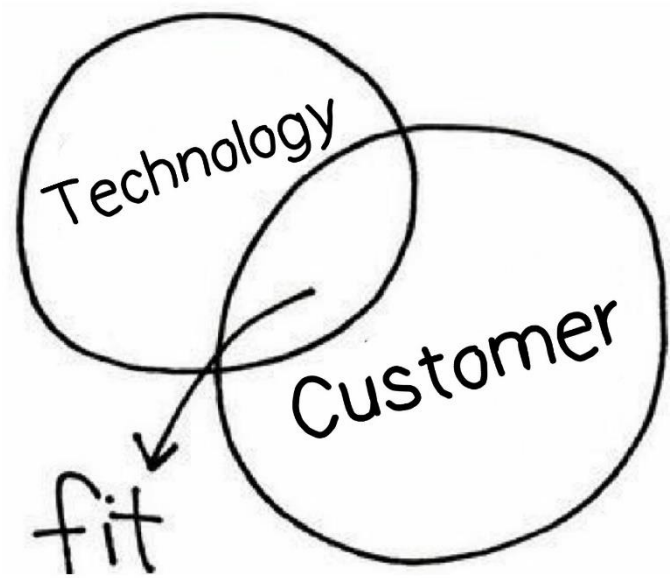
UNIVERSITY OF TWENTE.



A Technology/customer fit framework for new business development

Peter Hadarian
M.Sc. Thesis
August 2016

Supervisors:
Dr. A.H. van Reekum
Dr. K. Zalewska-Kurek

Management summary

The company where this research is conducted has built a product for a market that has some important advantages over similar products in that same market. This company wants therefore to use the same technology platform of their product for another market and take benefit here from. However, it is not clear what product to build and which market segment to enter.

The problem this research project focuses on is the lack of a coherent framework for the *front end innovation (FEI)* phase, the first phase of the innovation process. This framework is needed to reach a Technology/customer fit, i.e., to effectively build a product concept. A product concept is essential to move to the next phase of the innovation process, the *new product development (NPD)* phase.

To solve this problem, the Technology/customer fit framework is built in this research project that helps the company to effectively build a product concept. This is done by consistently combining and integrating the relevant theories, models, and techniques that are related to the front end innovation. In this framework the focus is on the technology platform and the lead users. Lead users are users at the front end of an important market trend and face needs and/or problems (not generally known to be solvable) that foreshadow general demand in the marketplace. In addition, they have usually built a solution and can provide design data.

The overall innovation process is divided into three parts: FEI, NPD, and the commercialization process. In this thesis these are referred as, respectively: Technology/customer fit, Product/market fit, and the Scale phase.

Table of contents

1 – Introduction

1.1 – General introduction


Confidential


Confidential


Confidential

1.2 – Problem description

Company X needs to know what the customers expect and what the functionalities of existing products are. There are different types of systems in market Y and even within the segments there are different needs. Together with the team of Company X a set of questions are formulated that indicate the most important matters concerning this new project. These questions are the following:

General questions:

- What is Company X's current activity?
- What is their next goal?
- Why is it interesting to enter this market?

Questions concerning market Y:

- Who are existing users/customers in this market?
- Who are future users/customers in this market?
- What are the (unsolved) needs/problems?
- What are the adoption factors?
- What are current solutions/products/systems and how do they work?
- What does need to be improved?

Questions concerning Company X:

- How can Company X solve these problems? What are the benefits that they can deliver?
- The technology has to be developed, what is needed for this development?
- Who needs to be contacted?
- What are the hurdles? How to avoid/overcome them?
- How to eventually switch from *customer type 1* to *customer type 2* and so on? (How to deal with different kinds of users/customers?)

