innovation can make current expertise obsolete by making the technology available for everyone in the technological context, leading to previous expertise to be of lesser value than before the new technology innovation.

2.3.2 Organizational context

The organizational context constitutes of all available resources within an organization along with its characteristics, that being organizational processes of execution and communication, slack resources, employee linkages and the magnitude of the organization. The organizational combination of the characteristics collectively creates the organizational context and is influential in regards tones implementation and adoption decisions (Tushman and Nadler, 1986). With implementation decisions, Tushman and Nadler (1986) mentions how linkages between different units within organizations can be innovation promotive, whilst gatekeepers and product champions are more associated with adoption. Further, the extent of cross-functionalism within organizations or ties to value chain partners, formal or informal, also play a role in the implementation and adoption decisions.

Overall, organizations that are characterized by decentralized and organic organizational structures are better suited and more prone to have success in organizational adoption of new innovation (Daft and Becker, 1978). This due to a higher elasticity in regards to employee responsibilities and a larger organizational structure emphasis on team cooperation. However, in regards to an implementation process, Zaltman et al (1973) states that more mechanistic structures are better suited for implementation of innovation, due to less elasticity in employee roles and more centralized decision-making.

Tushman and Nadler (1986) further emphasizes the role of organizational communication processes and explains how it can be a determining factor in the innovation adoption and implementation process. If top management can communicate support for innovation incorporation in line with the organizational mission and vision to its subordinates, measures for acting on new innovations will also be taken within the organization. Caution has to be taken by top management though, as the communicated support must clearly map out the organization's innovation history, why it is important, innovation initiative rewards and the organization's future strategy. With clear communication, subordinates and employees can more easily understand the overall organizational incentives and purposes for innovation adoption and implementation, and can thus better adapt innovation initiatives to the organization's current and future goals.

Organization size and resource slack, defined by Gerard (2005) as excess resources that are available to use for further organizational purposes, are other factors that are determining in the organizational innovation process. Rogers (1995) explains how resource slack is something that fosters and promotes new innovation adoption, where Tornatzky et al (1983) adds to the findings and states that resource slack however can be absent whilst the organization still experience a need for innovation. Thus, resource slack is to be regarded as an innovation catalyst that can promote innovation, but is not essential to the process as innovation will still occur without its inclusion (Tornatzky and Fleischer, 1990). Same goes for the organization size, where earlier studies struggle to establish a correlation between the size and the organizations aptness for innovation adoption. Rather, the term ”organization size” is a collective word for other underlying reasons that more focus on the organization characteristics, for example organization specific resources, expertise or innovation availability (Kimberly, 1976).

2.3.3 Environmental context

The environmental context constitutes of the industry regulatory system, presence extent in regards to technology services and the overall industry structure. Mansfield et al (1977) exemplifies how an industry structure of intense competition can trigger the industry members to engage in innovation adoption and implementation. Adding to this, Kamath and Liker (1994) states that leading organizations within the industry value chains can provoke other organizations to innovate, thus the industry structure is emphasized as highly influential for new innovation adoption and implementation.

Tornatzky and Fleischer (1990) explains how organizations approach towards innovation differs depending on the state of the industry life cycle. Organizations that are part of a growing industry tend to engage in innovation more than organizations that are part of a mature or declining life cycle. While some organizations in mature or declining life cycles may use innovation practices in order to expand business to new industries or segments, others will spend less effort on innovation practices in order to cut costs and profit as much as possible from the remainder of the industry life cycle. Further, organization innovation is also affected by the availability of technology support infrastructure. That is, the availability of labor that fits the requirements may have an effect of the organization's willingness to innovate. If the cost of labor is high due to scarce availability, the aptness to innovate for cost-reductions reasons is higher (Levin et al, 1987).

Lastly, governmental rules and regulations are directly influencing on organizational innovation, as it can both create beneficial contexts for innovation, or on the contrary suppress the possibilities for innovation. Innovation fostering regulations are exemplified as regulatory goals, such as pollution-control, forcing organizations to innovate in order to fulfill the regulatory set requirements. At the same time, innovation can also be hindered, as regulatory processes can be time consuming and costly due to the regulatory hardship of realizing new innovation due to extensive testing. Regulations may also inflict in other ways that are not directly connected to the innovation itself, and is exemplified with the banking industry and the law of secrecy regarding private banking. Thus, technological innovation not regulated by the government may still be indirectly affected, as the law of secrecy prevents it from being used in a banking context. This can work to an organization's advantage as well (Schneberger, 2012).

2.4 Combining the TOE framework and the DOI model

Combining the Diffusion of innovation model by Rogers (2010) and the TOE framework by Tornatzky and Fleischer (1990) has previously been validated. For instance, Wang et al (2010) conducted a study where they simultaneously used the TOE framework and the Diffusion of innovation model in order to study the technology of radio frequency identification. The goal of the study was to analyze the rate of adoption and underlying factors for implementation in the manufacturing industry. By combining the theoretical framework of TOE and the Diffusion of innovation theory, Wang et al (2010) were able to identify common variables among 133 manufacturing companies that seemed to be determining in the RFID adoption process. Moreover, Oliveira and Martins (2011) explains in a literature review how a combination of the TOE framework and the DOI model can be beneficial in order to better understand decisions and processes regarding technology adoption in an organization. Since the Diffusion of innovation model (internal context) and the TOE framework (external context) both work at the organizational level, they complement each other in order to get a better understanding of innovation adoption and implementation processes. Oliveira and Martins (2011) elaborate on this by providing examples of successful earlier mergers of the two theories, and mention among others Chongs et al (2009) and Zhu et al (2006) who combined the two successfully. The earlier empirical findings support the choice of combining the TOE and DOI into a theoretical framework to analyze innovation diffusion of drones.

As previously outlined in the theoretical framework section, Rogers defines innovation as *"An idea, practice, or object that is perceived as new by an individual or other unit of adoption."* (2010, p. 12). In terms of a technological innovation, he extends the definition to a "design for instrumental action" that decreases uncertainty in terms of cause-effect relationships in a context of problem solving. Similarly, Tornatzky and Fleischer (1990) defines technology innovation in their TOE framework by categorizing it into three main types: incremental, synthetic and discontinuous. The latter, discontinuous, aligns the most with Rogers (2010) innovation definition, namely as radical and of a substituting character where old processes and technology becomes obsolete for better results.

In relation to how both the DOI theory and the TOE framework handles innovation as a notion, and the drone technology being the subject of research in this study, it is important to make a distinction between the related terms of invention and innovation. Fagerberg and Mowery (2006) defines invention as the initial appearance of an idea for a novel product, process or service. This definition in contrast to innovation which is termed as the first attempt to apply the novel idea in practice. Even though drone technology is still emerging it has been around for quite some time, it is undoubtedly safe to argue that it can be defined as an innovation according to the distinction made above. Thus, the two main theories of DOI and TOE on innovation are applicable.

3. Research methods

In this section, the study's research strategy, its design and methods applied will be accounted for. This will enable the reader to thoroughly understand how the study was conducted and why certain scientific choices were made. In addition, delimitations explicit the scope of the research.

3.1 Theory approach

The approach taken to a study is something that greatly affects the way it is perceived in the eyes of the reader, as it guides the methodological strategy. Bryman and Bell (2017) retell the two most common methodological strategies as inductive and deductive, where they each take a different approach to the way the connect a phenomenon to existing theory and their fit. Using the deductive approach, Bryman and Bell (2017) explain how the scientist before testing their research question formulates hypotheses about the researched phenomena in order to test the fit with already existing theories. The whole purpose of doing so is to test the previous existing theory to either validate the theory or to dismiss it as incorrect. The inductive approach on the other hand acts in the opposite way as the deductive approach. First it studies a phenomenon, after which it tries to find appropriate theory in order to explain the studied phenomenon.

For this study, the chosen theoretical approach has been the middle ground between the inductive and deductive approach, which Bryman and Bell (2017) refer to as the abductive approach. The abductive approach is a more interactive research approach, as it is continuously is updated and fitted together with existing theories as the study goes on. The reason for choosing the abductive approach is due to the relative newness of the field of study. Basing the study on a fairly new innovation, drone technology, with little track record of previous research, the abductive approach has been a way of guiding the study in finding relevant theoretical frameworks (DOI and TOE), whilst also leaving room for the theories to expand or be added on throughout the study to better understand and analyze the results. A guiding indicator when searching for theories have been to follow the number of citations on Google scholar and the databases provided by University of Gothenburg. This to find relevant and scientifically tested and proven theories, in order to best analyze the findings. By applying an abductive approach, the hope is that the results and theories will have collectively co-created a better result and analysis that in a more accurate way explain the underlying reasons that hinder respective foster the innovation diffusion of drones.

3.2 Understanding of phenomenon

Bryman and Bell (2017) state that there are two main ways that researchers can interpret and study a phenomenon and labels them hermeneutic and positivistic. The positivistic approach stems from a willingness to through observations and interviews understand and give explanations to why or how something is in a certain way. The whole purpose is to generate a so called "truth" that later on can help in future research and prediction-making. The purpose for the hermeneutic approach on the other hand is to generate a more painting picture of a studied phenomenon, and more focus on people and why they say, do or act in certain ways. Finding an absolute truth is thus not the sole purpose, but rather gaining a more profound understanding is the goal in this approach.

For this study, the hermeneutic approach has been chosen. The reason for choosing the hermeneutic approach is because basing a whole "truth" on eleven interviews from different organizations in different industries is not enough empirical data. With the research question in mind, the goal however is to get an understanding of what possible reason there could be that fosters or hinders innovation diffusion of drone technology. The study merely strives to provide one of many possible scientific explanations, recognizing that it may not be an absolute truth.

3.3 A cross-sectional qualitative study

In order to answer the research question, eleven interviews have been conducted with various organizations in different industries engaged with drone activities to various degrees. The interviews were carried out during March 2020. Conducting interviews with various organizations in different industries is explained by Bryman and Bell (2015) as a cross-sectional study, where all actors and studied at one point in time. Further, they explain how a cross-sectional study can demonstrate relationships between variables, whereas conducting a cross-sectional study fitted well with the research question and the purpose of the study, which has been to gain insights in why and how organizations make decisions regarding adoption and implementation of new innovation. From the interview responses, analyses and conclusions were made regarding the innovation diffusion of drone technology, identifying common hinders and enablers of the development.

3.4 Primary data

As previously mentioned, in order to collect information and empiric material, eleven interviews were conducted with various organizations either just starting to implement drones or having done so for some years, however no organization exceeded 6 years back. The choice of doing interviews stems from what Patel and Davidson (2011) state about interviews; that they are to be viewed as a primary in source of information, as the information provided by the interviewee is unfiltered and immediately collected by the interviewer, whereas there is no intermediary filtering and interpretation of what is being said. Further, with doing interviews there was an underlying intention of getting deeper knowledge and understanding from the interviewees about the topics, as interviews provides a good setting for giving more nuanced and insightful answers about drone technology diffusion than possible in other settings (Bryman and Bell, 2017). Merely, with doing interviews the goal was to increase the chances of getting good and relevant answers to in the best possible way answer the research question.

3.4.1 Organization selection

In order to find relevant organizations to interview, a selection had to be made. There were two fundamental criteria that guided the selection of organizations: i) the organization had to involved with drone technology to some extent; ii) there had to be a spread between the organization industries. The aim was to include both public and private actors in accordance of the cross-sectional character of this study.

In order to find relevant organizations to interview, an initial contact was made with the largest drone conference in Sweden, UAS Forum. Based on their attendance list from the last held conference, 25 organizations from various industries were selected based on the listed criterion i) and contacted via e-mail, explaining the purpose of the study. Their respective websites were used as the main source of information, in addition to individual drone expertise of the researchers. With a response rate of approximately 45%, eleven interviews were scheduled and conducted with a wide range of organizations from both private and public sector. Known as a simple random sample (Bryman and Bell, 2011), the goal was to ask many organizations and then review the responses if the fulfilled the predetermined criterion ii). The eleven organizations that responded were deemed to be of enough spread to sufficiently give a nuanced perception of drone technology on an organizational level, being based in different industries.

Seeing that the time provided for this cross-sectional study is limited, there have been only one interview with each organization, with the exception for one organization that provided two. It is realized that this organization and the answers provided might weigh more than organizations who only had one respondent, potentially making it somewhat biased. However, these two respondents possessed different roles within the organization, and thus contributed with different perspectives on using drone technology. Nonetheless, this was taken into consideration by the researchers.

3.4.2 Interviewee selection

When sending out e-mails to organizations, it was included in the e-mail an inquiry of referral, meaning that there was an understanding that the e-mail initially could have been sent to the wrong person in the organization who had no or little knowledge about the organizational drone operation. Thus, there was a question included asking, if needed, for the e-mail to be forwarded to a more suitable person for the purpose within the organization. Bryman and Bell (2017) refer to this as a purposive sampling method, that later then turned out in a snowball selection. By this it means that the initial contact person with the organization was a by the researchers' subjective individual assumption of who was the right person to contact. If the right person was not contacted during the initial contact with the organization, a chain of referrals eventually leads to the right person within the organization with the proper competence and knowledge. The goal with pursuing this selection method was to gain as much relevant empirical information as possible from each interview, whilst also minimizing the risk of interviewing the "wrong" person, thus ending up with non-relevant answers trying to answer the research question. By and large, by following this method, there is a belief that the interviewee relevance is increased. Further, the goal is to adjust for researcher and interviewee bias whilst also minimizing the risk of losing out on crucial empirical findings.

