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School of Business, Economics and IT

Division of business Administration

Bachelor's Thesis, 15 HE credits in Business Administration

Uncertainties in the Innovation Process

The Impact of External Uncertainties

**Degree Project, Business
Administration
Spring Term 2020**

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Thank you

When we started to write this thesis, we had one goal. We wanted to contribute with research to a topic that we both found interesting, but also an area where the research done would be relevant. It has been no easy task, but with help from others, it was made possible. We are deeply indebted to our course coordinator, Nataliya Galan, our examiner, Ellinor Torsein and our opponents Erik Linder and Yafet Yohannes for constructive feedback and for invaluable seminars.

We would also like to extend our deepest gratitude to Sabrina Luthfa, our supervisor, for always taking her time with helping us massively, in several ways. We are also extremely grateful to the CEO and CFO of Gamma because without them, we would not have been able to finalize our thesis, and the data gathered has been incredibly insightful and essential for the purpose of the study.

Title: Uncertainties in the Innovation Process - The Impact of External Uncertainties

Semester: Spring Term 2020

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Abstract: This thesis is about *How External Uncertainties Affect the Innovation Process*. Written during the spring term of 2020 by Simon Algotsson and Johan Öhlander. The thesis main goal is to generate knowledge about the properties and sources of external uncertainties and create an understanding of how they can come to affect an innovation process. This research encourages organizations that are planning to participate, or currently resides in an innovation process to give it a read. Anyone who seeks a deeper understanding of the impact of external uncertainties may use our findings as a source of inspiration. The research question we have answered is: ***How do external uncertainties affect the innovation process?*** As the title and research question shows, innovation and uncertainties are the two most common denominators in this work. Presented in the theoretical framework is previous research done concerning the innovation process, and what it consists of. As well as how other researchers describe different types of uncertainties. We have also constructed our own model of how external uncertainties can give rise to internal uncertainties. For this type of research, a qualitative method has been selected, since it enabled us to go in-depth in one specific innovation process. We have conducted two interviews with the CEO and CFO of a company referred to as Gamma. They have both shared their own perspectives of the innovation process their company has gone through. The data collected from the interview has been transcribed separately and is later presented in the empirical evidence. The final sections of this thesis include the analysis and the conclusion. In these chapters we draw parallels between the research presented in the theoretical framework and Gamma's innovation process. The process we have investigated for this thesis encountered several uncertainties, both internal and external. In the analysis we present the authors own model of how external uncertainties came to affect Gamma's innovation process. The conclusion discusses the significant findings of the research such as how Gamma's innovation turned into a 'black hole' for the profits generated by the company.

Keywords: *Innovation, Innovation process, Uncertainties, External uncertainties, Resources.*

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1. Introduction

The introduction chapter will present what sections the first chapter of the study consists of. It explains what innovation is, why it is important and why it is a complicated subject. Followed by the problem discussion, highlighting what previous research that has been made regarding uncertainty within the innovation process. Next up is the purpose and the research question of the study. In the last part of the introduction, the expected contribution of knowledge will be presented.

1.1 Background information

The word innovation originates from the Latin word “*innovare*”, which means “*to renew or change*”. Innovation creates novelty, either through something completely new, or by picking up, and improving where someone else left of (Rogers, 1983).

Innovation is a concept applied by companies in order to stay relevant on their respective markets (Porter & Clark, 2000). Dynamic markets that changes frequently makes innovation an essential tool in order to gain an advantage over one’s competitors (Dodgson, 2015). What makes innovation complex is because it could be considered a never-ending process, depending on how it is being perceived.

Henderson (2017) explains in his article that innovation is important because it gives companies a chance of penetrating a market faster and it gets easier for them to make market connections. According to the article, innovation is an original concept that can result in companies standing out from their competitors which gives them the edge. Innovation is a necessity for companies, it makes them survive and to thrive on, this is explained by Mark Dodgson (2015).

Mehta (2020) described that innovation is normally high in globally uncertain times. Companies must adapt to the changes the market face. They must stay relevant in order to not lose consumers and to keep consumers interested in their services or products. They must be innovative, come up with new ideas. Needs emerge during these uncertain times, for example people are forced to isolate themselves and this creates new needs, they have changed from what it was before Covid-19. Even though the uncertainties are many, in times like these there are possibilities and needs to be satisfied.

Within the innovation process, it is expected that companies will encounter uncertainty. This is because, when exploring the unknown, and developing something new, there will be uncertainty. The information about possible challenges is limited (Jalonen, 2011). A more recent definition of uncertainty is stated by Jalonen (2011). He defines it as; uncertainty is a situation that occurs between the lack of information and the possibility of increasing the knowledge of something previously unknown. Uncertainty surrounds the concept of creating a novelty, making innovative thinking very difficult to achieve. As previously stated, innovation could either be something brand new, or an ongoing improvement of what already exists. This creates a challenge where companies

must improve products, strategies or concepts that have in recent times might been perceived as already optimized (Rogers, 1983). As an already complicated process, uncertainty makes the process even more convoluted.

What makes the process complex is that in order to innovate, financial investments must be made in order to obtain the required resources (Rosenberg & Landau, 1986). Resource uncertainty can for example be caused by the actors (different stakeholders) who are involved in the process as they may have different expectations and goals etc. (Luthfa, 2019). The three factors that makes out an innovation process are actors, activities and resources and these are essential for an innovation processes to be functional. Luthfa (2019, p.48) states that an innovation process “needs to be understood from an integrated perspective” to understand the interrelation and interconnection between the three factors. She also describes the correlation between all the three. This will be discussed further in the theory section. With this said, we will from here entitle these factors as components. These three components are essential for an innovation process to be functional (Luthfa 2019). Actors, activities and resources makes innovation possible. Without one of the components, the process will not work (Luthfa, 2019). It is expected by this thesis that it will provide a deeper understanding regarding the uncertainties that that may emerge in the innovation process. Therefore, the existing knowledge about these components will be highly necessary. We know that these components rely on each other in an innovation process in order to reach the wanted result, this is what Edquist & Hommen (1999) implies. On top of that, they are all affected by the uncertainties that may occur within the process (Rosenberg & Landau, 1986).

1.2 Problem discussion

There are a lot of uncertainties that need to be taken in consideration by companies while in an innovation process. Jalonen (2011) writes in his article about possible scenarios for uncertainties. These uncertainties are technological, market, regulatory/institutional, social/political, acceptance/legitimacy, managerial, timing and consequence. Rogers (1983) explains the different sections in the Innovation Development-Process. The first step in this process is to recognize a problem or a need, it then progresses on to generating information and doing research. These two steps are the initial phase in the Innovation Development-Process. After these two steps development begins, then commercialization, then comes the diffusion and adoption, lastly comes consequences. To gain a deeper understanding of how uncertainties emerge during the innovation process one must first understand the process. This will be further discussed in the theoretical section.

There has been plenty of research done and studies made regarding what the innovation process is and what uncertainties that may affect the process, both external and internal uncertainties. Luthfa (2019) states that there is uncertainty embedded in the innovation process. The key components that make the process function also creates uncertainty. There are also different external uncertainties affecting the process such as technological, market and resource (Jalonen, 2011). Recent research explains what kind of uncertainties that may emerge when companies are in an

innovation process (Luthfa, 2019; Jalonen, 2011). Less research has been made regarding how external uncertainties cause internal uncertainties to emerge, thus affecting the innovation process.

Luthfa (2019) explains how the internal components all affect each other, but we do not know much about how external uncertainties affect resources, actors and activities. Jalonen (2011) offers information about different external uncertainties. Hence, in our thesis we will try to deepen the understanding of how the external uncertainties affect the innovation process and how these can make other uncertainties emerge, since there seems to be a lack of knowledge in this specific area.

1.3 Purpose and the research question

The purpose of this study is *to develop an understanding of how external uncertainties affect the innovation process.*

To understand and accomplish the goal of the study the research question used is: *How do external uncertainties affect the innovation process?*

1.4 Expected contribution

Innovation is a subject which is very dynamic, and it comes with a lot of uncertainty. This means that writing a thesis regarding this area will be very useful for the time being. There are always uncertainties that may emerge and affect companies at any time. In some situations, it may be inevitable to not get harmed by emerging uncertainties. This means that by answering the research question, data will be gathered about uncertainties, and how they may come to emerge. Furthermore, this means that with a research like the one we conduct, companies can gain knowledge about what uncertainties there are and how these can create other uncertainties in the process. This gives them the opportunity to understand how they should avoid and work with the different uncertainties. If knowledge is created about how it emerges there is a possibility to prepare for it and to make the best out of it. If companies have knowledge about how these uncertainties emerge, they can easier prevent being affected by them, making the innovation process less uncertain and harmful.

2. Theoretical framework

In order to construct a chapter which presents gathered data, relevant to the chosen topic. We had to reach out through several different literature channels. Our topic of choice focuses on external forces that creates uncertainty in the innovation process. This section will present what defines the innovation process. We will then go into depth on what the components the innovation process consists of. Using models, we will then demonstrate how the process of innovation is affected by internal, as well as external factors, that bring uncertainty with it. The last part will contain a model that illustrates how external uncertainties affect the components in the innovation process

2.1 - Defining the innovation process

There are several definitions of what innovation means. According to Rogers (1983), “an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption” He further explains that the innovation does not necessarily need to be objectively new as long as it seems new regarding how it is perceived by the individual. Jalonen (2011) describes innovation from the perspective of Rogers, that the innovation is either an idea, practice or an object and that it should be new to the ones adopting it. It must also be considered as an improvement. With this he explains how there are three different assumptions regarding this definition. The three assumptions are that something that is not adopted is not seen as an innovation. Novelty of the adoption is based on the individuals experience. Lastly, he explains that just because innovation implies change, it does not necessarily mean that all change involves innovation.

Innovation refers to that something new is in the making, one is expected to come up with a concept that has not been done before. Rogers (2003) explains all steps that the innovation-development process consists of. To accomplish something, there are more necessities needed than just an original idea. In order to go from idea to action, decisions must be made carefully. On top of that, one must have access to the required knowledge of turning an idea into reality (Rogers, 2003). Besides having the technology needed, innovation often requires heavy investments to be made. This could imply that companies must seek financial contribution from external organizations. Although an innovation process seeks to generate profit and bring something new to the table, it is rarely given an infinite amount of time to implement and develop the product. Organizations must therefore prioritize their decisions within the development of the product, in order to not fall behind the schedule.