In figure 5 an Ansoff matrix is shown with possible areas where Company X could enter market Y. The *market penetration* area (established products, established market) is not interesting for Company X. Entering this area would mean entering a red ocean area and they could not benefit much here from. Company X's final goal is to create a new market with their product (diversification area), but as can be seen in the figure, this will take the highest risk with it. The company wants to establish itself in market Y in an efficient way, which means they will have to find the right area in the Ansoff matrix to start in. From there on Company X will try to reach their final goal with this product category. This area on the Ansoff matrix must be a blue ocean area.

Figure 5 – Ansoff Matrix applied to Company X (Ansoff, 1957)

It is not clear yet for Company X where this blue ocean area is, whether somewhere in *market expansion* (established products, new market), *product expansion* (new products, established market) or somewhere in between these two areas. It is also not clear yet whether the competencies of Company X will be enough to develop this new product or whether expertise is needed from the outside.

It has to be found out what is needed to enter market Y, i.e., what the minimum needed requirements are to enter and to satisfy the market. An important factor here is the product/market fit, which basically means being in a good market with a product that can satisfy that market. However, before getting to product/market fit, we need a sort of "technology/customer fit". The goal of technology/customer fit is to obtain a product concept by identifying the *lead users* of a market and find a match between the (functionalities of) technology and the lead users of that market in order to enter the market effectively. This technology needs to add value that is not delivered by existing solutions. Market Y is already being served (to a certain degree) by existing products, so there is already a kind of solution to the problem in this market, but perhaps with this technology, this market could be served in better way. We need to find out what value the technology of Company X can deliver to market Y. When this technology/customer fit is found, the step to the process of achieving product/market fit can be made, i.e., when it is clear that the technology of Company X can offer new value, the focus will be more on the rest of the market and the goal is then to create the actual product that will satisfy the market.

In this thesis the whole innovation process (from idea to market) is divided into three parts. In general it seems like the innovation process consists of the Product/market fit (new product development) and Scale (commercialization) phases, but now the Technology/customer fit (front end innovation) part is added to the process. This has been placed before Product/market fit, as can be seen in figure 6.

Figure 6 – The addition of Technology/customer fit to the innovation process

1.3 – Research question

The research goal is to make a *bottom-up market research* framework for Company X, consisting of the appropriate theories, models, and techniques that will help them to achieve Technology/customer fit, which is to build a product concept, and then move to Product/market fit and eventually to Scale (these three phases form the complete innovation process).

Based on the research goal, the next main research question is chosen:

> **How to translate customer perceptions into a technology configuration for a product concept?**

This framework must help Company X (and any other company with similar conditions) to translate the market needs to their technology platform and to find a right way to efficiently enter the target market (for Company X this is currently market Y).

To give an answer to the research question, the next sub questions are formulated and discussed:

1. Which theories, models, and techniques are going to be used for the framework?

   For the framework the most appropriate theories, models, and techniques are selected. These will have to do with the problems and conditions where (companies like) Company X is, which are reflected in the questions set in section 1.2. These theories, models, and techniques must also be related to each other in one way or another, in order to represent a consistent concept.

2. How to make a framework?

   A logic way of making a framework needs to be considered. Although there are no specific articles on how to make a framework for purposes like for this thesis, there are some relevant articles that are sort of related hereto and these will be used to give a good idea about it. The framework in this thesis will be considered as combination of systems that together form the innovation process.

3. What are the essential components of the framework?

   The framework will consists of a system that is divided into subsystems and elements. The most important system that this thesis will focus on is Technology/customer fit. For this the most appropriate factors are selected that are essential to achieve Technology/customer fit and to build a product concept.

1.4 – Outline of the thesis

This thesis is structured as follows (see figure 7): First the relevant theories, models, and techniques are consistently selected and explained, largely based on the questions set in section 1.2. This will form the theoretical framework and will be covered in chapter 2. It will also give an answer to the fist sub question of the research question.

Next, the method on how this research is conducted is described, i.e., how to make a framework. This will be the holistic approach of *systems thinking* and will be discussed in chapter 3. Also an description is given about some important requirements that a framework should meet. These will form the answer to sub question 2.