3.4.3 Semi-structured interviews

Before conducting the interviews, it was decided to follow a semi-structured interview approach in order for the interviews to be comparable and abled to analyze. Keeping a structure from which the interviews are based on, whilst still providing a setting for the interviewee in which he or she could speak freely, not limiting the interviewee to talk more about for the topic relevant side notes (Bryman and Bell, 2017). Using predetermined interview topics as umbrellas of what to discuss, the goal was to give the interviewees more "wiggle room" to talk about drones within their specific organization, hopefully resulting in more thorough answers and insights, as the interviewee had the possibility to touch upon areas and relating topics that otherwise could have gone lost in a structured interview. Also, the choice of doing semi-structured interviews was to ensure the relevance of the interview responses in order to meet and answer the research question.

To be able to conduct a semi-structured interview, seven relevant topics with related questions were formulated in an interview guide, which purpose was to guide the interview, whilst still leaving room for new questions to be asked of pursue a side note further (Bryman and Bell, 2017). The topics were mainly formulated based on the theoretical framework (DOI and TOE), that guided the formulation of the interview guide and its questions to a great extent. This since the theories have been empirically proved as previously stated (Oliveira and Martins, 2011). The overall topics were: i) Introduction and Role description, ii) Needs and Situational analysis, iii) Technology, iv) Environment, v) Drone implications, vi) Organization and vii) Future developments. See appendix

Using the interview guide during the interview helped to maintain an overall interview structure without losing flexibility, making sure that the interviewee's answers were relevant to the research question. Using the semi-structured approach was to the study a good fit, as it gave more space to gain more relevant empirical material, whilst also providing room to compare the answers, as the topics for the interview still guided the interviewees.

3.4.4 Conducting and transcribing interviews

At the time of each interview, they were either held in person or via videolink during March 2020. The choice of doing some interviews via videolink was due to time-distance matters, while organizations in more proximity to Gothenburg were held in person. During the interviews, questions and follow-up questions were asking according to a semi-structured approach. In order to be able to loop back and in an accurate and unbiased way analyze the interviews, all interviews were recorded and transcribed, with the consent of each interviewee. The reason for doing transcriptions was in order to minimize misinterpretations, whilst also not tweaking the truth and basing conclusions on misinterpreted information (Bryman and Bell, 2017). However, recordings and transcriptions are merely tools for minimizing truth tweaking and misinterpretation, but not a 100% guarantee towards preventing previously held social biases and perceptions of the researchers.

After each interview had been held and transcribed, a subjective categorization relative to the DOI framework was made of the organization in question. Since there is no absolute answer to the categorization process and in which segment each organization would be, the categorization is merely a guiding point to get a grasp of the organizational progress regarding innovation diffusion of drones, and to get a hint of what stage the organization is in. In addition, the categorization is a mean of providing the reader with an organizational context to better understand citation and presented results. Each organization was also given a codename for analyzing and citation purposes.

Codename	Type of organization	Sector	Categorization (DOI)	Setting	Duration (min)
FD	Fire department	Governmental	Early adopter	On site	78
C1	Construction	Private	Early adopter	On site	61
TD1	Technology developer	Private	Innovator	Videolink	58
C2	Construction	Private	Early adopter	On site	62
TD2	Technology developer	Private	Innovator	On site	49
M1	Municipality	Governmental	Late majority	Videolink	48
M2	Municipality	Governmental	Late majority	Videolink	31
M3	Municipality	Governmental	Early majority	Videolink	48
C3	Construction	Private	Early adopter	Videolink	54
FI	Forest industry	Private	Early adopter	Videolink	60
SF	Search and find	Private	Late majority	Videolink	47
					$\bar{x} \approx 54$

Table 3.4.4 Table of conducted interviews

3.4.5 Anonymization

For the study, a choice has been made beforehand to make all the interviews anonymous. The reason for doing so is to enable the interviewees to a larger extent and in more depth talk about underlying affecting issues that influences the organizational drone diffusion process, whilst not jeopardizing that the information will be negative or in any way harmful for the interviewee and the organization. This is likely to give a more honest picture of the reality. Bryman and Bell (2011) explain how The Academy of Management (AoM) Code of Ethical Conduct requires the researcher to tread carefully and minimize the potential harm that could be caused to the interviewee. It is thus important to ensure that the empirical data that is collected in no way can be traced back to the interviewee nor the employing company/organization, and information that can thus has to be discarded from the study. Screening the empirical material and erasing associative information can be hard, but still doable according to Bryman and Bell (2017).

In order to secure the anonymity of the interviewees and their organizations, each organization represented by an interviewee has been given a fictitious codename, as previously shown. Further, information regarding gender, age and organization name have been neglected in order to assure complete anonymity. Instead, the DOI segment categorization from innovator to late majority provides the organizational context in accordance with our theoretical framework. Furthermore, the type of organization each interviewee works at have been displayed to ensure the context is not lost. By doing so, the hope is that the interviewees have given thorough answers to the questions they have been given, not factoring in that their opinions can harm them, hopefully leading to less self-censorship. From the interviews, the transcriptions too have been subject to anonymization, in which all information that could be interviewee or organization specific have been withdrawn.

3.5 Thematic analysis

Having done the interviews and transcribed them, they were then analyzed using a what Bryman and Bell (2015) refers to as a thematic analysis approach. A thematic analysis approach is explained as the process of identifying common themes that in a suitable way relates back to the research question. As the purpose of the study was to investigate perceived hindrances and enablers, the thematic analysis approach was deemed appropriate to in the best way possible answer the research question. It was deemed the best alternative for analyzing the results, as with following a thematic analysis process, it leaves more room for the researchers to employ a more interpretative approach. This means that the themes can be extracted and analyzed beneath the surface to gain a better understanding of common themes that appeared to be of great value and importance in an innovation diffusion process, while acknowledging that the themes are subject to researcher interpretation bias (Bryman and Bell, 2015). Additionally, with an interpretative take on the thematic analysis, the thematic analysis process fits well with the hermeneutic approach upon which the study is founded, meaning that the interpretations by the researchers are merely a portrait of one of many possible conclusions from the study. Being a cross sectional study, the thematic analysis process also helped in identifying common cross organizational themes, as it gives more "wiggle room" to draw conclusions and parallels based on more "beneath the surface" questioning in order to find common denominators. This in order to recognize and find for the study relevant hindrances and enablers for drone technology innovation diffusion.

As such, with the thematic analysis process, and to gain an understanding of the common cross-organizational themes, all the transcribed interviews were coded. Bryman and Bell (2015) explains how coding can be conducted on the transcripts in several levels when analyzing qualitative data. Coding the answers and finding interview-centered codes, such as for example financial resources would be considered a first level code, whilst second and third level refers more to underlying assumptions and concerns for the interviewee that might have an effect on the implementation and usage of drones within their organization

Thus, in order to understand the second and third level coding, the transcripts and its citations were coded into codes that suited that specific statement and was of relevance to the research question. Caution was taken to not place the coding out of context, leading to misinterpretations of what was said during the interview. As such, citations that were vague or not clear enough in their message were left out of the coding process to account for citation bias. This was possible due to the amount of interview citations, whereas citations that were unclear could be put aside since there already was an extensive amount of citations available. However, if the number of citations would have been insufficient, contact could have been taken with the interviewee to clarify the meaning of the citation, thus accounting for citation bias.

In order to analyze the empirical data that was collected during the interviews, and in a more pedagogical way probe for all coding levels, the transcriptions were inserted into a thematic coding program called NVivo. NVivo is recommended by Bryman and Bell (2011) as a good data software program for coding transcriptions, as it is easy to use, time efficient and has a proven track record. Inevitably, a thematic analysis process and its coding is susceptible to be influenced by the subjectiveness of the researchers. Bryman and Bell (2015) propose that this can be minimized by letting several researchers code the same data and then compare the results in order to ensure an interpretation as objective as possible. Following this recommendation, each citation during the coding process was first screened by the researchers individually, after which a suggestion of a suitable node for the citation in question was made by each researcher. If the suggestions matched, the citation was coded directly to the corresponding node. If there was a disagreement, a there was a discussion regarding the node belongingness of the citation until consensus was reached. As the coding process went on, citations from 24 underlying codes were found. These codes were then grouped together into eight related thematic groups of similar coding level (that is first, second and third level) upon which the results and analyses are based on, which enabled patterns to be recognized across different interviewees. Each thematic grouping represents a common aggregated theme in section 4. Empirical findings and Analysis (except for the grouping "Advantages and Disadvantages", which is more standalone and have been scattered across all themes), along with sub-themes drawing from each node in more detail to better understand the result and analysis regarding drone technology diffusion.

<table>
<tr><th colspan="2">Grouping of codes</th></tr>
<tr><td>Usage (19)
Underlying needs (18)
Need - Technology match (22)
Technology development (12)
Drone uniqueness (6)</td><td>Attitude (29)
Bottom up (14)
Top down (3)
Innovation champion (23)
Time(14)</td></tr>
<tr><td>Cooperation and partnerships (18)
Social process (6)
Openness (9)</td><td>Competence (25)
Resources (18)
Work process development (16)</td></tr>
<tr><td>Data gathering (21)</td><td rowspan="3">Implementation (16)
Information Gathering (11)
Compatibility (8)
Strategy (21)</td></tr>
<tr><td>Rules and regulations (32)</td></tr>
<tr><td>Advantages (38)
Disadvantages (18)</td></tr>
</table>

Table 3.5 Each box demonstrates a group of codes that have been clustered. The number within parentheses shows the number of times each node was accounted for in a for the study relevant citation based on the interviews. Note that it is merely an indication of importance for each node, as the codes were assigned by the researchers during the coding process. See table 4 for the corresponding themes in the Empirical findings and Analysis-section.

3.6 Scientific relevance

When doing a qualitative study, it is important to determine its scientific value. Guba and Lincoln (1985) speak of a study's scientific value in terms its trustworthiness, and mentions three crucial aspects when it comes to generate trust: credibility, transferability and dependability.

3.6.1 Credibility

Credibility refers to the notion that the empirical material provided by the interviewee's correspond with the reality and the way things actually are. By using a semi-structured interview approach followed by a snowball selection to find the most relevant interviewee's in each organization, the goal has been to gain a good picture of the actual conditions and reasons behind perceived hindrances and enablers regarding innovation diffusion of drone technology. One must always account for that there can be some bias, both from us as researcher and from the interviewees. This was continuously attempted to limit this as much as possible, but it is always a good idea to keep in mind as a reader. Especially since the study follows a hermeneutic approach, trying to give an overall picture.

3.6.2 Transferability

Transferability refer to the notion of conducting a similar study in other settings, and then obtaining similar results. To this we reserved, as the innovation diffusion of drone technology is something novel and not easily comparable to other innovations or technologies. However, while there might be similarities to other implementations and innovations relative to innovation diffusion theory, we argue that this study will have to be viewed as one of many truths to how it can be, and not specifically the only truth.

3.6.3 Dependability

Dependability refers to the notion of conducting a similar study again with the same conditions, and thus gaining similar results. To this we also stay reserved, as new regulatory rules and regulations coming July 2020 will change the prerequisites for drone technology, changing the current ways drones are and can be utilized by organization (EASA, 2019). Thus, there is a chance that this study will not be able to be replicated in a few years' time, seeing that too much will have happened regarding drones technology and their usage, affecting the current conditions of this study, making it unreplicable. Rather, this study will have to be viewed as a current snapshot of current conditions from which we can learn for future knowledge and reference.

3.7 Delimitations

This research is conducted on a rather specific subject, the drone technology, in terms of a more general model regarding innovation diffusion. Thus, it is plausible that findings presented here might be applicable to other similar technologies. However, this is not the purpose of the study. With its narrow focus, the academic contribution and practical recommendations provided in the conclusions are not to be compared to other areas or technologies, while still acknowledging that they may be applicable in similar studies as well. Instead, the hope is to provide an enhanced understanding of how organizations adopt drones and what influences their decision making to do so.

3.8 Combing the empirical findings and the analysis

In order to present the findings from the study and the analysis of them, a deliberate choice has been made to combine the two sections into one - section 4. Empirical findings and Analysis. Eisenhardt (1989) describes how published studies often gives little room to analysis of the results, whereas a "huge chasm often separates data from conclusions". Eisenhardt (1989) further quotes Miles and Huberman (1984): *"One cannot ordinarily follow how a researcher got from 3600 pages of field notes to the final conclusions, sprinkled with vivid quotes though they may be."* With this they mean that it can be difficult to understand the connection between the results and the analysis and the conclusion of them. Adding to this that the study is a cross-sectional study of different organizations, the results have been deemed by the researchers to be less possible to grasp and understand without being accompanied by an analyzing aspect, by which a combination of the two have been chosen. Seeing that the results and their analysis are highly intertwined and difficult to distinguish from each other, they have been combined in order to account for what Pettigrew (1988) describes as *"danger of death by data asphyxiation"*, meaning that some value and knowledge in the results may go lost unless coupled with an analysis, but also to minimize repetition that otherwise would have been necessary. Thus, the hope is that this structure will provide a logic order, making it easy to understand the context in which the topic originated from.