As previously stated, the innovation process aims to create something that has not been done before, which implies that it could be considered a complex matter due its many stages. An innovation process therefore requires a stable structure, consisting of three main components. Furthermore, we will later in the chapter give an in-depth explanation of these components, being actors, activities and resources.

2.2 Uncertainty in the innovation process

To get an understanding of the subject discussed we must first define what uncertainty in the innovation process means and what it is. Jalonen (2011) describes uncertainty in the process as events that will take place in the future, and these will not be the same as the events that have taken place in the past. This means that there is no easy way to prepare for what is coming. In an innovation process, you must dare to do what is not known, you must dare to take a risk (Jalonen, 2011). Jalonen defines uncertainty; that it is something that resides within the innovation process. It can also be an independent variable you must take in consideration while working with the innovation.

There are both internal and external uncertainties affecting the process of innovation. The internal uncertainties are the ones that can be found within actors, activities and resources. Luthfa (2019) illustrates and explains with a model how uncertainty emerges in the innovation process and clarifies that it is something that is embedded in the process. As we pointed out earlier on in the thesis there are also different external uncertainties. Jalonen (2011) discusses the various external factors and has conducted a table for these. He points technological, market and resource uncertainties among several others.

Technological uncertainty	Technical uncertainty	Market uncertainty
Commercial uncertainty	Competitive uncertainty	Consumer uncertainty
Environmental uncertainty	Regulatory uncertainty	Legal uncertainty
Societal uncertainty	Political uncertainty	Economic uncertainty
Organizational uncertainty	Resource uncertainty	Decision-making uncertainty
Acceptance uncertainty	Task uncertainty	Behavioral uncertainty

Table 1: The various sources of uncertainty in innovation as identified in selected papers

In this table we can see the different uncertainties that Jalonen (2011) identified from selected papers.

2.2.1 Resources (external) - Financial

When discussing resources related to innovation, one might come to think of raw material, knowledge and equipment/machinery. However, in the context of resource uncertainty the financial capital can also be included (Godart et al, 2009). Godart et al (2009) claims in their work that the two most important prerequisites for an innovation process to work are the following. First, the ability to gather and develop information and knowledge, and turning it into a product that might give the organization a competitive advantage. Secondly, they describe the spending and distribution of time and money plays an equally important role as the first aspect. Jalonen (2011) describes the risks that come with investing in an innovation process, that includes external actors leaving their comfort zone, and replacing it with discomfort and uncertainty. These external actors include investors, banks and financiers, all of whom would be affected by the innovation process

were to fail. Receiving financial aid can always be a problem. Muller (2013) describes how banks often are wary of funding newly started, or smaller companies because for them it is considered a risk. Additionally, this uncertainty can therefore come to emerge from an internal or external source.

2.2.2 Technology (external)

Regarding technological uncertainty Jalonen (2011) describes how both technical tools and knowledge attributable to the technology could give rise to uncertainty for innovators. Furthermore, he explains how technological innovations could be divided up. There are four types and they are based on “the degree of technological novelty”. They are low, medium, high and super-high technological uncertainty innovations. To summarize, Jalonen (2011) states two things. The technological uncertainty that may emerge is firstly lack of knowledge about new technology or secondly, a lack of knowledge regarding how to use new technology.

2.2.3 Market (external)

When it comes to market uncertainty Jalonen (2011) explains how “innovation without a market has no value. He continues to explain that future market conditions can mean much uncertainty for organizations. The examples he describes in the section are disruptive effects of emerging technologies, empowered customers, new market entrants, shorter product life cycles, geopolitical instability and market globalization. Jalonen (2011) proceeds to explain that market-based uncertainty can be divided in three different categories. He describes how the most important source of uncertainty is customers. For this category the main sources of uncertainty are “demand for innovation, the unknown behavior of customers and unclear customer needs”. The second market-uncertainty that Jalonen categorize is more focused on competitors, the lack of knowledge about them. Regarding innovation, companies want to differ from their competitors. Without any knowledge about the competitors, this is difficult and Jalonen (2011) explains that organizations can never with certainty know the intentions of their competitors. Competing products and services, and the price development of these is the third category for market-uncertainty, even though it is a minor one, it is still one of the three categories according to Jalonen (2011).

2.2.4 Timing (external and internal)

Timing uncertainty are uncertainties related to time, how fast things can change or how fast a company must act in certain situations. Jalonen (2011) states that when it comes to management, timing is a crucial aspect. The global market is difficult, and there are rapid changes, and because of that decisions must be timely executed, (Jalonen, 2011).

Jalonen (2011) discusses the classical dilemma that is, “to innovate early, but not too early”. There are according to Jalonen three different time-related uncertainties. The first one is about what the statement was in the first sentence. As time passes by, the knowledge regarding the market increases. Meaning, the uncertainty is higher the earlier you enter a market. This could for example

be about investments, earlier in the innovation process there is a lack of knowledge and therefore it is difficult to decide when the optimal timing to know when to make an investment (Jalonen, 2011). This time-related uncertainty is connected much to being early in the process of innovation. The second one pertains to the later stages of the process and is described by saying that the later in the process a company is, more actors are involved, which increases the uncertainty. This is because with more actors involved you need to have more knowledge about these actors, and that can sometimes be difficult, which implicates uncertainty. From the beginning there are just a few involved, comparatively to the later stages. “Temporal complexity“ is a term discussed by Jalonen (2011) and it is the third considered uncertainty. Instead of just focusing on decisions to be made timely an organization should also think of time as “a multi-dimensional social construct with wide variability. This means that innovators face temporal complexity regarding time uncertainty.

2.2.5 Decision-Making (internal)

Just like the name suggests, this uncertainty relates to the decisions an organization must make within an innovation process. Jalonen (2011) describes decisions made during innovation are made in a state of uncertainty. It is unlikely that an innovation process would be completed without encountering uncertainties in any shape or form. When working on a project that aims to generate novelty, actions taken during the process must be made without complete information regarding the factors causing the need for the decision. Jalonen (2011) draws a parable between an innovation process and exploring the unknown, concerning decisions that could involve investments, development planning or other important components required during innovation. Depending on the decision, the whole process can end up being affected by the outcome. Combining that with limited or non-existing previous information to help to minimize negative consequences, this uncertainty becomes a complex matter, as well as expected to emerge during innovation.

As stated in the previous paragraph, decisions within an innovation process are made under uncertain conditions. Rogers (2003) states that uncertainty can under the right circumstances, result in better decisions taken by the organization. When actions are taken under a state of uncertainty, this can lead to mixed opinions of what potential problems that decision can spawn. He does, however, describe these problems as useful, since they lay as a basis for the next innovation, working on improving the existing product.

Another aspect of uncertainties related to decision-making is an extension of the category timing-uncertainty. Jalonen (2011) describes that the *timing of making a decision* can lead to unwanted and unexpected dilemmas if a decision is made too soon or too late in the process. Some decisions can be prepared through planning, such as larger investments can sometimes be planned for, in order to find the appropriate timing on investing, while smaller investments can emerge suddenly without warning (Jalonen, 2011).

2.2.6 Organizational (internal)

Uncertainties that emerge within the organization can often be traced to some internal conflict (Jalonen, 2011). Depending on the company and the innovation process, multiple departments and actors can be involved. Personnel, management and leading constitution are among those factors that can generate uncertainty within the organization. Organizations that innovate through developing new- or existing products commonly have a separate group managing the research and development of the product. Another group can be responsible for managing the network or the flow of resources that goes into the process. Looking at the figure 2.1 Luthfa (2019) illustrates how all the components depend on, but also affect each other. All the components are dependent on one another for the process to move forward. This includes the groups and departments an organization consists of. Meaning if uncertainty emerges within one of the departments, the others will be affected eventually in one way or another (Jalonen, 2011). Jalonen also states that innovation can generate uncertain effects like organizational performance and market acceptance.

2.3 How uncertainty emerge in the innovation process

The model shown below (Figure 1) was created by Sabrina Luthfa (2019). It illustrates how each component in the innovation process is correlated to one another as well as how the process itself can come to advance over a period. It also implies that the uncertainty that emerges within one component, can come to affect the other two in one way or another. The combination of the three components shown, results in the goal of the innovation process, being the intended novelty created.

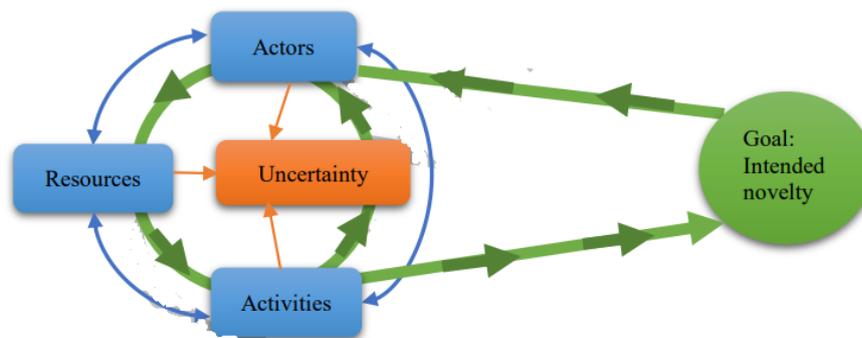


Figure 1: The Uncertainty-embedded Innovation Process Model

Among the three different internal components where uncertainty resides there is reciprocity which means that uncertainties that for example affect the resources bring uncertainty to the actors and activities. If there are no resources in the innovation process it does not matter if the organization got the actors or activities needed for the innovation process to work. With this said, one component from the model will affect the others. All three of them are needed for an innovation process to work and without any of them the process will remain still.