In chapter 4 the Technology/customer fit framework will be constructed. This will be done step-by-step on the basis of the questions set in section 1.2 using the theories, models, and techniques of the theoretical framework in chapter 2. Also a canvas will be made as a practical tool for the framework and different groups of users/customers are identified in chapter 4.

Finally, in chapter 5 the discussion and conclusion will be given based on the results of the sections before. Also the contributions of this research and the future work will be discussed.

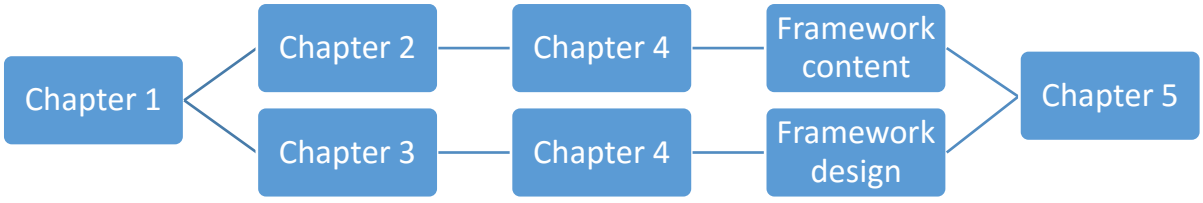


Figure 7 – Overview of the structure of this thesis

2 – Theoretical framework

2.1 – Introduction

In the following chapter the relevant theories, models, and techniques are presented that are needed to make the framework for Technology/customer fit. These are based on the questions set presented in section 1.2. In this chapter an answer will be given to the first sub question in a large extent.

To start, the focus is on the technology platform of the company. We will have to start from this point. One of the few theories that approaches new business development from the perspective of own resources is Sarasvathy's effectuation. Effectuation is being seen as a genuinely new idea that gives a refreshingly new look at the old phenomenon of entrepreneurship (Sarasvathy, 2009). In effectuation (Sarasvathy, 2001) one focuses on the available set of means and during the process of deployment the goals become gradually clearer. This takes place through the 'effectual cycle'. The reason for selecting Effectuation as part of the theoretical framework is because the emphasis here is literally put on starting from the own resources and to see what can be done with them. In this theory it is suggested to look for people who can help with this deployment of the goal(s). This is also an important issue in the questions set in section 1.2, i.e. to contact the right users. However, this is only globally covered in the effectual cycle, but it serves as a good point to continue from there on. Furthermore, Effectuation can be used for startups, small and large companies (Wiltbank & Sarasvathy, 2010), however, they warn that not just "anything goes", but that constrained creativity is needed. This will be covered in section 2.2.

The other very important factors in the questions set in section 1.2 concern the users and/or customers and with whom exactly to get in touch. This is also an important point in the effectual cycle of Sarasvathy, as already indicated here above. According to Cooper & Dreher (2010) users/customers are the best source of new-product ideas. These users/customers, namely, can tell us much about the (in the questions set listed) needs, problems, and adoption factors, but also whether there are already potential solutions. For this the voice-of-customer will be used, which is a process to capture customers' requirements (Gaskin et al., 2010).

First we must, however, identify the different types of users/customers and for this the diffusion curve of Rogers (1962) is chosen. This theory was chosen because it shows how an innovative technology spreads among the different types of users/customers. However, this curve represents the distribution of the innovative technology as something that occurs gradually, making it appear that the related processes that the company has to implement should also go gradually from on to the other. But this is not the case at all and it causes problems for companies, because the groups of users/customers behave very differently. This is where Moore's *the chasm* fits well with. Moore (1999) found out that the users/customers on Roger's diffusion curve were, in fact, separated in two groups with a chasm in between

them. This, therefore, indicates that these two groups show different characteristics and therefore different ways of approaching them are needed. This also indicates that certain requirements need to be met before moving from one group to the other one. Understanding this can reduce risks and can help companies to effectively satisfy both groups. Moore (2004) then continues with other strategies that become only important in later stages, but they are useful and give more clarity to the innovation process as a whole. These will be discussed in section 2.3.