4. Empirical findings and Analysis

In this section the main findings in terms of findings and patterns from the analysis are presented. As declared for in section 3.8, the empirical findings and the following analysis have been compiled into one in this study for enhanced conceptual understanding.

This section has then been divided into the eight sub sections based on the different key themes identified in the thematic analysis. Each section presents results in terms of quotation and notes, after which the analysis and connection to the theoretical framework are intertwined and discussed. The table below provides an overview by summarizing the themes and connecting each to the corresponding group of codes from which the theme was derived.

Codes	Themes	Section
Usage Underlying needs Need-Technology match Technology development Drone uniqueness	Drone technology democratizes airborne data gathering and increases data accuracy	4.1
Usage, Underlying needs Need-Technology match Technology development Drone uniqueness	Drone technology proves unique in the sense of the broad spectrum of application areas and is fairly easy to match against a real need	4.2
Rules and regulations	Rules and regulations prevent new innovation and influence the adoption of it	4.3
Cooperation and partnerships Social process Openness	Operation of drones is not an isolated activity	4.4
Implementation Information gathering Compatibility Strategy	The implementation process is i) organization specific ii)) has been characterized by “lack of track record”	4.5
Attitude Bottom up Top down Innovation champion Time	Individual innovation champions are key drivers in the incorporation of new technology	4.6
Competence Resources Work process development	The competence of both the user and the organization determines the potential of the technology	4.7
Data gathering	The data gathered is broad and often demands complementary assets and supporting functions	4.8

Table 4. Illustration of derived themes from corresponding group of clustered codes in table 3.5.

4.1 Democratization of airborne data gathering

This section accounts for the theme "Drone technology democratizes airborne data gathering and increases data accuracy" which stems from the codes Usage, Underlying needs, Need-Technology match, Technology development and Drone uniqueness. Below, the findings related to this theme are presented, analyzed and discussed.

Drones replace existing technology as well as meeting new needs

For the absolute majority of the cases, both in the interviews and in the real world, the drone is utilized as a carrier of a sensor, typically a camera of different variations. This enables application areas such as gathering data from the air, for instance photographing an area of interest which then can be used as a valuable source of information, which previously was not possible. More on the application areas in section 4.2. Historically, this task of aerial footage has been carried out by airplanes and helicopters, making it costly and only applicable in certain cases. One of the interviewees from a land-surveying department at a municipality captured this:

"...before when we did a fly photo by airplane, we always got footage of approximately a third of the municipality's area. If you are doing a mapping update on a smaller area, such as a road or a local plan, the drones is a good alternative. Basically, it provided more possibilities…" **M2, Late majority**

As the interviewee emphasizes, the airplane is an effective alternative for covering larger areas while the drone has proved to be more suitable for smaller areas of interest similar to helicopters. This was also mentioned by others in the interviews. Since the drone technology has made airborne data gathering more common, it has also been applied to new areas and meeting needs that previously were overlooked. In that sense, the drone technology seems to replace existing technologies and methods while also creating new needs not previously expressed nor viable to most of today's customer groups. Few of our interviewed organizations previously used air footage by airplane or helicopter, but now use it on a daily basis with drones. Returning to the TOE framework, three main types of technology was proposed: synthetic, discontinuous and incremental (Tushman and Nadler, 1986). According to our analysis, the drone technology is best explained by what characterizes a discontinuous technology, considering its radical character and substitution of current technology.

More up-to-date information and data reduces uncertainty

Since the drone technology can be applied on a much broader scale and more often than competing technology, more data of high quality and richness can be gathered than before. Combined with improved sensor technology, this seems to have increased the data accuracy in organizations' operation which traditionally not seldom were of rough guesses. Both a construction firm and forest actor acknowledged this fact, exemplified by the common use of "eye measurement" to calculate masses of different kinds which is subject to faulty estimates. Similarly, another interviewee framed the advantage of using drone data by stating:

"...often when in construction, you base your decisions on the available pictures and maps on the area. Typically, these maps are outdated, which can be a risk factor. Hence, it must be much easier to make the right the right decision if the information is updated and accurate…" **C3, Early adopter**

In relation to this, another interviewee of a fire department who had successfully incorporated the drone into their daily operations, demonstrated how the drone often provides a valuable overview of a situation, making it possible to use their resources more efficiently. A leakage accident in a lake was mentioned as a prime example, which historically are incidents that are identified from the ground level walking around trying to derive the source visually. A difficult task which became much easier using a drone, thus decreasing the uncertainty and time used.

"...today, if I am about to calculate the volume of a mountain, it may take me 4 hours to build me a 3D model that is easy to use. However, previously, that same process would have taken me 2-3 weeks to get the same results with the tools available at that time. And we should not even speak of the previous process cost…"

C2 (Drone pilot), Early adopter

The time-saving component, better use of resources together with increased safety were the primarily drivers mentioned as what the adoption of drone technology has offered. Increased safety was emphasized in more or less all interviews. For instance, by the fire department actor who now do not need to put their employees in harm's way when inspecting a railway accident. Similarly, the governmental organizations, constituting municipalities land-surveying functions, declared that the drone can perform tasks that were previously performed manually in risky circumstances, such as walking a trafficked road in rush hour when measuring with GPS equipment. It was obvious that safety is a theme that organizations take seriously. Since drones seems to offer just that, it has likely to have fostered the innovation diffusion process overall.

In terms of the theory applied, there are obvious elements of both the DOI theory and TOE framework present. Rogers (2010) defined an innovation as a mean of decreasing uncertainty in a problem solving-context. As stated above, it became clear that the drone technology as an innovation has significantly increased data accuracy and relevance, decreasing uncertainty. Thus, it seems to comply with the definition in Rogers diffusion theory. Moreover, Rogers (2010) claimed that an innovation needs certain attributes, one being to bring a relative advantage compared to existing solutions. Based on our results above, there indeed seems to be a perceived benefit by the adopters of drones which is likely to be an explanatory factor why the technology has diffused as rapidly as it has. Bringing up-to-date and accurate data, increased application possibilities while replacing costly alternatives are all perceived benefits expressed in our interviews.

Rapid technology development and decreased cost of drones accelerates the adoption

It seems not to be an exaggeration that the drone technology has developed at a rapid pace in the commercial and private setting. One interviewee mentioned that the technology today is a predominant theme in "every booth at exhibitions", but were nonexistent only five years ago. DJI, a Chinese drone manufacturer, is acknowledged as the leading developer of drones reflected in the fact that the majority of the firms interviewed used their equipment. DJI's ability to address the actual needs of the market, by matching their offering accordingly, seems to be a success factor. The following quote by a construction firm, categorized as an early adopter, sheds light on this:

"...DJI existed, but their drones did not fulfill the requirements we had on the drones at the time. Two years later they came with new drone offerings that suited our needs and purpose perfectly. All you need now is a drone and a software program in order to get started. Today, drones are very cheap, the cost is more or less similar to a portable computer, which makes it easy to purchase larger quantities. It is easy to get up and running…"

C3, Early adopter

The relatively low and diminishing price, in combination with how easy drones are to fly today, were two elements that were stressed by several organizations at numerous occasions during our interviews. In other words, flying the drone was not mentioned as a major hindrance to adopting it which came as a surprise. This seems to have made the technology available to the broad mass, both in terms of organizations and private people. Similarly, a forestry actor (FI) stated that the drone is a tool in the toolbox at every office today, meaning several hundreds of drones are used in their daily operation. That the price tag of a drone has plummeted as the technology has been developed, should be reckoned as a key explaining factor for its rapid diffusion. As the quotation above illustrates, it seems to have reached a point where it is accessible for the vast majority of organizational actors, regardless of their size, industry or sector.

Rogers (2010) innovation attribute of complexity in the DOI theory is relevant to mention here, defined as how difficult an innovation is to understand and apply. The more complex an innovation is, the bigger the hurdle is to adopt it thus limiting the innovation diffusion. In terms of drones, it became clear that this seems not to be the case. Several of our interviewees stated that drones are easy to grasp, "everyone gets it". Especially the flying part. Instead, the work preceding or following the flight, like analyzing data or setting up the organizational structure, proved more demanding. It can likely be explained by the fact that the leading drone manufacturers have been successful in making the technology user-friendly and thereby limiting the learning curve and prior knowledge needed to adopt it.

Furthermore, what was noted in the interviews were the fact that the drone technology is being applied to the extent that it is referred to as "a new standard". This was especially clear in the construction industry. In our opinion, this is the ultimate evidence that the innovation diffusion of drones has reached a broad adoption. All three interviewees in the construction industry (C1, C2 and C3) claimed that the drone as a technology has been greatly welcomed since the overall technological development in that particular industry has been slow. Similar points were made by the forest actor (FI), which is also typically viewed as a conventional and traditional industry. Thus, it became clear that the more "outdated" an industry is, the larger the impact of introducing drones technology seems to be.

4.2 A broad spectrum of application

This section accounts for the theme "Drone technology proves unique in the sense of the broad spectrum of application areas and is fairly easy to match against a real need" which stems from the codes Usage, Underlying needs, Need-Technology match, Technology development and Drone uniqueness. Below, the findings related to this theme are presented, analyzed and discussed.

Organizations acknowledge drones as a versatile and complementary tool

The drone proved to be a versatile technology that can be used by organization in many different circumstances. As outlined previously, organizations based both in the private as well as the public sector were included in the study, ranging from construction, technology developers, forestry to fire department, search and municipalities. All used drones on a daily basis. This itself is likely to be a vital explanation why the innovation of drones has diffused as rapidly and broadly as it has, compared to more niched technology. Below, the different application areas mentioned by the interviewees are listed, demonstrating the variety of tasks performed by drones:

Application area	Definition
Search and find	Locating lost people and wild animals
Photography	Taking photos of areas of interest from above
Filming	Filming areas of interest from above
Mapping	For example land surveying
3D-modelling	Generate 3D models of geographical areas, surfaces and/or buildings
Visualization	Creating visual models of non-existing objects in existing environments
Measuring traffic flow	Control the flow traffic, identify vehicles
Orthophotography	Creating a digital copy of specific areas of interest
Object Transportation	Transportation of objects of interest from one location to another
Progress tracking	Follow up and document progress in specific areas
Volume calculations	Calculate the amount of material and its monetary value
Security and surveillance	Monitor an area of interest from above and identify irregularities
Inspections	Scan an object of interest for update purpose on its status
Danger avoidance	Mitigating risks by using drones instead of conventional methods
First responder and firefighting	Status assessment for a better resource allocation
Inventory inspection	Calculating of various kinds, such as number of animals within an area

Table 4.2 List of mentioned application areas.

Another key explaining factor to the broad application areas of drones that were emphasized in the interviews was that the technology has been easy to match with an actual need posed by the organization. This became particularly evident when the interviewees were asked to compare the drone with other innovations in their respective fields. For instance, one of the construction firms (C3) compared it to VR and AR technology, stating that VR/AR is "cool to look at" but hard to apply in the actual operation. Another interviewee (C2) also mentioned VR/AR and similarly claimed it has been hard to see an actual application area. The drone technology however, has been easy to fit with actual application areas, addressing real needs, which were acknowledged by the majority of interviewees. In relation to this, it was noted that it seems easier to match the drone technology with a suitable need the more knowledge the employee possesses about the task at hand. For instance, being a measurement technician with vast knowledge in construction measurement, rather than being an external drone pilot with no knowledge about the specific field or task. This is also one of the reasons why the majority of the interviewees said they prefer having drone competence in-house, adding it on top of their employees existing role and task. Competence will be further discussed in subsection 4.7.