2.3.1 Actors

What defines an actor within an innovation process depends on several factors. The component itself has gone through various definitions over the years. Schumpeter (1934) claimed that actors take on the responsibility of bringing something new to the table within an innovation process. Other researchers have said that it is the actors that bring the solution to the need, and thus offering the market a novelty (Drucker, 1985). Actors can also be perceived as the ones who carry out the biddings needed in order to stimulate the process. What the term actor is referring to could vary depending on the scenario. Actors could be a single individual, a group of people or an entire organization (Francolini, 2010). Håkansson and Snehota (1995) write how actors could be considered a flexible component because of its ability to interact between different parties. The relationship between actors carries a significant importance to it. It can be used to combine resources from several directions, in order to make a process possible (Håkansson & Snehota, 1995). Although the innovation process consists of three components, actors are the one part that

could carry out the activities needed, along with gathering the resources required. For this to be possible, actors are required to have knowledge of how to carry through the activities (Håkansson & Snehota, 1995).

Earlier in the theory we discussed how decision making can be considered an uncertainty. Entrepreneurs regularly need to take decisions that entails risk which can be an uncertainty for the company. Miller (2007) describes how entrepreneurs taking investment decisions are considered rational, that is when outcomes are probabilistic. In this case probabilistic means that the decisions will not either be correct or incorrect but there is a probability of succeeding or not.

2.3.2 Activities

Regarding activities, several different activity-based models have been developed through the years. Past models that illustrated this were more linear and not so diffuse as they can look like today. Of course, models today have developed and do not look like they did a long time ago. Godin (2006) explains this, but also depicts a linear model created in 1945 by Vannevar Bush and the model consists of the steps basic research, applied research and lastly development.

Richardson (1972) discusses how relations with actors in an organization can affect the activities performed by the company. He further explains for example how a company can own shares in other organizations and how this can affect the relationship between them. This can open opportunities which can lead to positive effects such as discounted prices and similar positive effects making activities smoother to perform.

Richardson (1972) states that for production functions (i.e activities) to be performed, there are some necessities required. For example, managerial but also material technology is needed. He proceeds on to point out that activities are not something that is dependent on the state of the art. An activity is something that needs to be undertaken. It needs to be undertaken by certain experience and skill inherent in human organizations. Activities within an organization can be a lot of different things. Richardson (1972) states that it could be information regarding either future wants, research or discovery of development and design. These are some examples of what activities that could be undertaken by an organization. As earlier mentioned, he also clarifies that in relation to the activities above, they need be executed by appropriate capabilities, i.e. the organizations doing it must possess the right knowledge, experience and skill. Activities that need the same amount of capability is said to be similar activities. Other activities that are called complementary activities must be matched in either level or specification. To be most advantageous, firms would focus on both activities that are similar and complementary (Richardson, 1972).

Luthfa (2019) explains a type of uncertainty that she calls activity void, this is a serious uncertainty that can affect the innovation process critically. She describes this as a situation in the process where no activities can take place because resources are missing. Either by actors being unwilling to share resources or by the fact that the resources properties are conflicting.

2.3.3 Resources

The final component that together with actors and activities, make up the three main roles of an innovation process are resources. Although resources can easily be visualized as something purely materialistic, it is an equally important component as the other two within the innovation process. It is true, that when discussing resources, one is usually referring to raw material or equipment (Schumpeter, 1934). There are dimensions hiding behind the resources that truly show what importance they play in the process. This is unless the same organization found within an innovation process, are also their own supplier of resources, they need network or partnership in order for the resources to be accessible (Ely Paiva et al., 2007). Because of this, resources are a common denominator, bringing with it, alliances and cooperation between several actors. That together makes the innovation process possible (Ely Paiva et al., 2007).

2.4 Resource uncertainty and how it emerges

There are several uncertainties inherent in the innovation process, especially regarding the resources. Luthfa (2019) points out where uncertainties emerge during the process when it comes to resources. One of the uncertainties is when the resources needed by an organization is missing. Another one is when different resources create a resistance to the integration of other resources and a third uncertainty is when resources have conflicting properties. We are going to go a little more in depth about what these three different uncertainties mean according to Luthfa.

Regarding resources not being available, Luthfa (2019) explains that it is not always that resources are available for exploitation or recombination (i.e, not able to utilize the resources). There are different ways that this uncertainty can affect the organization. One way is that there is a lack of technology and that actors cannot invent the intended way. It can also be that other actors are not willing to supply the organization with the resources needed to produce the product (i.e, it is not possible to obtain the necessary resources for the desired activity). One uncertainty is that a business might not be able to borrow money, not being able to obtain the wanted financial resources and one is that some actors may not have the wanted knowledge, (i.e, they do not possess the required knowledge) (Muller, 2013). These are some of the most crucial uncertainties regarding resources. When discussing all these factors Luthfa (2019) also points out that when resource unavailability takes place, it is when a specific activity does not possess the needed resources and that it is called inertia, also called activity void. When this happens, it creates a gap in the activity sequence, making it impossible to carry out the activities.

Another uncertainty that may emerge during an innovation process is when a resource may create resistance for other resources to be integrated. According to Luthfa (2019), there is a possibility that when an organization is going to mix new resources with an existing resource combination, a possible outcome is that there will be friction and resistance between the resources in the combination. This friction will affect the activities which are to be undertaken by the actors. The whole process of innovation will be affected just by adding resources to an organization's existing resource combination.

The third resource uncertainty that we will discuss is that resources may have conflicting properties. Resources do have conflicting properties, and this can affect the innovation process. For example, if an organization is recombining resources, it may not be very beneficial for them if the resources recombined have conflicting properties (Lutfha, 2019).

Resource uncertainties can be a direct consequence of external factors, affecting the process (Godart et al, 2009). Although, uncertainties related to the resources such as lack of material, knowledge or insufficient capital could be defined as internal uncertainties. The necessity of explaining this lies within the source of the uncertainties, being from an external force affecting the process from within. This was notified in our specific case and that is why resource uncertainty is discussed in this chapter but not uncertainties related to actors and activities equally much.

2.5 - Conceptual framework

We have used Luthfa's *The Uncertainty-embedded Innovation Process Model* combined with Jalonens table of different external uncertainties, in order to create a model of our own. As a result, we came up with a model called the Preben model. The name of this model originates from a problem that arose when we (the authors) tried to combine our last names, only to realize it was close to impossible to get a suiting combination. We then decided to settle on a name we both appreciate. We came up with the conclusion that we both like the Danish male name Preben, making it the name of our model. It uses Luthfa's model as a base, but applying another component to the process of innovation, being the external uncertainties that can influence the progress of the innovation.

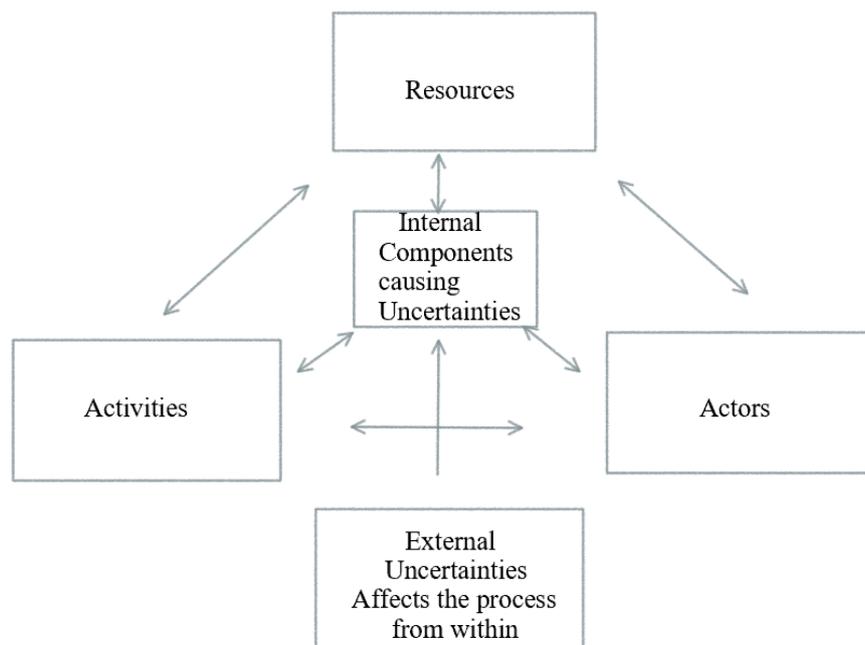


Figure 2: Authors own. Preben Model

This model illustrates how not only internal uncertainties affect the innovation process but more importantly, how the external uncertainties affect the process. With this figure we want to show how the external uncertainties affect the components the innovation process consists of. The external uncertainties can come to affect a company's innovation process. We believe that external uncertainties affect the three components that the process consists of making internal uncertainties to emerge. The model will be used in the analysis part to see what uncertainties that have affected the innovation process for our specific case, the uncertainties that have been previously discussed in this chapter.

This model illustrates how external uncertainties can come to affect the components of the innovation process. The external uncertainties presented in 2.2 (resource, market, timing and technological) are variables that fit into our model. This is because the consequences they may bring can cause uncertainties to emerge within the components (i.e. internal uncertainties, organizational and decision-making).

Luthfa (2019) claims that uncertainties are embedded within the innovation process. She advocates that the uncertainties emerge in the three components, actors, activities and resources. What she fails to take into consideration is that external uncertainties also affect the process from the outside, making internal uncertainties emerge. This is what our model illustrates. One must also take the external uncertainties in for consideration, when discussing phenomenons affecting the innovation process.

3. Methodology

The methodology part consists of five separate sections. The first one, research approach, argues for our choice of study, being qualitative. In the second part we define our selection as well as a table with information about the participants. Third, we present how we performed our interviews and some general information of how they were conducted, along with the creation of the interview-guide and a few data collection limitations. Fourth, we describe the ethical aspects we applied for this assignment. The fifth and final paragraph explains the aspects of quality regarding this study, where we explain what we have done in order to ensure higher quality of the study.

3.1 Research strategy

The purpose of this study is to develop an understanding of how external uncertainties affect the innovation process, making this a study of different phenomenon. An innovation process carries a story of how a process goes from an idea to action. Along the way, uncertainties might emerge and affect the actors involved in the process. This makes each innovation process unique. We therefore deemed it appropriate to approach this study using a qualitative method (Bryman & Bell, 2017) A qualitative approach makes it possible to dig deep into a specific innovation process, making it the most optimal way for us to gather the data we need for this study (Bryman & Bell, 2017).