The most important users for the Technology/customer fit framework are Von Hippel's (1986) *lead users*. This type of users, which were already mentioned in section 1.2, can help us build a product concept. The reason that these users are important in particular is because they face needs and problems months or years before the marketplace encounters them. Moreover, they have already thought about or have even built a solution. Together with lead users, a company can use these solutions to build technology concepts, in a process called *lead user workshop*. However, recognizing lead users is difficult and the process to identify them must be well understood. Therefore, first the users on Roger's diffusion curve are covered, because they are (among other things) part of a certain method (which is called *pyramiding*) for identifying lead users. This will be covered in section 2.4.

After having discussed all the relevant users for the Technology/customer fit framework and what characteristics they have, a right method of voice-of-customer must be chosen. In this thesis the Customer Development methodology has been selected (Blank, 2005). Although in the literature it has not been found that Customer Development is recognized as to be a voice-of-customer method, it does have a lot similarities with existing methods. But it goes further than that. The reason why Customer Development is chosen because it is more than just a voice-of-customer method. It is an iterative process and involves more aspects of the business model with the customer at the center. With Customer Development one has also the ability to parallelly work on product development in an effective way. Blank (2015) has made a diagram (or loop) for this process. The goal of this all is to make a product that the customer wants instead of guessing what the customer wants. Even though Customer Development is primarily intended for the Product/market fit phase, it can be, however, useful for the Technology/customer fit phase as well. In addition of capturing information from the different users, Blank's (2015) diagram could be used in combination with the lead user workshop, for example. Customer Development will be covered in section 2.5.

The last section of chapter 2 will be about Product/market fit. Although in this thesis the focus is on Technology/customer fit, it is still important to know what is happening after a product concept is build. Moreover, the Product/market fit phase has a useful tool that has become very popular among different kinds of companies. This tool can be used as an inspiration for a similar tool for the Technology/customer fit phase. This tool, the Business Model canvas, is shortly described in section 2.6, but explained in detail in Appendix B.

2.2 – Effectuation

Causation and effectuation are terms that were introduced by Saras Sarasvathy (2001a). Entrepreneurs continuously make decisions and take action. Two questions that came up here were “how do they do that?” and “are there any universal methods or principles they use?” (i.e., what makes entrepreneurs entrepreneurial?). Sarasvathy (2001a) tried to answer these questions and the result hereof was *effectuation*. Effectual reasoning (or effectual logic) is the opposite of the traditionally causal reasoning that is being taught at business schools. These two terms differ from each other primarily in the way that causation is used when the future is predictable, while effectuation is used when the future is not predictable.

The focus in causal logic is on achieving specific goals through a given set of means. Causation refers to searching and selecting the right resources, where many of them established on management theories, to achieve those goals (“what do we want” → “what do we need”). Supporters of causation think that if the future is predictable, it can be controlled.

On the contrary, in effectuation one focuses on the available set of means and during the process of deployment the goals become gradually clearer (“what do we have” → “what can we do”). Effectuation supporters think that the future can be created and therefore does not need to be predicted. The process of finding the right time to start, the optimal opportunity, and other external factors like timing and dumb luck are not paid a lot of attention here, as effectual entrepreneurs believe they have full control (Sarasvathy, 2001a).

In figure 8 this is represented in a schematic.