Connecting this reasoning back to the theoretical framework, the innovation attribute of compatibility proposed by Rogers's (2010) diffusion theory is relevant to mention. Compatibility was defined as the match between the innovation and the organization adopting it, that is its consistency with "existing values, past experiences, and needs of potential adopters.". Based on what has been noted so far in this section, the drone technology seems to be compatible with varying organizations, fostering the diffusion process in accordance with Rogers's (2010) DOI theory. One of the municipalities interviewed (M3) concluded that the drone has been relatively easy to implement, since it suited well with how they already worked. The knowledge and skills needed to process the data from the drone they already possessed through their employees. Again, the underlying reason to adopt it as a tool became the increasing resource efficiency it offered:

"...from the start we discussed having a measure technician out in the field doing the measuring, but we realized quite quick that it was not possible, simply due to the amount of resources it would have required. This in turn sparked the whole drone discussion, which resulted in us starting to use drones as a tool. The amount of data that was being demanded in this particular case would have required a measure technician dedicated full-time. We simply lack the resources to do this, which is why starting to use drones became a natural step…"

M3, Early majority

Furthermore, the drone proved to be applied in all phases of an organization's operation. Before an event, such as collecting material to be used in decisions. During an event, such as getting an overview of an accident or ongoing fire. After an event, such as securing documentation or inspecting a final construction. This is likely to further contribute to its versatility. Still, it was often stressed in the interviews that it does not solve all problems alone. Instead it is seen as a complement to the rest of the tools used in order to increase resource efficiency and facilitate decision-making. The quote below by a forest actor (FI) demonstrates this:

"...the old method means going back and forth in the forest, which is hard in a dense forest. But with drones you can fly and get an overview of the area and the decide which areas needs further inspection…"

FI, Early adopter

Advancements in add-on technology accelerates drone development

As previously has been mentioned, the drone typically is used as a carrier of a sensor such as a camera. Often the camera is integrated in the drone itself by the manufacturer, but some larger drones allow the user to attach other, more traditional, camera technology. We refer to external sensor technology as add-ons to drones, which has sparked a sensor customization to fit drones. The fact that DJI, the leader drone manufacturer, acquired Hasselblad, an iconic camera manufacturer (Tech crunch, 2017), demonstrates this. An interesting realization in terms of this was that as the technology of add-ons has been developed simultaneously as the drone itself, it has fostered further increased application areas where drone technology can be applied. In other words, an integrated yet separate technology of the drone (that is sensor technology), has accelerated the innovation diffusion of drones. Again, referring to the forestry organization (FI) interview, they declared that significant progress has been made lately in developing an inventory method using drones, as the sensor technology (add-ons) has been improved. Previously, this limited their operation more rather than the drone itself. Another interviewee (C3) based in the construction industry acknowledged this by stating that the camera, and its dependency on good light etc., have been one main limiting factor.

The adoption of an innovation causes consequences, changes, in an organization. As outlined in the theory section of this study, Rogers (2010) divided these consequences as i) desirable versus undesirable, ii) direct versus indirect and iii) anticipated versus unanticipated. In the interviews it was noted that introducing the drone as an innovation have had both indirect and unanticipated consequences many times. A drone pilot (C2) working with measurements in construction captured this by stating that he continuously finds new unexpected ways of using it that improves his work. Similar unanticipated and desirable positive changes were also mentioned by other interviewees. In terms of undesirable consequences of unanticipated kind, the same drone pilot (C2) interestingly derived the heavy regulations on drone technology to the broad mass adoption of the technology, see quote below. The effects of regulations will be accounted for in next section.

"...like this, if the drone technology had been used only within the construction industry there would not have been any regulations. It is because the drone is used by the broad mass and ordinary people. That is the main reason we have all these regulations governing our drone operations…" **C2 (Drone pilot), Early adopter**

Customer satisfaction and their increasing request for drone data

An interesting aspect is that the actual end customer, the person or organization receiving the data that the interviewed organizations have gathered with drones, seems to have reached a point where they accelerate the innovation diffusion by explicitly asking for drone material. One of the construction organizations interviewed (C1) said that they have 100 % returning customers on those who have got drone material so far in different projects. Similarly, a municipality (M3) declared that their "customers" are often amazed over the broad amount of data they get and thus what the drone can provide. He said that once they have been "spoiled" with this richness they will continuously ask for drone data. As expected, when the end customer specifically asks for drone as a part of their procurement process, this will speed up the adoption of drone technology. Neglecting the drone technology and the demand for it simply seems to leave an organization behind its competitors offering it, why there ultimately will be no choice but to embrace it.

In addition, the broad spectrum of applications and the easiness to apply the technology stems from each organization's ability to be aware of its surroundings and the technological environment. Rogers (2010) arguments about openness and its positive influence on organization innovation fits well together with what Schneberger et al (2012) tells about the TOE-framework, and states how new technology and technological advancements in similar contexts can demonstrate new ways for organizational evolution, growth and technological innovation. This is because there is an underlying assumption that in order to understand the merits of implementing and diffusing a new innovation, there first has to be an understanding that the innovation exists. A municipality (M1) exemplifies this accordingly:

"...it is more during the last three years that we have started to recognize the technology as it has become widely available and how to apply it…" **M1, Late majority**

Thus, unless there is an understanding of how an innovation could be used, it is also hard to realize any underlying needs that the innovation itself could solve. This means that unless the organization is open for input and continuously screens its organizationally close environments for new innovation, there is a chance the organization will not find new underlying needs to meet or fulfill. However, if there is an awareness of the innovation and its application areas, merely acknowledging the availability of the technology, and in the study drone technology, it is possible for organization to realize underlying needs to improve their operations that otherwise would have gone unrealized. As such, rather than being a utopian discussion area of what could have been nice to have, the knowledge of the innovation can instead be put in to the organizational context, whereas underlying needs can then be realized to exist and met with the new innovation.

4.3 Rules and regulations

This section accounts for the theme "Rules and regulations prevents new innovation and influence the adoption of it" which stems from the code Rule and regulations. Below, the findings related to this theme are presented, analyzed and discussed.

Everyone awaits the new EU harmonized drone regulations

By the 1st of July 2020, the new EU harmonized regulations will enter into force. More or less all interviewees said that they apply a "wait and see"-approach what the new regulations will imply, that is taking no action before it is introduced and more details are released. Still, the rules will enter into force by the 1st of July, meaning that all actors operating a drone should be compliant by that date. Some traditional provisions exist. This might prove problematic since everyone will need to be educated and become certified at once, with all what that means. For instance, one of the municipalities (M1) expressed this worry, arguing that too rigid and radical rules cannot be forced into place in such a short period of time. The fact that the main majority seems to wait and is unaware of what exactly is to be expected, might indicate that the information from the concerned authority has been inadequate. Another municipality (M3) similarly expressed:

"...otherwise, we just follow the directives. For the time being we wait until there is something more concrete to consider, as of now there just a bunch of different interpretations and speculations…" **M3, Early majority**

As Rogers (2010) concludes in his DOI theory, the process of adopting a new innovation starts with gaining knowledge and gather information, before the decision can be made. In relation to this, complexity was proposed as an innovation attribute that prohibits innovation diffusion. This refers to that the more difficult an innovation is to understand and use, the more skills and knowledge are required, slowing down the rate of adoption. As asserted in section 4.2, the drone itself as an innovation seems easy to use in terms of flying it, perceived as not that complicated.

But, since the regulations to a great extent dictate the terms how it can be operated, the user needs to stay up-to-date and understand the regulatory framework before using drones (similar to acquire a driving license before being able to use a car). This obviously seems to be a struggle and thus might increase the complexity perceived by drone adopters. This in turn means that potential new adopters of drone technology might put the implementation decision on hold, slowing down the innovation diffusion process. At least until clarity regarding the new regulations emerge and molds consensus in the social system of adopters.

There is an unmistakable uncertainty in terms of the drone regulations
One interviewee (SF) mentioned that the uncertainty in terms of regulations actually has led them to not apply drones at certain occasions, even though they had the chance and it would have been beneficial to do so. Thus, the ambiguity of rules and regulations has hindered their adoption and usage of drones. Similarly, another interviewee (M2) who operated drone for his municipality expressed that flying in an urban area often is hard since permits are needed to fly over people and property, which had disturbed their usage of drones. This overall uncertainty in terms of the regulations and how to interpret them were mentioned by more or less all interviewees. Subjective or not, drone users find the regulatory landscape confusing, illustrated by following quote:

"… there has been a lot of changes during the last three years with many new laws, first Länsstyrelsen was in charge, now I think it is Datainspektionen, and now it is EU as well…" **M3, Early majority**

It is not only the end user (drone pilot), this is the organization applying drone technology in their operation, that is affected by the regulations. The actors that actually develops offerings based on the drone technology are to a great extent influenced in what they can and cannot do. For instance, developing autonomously flying drone systems is not worth the effort if the regulations prohibit this kind of innovation. In this study, two technology developer start-ups were interviewed, sharing their view on the matter. Both were categorized as innovators according to the DOI theory by Rogers (2010), and acknowledged that they have felt hamstrung in developing their innovations by the regulations at certain points. This essence of it was framed by one of the two:

"...the biggest hindrance is the uncertainty regarding directives from authorities in order to fly as intended. The stakeholders we discuss with are all very enthusiastic about what we are offering, so the question is rather if we are allowed to do it. The problem is that when you call Transportstyrelsen, they say that they cannot make general statements. Instead, you are asked to send in a description of your specific case, whereas they will make an assessment of the specific case…" **TD2, Innovator**

The TOE framework by Tornatzky and Fleischer (1990), emphasis the regulatory system as one of the main elements affecting the environmental context of an organization. In turn, this influence the innovativeness and ability to adopt new technology. Concretely, it is proposed that regulations can implicate both beneficial contexts as well as suppressing opportunities for organizations. Based on the results presented so far in this section 4.3, regulations seem to be one of the main influencers on drone technology and the innovation diffusion process of it. In this aspect, the TOE framework seems to be relevant in researching drone as an innovation.

Regulations have lagged behind the rapid technological development of drones

Thus, balancing the regulations and making sure it does not prohibit innovation is vital in order foster continuous development and innovation. As outlined in section 1.1.2, EASA seems to have acknowledged this, claiming the new regulations to be "innovation-friendly". Nonetheless, it is likely that new regulations will suit some industries and operations better than others. As previous versions have. Again, one of the technology developers witnessed how the regulations has been very centered around the actual user flying the drone, leaving the developers in the shadow, as the previous quote demonstrated. However, having an EU-harmonized regulation of the technology was welcomed since it allows actors to operate outside Sweden much easier than before. Interestingly, this in turn could speed up the innovation diffusion of the drone technology, demonstrating how regulations can go both ways. This is why it becomes more important than ever that the new regulations have taken all the aspects in consideration. Still, it is likely after it has been fully implemented that we know for sure how all stakeholders will be affected. Until proved otherwise, the regulations seem doomed to continuing lagging behind the rapid technology development:

"... it is the regulations that hinders the technological development, for sure. Policy makers struggles with keeping up with the rapid development pace…" **TD1, Innovator**

Moreover, an element that was mentioned by several interviewees from different industries, when being asked to reflect upon the regulations, were the request for exceptions in the regulations. The argument made was that this would allow a more flexible compliance, enable certain actors to operate their drones in a desired way without neglecting or even breaking the rules. For instance, it was suggested that being able to close a certain part of an airspace dedicated for the drone operation would have been beneficial and allow a broader application of drone usage. Another suggested having less strict rules in rural areas were people nor property could come in harm's way. In relation to this, it can be concluded that "generous" test beds and facilities are likely to become extra important for new drone innovation in this regulatory landscape. This should definitely be exempted from relevant regulations if needed in an early phase of the development. Nonetheless, a general optimistic view towards the new regulations were noted since the hope is it will be better suited than the present framework in place.

Keeping up with regulations is perceived as costly and exhaustive process

In the interviews, it became obvious that keeping up with regulations and staying compliant requires effort and resources. In some cases, to the extent that the rules are neglected. An interviewee even admitted that they have deviated from the rules by flying out of sight at numerous occasions (not allowed without permits), though emphasizing it was done in a safe manner. Otherwise they would not have been able to achieve the real advantage of using drones in their specific circumstance, which demonstrates well how the potential of drone innovation is limited by a too rigid regulatory framework. Those who do stay compliant with the regulations, stated that it is a resource intensive process, best illustrated by this quote:

"...rules and regulations dictate the terms of usage to a great extent. A more complicated regulatory framework, where we cannot make detours from the main framework, requires more resources from us…"
FD, Early adopter

The interviewees based in construction expressed similar opinions and said that this is one of the main reasons why they had chosen to centralize a drone function at their respective organization, having full-time employees making sure the drone operation is safe and compliant with regulations. A key component in staying compliant with the regulations is providing a proper education of the actual drone operators. Around half of the organizations operating drones said they had established internal drone education to keep their pilots up to date. The governmental actors, especially the municipalities, seemed less interested in having internal educations instead relying more on the drone supplier's initial introduction. Nonetheless, this demonstrates that resources are typically needed in order to stay compliant with regulations, logically implying that for organizations with more resources it should be easier to stay compliant than for smaller actors. This reasoning aligns with both DOI and TOE theory, stating that organizational size and slack resources in general foster the innovation adoption process. On the other hand, larger organizations typically operate more drones, demanding more resources per definition. Interviewee C1 captures this quite well:

"… We have developed our own internal drone education, adapted to the present laws and regulations. This means we will have a "fun" journey this summer when the new EU harmonized drone regulations come, since we probably have to re-certify and educate our 70 drone pilots in short notice …" **C1, Early adopter**

4.4 Operation of drones

This section accounts for the theme "Operation of drones is not an isolated activity" which stems from the codes Cooperation and partnership, Social process and Openness. Below, the findings related to this theme are presented, analyzed and discussed.