We have chosen to do a case study where we conduct semi structured interviews with individuals of different positions within the same company. We seek to generate knowledge about how external uncertainties can come to affect a whole process of an innovation. This means we required to get an in-depth understanding of a specific innovation process from the company we have interviewed, in order to fulfil our purpose.

Through a qualitative approach we can expect to collect enough data about the most essential components regarding our chosen subject. These terms would be external uncertainties and the innovation process. The individuals of each position will be able to provide us with a detailed explanation of all these terms, assuming we take advantage of our choice of interview method (Bryman & Bell, 2017).

Although we deemed our method of choice suitable for this study, there are other approaches that could have worked. Structured interviews are one way of collecting data for this kind of research. However, this type of research is more appropriate when conducting research about several cases and would demand a quantitative approach (Bryman & Bell, 2017). Our purpose relies on getting a deep understanding of a certain phenomenon. This requires in-depth discussion, and not a broad overview. Semi-structured interviews make this easier to achieve than structured interviews through the freedom it offers the ones conducting the interviews (Bryman & Bell, 2017).

Another way to approach would be through structured observations. This is commonly used when you are trying to identify a problem through analyzing people in real time. This would have been

an interesting approach indeed but would require an innovation process that is taking place while conducting this study (Bryman & Bell, 2017).

3.2 Selection

When studying uncertainties related to an innovation process, we had some criteria's that had to be met with the company we were going to conduct our interviews with. The company had to be well-established, to be considered a production company and lastly be within an active innovation process or have been through one. With well-established we mean; the company should have been active for some time and have a stable place on their respective market. Although we did not exclude potential start-up companies, we just deemed it more appropriate to have the look-out for companies that have been active on the market for a while. The reason for this criterion was that before we got access to specific information about the company, the knowledge about what they have gone through with their innovation process was limited. More established companies could be expected to have at least one relevant innovation process to share with us, the authors. The last criterion is rather obvious. Since we want to investigate a specific innovation process, there must be an active process or a previous one to investigate. Here you see a table with some information about the participants we got to interview. The name **Gamma** is a pseudonym used to keep the company we have investigated anonymous.

Company	Participant's name	Position of the interviewee	Years of experience	Year's within the company
Gamma	Marth	CEO	30	6
Gamma	Lucina	CFO	18	15

Table 2: Information about the participants

The individuals that agreed to be a part of our study also had to fulfill some requirements, in order to be able to provide us with relevant data and insights into their innovation process. When we got in contact with the company, it was “Marth” who recommended that we also interviewed their CFO. By interviewing both the CEO and the CFO, we would get answers from two perspectives, from people with different areas of expertise. Both of our participants were present while the innovation process was still active, meaning they both had their perspective to share with us

3.3 Data Collection

The interviews were conducted in the end of April and beginning of May, with the company that will be referred to as Gamma. Our goal was to conduct interviews with at least two people of different position within the company in order to understand the progress of the innovation process from more than one perspective. Semi-structured interviews made it possible for us to have an

interview-guide to follow throughout the interviews, while leaving enough room for follow-up questions that might be appropriate depending on the situation. An additional advantage of using this interview method was that we could focus our questions, both the primary and the follow-up, towards the area of expertise of the participant (Bryman & Bell, 2017). This made it possible for us to get the perspective from two people within the same process. In order to maximize the use of our choice of interview method, semi-structured interviews offer flexibility when it comes to investigating separate perspectives on the same event (Bryman & Bell, 2017).

The interviews with the CEO and CFO were conducted while visiting Gamma's office. These were done face-to face with one person at the time. Preparing for this, we used some hints from Bryman & Bell (2017) to make the setting and general atmosphere of the interviews more optimal. The environment where we conducted the interviews was a place they chose, making them feel more at home. This took place in a conference room within their office. Prior to the interviews we did a few test-runs with the recording programs we used so we were up to date of how they worked and to make sure to minimize the risk of anything unexpected to happen. Both the authors were present while conducting the interviews. One of us had the main role of leading the interview, asking questions, follow-up questions and such, while the other had the role of "the passive interviewer". The passive interviewer may interfere whenever but is primarily responsible for taking valuable notes (Bryman & Bell, 2017).

When reaching out to Gamma by phone, we informed (about the purpose of the study as well) that we were willing to proceed with the interviews according to their preferred fashion. This resulted in us visiting their office and having the interviews with the CEO and CFO in person. As previously mentioned, the current situation of COVID-19 has affected the opportunities to meet people face-to face. However, we could visit them, if none of us had symptoms of being sick the last couple of weeks.

For every interview, we made sure there was enough time to complete it. This is to make sure we and the participants did not need to stress through it. This would result in hastily answered questions, and that is something we wanted to avoid. The interviews were recorded using an application in one of our phones, and as a backup, another phone was used to record the conversation if the primary source were to experience technical errors. Getting their permission of recording the interview was something we had to agree on before starting the interviews. After the interviews were done, they were separately transcribed and analyzed. The transcription for each interview took approximately four hours each.

Gamma	Position	Date	Tool	Recording	Length, min	Transcription, hours
Marth	CEO	28th April 2020	Face-to face	Yes	70	4
Lucina	CFO	28th April 2020	Face-to face	Yes	70	4

Table 3: Information about the interviews

3.3.1 Interview guide

Once we had settled on which company we were going to study, we constructed an interview guide (**Appendix 1**) as a preparation for the interviews. For both two sessions we used the same interview guide as a base, knowing the follow-up question would vary due to the individual's different areas of expertise. By this, we could take advantage of our method of choice, being semi-structured interviews. We formulated our questions after what we deemed suiting to get an in-depth understanding of, and the uncertainties related to the innovation process we were going to investigate (Bryman & Bell, 2017). Each of the participants had their own perspective and their own experience working within the process. This motivated us to use the premade questions as guidelines, while the made-up questions could give us more specific knowledge about certain scenarios (Bryman & Bell, 2017). For example, the CFO could give us more insights related to capital and financing difficulties, while the CEO could explain about uncertainties taking place within the actual production of the product.

Once the interview guide was complete, we let detached people such as our supervisor examine the interview guide. This was done to get feedback in hope of improving the guide, in areas it might seem vague or unclear (Bryman & Bell, 2017).

The layout of the interview guide is divided up in four parts. We began each interview with presenting ourselves, the purpose of the interviews as well as how the interviews will be beneficial for the study. We then proceeded to clarify the ethical aspects regarding the interviews. We also made sure nothing was unclear or confusing, as well as explaining how we will use the information given to us. We finished off with getting an agreement over the confidentiality related to the usage of the company name. The third part is where we began asking the interviewee's general questions about the company. These questions gave us the staffs own perception of the company values, and how the company has structured its separate departments. The final part of the interview guide consists of the premade questions, which made the respondents share information relevant to our research question.

3.3.2 Limitations

Regarding limitations in qualitative research there are some limitations that might affect how you collect your data but also how much data you are able to collect. Both the economical but also the time aspect have been two factors affecting how well we could prepare and conduct our interviews with Gamma. Preparations such as forming our interview-guide and discussing when and how to conduct the interview could have been better when we decided this with the CEO of the company. Because of the time aspect which has by us been perceived as a limitation we have only managed to conduct interviews with one company, with more time more interviews could have been done. Another limitation we have had in mind has been a geographical limitation, though, in the end it did not really affect us. What our purpose is and what data we need would not be negatively affected whether we got the data from Gothenburg, Stockholm or Sydney as long as the data gathered is relevant to the purpose it does not affect where it is gathered from.

Radu (2019) discusses a few different aspects that could be considered limitations regarding data gathering in a research like this. One aspect that he discusses and describes is that a research like this is time consuming, hence the discussion earlier where the time we have had to work with affects how well and structured the data collection has been. A few things that he mentions is partly that you cannot verify the results of qualitative research, which is a limitation. Though, our purpose is to get a deeper understanding and creating knowledge, hence it is not considered a limitation for us. However, the purpose of our study is to research how external uncertainties and the innovation process are connected. Radu (2019) states that proving causality is something that might be considered harder in qualitative research. Though, we do not want to prove something, yet we want to create knowledge of how some things are connected and create an understanding about the subject. That is why we must at least take this in consideration. We do not want to prove it as explained above, though we are trying to develop an understanding and generate knowledge regarding how the uncertainties and the innovation process are interrelated.

3.4 Data analysis

Bryman and Bell (2017) describes what inductive theory generation means. They explain that this research strategy is the one that should be used when you investigate how the used theory is related to the research. While doing this research we formulated our purpose, research question and gathered relevant data, then conducted our data collection. The data was gathered so that the theory used would be relatable to the data. Though, after the data was collected, we notified what uncertainties Gamma faced. These different uncertainties could all be found in Jalonen's paper, and they are presented in the theory section. This was not done prior to the data collection; it was done afterwards so that the reader could more simply understand what is being said in the empirical data and the analysis section. The disclosed uncertainties are the ones discussed in the theory section. With this said, Bryman & Bell (2017) describes that if reformulation of the theory is being done after the data is collected you are using a deductive approach, this is the research strategy we have used conducting this work.

What has been used by us when collecting and analyzing the data is a narrative approach. Bryman and Bell (2017) states that this is a useful approach when the individual interviewed is the teller of a story and describes what has happened in this said story. When conducting the interviews with the CEO and CFO of Gamma the interviews consisted of the whole story of the innovation process in chronological order. They described all the uncertainties they faced and in what way they worked against them. We have therefore deemed it appropriate to use a deductive narrative approach.

3.5 Ethical aspects

When conducting a study like ours it is important that you follow ethical guidelines in order for the study to be considered done ethically correct. This is not only because a study should follow ethical guidelines but when following these the quality of the study also increases. They all affect the confirmability, the objectivity but they could also improve how well the research could be considered valid and reliable. To make this possible there are four different aspects that will be used by us. Vetenskapsrådet (1990) explains which the four different aspects are and what each and one of them mean. Informational is the first, agreement is the second, confidentiality the third and use is the last. In the following sections you will read about each of them and what we have done regarding each when conducting the interviews.