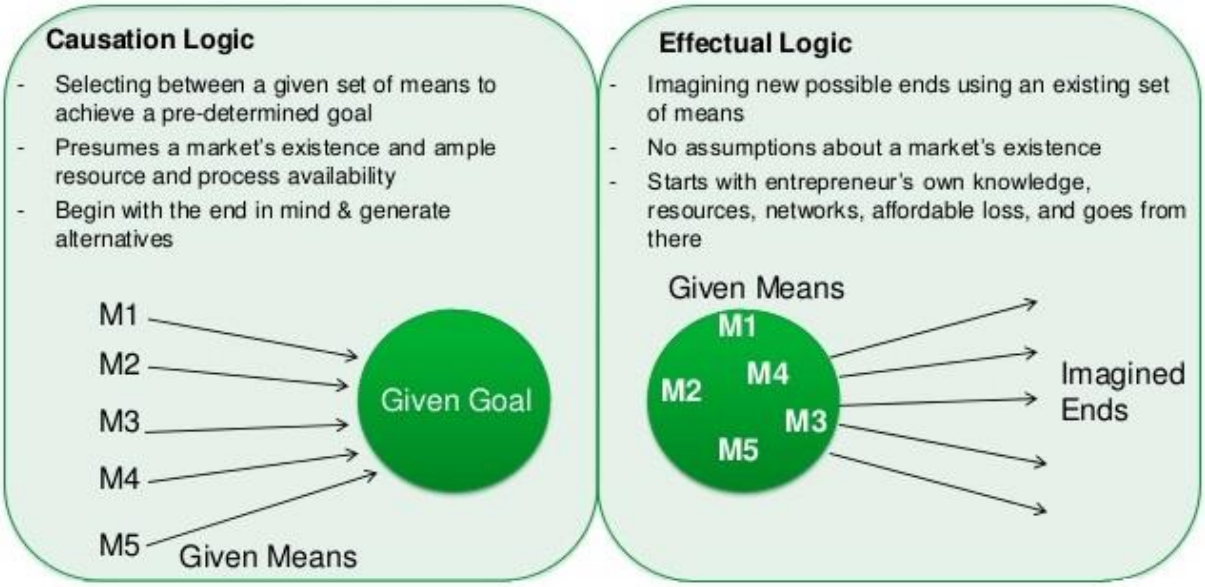


Figure 8 – Causal vs. Effectual reasoning (Sarasvathy, 2001b)

Sarasvathy (2001a) explains these concepts in the form of a story about two chefs in a restaurant that want to cook a dinner in two different ways. The first chef will let customers to pick something from the menu in advance. After he knows what they want, the chef will list the ingredients, buy them, and then cook the meal. This is an example of causation. The chef started with a given menu (desired goal) and then the focus became on selecting the effective ways to prepare the meal. The goal is well defined and the result is predictable.

The other chef will work in a different way. Instead of letting customers pick a meal from the menu, he will cook a meal based on the ingredients and utensils available in the kitchen. Here different menus are possible and the chef has to use his imagination in order to prepare the most delicious meal. This is an example of effectuation. The chef started with certain ingredients and utensils and the focus became on how to prepare a good meal out of the many possibilities. Here the goal is not well defined and the outcome is not predictable, only the means, which are the ingredients and utensils in this case, are well known.

Effectuation consists of five core principles (Society for effectual action, 2011):

- The **bird-in-hand** principle: Entrepreneurs using effectuation start with any means they have (who I am, what I know, and whom I know), without having a specific goal and without having to worry about opportunity costs or carrying out elaborate competitive analyses. The entrepreneurs then imagine the possibilities that originate from their means.

  The bird-in-hand principle is in contrast with pre-set goals or opportunities (causal reasoning), where first a goal is set and then the means are assembled.

- The **affordable loss** principle: Effectual entrepreneurs focus on the downside risk instead of on potential profits. Here the risk is limited by understanding what is affordable to lose at each step rather than investing in calculations about expected returns.

  This contrasts with causal reasoning's expected return, where the focus is first on targeting a return and then on working to minimize associated risks.

- The **lemonade** principle: Effectual entrepreneurs acknowledge and appropriate contingencies by interpreting "bad" news and surprises as potential clues to find new opportunities and markets, instead of making them "what-if" scenarios to deal with worst-case scenarios.

  This is in contrast with causal entrepreneurs who work to minimize the probability of unexpected outcomes and avoid surprises.