Throughout the study, it has become apparent that the more openness and cooperation an organization has towards its surrounding environment, the more potential they can extract from the innovation. Drawing on Gerard's (2005) explanation of slack, the value of using drone technology and minimizing the unused potential is related to an organization's ability to cooperate with affected parties when flying, such as military zones, urban areas, airports etc. While mentioned in all interviews, a fire department demonstrated the most difference in the drone technology potential in regards to cooperation:

"... we are allowed to fly within military zones as well, but then we have to contact the commanding officer first for approval. We are allowed to fly over for example arenas that are otherwise closed zones. We are also allowed to fly beyond vision line of sight. The requirements then are that we call Luftfartsverket and have them close that geographical area for other airborne traffic. We can thus in collaboration with them generate a free flight zone for us to operate within…" **FD, Early adopter**

Whereas, the better the cooperation is, the more step-offs and temporary permits can be made between the affected parties, resulting in a better usage of the innovation. Furthermore, the potential for the drone technology is enhanced with cooperation within organizations and their partners as well, demonstrating that not only does cooperation between regulatory parties matter, but there is also a knowledge-aspect to the cooperation by which cooperation for a better understanding of the innovation itself can be related to its potential. A municipality exemplified how they used cooperation between municipalities:

"...we have an exchange between nearby municipalities which also has land surveying functions, where we meet once a year in order to discuss thoughts, ideas and legal aspects. Last time, the final theme was a demonstration of the drone and how it could be used, and that is when we realized a great potential in using drone technology ourselves…" **M1, Late majority**

As Rogers (2010) defines the social system like "*a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (*p. 23), an organization's cooperation with both internal and external parties and the extent of the organizational social system thus determine the value of the innovation and its organizational diffusion. Thus, without the dialogue and cooperation with affected parties or with other partnerships, especially the regulatory societal entities, the interviewees implied that the possibilities to utilize the drone becomes limited, whereas the better the cooperation, the less slack will be perceived by an organization. As the drone technology is dependent on using a shared resource, the airspace, the more collaboration there is between all parties, the more efficiently the airspace can be used in favor of each organization, enhancing the potential of drone technology. Another municipality (M3) exemplified how collaboration enhances their use of the airspace, whilst still experiencing that there is hierarchy in who is allowed to use the space.

"...we have good collaboration with the airport, we have so called collaboration agreement with them, meaning that they have sent us a map of areas where we have to call them beforehand to check if the airspace is available. We also have military airborne vehicles, such as helicopters flying around this region, so sometimes we can be forced to suspend our drone flight with short notice…" **M3, Early majority**

However, with collaboration and open communication, the use of airspace was said to be open to reconfiguration, meaning that with a high amount of collaboration, for example airplanes could be directed to different routes in order to make way for the municipality to use their drone, that otherwise would not have been possible. Hence, in order to use the drone technology to the best of its potential, it seems there has to be an active engagement in social system activities, where all entities together collaborate in order to solve the problem of using drone technology for certain purposes or in different locations.

On another note, it has been shown during the study that organizations classified as innovators (DOI) are more dependent on openness to a social system than the later segments, the reason being that they pave the way for new innovation development and the market innovation fit. One innovator (TD2) exemplified the importance of openness to social systems and collaborations within their field as:

"...we have always been open for collaboration, it feels stupid to sit and hold on competences here in Sweden when we merely have a fraction of the world drone market, so it is better to collaborate and enhance the product offering together…" **TD2, Innovator**

Another innovator (TD1), who has built a company group of companies supporting his development of large drone solutions, further explained his approach to actively engaging in a social system:

"...I have built a business center consisting of 25 companies collaborating under special conditions...there are several components in this model, such as the CEO:s having lunch together once a month to exchange experiences and competences…" **TD1, Innovator**

Thus, it can be said that openness and collaboration are important aspects for all organizations, however the underlying reason for its importance varies with the characteristics of the drone operation. For example, openness and collaborations are important for innovators (DOI) in the sense that social systems acts as innovation accelerators, meaning that collaborations further adds to the abilities and functions of the technology that is being developed, combining the competences and expertise of many different areas for being and enhanced product that more easily fit the intended market and eases its implementation. The social system and openness for innovators is thus more focused on other innovators, whereas for the organizations purchasing the drone technology, the openness and engagement to social systems is pivoted towards more regulatory entities, meaning that in order to fully utilize the innovation that has been developed, there has to be an active engagement to collaborate with the regulatory entities and other stakeholders. As such, without the collaboration, the innovation itself risk being too underdeveloped in order to meet the needs of the targeted market, whilst the market risk on losing out on the potential and possibilities that the innovation sits upon.

To add on the previous paragraph, there seemed to be a need for awareness in regards to the new technology innovation (drones) that also had a fostering impact on innovation diffusion. With what Rogers (2010) mentions as observability and compatibility, one interviewee explained his experience about being open with what they are doing:

"...it seems to be noticeable that we are using drones in our operations. We have made a lot of presentations on both schools and other forums… obviously, our activities are observed by others when we demonstrate how we use the technology, which in turn might inspire them to use this technology themselves. I think a lot of people feel like using drones is something they could do as well…" **C3, Early adopter**

Hence, with drone technology visible to see and understand, the mere awareness of its existence seems to become a springboard for organizations to compare it with their own organization and analyze the compatibility of it to the organizational characteristics. Overall, there seemed to be what Tushman and Anderson (1986) refers to as competence-enhancing innovation, meaning that the drone technology added value of more expertise with its implementation in all the interviewed organizations, adding to the notion that drone technology is constitutes of a very broad spectrum of usage areas. The key takeaway from that although was that organizations did not find drone technology or its merits the main challenge, but rather the surrounding activities such as regulatory framework awareness and flight zones the main areas to effectively handle in order to gain as much potential as possible from the drone technology.

By and large, openness regarding drone technology is thus not only important for organizations in a sense that they are open to incorporate new knowledge and insights, but rather also being able to be open towards others is generating traction for the drone technology itself, where more areas of usage can be realized and observed for further innovation diffusion. Organizations taking the lead on regulatory aspects and the mere handling of surrounding aspects also serve as a catalyst, where openness on how to handle those questions make way for more organizations to follow the same path and utilize the drone technology to its full potential.

4.5 Implementation process

This section accounts for the theme "The implementation process is i) organization specific ii)) has been characterized by lack of track record" which stems from the codes Implementation, Information gathering, Compatibility and Strategy. Below, the findings related to this theme are presented, analyzed and discussed.

As one could expect, the implementation strategy differed significantly between the organizations interviewed. Some actors have established a predetermined strategy based on extensive information gathering on how to best implement drones into their specific operation, while others have embraced a "learning by doing"-approach, without formulating a strategy at all. For instance, a governmental actor (FD) based in firefighting stated that they did a 1,5-year investigation before they actually bought the drone technology. Others bought a drone from start. It was acknowledged that the time and resources spent before adopting a new innovation naturally depends on the characteristics of the organization, such as hierarchy structure, degree of centralization and what task to be performed. Thus, a less developed strategy from start does not necessarily mean fewer satisfying results. Moreover, there is not just two approaches. Other organizations applied a mixed approach, as demonstrated by interviewee C1:

"...mostly, we have let our usage of drones develop as we have been using them, learning by doing. We identified some key questions and areas of importance whilst flying drones, and when we felt we had a solid concept we could scale it up further…" **C1, Early adopter**

Centralizing the drone function and support seems beneficial in certain cases

Not only did the implementation strategy differentiated between organizations, the organizational structure chosen did. It could be seen that larger organizations tend to establish a centralized drone function in order to address the questions and issues involved in implementing the drone technology, especially among the private actors. Some of these (C1 and C3) even had a group of full times employees which they said is quite unusual when adopting an innovation, proving a unique point of drones. One of these had even grown to the size that it had become a matter for the corporate group's management to consider. Regardless, the decision to centralize a drone function typically stemmed from requests rising from the bottom of the organization to the top, as this quote shows:

"...there have been a lot of inquiries regarding usage of drones to the board in Stockholm in terms of how to use them, if to use them, and what laws and regulations to adhere to. It was unorganized, everyone was doing their own thing, which is why we decided to appoint the Drone Committee, to establish a common ground for all 20+ branches of our organization. This accelerated the implementation process…" **SF, Late majority**

Centralizing the drone function seems to have been a successful strategy for those applying it. As previously declared, there are several components involved in operating drones as an organization. Processes and routines need to be in place, the pilots need to be educated and up-to-date, permits and software needs to be acquired - to mention a few. Having a drone function, with a team and expertise dedicated to this task, seems to foster an efficient flow and usage of the drones technology, maximizing its potential. Those organization who had centralized a drone function were satisfied with the results. It became especially interesting when we had the opportunity to interview a drone pilot who actually is the end "stakeholder" in this. Working at a construction firm with a centralized drone function, he agreed upon their importance for his day-to-day work when operating the drones:

"...the drone department has played a very vital role, we would not have the drone technology we have today and used it the way we do, had it not been for the centralized drone department. We as pilots do not have the time to keep up with regulations, and we would definitely not have time to develop the necessary software which enables us to use the drones effectively and process the data gathered…" **C2, Early adopter**

Governmental actors proved more reliant on their external context

Not only did the internal organizational context seems to affect the innovation diffusion process. Some of the organization interviewed proved to be more dependent on external competence, their environmental context, in the process of implementing drone technology. Especially, it was noted that the governmental actors in terms of municipalities relied on external competence to a greater extent than the private actors. This is demonstrated by one of them (M3) in the quote below. This logically has the implication that the better the sales skills of the suppliers are, the more rapid the innovation diffusion process can be expected to be. Especially in an early phase of innovation diffusion when there is limited previous "peer cases" to observe and consult. In terms of the DOI model by Rogers (2010), this might not be the case for the categories of innovators and early adopters since they are overall positive to new technology. But for the majority category, suppliers can be key in convince them of the usefulness of the innovation at hand. Thus, bridging the so-called chasm, termed by Moore (2014), referring to the tendency of innovations failing to make the leap from innovators/early adopters and the majorities/laggards.

"...we have had suppliers that have shown us drones before, so we knew they existed and that the technology was emerging. Around the time there was a bigger project that we were involved in, where we identified that we could use drones. Thus, we called the suppliers and had them show us the drones again, after which we chose on of the demonstrated drones…" **M3, Early majority**

Observability in an emerging industry - moving towards standardization

It is safe to say that the drone industry is still emerging, even though sectoral differences exists, and early adopter categories and late categories can be found in the same sectors. This is interesting since TOE (Tornatzky and Fleischer, 1990) affirms that organizations that are part of a growing industry have a higher tendency to engage in innovation than in a mature industry. Still, some organizations believed the technology is approaching its peak in terms of maturity while others believed in it still in an early stage. Nonetheless, the novelty and lack of track record due to the rapid technology development were numerous times reported as a hindrance. This simply because there has been limited previous cases to observe as touched upon. Observability of a novel innovation is emphasized as a fostering factor for diffusion by both the TOE and DOI theory. As Schneberger et al. (2012) proposed in line with the TOE framework, being able to observe new technology applied in a relatable organizational context in turn enables recognizing how it can be implemented. This is captured by the innovation attribute of observability by Rogers (2010), stating that transparency and visibility, particularly between peers, offers exchange of experience between adopters which in turn enables increased innovation diffusion.

For instance, construction firm (C1) categorized as an early adopter, stated that in their first years of operating drones they had to invent best practices and even develop their own software. Basically, there were no suitable offerings out there and few peers to consult. In terms of the DOI theory and the proposed adoption categories, the innovators and early adopters seem to pave the wave in this sense for later categories, such as majority and laggards who now start to have previous cases to study upon implementation. Since some industries proves more mature than others in using drones, new standardization resulting from drone usage, could be seen. The fire department (FD) mentioned that their parent union was developing standardized packages based upon the innovation of drones. Furthermore, one of the drone pilots interviewed (C2) was asked to reflect how it compared to previously introduced innovations in his field and stated:

> *"… In my opinion, once every ten years an innovation so revolutionary and cost efficient that it becomes a new standard within our industry - the drone is definitely one. It enables cutting costs and man-hours which enables focusing on much else…"* **C2 (Drone pilot), Early adopter**

Consulting peers differs between private and governmental actors

Furthermore, there seemed to be a difference between governmental entities and the private sector regarding the degree to which they used their social system in the information gathering phase to decide whether to implement drones or not. This might be explained by the fact that the former has no profit requirements, compared to private organizations, which seems to enable broader exchange of experiences with peers in terms considering new technologies. In the private sector there seemed to be more focus on timesaving or less man-hours, combined with less willingness to engage in a social system in terms of disclosing company specific information to their competing peers. Whereas for the governmental sector, engaging in a social system was seen as a mean of keeping up with other municipalities and help each other as colleagues. For instance, one municipality (M1) told us they had annually meetings with neighboring municipalities where they gathered and discussed new innovations, as drone technology, and the questions it imposes. This ties well into what Rogers (2010) referred to as the element of communication channels, proposing that the process of innovation diffusion is social and to a great extent "relies on potential adopters imitating peers" and partners who already have adopted the innovation. In addition, all three municipalities (M1, M2 and M3) declared that they had been in direct or indirect contact with other municipalities as a part of the implementation of drones. On contrast, the (private) construction firms interviewed were competitors and had only monitored each other's drone operation from distance, with no direct contacts. To finalize, in regard of our theoretical framework, the private sector seemed to engage in new innovation implementation earlier in accordance with the innovation diffusion curve (Rogers, 2010), as well as choosing to do their information gathering about new technology in-house compared to public actors.

4.6 Innovation champions

This section accounts for the theme "Individual innovation champions are key drivers in the incorporation of new technology" which stems from the codes Attitude, Bottom up, Top down, Innovation champion and Time. Below, the findings related to this theme are presented, analyzed and discussed.