There are different ethical standpoints with different meanings. They all have various explanations of whether how important the ethical aspects are and what it could infer by not following some of them. Bryman and Bell (2017) describes all four. The first one is universalism which means that you are not allowed to break any ethical rule. The second one is situational ethic which has two different alignments, “the end justifies the means” and “no choice” and both of these implies that in some cases you must break some rules in order to reach the desired results. The third is “violations of ethical rules always happen” and it means that it is almost impossible to avoid any violations in researches. The last one is “everything is allowed” and means that researchers should be able to study any who they want in any situation they want, (Bryman & Bell 2017). The standpoint we as authors follow is universalism where we do everything in our power to follow all the ethical aspects that are described in the following sections.

3.5.1 Information

Information – The information aspect means that the participants should be informed of what the purpose of the study is but also how the approach of the interviews looks like. Vetenskapsrådet (1990) also explains that we as authors should enlighten the interviewees that their participation is voluntary and that they can cancel their participation at any time.

All the points in the section above were done prior to the planned interviews. When we first contacted the organization, we told them about us and our cause and asked if they would like to be interviewed and contribute to our research. A few days before we conducted the interviews, we spoke with them by phone. We described the questions we were going to ask. We did this so that

they could prepare what to answer for the upcoming discussion. When we met them in person, we once again explained the purpose of our research, about the participation aspects and we also asked if we could record the interviews.

3.5.2 Agreement

Agreement – For a study to be done in order with our chosen ethical guidelines there must be an agreement between us, the authors and the ones we interview. The ones who participate in the interviews should, according to Vetenskapsrådet (1990) decide on what terms they are interviewed and for how long. Any canceled participation should not mean getting exposed for negative consequences.

Beforehand of the interviews this was also something that was discussed in order to get a common agreement between us as authors and the company we conducted the interviews with.

3.5.3 Confidentiality

Confidentiality – When it comes to confidentiality Vetenskapsrådet (1990) explains that unwarranted persons should not by any means be able to take part of information or personal data about the company or the persons interviewed. There should be no risk for either of them to be identified.

What we have done in order to achieve this is that every time we talk about the company or any of the individuals we interviewed, we refer to them with pseudonyms. The company will be referred to as Gamma and the interviewees as “Marth and Lucina”. By approaching the ethical aspect this way both will remain anonymous and none of them risk being exposed to identification.

3.5.4 Use

Use – According to Vetenskapsrådet (1990) the use aspect is all about how the gathered data should be used in accordance with the guidelines. The collected data should only be used for scientific purposes, never for any non-scientific purposes.

This was also something that we explained, how the data we collected will be used, that it may be used for other scientific purposes but for no other purpose than this.

3.6 Aspects of quality

In a qualitative research validity and reliability are not the terms that are used, at least not in the same way as in a quantitative research. In this context, there are four other terms that you must consider. These four terms correspond to validity, reliability and objectivity and each of them must be considered high in order to make a well written, valid, reliable and objective work. Down below you will find explanations for each of the words and what we as authors have done and thought of in order to increase the quality of the research.

3.6.1 Credibility

Credibility – According to Bryman and Bell (2017) credibility is internal validity. Bryman and Bell also explain that high internal validity is reached through high acceptability, and this implies that the research is credible.

What we as authors have done in order to attain high credibility are numerous acts. We have as much as possible used up to date theories and articles. They have been as scientifically written as possible. The literature we have used has been the newest possible edition and it has been literature with connection to the purpose of the study making it easier for us to answer the research question. Both the authors have during our time at University West studied several courses with applicable content to what our research is all about. When it comes to marketing, we read two courses the first two years and before the beginning of our thesis writing we also completed the Market Communication and Market Research courses which has helped us a lot with this work.

To increase the internal validity with relevant empirical data we conducted our interviews with a company that were very knowledgeable regarding our chosen subject. The company that was interviewed was a company with a significant technical innovation and they had been affected by many external uncertainties during their completed innovation process. It made it uncomplicated for them to give us data that was relevant and easy to connect to our purpose. All the gathered data has been insightful, when it comes to understanding the process and emerging uncertainties. Furthermore, to increase the internal validity we will include quotations in our section for the gathered empirical data to make it more trustworthy.

3.6.2 Transferability

Transferability – Bryman and Bell (2017) explains that transferability is equivalent to external validity. With attained high external validity it is implied that between terminology and observations there is high accordance (Bryman & Bell, 2017).

The transferability of this research is by the authors considered high. The subject written about is something affecting all companies and organizations, all of whom are always afflicted with uncertainties for each innovation process they are going through. The data gathered by us and the conclusions we came up with will give rise to other researches and the data collected will be

possible to use in other contexts. Uncertainties are continual and will not disappear, they will always exist and affect companies and organizations in processes of innovation which mean this research will remain relevant for years to come. Why the external validity is also considered high by us is because constraints like geographical does not affect the transferability. It is not only companies in Sweden who are affected by uncertainties. Companies worldwide always need to take uncertainty in consideration and work with it to prevent harm or minimizing it.

3.6.3 Dependability

Dependability – Dependability in a qualitative research is equal to what reliability is in a quantitative research. With high reliability it is implied that the research could be conducted once more, while attaining the same results (Bryman & Bell, 2017). To achieve this, we have conducted this research with an examining approach called “auditing” (Bryman & Bell, 2017).

Auditing means that all the phases of the process of writing we authors go through must be complete and accessible. This process includes how we formulated and created our questions for our interview guide, how we found a company and if the company would be relevant and useful for the report. The process also contains the steps how we should take notes, recording of the interviews and how we should analyze the data. (Bryman & Bell, 2017). For all the steps we have gone through we have had a supervisor giving us feedback and suggestions of what we could do to improve our work. We have had continuous contact with her, several times a week. Our supervisor has been the one going through what we should focus on next, giving us advice and a lot of feedback on the interview guide formed by us.

As authors we feel the reliability should be high and that if the work, we are doing would be reconducted under the same circumstances as we have had the results would be the same in times like this. This is mostly because external uncertainties are usually something that lingers in certain times. Numerous companies are right now affected by Covid-19 and it is an uncertainty all must take into consideration and to work against. If others would conduct this research during the same time under the same conditions with the same theories as we have used, we are positive the results presented would be the same.

3.6.4 Confirmability

Confirmability – If the confirmability of a research is high it implies that the gathered data is collected in an objective way. When collecting data, you should always strive to have as objective data as possible even though you must know that data can never be completely objective (Bryman & Bell, 2017). There are always factors affecting the data and values, and opinions from interviews can never be totally free from subjectivity.

There are numerous acts you can do and think of to avoid harming the objectivity of data. It is important that you stay objective when forming your interview guide and create the questions

without putting any of your own values into the questions, making the respondents answer in a way that you want. Both of us were very careful when doing this asking each other for advice and help to avoid that. We were also given a lot of feedback from our supervisor and opposition seminars. When conducting the interviews, we were careful with what kind of follow up questions we asked so that we did not ask any leading questions affecting the results. The interview-bias is something that we discussed before and had in our mind throughout the interview. With these mentioned acts we feel that we did what we could to reduce any possible impact on the answers. The conducted interviews were also conducted face to face in harmonious areas where both the authors and the ones interviewed felt very relaxed and secure.

A few other things we did to make sure the gathered data would be objective was that we let the ones we interviewed look through the notes we made during the interviews having their opinion on if they were okay with the notes and that it was what they had actually said. We also recorded the interviews on two separate phones to ensure that no data was lost and making it easier for us to transcribe all the data. What is also an important factor to consider when working with the objectivity is to make sure that the ethical principles are followed when conducting the interviews. Before each interview we explained what the research was about, that their contribution is all voluntary and that they could quit whenever they wanted or if they needed to. The confidentiality was explained and what our data will be used for, solely for scientific purposes of course. By following these four principles we feel that the objectivity of the data is improved.

4. Empirical evidence

In this chapter we will present the collected data from two interviews we conducted with employees from Gamma. Presented will be a combination of some of the questions and answers we deemed to be most relevant regarding our theory and research question. We will present the discussions we had with the CEO and the CFO about the uncertainties they encountered during one of their innovation processes. The chapter starts out with some background of the company, followed by what uncertainties that emerged during the process and is finished off with explaining how the uncertainties affected the company and what they had to do in order to proceed with the process.

4.1 Company background

Starting out as a small consulting firm in 2012, Gamma had prior to this gone under a different name. Gamma has since then gone through major constellations including different owners, partners and governmental involvement. When it was founded, the company idea was based around technical consulting. It was through some external incidents they ended up producing technical products. When another company went bankrupt, Gamma seized the opportunity of hiring some of the engineers that lost their job due to the bankruptcy. Along with the engineers, an opportunity and an idea revealed itself. With the help of the newly hired engineers they saw a possibility of rather quickly developing a technical product that was presumed to be very profitable.

For several years now, Gamma has been selling, developing and manufacturing products. The products they now offer are components that other companies use within their products. Considering the changes and challenges they have faced along the way, they are still a well-established company that resides within the same market, just with a wider assortment of services and products to offer.

4.2 What uncertainties did Gamma meet during the innovation process?

When conducting the interviews with the CEO and CFO of Gamma, we were told about multiple uncertainties they faced. They both spoke of the uncertainties and how they affected the company from their perspective. During the innovation process they got affected by several uncertainties, the process got affected, slowed down and even stopped at some points due to the external uncertainties affecting the innovation process. Down below we will shortly describe the identified uncertainties, both the external but also the internal ones that emerged due to the external. After the interviews had been conducted, we transcribed the data. When transcribed, we analyzed it, trying to identify what kind of uncertainties Gamma had met during their process. We did this simultaneously as looking at Jalonon's table of uncertainties (see figure 1). The ones we noted were market, technological, resource, organizational, time and decision-making uncertainties. These uncertainties are a mix of external and internal.

4.2.1 Market

While discussing the market, Marth told us his perception about why the market is very complex and difficult. When describing the market Marth described it like this. *“The market we operate on is amusing in that way because it is so dynamic but also so damn conservative”*.