Innovation diffusion relies on innovation champions

Innovation champions, derived from idea champions (Schön, 1963), proved to be key for the adoption of new technology, a phenomenon that was emphasized by most of the interviewees from different types of organizations (especially by FD, C1, C3, M1, M2, FI). Interestingly, not only in the private sector but equally important among governmental actors interviewed which were surprising. It was stated that someone needs to willingly take the lead when implementing something new. Thus, champions were often pointed out as an enabler and key driving force for a successful implementation of innovation. These individuals were often described as "technology-keen" and "curious" by the interviewees. It also showed that their personal interest in drones not seldom guided their actions in their professions. For instance, the quote below illustrates how interviewee (C3), described as a champion, used his creativity to overcome the hurdle of cost in the early phase of drone technology:

"...at the time, I spent a lot of my free time flying drones, and realized that we could build drones ourselves at the company. So, we built 8 large drones that cost 30 000 SEK a piece instead of 300 000 SEK, which in turn made it possible to utilize the technology ... we chose 8 measuring technicians that became our test pilots. It was a way to access the technology at an affordable cost, so that that we could implement drones in live projects to see its potential and the advantages…" **C3, Early adopter**

This finding clearly demonstrates champions' importance to innovation diffusion. This aligns with the research in the theory section, stating that the innovation process is often dependent on innovation champions on an organizational level (Rogers, 2010). Similarly, the TOE framework acknowledges champions to be associated with technology adoption (Tushman and Nadler, 1986). In relation to this, it was noted that innovation champions seem to be of particular importance in the early stage in the adoption process, when the innovation is most vulnerable to rejection. Rogers (2010) described the adoption process with five steps where the first three should be considered "early stage": 1. Knowledge (awareness and fundamental understanding), 2. Persuasion (forming a positive or negative attitude towards the innovation), 3. Decision (rejection or adoption). Innovation champions are key in bridging the gap between each phase. Typically, it all started with one individual who took action and mobilized resources which set the process in motion, often based on a vision that others could not see at that point:

"...I was hired as [the first] drone pilot by my colleague who initiated the drone function within the company. He had an interest in the technology and saw that it could be used within our operations. He started it as a side project to his main working duties…" **C1, Early adopter**

As one can expect, being a champion and fighting for an innovation is typically not a straightforward process. It involves overcoming resistance in order to unite the organization's members, consisting of both proponents and opponents. Rogers (2010) accounts for the importance of innovation champions in the DOI theory, acknowledging their key role in overcoming resistance and skepticism towards a new innovation. He adds that these individuals can be found at any level in the organization, not only in the top management. In our interviews, it became clear that champions tend to be found in the lower part of the organization, in close proximity to the application of the innovation at hand. Nonetheless, the common denominator is that these individuals use their charismatic side to influence others, willing to take risk and action that others are not, making them innovation-minded (Rogers, 2010). One of our governmental interviews (FD) expressed his empathy for what it takes to be a champion:

"...we are a pretty large organization, which means if an individual thinks of a good idea, the journey to have the idea realized and implemented is quite long. And unfortunately, the interest to pursue the idea can fade away when facing too much resistance coming from the bottom up…" **FD, Early adopter**

Bottom-up implementation proves preferred

In the absolute majority of the cases interviewed in this study, the technology adoption typically stemmed from bottom-up in the organization, in contrast to directives coming from the top management. The researchers concluded that the explanation of this is likely to be the proximity the employees in the bottom of the organization have to both the actual need and the technology. Their hands-on knowledge and expertise seem to make it easier find a place for a new innovation within the particular operation. Now, this may be problematic since lower hierarchies naturally possess less decision authority than higher hierarchies, meaning that the decision to adopt new innovation cannot be made by themselves. Thus, the top management ability to acknowledge initiatives and request coming from the bottom of the organization will affect the innovation diffusion process to a great extent. Rogers (2010) termed this the attitude towards change by individual leaders in an organization. If the attitude and ability to listen is favorable, this will have a positive impact on the innovativeness and vice versa. One of the interviewees based in the forestry industry sheds light on this aspect:

"...top management are very keen on listening on the ones working out in the field. Take the drone app for instance that has been developed. It was not initiated by top management, because they do not have insights or specific knowledge of the daily activities in the field. It was the field personnel that expressed the need for this innovation…" **FI, Early adopter**

Obviously, it seems to be a clear perceived advantage when an innovation stems from the bottom of an organization. This does not mean that implementation cannot be successful top-to-bottom. However, when initiatives to implement an innovation comes from the top, there is a risk that the innovation at hand actually does not contribute as expected. Simply because top management naturally lack the full insight and knowledge in most cases that the lower functions with proximity to the actual operation have. One way of mitigating this risk is to include representatives from the "bottom" of the organization in top management discussion when considering a new technology. Nonetheless, even if an innovation is adopted from the bottom and proves successful and its operation grows, it often comes to a crucial point when the top management needs to be convinced anyhow in order to take the next step. For instance, it could concern questions as how to form the organizational structure around the new innovation or how much resources that should be spent. This could be a hindrance where a promising innovation coming from the bottom is dismissed, potentially losing the total benefit it would have brought. One of the construction interviewees (C1), responsible for the drone operation, expressed that he had lately felt hamstrung since they reached a point where the group management needed to be involved. However, the journey up until this point was described as:

"...our [drone] group has grown from the bottom and up in the organization. Which is good, since we realize what the projects actually want. That in turn makes us profitable, which is a huge advantage…" **C1, Early adopter**

Attitudes towards innovation and the importance of testing

The organizational specific context in which the drone technology is used seems to affect its overall potential. It was noticed that those organizations with a clear practical connection, referring to having employees out in the field firsthand seeing the need, tend to apply drones to a greater extent than less "practical" fields. For instance, the organizations based in construction and forest industry indicated this. This contributes to a positive attitude toward change.

"...to my knowledge, it is the forest industry that buys the most amount of drones in Sweden today...it can probably be explained by the fact that they spend a lot of time in the field and thus experiences the time saving. Also, the landowners are expressing their desire for this kind of drone material..." **FI, Early adopter**

The key of testing and having a curious mind-set towards new innovation were emphasized as a key component in successful technology adoption by numerous interviewees. This enables the organization to get their hands on the innovation and test its potential in regard of their specifics before a full-scale adoption is made. As demonstrated by the first quote in this section, the innovation champions often have a key role in making the testing happen and then bridge the gap to final implementation. Both private and governmental organizations stated that clearly motivating the adoption decision is essential:

"...I think that overall, it is not that hard to get approval to purchase new technology for testing...with a decent motivation explaining the purpose and why we want to test it, the investment for testing is as a whole insignificant…" **C3, Early adopter**

In relation to this, the same interviewee also stated:

"...quite often, technology and innovation are bought for testing and when more people want to use it, it becomes obvious: Hold on, who is going to run point on this? How does it work with licenses and other practical issues?" **C3, Early adopter**

This quote demonstrates that the testing phase is also important to reveal factors that need to be addressed if the decision is made to implement the technology. Rogers (2010) captures this aspect with his innovation attribute of trialability, described as the degree to which an innovation may be experimented with. As expected, an innovation that is triable offers less uncertainty than an innovation that is not triable. However, the line separating testing or trialability from adoption seems unclear. Is buying one drone for testing purposes testing or implementation? Nonetheless, the point made is that testing enables the decision-maker to evaluate an innovation at a low cost, mitigating the risk of spending resources on something that later proves useless. This was particularly emphasized by three actors (C1, FI, C3). Still, there are more ways to test a new technology. One municipality (M3) declared that their first testing of drones was hiring a consultant that provided them with a material that they could evaluate.

Not only the attitude of the decision makers and actual user of an innovation affects the innovation diffusion process. It was found that the end customer's attitude is also important to consider since they have the power to dictate terms in business deals. Especially the construction organizations stated that it is becoming increasingly common that their customers require drones to be used in the process, since they have perceived the value it brings in previous projects. This means that using drones seems to have provided a competitive advantage which will logically accelerate the innovation diffusion process in a social system of adopters. C1 expressed this phenomenon:

"…We have actually won projects where drones have been a requirement connected to the construction process. I have never seen that elsewhere before. We actually do jobs indirectly for our competitors, since their employer request our drone competence…" **C1, Early adopter**

4.7 Competence of user and organization

This section accounts for the theme "The competence of both the user and the organization determines the potential of the technology" which stems from the codes Competence, Resources, Work process development. Below, the findings related to this theme are presented, analyzed and discussed.

An interesting finding was made when the interviewees were asked to explain whether or not the drone technology were perceived as "competence-destroying" or not. The researchers of this study expected to find some support for this, considering the revolutionary character of the drone technology. However, it did not seem to be the case. The attitude towards drones was overall that it is a complementary tool that makes the employee using it more efficient compared to previous methods. One of the drone pilots interviewed, also a measurement technician, stated:

"...sometimes we could receive invoices of 15 000 - 20 000 SEK from the drone department, which made the site manager wonder why we had to pay. But when I could demonstrate that the alternative cost was 100 000 SEK for me doing the measuring the traditional way, it was fine. There has to be a purpose and a profit of some kind with the technology you implement…" **C2 (Drone pilot), Early adopter**

The TOE framework elaborates on whether or not an innovation is "competence-enhancing" or "competence-destroying" in terms of discontinuous technology, stating it needs to be taken into consideration by the adopting organization (Tushman and Anderson, 1986) . Here it seems that the drone is perceived as ”competence-enhancing” rather than “competence-destroying, referring to enhancing existing qualifications and expertise of the employees. This is likely to be another key explaining factor why the drone technology seems to have diffused at the rate it has, compared to other technology. One of the interviewees captured this relationship:

“...it is beneficial to make sure that the ones that are educated to operate a drone already have previous experience about the task at hand. For instance, a measure technician has experience and fundamental understanding of measuring procedures, and can thus understand and handle drone activity that are aligned with that purpose. For that reason, it is a bigger advantage to have your own personnel flying drones. I prefer to see many of us flying less but targeted flights, rather than having a few of us flying a lot…” **C1, Early adopter**

In terms of competence, almost exclusively all actors interviewed said they preferred having drone as an inhouse competence rather than outsourcing it. Numerous reasons were given as explanation to this. For instance, the material and data gathered by the drone can be of sensitive character, or even confidential, which is why external insight needs to be limited. Moreover, many interviews said it is cheaper to have it inhouse in the long term: hiring a drone consultant for every flight is expensive. Another important aspect was that having the drone competence inhouse, the organization ensures full control and know what they can expect from the data gathered. This is not always the case when outsourcing to an external actor. Finally, as the quote above demonstrated, inhouse competence ensures that the user (employee) know what the drone should be used for and how, especially if he/she possess industry specific skills of the operation at hand. This can be hard for an external drone consultant to understand if being temporarily hired. However, establishing and retain the drone competence inhouse can be a resource intensive process, often requiring supporting functions as accounted for in section 4.5. The following quote demonstrates this well:

“...our drone department is a function where we support everything that has to do with the drone operations, such as licenses, software, education, permits and so on. The actual flying of the drone is the easy part, it is the surrounding elements that needs to be addressed. And that is way we have full-time employees working with this, just to offer full support to the drone pilots…” **C3, Early adopter**

Regardless of size, all organizations operating drones will by the new EU-harmonized drone regulations be required to become educated and certified to legally fly. With that said, even though the existing rules and regulations have been more liberal in terms of training and education for drone pilots, there has already been a need for that, expressed in our interviews. Typically, our study found that bigger actors with larger drone operation and/or more resources tend to establish their own drone education internally. This in order to make their drone employees compliant and confident in using the technology to achieve company objectives. On the other hand, smaller actors seem to lack the resources for having the same organizational structure and thus rely on external competence to a greater extent in terms of training. The municipalities (M1, M2 and M3) all relied on the introduction and/or addition course offered by the drone supplier. As previously been reported, flying the drone was perceived as easy by the interviewees: it is the elements around its operation that can be challenging and resource intensive. This will now be further elaborated on in the final theme, section 4.8.

4.8 Data gathering

This section accounts for the theme "The data gathered is broad and (often) demands complementary assets and supporting functions" which stems from the codes Data gathering. Below, the findings related to this theme are presented, analyzed and discussed.

The final theme discusses the thematic code from data gathering, and is similar to the rules and regulations code an issue that was widely described and discussed during the interviews. The data gathering code focused on organizations ability to use drone technology for data collection, and the advantages and disadvantages of doing so. One point that was discussed and mentioned by every organization was the amount of data that the drone technology is able to provide.

"...first and foremost, the amount of data that can be gathered during one flight is remarkable, you can gather so much data about volumes, views, distances and other perspectives that is not possible from the ground…"
M3, Early majority

The drone technology was seems superior in its ability to collect multiple types of information that could be of value to the organization, as it could provide overlooks and collect several types of data at the same time, saving time and resources to the organization. However, with the fair amount of data, there was also issues with the handling of the data, as the amount of data was far more than previously experienced by the organizations.

"...from the amount of data we gathered, we have not had the capacity or software to properly handle it. Sometimes, it has been easier to let two people run around for two weeks and measure the traditional way instead of sending up one drone one day to gather all the data…" **C2 (Drone pilot), Early adopter**

Hence, despite the superiority of using drones, the lack of supporting functions and complementary assets made the drone appear of lesser value, as the complementary task that needed to be executed could not be done efficiently enough to exceed the previous technologies. Collins et al (1988) mentions based in the TOE framework how the technological current status of the organization influences the speed of which implementation can be done. Especially in the earlier segments, according to the DOI framework (Rogers, 2010), organizations seemed to be struggling more with fitting their organizations technological current status with the necessary technological level required in order to operate and utilize the drone technology potential to the fullest. Often, it required the organization to update the technological status in order to adapt to the technological requirements and utilize the information the drone technology could provide more efficiently. The most distinct areas where the data handling became an issue was firstly data processing. Due to the amount of data, the collected data often had to be sent for processing where there were computers with enough processing power to manage and sort out the data. Seldom could data processing be done in connection to a drone flight, but rather there was a lagging time in getting the memory card to the proper computer. Secondly, once the data had been processed, organizations found it had to actually apply all the data that they had collected. Due to the amount of data, there were issues with making sense of the data collected and apply it.

"...I think that there are a lot of things missing on the software end. We have had to develop our own software in order to manage certain aspects since there has not been any viable alternatives...this was to a great extent the reason why we paused the internal education of drone pilots, we had to figure out how to tackle the amount of data gathered and generated. Once we had found a good work methodology, we could proceed…" **C1, Early adopter**

Thus, with using drones, the lack of complementary functions to support the data that had been collected proved to be one of the key hindrances to overcome in order to efficiently utilize the drone technology to its fullest. Furthermore, the amount of different kinds of data often required many different types of software, whereas unless the data was structured beforehand and analyzed in the proper software program, the data made no sense and was thus perceived to be of lesser value. With previous technology the methodology was perceived to be more hands-on and clearer, where one technology had one purpose and a designated software to handle its data. With drone technology, the amount of data collected is so broad that the methodology of how to analyze it is unclear, and unless there is a proper methodology of how to handle it, the drone technology and its merits can be perceived to be of lesser value.

Subsequently, the effectiveness of using drone technology highly correlates with an organization's ability to comply with the complementary technologies needed. The better the fit with supporting technologies, the more value can be extracted from the drone technology, and the amount of drone potential slack can be minimized. Rogers (2010) explains how the complexity of an innovation can be a determining factor in the rate of innovation diffusion, where however in this study the complexity of drone technology does not lie in the technology itself, but rather the complementary tasks and functions that need to be executed. Drone technology is thus easy to use, but the results it produces are more difficult to understand and requires the organization to learn the required skills and knowledges in order to make use of it effectively. By and large, once the methodology for using and handling the data that drone technology can produce is established, the value of the drone increases significantly illustrated by this quote:

"...what typically happens is that a drone pilot goes out and flies the designated area, after which the data is sent to us for processing and refining. Then it is uploaded to the cloud platform, where points of interest can be measured in the program. This saves a tremendous amount of time. The final report then goes to the controller and finance department who can then determine the monetary value and use that as an input…" **C1, Early adopter**

Once again, the perceived value of the drone technology correlates with the ability to process and handle the data that is collected, where the more refined and structured data enhances the drone value. As exemplified in the above citation, the value of the drone lies in the organization's ability to process the data, which in turn provided an opportunity to have only one drone pilot collecting data instead of having several people doing it, which is a cost-efficiency since those manhours can be put to use elsewhere. The refining and quick gathering of data further made it possible for the organization made use of the data in other departments such as finance, which in turn can be analyzed as that the value of drone technology is not only determined by the technological support and complementary assets, but is also correlated with the organization's ability to refine the data and disperse it to departments of interest. In this case, the organization's ability to handle and refine data made it possible for the finance department to keep an updated and more real time value on inventory.

In addition to this, nearly all interviewed organizations state that the broad collection of data made it possible to revert back to data about an area that had been flown over in order to double check other data than initially intended. Meaning that if there was a need to check something more, the chances were good that the drone had gathered data about that specific issue as well thanks to its broad spectrum. Conclusively, all interviewed organizations acknowledged that if they had not had complementary technology to support the drone technology, the value of it became less than the technology they already had in their possession, whereas it rather became an obstacle. If there were no supporting functions or technology, flying drones was more seen like a lost resource that could have been spent doing something more productive and manageable.

5. Conclusion

In this section the study will be finalized with an ending reflection. The research question will be answered and the main findings will be concluded. The two-fold contribution will be accounted for before acknowledging the limitations of the study.

5.1 Answering to research question

Connecting back to the research question of the study, the main question to be answered was: *What are the perceived hindrances respective enablers regarding innovation diffusion of drones in an organizational context?* The aim was to shed light on the innovation diffusion process of the drone technology, generating an understanding of influencing factors for adopting organizations.

As the study concludes, many interesting aspects and results have been found in regards to the perception of drone technology and its hindrances and enablers for organizational innovation diffusion. In many aspects, the application of drone technology proved competence-enhancing rather than competence destroying, where the main issues with diffusing drone technology did not lie with the technology itself, but more focused on the surrounding functions. The main takeaways from the study is now summarized, divided on hindrances and enablers.

5.1.1 Drone technology hindrances

i) Regulations proved to be a main perceived hindrance for innovation diffusion of drones
It was clear that the regulations have lagged behind the rapid technology development of drones. The technology is heavily regulated and staying compliant can be an exhaustive and resource intensive process for organizations. The regulations to a great extent determine what can be done and what cannot be done in terms of drone operation and technical solutions. Finally, there was an unmistakable uncertainty regarding the new EU-harmonized rules and its implications entering into force on the 1st of July 2020. Altogether, regulations prevent the diffusion of the innovation.

ii) The drone itself is not the main hindrance, but rather its complementary tasks
The drone technology was perceived as user-friendly, implying that learning to operate a drone was perceived as fairly easy for adopters. However, the management of the vast amount of data that the drone could collect proved to be an issue where there was often a lack of technological support or competence to handle it. With this, unless supported with proper technological advancements, such as software to complement the drone, it was perceived of lesser value since it could not be used to the intended extent and purpose. In addition to this, the work preceding adopting drones and then maintaining its operation typically demands effort and resources to, for instance obtaining certificates, setting up the organizational structure and dealing with strategic objectives.

iii) The novelty of the drone technology means there was limited track record and "know-how" knowledge about implementing it
This proved especially true for the innovators and early adopters who have paved the way for later segments, which is probably a common phenomenon for most new innovations. Nonetheless, the

struggle of starting from scratch with no roadmap, previous cases to study or peers to consult when implementing drone technology was emphasized by early adopting segments. The industries emerging around drones seem to still be growing even though maturity tendencies could be seen in some cases, for instance in construction. On the other hand, this means that later adopting segments, such as late majority actors, to a greater extent have previous cases or peers to consult for guidance before their adoption. Although, regardless of the adoption segment, the broadness of application of drone leaves organization continuously having to learn new ways to utilize the technology.

5.1.2 Drone technology enablers

iv) Innovation champions are key enablers in the innovation diffusion process
These individuals take action and fight for the innovation by uniting the organization and overcoming the resistance that exists, especially in early phases. They often take a leadership role in having the organization to try out a new innovation, whereas if there are merits to the technology they are as mediators in bridging the gap between the testing phase and the technology's implementation. Interestingly, the importance of an innovation champion proved equally vital in the governmental sector as with in the private sectors, further emphasizing the value of the champion in regards to innovation diffusion. Adopting new technology is a challenging task and someone needs to be in charge, forcefully entering the role of innovation champion.

v) The many applications areas for drones makes the innovation easy to match with an existing need
Due to the broadness of usage and add-ons, such as new cameras and sensors, the drone technology can be applied in a vast amount of organizations, with different purposes, which further enables and accelerates the innovation diffusion of the technology. Furthermore, drones showed to replace both existing methods and technologies, while also addressing both existing and new needs, contributing to its success. This all combined lead to the conclusion that drones have democratized airborne data gathering, making the innovation a versatile technology to be used.

vi) Drone technology proved competence-enhancing rather than competence destroying
In all interviews there were a consensus that using drones was rather seen as a competence-enhancing technology instead of competence destroying. Merely, it was viewed as a complementing tool to in a better and more efficient way extract data and allocate resources, in order to maximize daily activities. Being a tool for efficiency, it left the organization with more time to focus on their core operations and do more in a shorter period of time. In addition to this, it increased safety for the employees as certain tasks with high risk could be done remotely instead of manually. Conclusively, the technology seems to bring a competitive advantage, which has led to an increased demand for the technology itself, accelerating its diffusion process.

vii) The low and diminishing price of drones enable broad adoption
As the drone technology has developed rapidly since it was introduced to the commercial market, the price has diminished significantly. Today, a middle segment drone cost similar to a portable computer, a price range that organizations can accept. This means that the innovation is not limited

to only an exclusive segment, instead more or less all segments and organizations in a social system can afford it. All organizations have a limited amount of resources which needs to be prioritized prior to making a new investment. Thus, relatively cheap innovations, like drones, seem to diffuse more rapidly than more expensive ones that typically demands top management decision-making and authorization. That is, purchasing the drone technology is a decision that can be made independently in lower hierarchies in an organization, confirmed by the interviewees.

viii) The user-friendliness of operating drones further enables broad adoption
Another enabler for drone technology diffusion proved to be the easiness of operating it. While it may require complementary technology to support the operation, the drone itself was perceived as easy to understand, by which using it was not a seen as a far stretch from current the toolkit. Thus, due to the relatively low complexity of operating drones, the technology can diffuse more and be implemented by a wide range of organizations.

ix) The act of testing new technology is key in matching the technology to underlying organizational needs
The importance of testing was emphasized by the main majority of the interviewees to compensate for technology novelty and lack of technology "know-how". It is typically the first step in gathering vital decision material whether or not the innovation proves promising and seems to fit the organization and its need. The testing varied from letting a supplier or external consultant demonstrate the technology or buying a single unit for internal testing. Nonetheless, testing offers a cost-efficient way of assessing new innovations and therefore mitigating the risk of adopting a technology on full scale that later proves of lesser value.

5.2 Reflection

The findings of the research were both expected and unexpected for the researchers. For instance, it was expected that the regulations would be a main hindrance to innovation diffusion of drones, which it clearly proved to be. Furthermore, the wide range of application areas were expected, even though it turned out to be even broader than expected in combination with organizations finding new ways of applying it to address their specific needs. On the other hand, it was not expected that individual champions were such key enabler as it turned out. Especially not in the public organizations, expected to be characterized by more bureaucracy and less room for own initiatives, thus not typically attracting this type of individuals. Another interesting factor that was not expected was the major implication of the data gathered. The richness of data gathered by drones were emphasized as one of the main advantages of the technology, providing several parameters. Simultaneously, it was also considered a hindrance in some circumstances since complementary competence and software are needed in order to process it properly. This had even led to some organizations pausing their drone operation or even deciding not to use it (until they mastered the data handling).

Regarding the fit between the theoretical framework and the actual empirical findings and analysis conducted, it turned out more or less as expected. The researchers knew that the main theories chosen, DOI and TOE, have been empirically tested and proved useful in similar research which was one of the main reasons they were chosen. Their robustness is likely to be explained by their overall simplicity and broadness. For instance, Rogers (2010) concludes that complexity prohibits innovation diffusion. One can argue that this is quite obvious and the term complexity can capture numerous factors. Thus, the theories are easy to apply, explaining why they are still relevant despite their age. On the other hand, they carry the risk of being too general. Nonetheless, in terms of the innovation studied, drone technology, and the theoretical framework, the fit proved satisfying for the purpose of the research.

However, considering how vital rules and regulations turned out to be for the innovation diffusion process, this factor would have preferably been emphasized even more if one would have constructed a new model specific for drones, similar to DOI and TOE. In addition, innovation champions should have been included as a main driver for technology adoption, considering how vital they proved to be in this research. These two core elements are visualized below in red boxes in their particular position in each of the two theoretical models. The researchers interpretation is that innovation champion falls into the category of Individual leader characteristics, influencing the attitude towards the innovation, demonstrated in the Diffusion of innovation model in figure 5.2a. Regarding the found importance of rules and regulations, this aligns well with the component of Governmental regulation in the external environment of the TOE framework, figure 5.2b.