With this said, we wondered what he meant, so we asked if he could specify conservative in this context. Marth explained that because the market looks like it does, it can sometimes be hard to find reliable and credible suppliers, willing to provide the company with resources and with good credit terms. Since Gamma was considered a new company at the time this was a difficult situation for them. Marth told us that usually they got the leftovers after the supplier had supplied other bigger companies than themselves. What he meant by calling the market is conservative, he described it like this. *“I mean, you do not easily change a supplier”*.

By saying this he implied that for a new company like Gamma, it is hard to find suppliers and to build strong relationships from scratch. It affects the chance to get supplies delivered with good terms. Both their customers and their suppliers were big actors on the market.

4.2.2 Resources (Financial)

Regarding financial uncertainties that Gamma faced during the innovation process for the product, the CFO told us how the process got affected by certain incidents. Their possibility to get financial support were reduced due to them being a newly started company, but also because the potential investors rarely understood what the innovation meant and what it consisted of. During the interview, we asked about what economical and financial uncertainties they believed was the most difficult throughout the process. The CFO stated the following. *“The biggest and most difficult uncertainty was to find capital whatsoever. You had to have a lot of dialogues with banks, financiers and the government”*.

The CFO also described the issue of getting financial support when their investors were no innovators and it was hard for them to see it from their point of view. It was difficult to reach through to them about what their innovation was, hence, the problem to receive financial aid emerged. Lucina said this. *“Another challenge is when you mix innovators that are a certain type of people. At one point in the process we had governmental owners but also a local bank as partners, they are not innovators as people, it was hard for them to see another aspect”*.

By stating this, it became clearer for us why it was difficult for them to receive the financial aid that was needed for them in order to progress in their innovation process.

4.2.3 Technological

To be active on a market like Gamma, uncertainties will come to affect. The market was earlier described as dynamic and conservative. When discussing with the CEO why he described the market as conservative he said that technology is not something that can easily be changed, it is as hard as changing a supplier. There are always risks when it comes to technology, this means that companies of course want to be fast, though, according to the CEO no one wants to be the first to launch a new technical product. *“You do not easily change technology, because everything should be so thoroughly tested but still, you would like to have a leading edge with new technology, but no one wants to be first, everyone wants to be second”*.

He continued to explain that one major mistake on this market can make the company fall, he described it as “pulling down the blinds” and meant that a mistake like this could be fatal when it comes the technological market as the one they operate on. Both the CEO and the CFO also mentioned that they got a factory with a lot of fixtures within. Unfortunately, none of it could be used to produce the product they were to manufacture. This was one of the factors to why they sought financial aid.

4.2.4 Timing uncertainty

Gamma had during the innovation process also experienced uncertainties related to time aspects. When we asked the CEO of Gamma about their perception of “time to market”, meaning how long it would take for them to make their first profit on the product they were developing, Marth had this to say. *“We need to put a lot of resources into this innovation, it will not generate profit for us now, but possibly in the future”*.

Marth implied that they knew that they had to make a gamble of how to distribute the resources. He also explained that it was necessary to do some investments now, and by that, later generate profit. However, this was under the assumption that the profits started rolling in according to the time schedule. He then added that this did not go as expected. *“At first, things went south. Meaning our second “time to market” was delayed even further”*.

4.2.5 Organizational

Gamma’s innovation was troublesome, partly because they were a newly started company. Some uncertainties regarding the organization emerged. First off, we talked about the innovation and what it meant for Gamma, but we also discussed their thoughts looking back at it. The CEO mentioned that knowing the organization back then had a management not knowing what this innovation process would mean and how to handle it. He explained it this way. *“To be honest, there were several individuals involved that had not gone through with a process like this before as a leading constitution”*. He said that if they were to know this, and if they would have had some common sense at the time, they would probably not have gone through with it.

What he also mentioned was that when they faced difficult times in the process, the harmony in the organization was not always that good. *“The atmosphere was clearly affected, the harmony was quite uneasy occasionally, and it got infected from time to time”*. This is how the CEO described how the harmony in the organization was affected due to the difficulties that the company faced during the process.

4.2.6 Decision making

Gamma encountered uncertainties related to the decision-making within the process. In order to develop the product, they had to decide how the development process was going to be performed. They were put within a scenario, where they a goal and most of the necessary equipment. However, they also found themselves uncertain if this was enough in order to produce the product the way they wanted. The CEO explained it like this. *“It comes down to making a decision, regarding the process method and what material you will use. It was here a problem emerged. We already had a factory, so we had to extend, and compromise with the existing process”*.

The development process of the product came with multiple challenges they could not foresee. Technological difficulties turned out to be more of a challenge than expected. Although decision making could be a useful tool, in order to minimize possible uncertainty. The tables were turned for Gamma, they had encountered uncertainty related to how to develop the product. However, with already heavy investments of time and capital into the process, they found it difficult to cancel the project. *“So, there you stand. We had some of the required components, and a given parameter. You have the planned product, the development process and the equipment. What in God’s name do you have left to gamble with? It is always easier if you have a clean table”*.

According to the CEO, decisions had to be made with the purpose of moving the innovation process forward, rather than backing out of it. They were already so deep into the process currently, that cancelling the project was not an option.

4.3 How the uncertainties affected Gamma and their innovation process

In this section we will with quotations, and explanations of the quotations describe how the various uncertainties discussed above affect each other (i.e. the correlation between them). What is different in this section is that that we discuss them all together and not separately.

To begin with, as previously mentioned, according to the theory there are both internal and external uncertainties that may affect the innovation process. This chapter will use quotations both from the CEO and the CFO to show how experienced external uncertainties for Gamma has affected the company’s innovation process.

The CFO described how financial aspects had clear effects on the organization on several levels. It affected the organization, both the harmony between the employees but also the resource availability. It made it harder to receive material but also money from financiers (i.e. not possible to pay the suppliers). In an organization, the employees are also considered a resource and as described the atmosphere at times were uneasy. *“The atmosphere was clearly affected, the harmony was quite uneasy occasionally, and it got infected from time to time because we had employees who generated a positive result, but this just vanished into the black hole”*. He meant by saying this that the generated positive results got sucked into the innovation process (i.e. the black hole) for this product and no one knew if this process was even going to end positively. Other successful innovations or projects that were completed by employees, generated money, was used for something unknown but it was a risk they were willing to take.

When we asked about the market Gamma is operating on, Marth explained that the most common is that the market inquires for higher quality and demands. The companies acting on this market always need to consider what the market asks for. What was also stated was that a marketing research is primarily done by itself, no one needs to conduct one, you just analyze what the market inquires. The CEO described it as this. *“It was the market that pushed this forward. We did not create a brand-new product; it was because of the high standards the market set that innovated it”*.

With the organization needing to adapt to the market the employees had to work differently. As earlier described, what was always a challenge in the innovation process was the financial uncertainty. With the market setting these standards and demands, Gamma had a challenging time trying to obtain the financials they needed. Because of this the organization had to adjust to the uncertainties that emerged because of the market. The work force at Gamma did at some points in the process work much overtime to be able to finish all their missions and projects. The staff had to be flexible, which they were according to the CFO. At different times of the year, especially during off-seasons much staff had to do more consulting works. The consulting works made Gamma generate floating assets which could be used for the innovation. The generated money disappeared into the “black hole” as the CEO referred to innovation process as. This showed how the organization in the long run got affected by external uncertainties. Regarding the flexibility of the staff the CFO said this. *“The staff have been more flexible. Some of the engineers have been sent out on consulting projects when it was off-season. After the off-season they come back home”*.

The problems that had occurred concerning the development process of the product, had emerged through the uncertainty of whether the equipment and resources they had were sufficient. This forced Gamma to take several crucial decisions of purchasing additional equipment and come up with a new method of how to develop the product. The CEO of Gamma referred to this period as highly intense. This was because they had to start all over with a new development process. *“We had to start from scratch. New decisions and a new method, for everything”*.

This resulted in new investments, additional planning and potential problems to keep up with the set deadline. Since the development process did not go as planned, a fear for falling behind their time schedule aroused. Marth stated that at this point during the process, it was highly essential to

stick to the time schedule. The consequences of falling behind would have resulted in the following. *“The time aspect of the process was rather critical. From the moment we got the deadline, to the point where we started producing, we were under severe pressure to remain on schedule”*.

Gamma experienced pressure, not only due to the delayed process, but also with the strict deadline. However, this came with an additional sacrifice, if they were to fail to start the production in time. The product Gamma manufactures is a vital component in another product sold by other companies. The CFO explained the following. *“If we were to miss the deadline, we would have to adapt to a new technological change, which we would not survive, economically that is”*.

What the CFO implied was that the product was supposed to be sold and put into a specific year model. Meaning, if the contractual date of producing the product was not met, they would have to wait another year before being able to sell their product.

4.4 What did Gamma do during the innovation process in or order to continue the progress?

During the interview we explained our view of what the vital components of the innovation process consists of. We asked some questions regarding what Gamma did to in order to get through the process. One question we asked was *“How did you handle the uncertainties that emerged within components during the innovation process?”* and from the CFO we got a well-explained answer. Lucina stated that, what made it possible for them to finalizing the process was help from other actors. The most vital help they got was from customers. The CFO explained that instead of getting completely paid when they delivered to their customers they got paid for different steps in the process of the production. Lucina stated this. *“Partially we have got through the process with additional help from our customers”*.

As described in the text above Gamma received help from customers, regarding how they helped, the CFO said this. *“As when we were going to get paid in unit price for our product, from one customer we got paid for each step of the process. We got help with partial billing at different levels that were predefined”*.

Getting through the process was burdensome for Gamma, both the CEO and the CFO stated. It took many years. Getting help with financial contribution from different customers helped them massively since the financing from financiers and investors were difficult during many parts of the innovation process. It was important because financially the organization got affected on several levels.

Towards the end of the interviews, we asked the CEO if he could pinpoint some of the larger uncertainties they had gone through, and how they managed to deal with them. Marth started out with what he perceived to be the most significant area of where uncertainties had emerged, which was related to investors and the capital. He said the following. *“The most significant difficulty, constantly present, was always the lack of capital. It would have helped if we had more capital at the right time. Looking back, we eventually managed to gather the required amount”*.

Although the most crucial interferences during the process can be derived from the lack of capital. The process still worked out. Gamma managed to pull through with the innovation process, regardless of the obstacles they had encountered during the way. They had to assess a strategy where they did what they could, with the pawns that were available at the time. *“After all, we have a working factory. However, we were in great need of that capital earlier on in the process. If we did, we could have saved money. Now, we had to wait until the last minute before investing in certain equipment. After that, we found ourselves thinking “wow, it actually worked”.*

Throughout the process, Gamma had encountered uncertainties within the organization, the market, technological aspects and decision-making. The financial difficulties had a vital role in each of these uncertainties. Although we will never find out if unlimited capital would have prevented all the uncertainties that emerged during the process, it would have minimized the amount of challenges along the way. During the interview, the CEO used a proverb. *“It is damn expensive to be poor (...) The most important thing is to never give up”.*

Without the required capital, every single investment can be perceived as expensive. As previously stated, Gamma had to carefully distribute their resources in order to complete the process. This could, like Marth stated, only be achieved by never giving up.

5. Analysis

This chapter presents the analysis of the innovation process conducted by Gamma. We have used the collected data and compared it with our theoretical framework to showcase a fulfilled analysis of our case study. This was established by interpreting the quotations from the participants and relating the scenarios they experienced during their process, to the research presented in the theoretical framework. The analysis ends with a model illustrating how the external uncertainties affected Gamma's innovation process. The model also showcases all the actors involved and what the components in the innovation process consisted of.

5.1 - The innovation process

As described in the theory section there are several different definitions of what innovation means. Rogers (2003) describes it as an idea, practice or object that is perceived new to an individual. In Gamma's case it was an object, to be exact, a product. It was an already existing product, but they made reinforcements and improved it so that it was sturdier and more advanced than the already existent corresponding products on the market.

What Rogers (2003) also describes are the different steps in the Innovation-development process. Needs/Problem, Research (basic and applied), development, commercialization, diffusion and adoption and consequences. He discusses the fact that to go from idea to action, decisions must be made carefully. Regarding the six steps of the process, when referring to these steps to Gamma's case we could clearly see that the first two steps came very naturally and undemanding. As mentioned in the empirical data, suddenly, these engineers came from the bankrupt company. They brought the idea of inventing this product and the need/problem for this specific item had existed for a while. The research was mostly done by the engineers as well. This made the initial phase of the development process very smooth for Gamma.

The need had been identified and the research had been made. It was after these steps the process became more troublesome and problems began to occur. Throughout the rest of the process several uncertainties emerged and affected the flow through the remaining four steps of the process.

5.2 Uncertainty in Gamma's innovation process

In this section we will go in-depth of the uncertainties that Gamma had to face. We will put those in relation to the sources discussed in the theory section. During the interviews, it was revealed that several uncertainties found on Jalonen's table are applicable on the uncertainties Gamma experienced.

5.2.1 Resources - Financial

Marth implied that the most critical challenges with the whole process was related to insufficient capital. We have broken down the most significant factors to the uncertainties that had emerged due to the lack of capital, throughout the process. When Gamma began working on their development plan for the enhanced product, which would be the start of the development phase of their innovation process. They immediately found themselves in need of additional investors. This would as a result lead to one of the uncertainties emerging related to their capital. Jalonen (2011) refers to difficulties related to the financial aspects as a resource uncertainty. When a required resource is missing, the innovation process suffers. In Gamma's case, they needed financial aid in order to get the process going. Consequently, this created a gap in the activity sequence. According to Luthfa (2019) this is an expected result of unavailable resources. Gamma had the necessary knowledge and personnel to carry out the activities, but were missing an important component, which put the process in inertia. To counteract the inertia, the black hole had to consume heavy amounts of the available profit the company generated, thus, the activity void was decreased.

Lucina shared during our interview, how the process of finding potential investors and sources willing to contribute with capital was a task filled with challenges. According to the CFO, one of the reasons why they faced difficulties with the financial aid was because of the mix of different people, supporting the project. Gamma were desperately in need of financial contribution from their investors, for the process to proceed as planned. However, this turned out to be a problem for them. The investors were not considered innovators, who could not see the process from Gamma's point of view. Gamma could not offer a well-established time schedule of the future. Information regarding when the innovation would start to generate an income was a requirement from the investors side, and a reason for their lack of trust for the project. This resulted in a constant chase after additional financiers or be willing to compromise with the investors already involved. The CFO of Gamma explained how they got financial aid by getting paid for each step completed in the process by customers. This meant that the roles of some of the actors changed, where the customers became financiers in some steps of the process. Håkansson and Snehota (1995) points out that relationships between two actors partly depend on having a mutual orientation and understanding. For Gamma's case, this meant that they had to provide all information possible about their progress, in order to make their perspective clear. Thus, encouraging the investors to contribute with additional capital, which in turn was made possible through adapting to the investors demands.

As previously stated, the lack of necessary resources resulted in Gamma not being able to perform certain activities. What is explained in the research by Richardson (1972), is that the relationship between two companies can be affected if one of the two organizations owns shares in the other organization. We found out during the interview with Marth, that investors such as banks needed information regarding the future, in order to continue to support the process. A similar problem aroused with the investors not being able to see the process from Gamma's point of view. This led to cold feet, and additional financial contribution became limited from several sources. Muller (2013) states that monitors (i.e. banks, financiers) usually are wary with funding newcomers because they must take a risk. This means that for newcomers and for small firms it is usually

difficult receiving awaited funding for their innovations. We could see that in Gamma's case, early in the process, this was the problem. They had the idea and knowledge but not the resources required to move forward. Without the funding they needed they had to acquire capital in other ways.

5.2.2 Technology

In the interview with Gamma they told us how they got a hold of a factory that was not in use anymore. Unfortunately, the equipment that was installed could not be used in the manufacturing of their product. Jalonen (2011) describes how technology can both be defined as tools, technical tools, but also the knowledge that is needed in order to use these said tools. How Gamma got hold of this factory with technology that was not serviceable for their specific production is considered a technological uncertainty.

As said by Jalonen (2011) the factory fixtures are considered technology, it is within the tools and the knowledge to use them uncertainty can emerge. Since Gamma was a new company it was hard for them to build relationships with other actors on the markets. It was difficult to find suppliers and customers. By having a troublesome time finding suppliers it was also problematic finding and obtaining the technology needed for their production. The knowledge to use the technology is as stated, considered an uncertainty. As the CEO mentioned, no one wants to be first when it comes to releasing their product first on the market because it would be fatal if something with the product would be wrong. We connect this to the fact that one must possess knowledge of the technology, if you lack knowledge, this is an uncertainty that may affect the whole organization. This is what Richardson (1972) stated, that for organizations to perform activities, the right technology, but also right the knowledge, experience and skill is needed

Richardson (1972) describes how material technology is needed for production functions (i.e. activities) to be able to perform. Without the resources (i.e. money) Gamma had some troubles achieving the wanted technology (i.e. machines to produce). This means that the possibilities to the right technology, without financials, external uncertainties led to the innovation process being slowed down and internal uncertainties emerged. This will be further discussed later in the analysis, that is, the uncertainties that emerged.

5.2.3 Market

As described in the theory section, there are market uncertainties that can come to affect the innovation process according to Jalonen (2011). He mentions market conditions, which includes some different possible uncertainties. He also mentions the categorizations, the first, the most important, is customers, secondly, the lack of knowledge regarding competitors and lastly, a minor one, and that is the uncertainty of price differences between your products and services versus your competitors.

Customers is the first categorization of market uncertainties, which is the most relevant in our case. The CFO from Gamma told us how the customers they turned to were big actors on their market. Gamma were a newly started company with less experience and relationships on the market, this affected them a lot. The CFO also described the difficulties of having big actors as their customers. Lucina stated that these customers were not always willing to pay right away as Gamma wanted, though, sometimes they got paid when they started producing. As Jalonen (2011) mentioned, by having bigger and more well-known actors as customers can be an uncertainty. Deals and agreements can be harder to attain, this was something that affected Gamma. Partially this affected them financially but in other aspects as well, e.g. the organization got affected, frustration more easily emerged when the innovation process faced difficulties. As mentioned above, Gamma did at some points during their process face difficulties with their customers. Though, as mentioned in the resource - capital section they did at some points in the process receive financial aid by customers with partial billing throughout the process.

5.2.4 Timing

The uncertainties related to time and timing that emerged during Gamma's innovation process happened within these following areas. The time to market, the deadline of the process and uncertainties related to the later steps in the process.

According to the CEO, Gamma's first time to market was estimated to generate money rather far into the process. This was at first not deemed to be an issue since the resources and time put into the project would hopefully come to generate more profit than what had been invested. Jalonen (2011) states that uncertainty is higher during the early stages of a process because there is less knowledge regarding the market. For Gamma's case, they were the actors involved in the process that had knowledge and understanding about the development of the product, while the external actors did not. The financial aid was a requirement for Gamma, in order to continue further with the process. Financiers that got involved later in the process therefore could not see the potential of the project, the same way as Gamma. Which in turn made the time to market being postponed. This slowed down the progress and made the existing time schedule obsolete. Because of the challenges of receiving additional funding, Gamma now had a factory waiting to produce the product but were missing resources to do so.

In the later stages of the process, more actors had joined in than what was originally predicted. Jalonen (2011) states that with more actors involved in the process, there are more opinions to account for, and you know less of the other actors. According to Rogers (2003), the first two stages of the innovation process are needs/problem and research, and these were completed with ease. It was later, in the development and the manufacturing of the product things had escalated. As Marth stated during our interview, once they began producing the product, they found themselves under severe pressure to remain on the time schedule from many different actors involved.