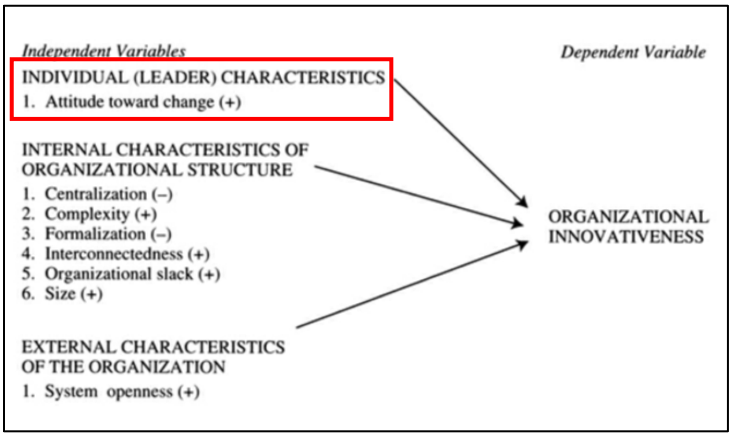

Figure 5.2a Illustration of variable proven most important in regards to the DOI theory (Rogers, 2010, p. 411)

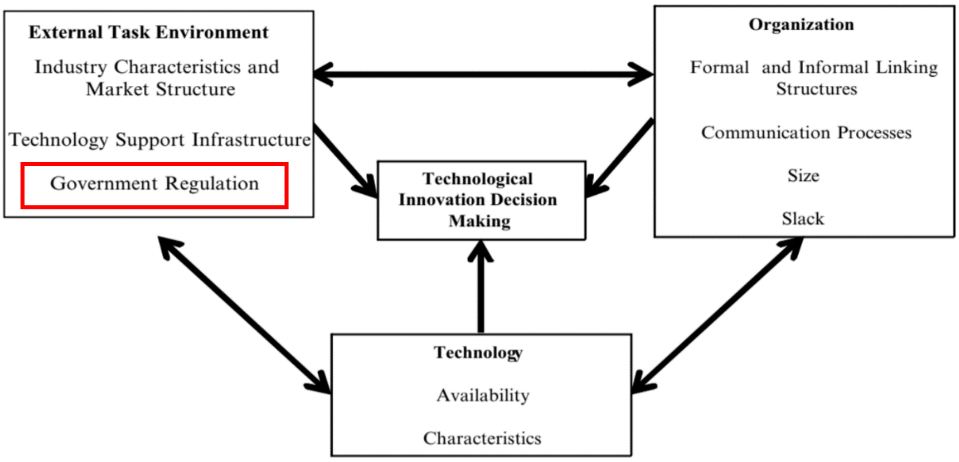

Figure 5.2b Illustration of variable proven most important in the TOE framework (Schneberger et al, 2012, p. 236)

5.3 Contribution of the study

From the study, the main goal has been to highlight the perception of hindrances and enablers in regards to innovation diffusion of a regulated technology from an organizational viewpoint. As previously stated, the contribution of the study can be separated in two, the academic contribution and the contribution for organizations in terms of practical recommendations.

5.3.1 Academic contribution

The main academic contribution by this study is a deeper insight regarding research on the application of drone technology among organizations. It has shed light on determining factors in terms of enablers and hindrances that seem important to consider when conducting research about drone technology diffusion. The focus has been on the organizational level, where the greatest contribution has been to further gain an understanding of how a regulated technology, whilst having a broad area of utilization, diffuses in a social system. Especially since there seems to be a shortage of research regarding innovation diffusion in an organizational context. It stands well as an academic contribution and as a starting point from which further research can be conducted on this topic. More on this in section 5.5 Future research proposal.

Moreover, the academic contribution of this study also to some extent lies in validating the theory of Diffusion of innovation that was initially proposed by Rogers back in 1962. Seeing that the theoretical framework now dates almost 60 years back, the technological development, globalized competition and digital world during that time is something that Rogers could not have foreseen. However, this study has validated the fact that the theory still holds its ground in the age of technology and innovation, as its components and theoretical conclusions fit very well with the results found in the study. This in coherence with other recent research conducted in similar fields.

Finally, additional academic contributions are the further validation of how the TOE framework and the DOI theory fit well together, whereas they complement each other when analyzing innovation diffusion. Especially since this study found that rules and regulations (an external element in the TOE framework) together with innovation champions (an internal element of the DOI theory) proved to be core in the innovation diffusion process and application of drone technology. Thus, the study has validated that theoretical gaps existing in the TOE framework and the DOI theory can be filled or explained with using them cooperatively, by which there is scientific value in letting the theories support each other's deficiencies to better understand and analyze innovation diffusion.

5.3.2. Practical recommendations

Since this study has generated a deeper understanding of organizations that have adopted the drone technology, it has enabled the researchers to also notice and conclude on practical recommendation that be considered upon adoption. These are now accounted for briefly below.

i) Drones and its value correlate with the user's ability to collaborate

In order to maximize the potential of drone technology, the extent to which a user can extract that potential correlates with the user's ability to collaborate with regulatory entities like for example Luftfartsverket and airports. Thus, intensive communication and collaboration with affected entities will have a positive effect on drone operation. Hence, the adopting organization should early on establish a long-term relationship with the stakeholders involved in their operation.

ii) Foster a bottom-up implementation environment

It proved to be an advantage when an innovation is recognized and adopted in the lower parts of an organization, rather than top down-implementation. The main reason for this seemed to be that the employees, who actually run an operation or task based on their competence, are better equipped to match a new technology with an actual need. On the contrary, top management does not always have the proper insight and understanding of how an innovation might fit the operation. If the adoption decision is top down, representatives from lower parts of an organization should at least be invited into the adoption process. Regardless, management on different levels in an organization should encourage and acknowledge requests and initiatives regarding promising innovation. In relation to this, it seems to be beneficial if the drone competence is added on an already existing competence of the employee, since this makes it easier for the individual to understand how drone should be applied.

iii) Centralize and dedicate a supporting drone function

This proved to be especially beneficial for larger organizations, operating more drones. The task of the drone function was to provide the drone pilots with the proper conditions, such as training and education, permits, insurances and support for handling the data gathered. This allows the pilots to focus on their core task of flying and gathering valuable data, rather than administrative work. This increased the overall drone efficiency, acknowledged by drone pilots.

iv) Allow testing of promising innovation and invest in supporting technology

The role of testing new innovation seemed to play a key function in the study, whereas allowing for tests to be conducted can help organizations realize effectiveness-deficiencies that can be helped with new technology. The testing phase also reveals factors that need to be addressed if the decision is made to implement the technology. Though momentarily costly, testing will in the long run prove cost-effective as new technology over time will exceed the initial cost of testing in cost-savings compared to older technologies. These cost-savings and its efficiency correlate with the technological support structure, whereas the better equipped an organization is in regards to this, the more efficiency will be obtained and cost-savings will over time be even bigger.

5.4 Limitations of the study

As this study and its results has been centered around eleven interviews from different industries, it is reasonable to argue that the number of interviews does not in a statistically correct way portray a whole population of organizations using drone technology. Instead, the results and the analysis of them rather refer to this specific cross-sectional case study conducted at this point in time in Sweden, making it uncertain to predict whether similar results would be obtained if a similar study were to be conducted once again. Especially since this thesis has been written between January and June 2020, with its interviews conducted during March, just before the due date of the new regulatory changes entering into force in July 2020. However, this fits the researchers hermeneutic approach to the study, in which one of many possible truths about drone technology innovation diffusion were to be displayed with conducting the study. The researchers have also attempted to minimize the bias of the data collection sample with using different kinds of industries, focusing on the common themes across industries boundaries in hope of in a better way portray a most realistic picture possible.

Further limitations of the study center around the ever-changing variables that affect drone technology diffusion, for example regulatory framework and current technological support structures. As regulations and technologies are continuously developing, the study can only focus on the current situation, making it a snapshot of drone technology diffusion that may deem of lesser value due to change in the future. Nonetheless, the study unveils variables that proved influential which may be equally relevant in further research.

Conclusively, to extend the study further, more organizations and regulatory entities could have been included in the interview process. Perhaps even backed up with quantitative research. For now, the focus centered around organizations already using drone technology, explaining their story of what they perceived as hindrances and enablers when implementing it. However, to provide an even more nuanced picture, organizations that were not currently using drone technology could have been interviewed in order to cross-reference if their perception of starting to implement drones in their operations was similar to organizations that had already done it. In addition, regulatory entities like Luftfartsverket could have been interviewed as well in order to gain a better understanding of why the regulatory framework is structured the way it is and what potential areas of improvement could or should be dealt with to optimize organizational drone technology usage.

5.5 Further research proposal

This study has mainly been focusing on the current situation for drone technology in Sweden and how organizations have approached the technology. Even though there are mentionings about social co-operations and collaborations, the study is bound to the organizational contexts upon which the perception of drone technology hindrances and enablers stems from.

For future research, another study could instead focus more on the societal implications of implementing drone technology. A proposed area of study could be to conduct a cross-sectional study of the implementation-process for rural areas, and the perception of hindrances and enablers for complying with drone technology as a more intensive social function. Comparing different kinds of rural areas, spanning from for example a 30-minute drive to a 2-hour drive from urban areas to cover most kinds of rural areas, the focus should thus not be on the merits of using drone technology. Instead, focus should rather be on the implementation process and the complementary tasks required to realize an effective substitution from current infrastructure to one more reliant on drone technology. Transferring the implementation of drone technology from an organizational context to a societal context highly influences both the purpose and circumstances by which implementation of drone technology is attempted, and would benefit from more research to fully understand it.

A further area of study could be to focus on drone technology and its merging with AI, for example autonomous flying, in relation to the regulatory framework. This study has been heavily influenced by the regulatory framework and explained how it has lagged behind the rapid development of drone technology, thus creating a main hindrance. With regulations that have been more focused on the operative side of drone technology, future research could focus more on how regulatory entities should tackle the emergence of AI as an innovation and its merging with drone technology, once again requiring regulatory entities to take action. Preferably, the research would be in the shape of a case study, studying one or multiple companies merging drone technology and AI. This in order to get a thorough and deeper understanding of how the two influence each other and the regulatory impact on the combination of the two. However, it could also be a cross-sectional focusing more on how regulatory entities would affect different kinds of organizations of industries with regards to drone operation and its mergence with AI.

Conclusively, the two proposed areas of future research could both be conducted separately, but there is also merits in conducting them together, where perhaps the researchers ability or assigned time would determine the extent of such a future study.

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Appendix

Interview guide

Introduktion och rollbeskrivning	
Vi inleder mer att berätta om oss, vår uppsats, dess syfte och intervjuns upplägg. Informerar om anonymitet och ber om tillstånd att få spela för att sedan kunna transkribera vårt material. Berätta om din roll och ansvarsområde (samt koppling till drönare)?	
Nuläge	
Kan du beskriva hur ni använder ni drönare idag?	
Kategorisering	
Hur kom ni i kontakt med drönartekniken från första början?	DOI
Vilket typ av behov styrde beslutet att använda drönare?	DOI
Studerade ni kollegor eller konkurrenter i beslutprocessen? Utveckla.	DOI
Hur länge har ni använt drönare?	DOI
Hur ser ni på er själva inom er bransch på användandet av drönare, var ni tidiga eller sena?	DOI
Huvudfrågor	
Hur ser ni på drönaren i förhållande till andra innovationer inom er bransch?	DOI
På vilket sätt skulle du säga att drönaren gör skillnad för ditt/ert arbete?	DOI
Hur ser ni på drönare som kompetens? Inhouse vs outsourcing ex. - Hur säkerställs rätt kompetens och utbildning för drönarpiloter?	DOI / TOE
Vad möjliggör drönaren och dess teknik som tidigare inte var möjligt? - Hur har den påverkat er tid/resursutnyttjande?	DOI
Teknik	
Hur jobbar ert företag med att ta sig till ny teknik (generellt)? - Hur förändringsbenägna är ni? Vad är inställningen? - Hur komplext är det att inkorporera ny teknik i företaget?	TOE
Hur skiljer implementering av drönartekniken jämfört med implementeringen av annan befintlig teknik?	TOE
Ersätter drönartekniken befintlig teknik eller appliceras den på ett nytt behov?	TOE
Känner du att ni saknar något gällande drönare? Ex brister eller hinder. - Hur planerar ni tillgodose detta behov?	TOE

Vilka förutsättningar måste finnas för att ni ska ta till er ny teknik, såsom drönare?	TOE
Organisation	
Hur ser implementeringsprocessen ut? Beskriv - Hur sker beslutsfattandet?	TOE /DOI
Hur komplext anser du det är för din organisation att implementera drönare?	TOE /DOI
Stötte ni på något motstånd/support under implementeringsprocessen?	TOE / DOI
Vilka fördelar ser ni med att använda drönare?	TOE / DOI
Vilka nackdelar ser ni med att använda drönare?	TOE / DOI
Omgivning	
Har ni något partnerskap med andra aktörer kopplat till ämnet?	TOE /DOI
Har ni haft någon kompetensutbyte med andra aktörer? Beskriv.	TOE
Hur skulle du beskriva branschens status kopplat till drönare? - Hur väl utbrett är användandet?	TOE
Hur öppet upplever du att ni är mot er omgivning, som att ta till er nya teknik?	TOE
Vad utanför er organisation skapar förutsättningar för ert drönaranvändade?	TOE /DOI
Hur förhåller ni er till det regulatoriska ramverket för drönare? - 1 juli kommer nytt regelverk. Hur kommer ni hantera detta?	TOE
Avslutande	
Vad hade kunnat göra ert användande av drönare ännu bättre? Ta nästa steg. - Har ni rätt kapacitet?	TOE / DOI
Hur tror du ert företags relation till drönare ser ut framtiden?	TOE /DOI

Något sista medskick till oss, något annat du vill lyfta eller förslag på förbättring gällande frågebatteriet?

Tackar för intervjuobjektets deltagande och informerar om tidsplanen. Vi lovar också att återkoppla till alla som intervjuats när uppsatsen är klar ifall de vill ta del av den.