5.2.5 Decision-Making

The challenges that were related to the technological difficulties of developing a product, emerges when you have insufficient equipment resulted in crucial decisions had to be made. Schumpeter's (1934) definition of resources includes raw material and equipment. Gamma had at this point in the process faced problems regarding their development process. The current equipment was, as previously stated, not adapted to the product they were going to manufacture. Meaning they would have to decide on how to acquire the right equipment. Just like the CEO stated during our interview, compromises had to be made regarding the material and processing method. They were already too deep into the process to drop out. Therefore, their decisions had to be made, under the assumption that they would carry through with the process, purchase the necessary equipment and make use of what components they already had available. This ties back to the discussion in the theoretical framework of the uncertainty related to decision making. Going into an innovation process, one can expect situations where one must act in order to continue with the process (Jalonen, 2011). Gamma had two choices, to quit or go all in. As stated by the CEO, this requires a lot of thought, it is not a decision you make on the spot. Jalonen writes that uncertainties that force decisions can come to affect the entire process, directly or indirectly. For Gamma, this was the case. At this point, the CEO stated that the development plan was prepared and other vital components such as investors and equipment had been acquired, new engineers and staff had been hired etc. Although there was no telling of how the future of the project was going to play out, Gamma kept going by taking a step into the unknown. In many cases, entrepreneurs can be considered risk-takers. However, this action would, according to (Miller, 2007) be considered a rational way to act, when faced with a high-risk high-reward scenario. This implies that Gamma chose the most rational decision, the probabilistic of them succeeding was higher than prematurely backing out of the process.

Regarding the timing of making an investment, Jalonen (2011) states that the optimal timing for the most important decisions should be made early in the innovation process. Considering what Gamma told us regarding the decision discussed in the previous section, this ended up becoming a dilemma due to poor long-term planning. It comes down to whether the investment decision could be correctly predicted, since some of the equipment needed to finish the product were accessible early in the process, other parts had to be purchased later.

5.2.6 Organizational

Jalonen (2011) explains what types of uncertainties that can emerge within the organization. He discussed that innovation can generate different kinds of uncertainties, for example organizational performance. In Gamma's case, they had a very long process for their innovation, and they described how the innovation at several times through the process affected the organizational performance. He spoke of having some employees having their projects generating positive results and the money generated had to be used for the innovation. This created internal conflicts within the organization, when some workers achieved positive results but those results just vanished to "the black hole".

There are some types of uncertainties more connected to challenges regarding managing an innovation process (Jalonen, 2011). An example of this could be Gamma's R&D management. The CEO mentioned that when they started the process for their innovation there were a lot of people who had not gone through with a process like this. Marth also stated that if they would have had more experience with innovations. they probably never would have gone through with the process at all. This implies that if more research would have been done and if the management would have been more knowledgeable, the process would possibly have been completed more painlessly and with less uncertainty.

5.3 How the external uncertainties affected innovation process

We will in this section use our model and write about the uncertainties that were previously discussed in the analysis. What will be discussed is how they can come to affect each other and have an impact on the innovation process. They can make the innovation process stop from time to time or make it go back and forth. The Preben model will be used but with some modifications since new data has been collected and knowledge has increased. The gathered data regarding Gamma's innovation process will be applied for constructing our new model.

After going through a lot of theory and examining all our data, we could see clear connections that external uncertainties can cause internal uncertainties within a company to emerge but also affect the components within the innovation process.

The purpose of the study has been to develop an understanding of how external uncertainties affect the innovation process. This remains the same, but the focus has mostly been on the financial aspect since this was the most critical uncertainty that affected Gamma's innovation process. Financially Gamma was affected in several ways. Gamma's innovation was throughout the whole process depending on external actors to contribute with financial aid. According to the CEO, this was the main issue haunting the entire runtime of the process. Without the financial contribution, the required technology (i.e resources within the company) to produce was not possible to obtain. With the financials for the technology missing for the manufacturing, the product could not be made, meaning the activities for the process could not be performed. This in turn, resulted in that the actors within Gamma could not act out the activities without the necessary resources.

The external actors involved affecting the process had their own expectations and demands. This made uncertainty related to time emerge. Gamma had their own expectations, and they could not always deliver what was expected in time. This made the help from investors and financiers more difficult. At one point in the process, Gamma had to decide whether to end the process, or to continue, without knowing how the future would come to play out. They were willing to jeopardize their entire capital in order to proceed with the process. The CEO stated during our interview that if they had prior to the process known about all the uncertainties they would come to face Gamma never would have started the process in the first place. As mentioned earlier, according Miller (2007) this was considered an entrepreneurial decision, the most rational one. Today the factory is producing the product, meaning the process was eventually successful.

The process was also affected in other ways. Organizational uncertainty emerged when financials were missing. Required financials for the innovation made the organization adapt. What they did was that during off seasons they sent out consults to generate money. Meanwhile, other projects within the organization were conducted, generating capital, but they just vanished into the black hole, the innovation. Both the CEO and the CFO explained that it became an “we and them” atmosphere in the company with some having their own, cash-generating projects and the other ones working with the innovation. The market also had its impact. It was as the CEO explained that the market was the one setting the demands for this product. Because of this, the innovation was very demanding, pressuring them timewise which meant the missing capital was a factor that Gamma sought earlier and faster in the process, but without luck.



Figure 3: Gamma's Innovation Process Model

This model illustrates what kind of uncertainties Gamma faced, and how external actors gave rise to those uncertainties. It also shows what the resources, actors and activities within the organization's innovation process consisted of and what kind of internal uncertainties that affected the process. Sometimes throughout the process, Gamma lacked the necessary resources to be able to make their innovation progress further. In this case, according to Lutfha (2019) this is called activity void as described in the theory section. There is no possibility to perform the required activities because resources are lacking. When financiers did not want to invest, Gamma got help from customers with partial billing stepwise of the production. Thus, we had to add another external factor to our model to illustrate how some external actors became investors and financiers in Gamma's case. Customers in this case acquired the role of financiers helping the process to move forward. Timing uncertainty is classified in this specific innovation process as both internal and external uncertainty. This is because the source of the timing uncertainty came both from the external actors, deciding the deadline. While Gamma had important decisions to make that caused additional delay to the production.

6. Conclusion

When we started conducting this research, doing the introduction and the theory chapters we found a lot of studies regarding uncertainties in the innovation process. These studies had different conclusions, some said that uncertainties are embedded within the process and other studies stated that there are external uncertainties that affect the process. The purpose of our study has been *to develop an understanding of how external uncertainties affect the innovation process* and we feel that with the empirical data gathered we have got a better understanding of how external uncertainties can affect the innovation process, making internal uncertainties emerge.

Another phenomenon we found interesting and that we have given much thought is the “black hole” that the CEO of Gamma spoke of. In an innovation process you must always dare to take financial risks, which is to be expected by entrepreneurs. You spend resources (i.e. cash) on something that you cannot for sure know will generate money. We believe that an innovation process could always be seen as a “black hole” until the time where you see that you start earning from the innovation. The innovation is considered a black hole until the company generates profit from the process they have gone through.

What we as authors have tried to do when conducting this research is to see how external uncertainties affect the innovation process and the components within. Moreover, what we have identified is how the phenomena, the black hole and activity void are interrelated with each other. Our perception of how these are interrelated are that when an organization is lacking the required resources, the actors cannot perform the wanted activities, and this is the activity void. This affects the whole process. When the activity void is active, the process remains stagnated and financials are needed. The black hole needs to be fed up in order to reduce or remove the activity void for the innovation process to progress on. Our conclusions, based on what Gamma experienced during their innovation process, is that when a black hole emerges, it can drain capital from the entire organization. It will drain capital until the point where the activity void is completely faded, the black hole is totally fed up and the innovation process starts to generate positive results.

Another interesting aspect that was detected was the fact that when external actors create uncertainties making financials hard to receive from other actors that could help. In Gamma's case, it was throughout the process in some scenarios that the customers took the role of investors, helping with partial billing for their innovation to continue, when help from financiers and investors was difficult to obtain.

Regarding limitations this work has faced, the time aspect has been crucial. If there would have been more time this could have been made into a cross case study. We could have had the opportunity of conducting interviews with more than two organizations. Our research resulted in several interesting conclusions, according to us as authors. Though, the research has mostly focused on how financial aspects affected Gamma and what other uncertainties that affected the financial ones. Moreover, it illustrated how the process came to face difficulties and how the different components were affected, but also how Gamma managed to overcome these uncertainties. With

more organizations and more interviews, we could have investigated more innovation processes and what alternate uncertainties they would have faced and how they would have been solved.

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Appendix 1: Interview Guide

1st part: Presentation

We are two students, Johan and Simon. Currently we are writing our bachelor thesis at the University West of Trollhättan. The purpose of this thesis is to contribute with additional knowledge about how external uncertainties can affect internal components during innovation processes. In order to accomplish our set goal, we are conducting a case study. These interviews will aid us in enabling the collection of information needed.

2nd part: Ethical questions

- Do you understand the purpose of this study? Do you have any additional questions or is everything clear?
- The study is anonymous. There is a possibility to sign a confidentiality contract, if requested. If you do not feel that is needed, we assure you that we respect the confidentiality completely.
- Do you accept to be recorded during the interview?

3rd part: General question

- Can you present your company in terms of history?
- Can you present your main products?
- Can you explain how your company is organized or do you have an organization chart?
- Are you present in foreign markets or just the Swedish one?
- Who are your (three most important?) key suppliers, and what do they offer you? How would you describe your relationship with your suppliers?
- What are your targeted customers, and would you consider them dynamic or consistent?
- What is your company's values?

4th part: The heart of the subject

Innovation processes related to the company

- Would you consider the fuel idea the most important innovation for your company?
- How did you come up with this idea?
- What were the most important steps, in order to go from idea to action?
 - What were the first steps?
- What was your general understanding regarding time to market?
- How did the overall procedure go? According to you.
- What uncertainties could one expect to encounter during this kind of process?
 - What uncertainties and risks did you encounter?
- What crises did you go through?

- Assuming you had to do heavy investments, what uncertainties did you experience because of this?
 - How did you react to these uncertainties?
- Did you encounter any problem regarding payments/financing from investors or other resources during this process?
 - How did you deal with these problems?
 - How did that affect your company, along with the overall process?
 - How was/is your relationship with the investors/financiers? Before and after the incident?
 - How much contact did you have with your suppliers during this process?

- Regarding technical innovations, one would also need actors, a sustainable market and room for activities. What uncertainties emerged within these components?
 - How did you overcome these challenges?

- Pick one of the challenges you managed to overcome, how did that affect the result of the process?

- From where you are now, what do you judge to be one of the possible upcoming challenges you might face?



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