- The **patchwork quilt** principle: Entrepreneurs that use effectuation build partnerships with parties they can trust. These parties are self-selecting stakeholders that can help reduce uncertainty by giving pre-commitments for example.

The patchwork quilt principle is in contrast with causal reasoning's competitive analysis, which assumes that competitors are rivals to contend with.

- The **pilot-in-the-plane** principle: All the previous principles are put together here. Effectual entrepreneurs focus on activities within their control and know that their actions will result in the desired outcomes. They think that the future is not found or predicted, but rather made by controlling some of the factors that determine how it will turn out.

  This is in contrast with causal entrepreneurs who think that established market forces will cause the future to unfold through inevitable trends.

In figure 9 the effectual cycle is shown, which comprises the five effectual principles. The entrepreneur starts with an inventory of his means (bird-in-hand principle), from which he will imagine goals. The goals the entrepreneur tries to achieve these goals taking into account the affordable losses. Here he has to consider the goal construction and goal achievement, as they are two different things, yet related to each other. What also has to be taken into account here is the leverage surprise that can be added to these means and goals (lemonade principle).

The next step is to interact with other people to join in co-creating the new business. These will have to be committed stakeholders that will influence the entrepreneur by smoothly change and add to the original idea into one that whole network of parties are committed to (patchwork quilt principle). These interactions and commitments can add new means to the resources which will help the goals to take a more definite form.

The cycle continues as the effectual entrepreneur still grows closer to a well-defined business model, i.e., a sellable product, complete with committed customers and network that comprise the new market (pilot-in-the-plane principle) (Society for effectual action, 2011).

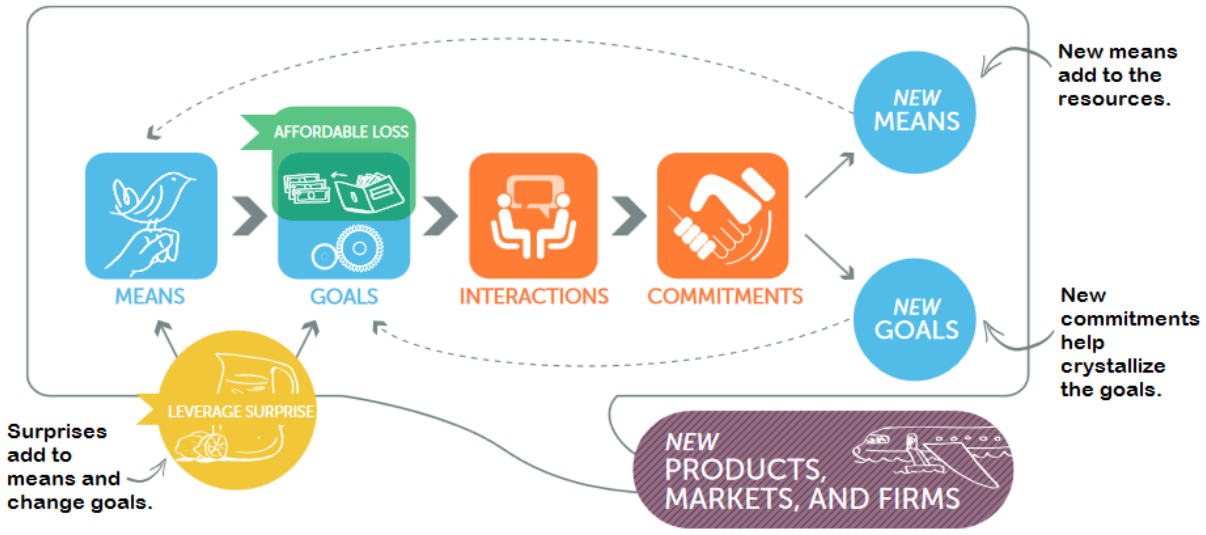


Figure 9 – The effectual cycle (Society for effectual action, 2011)

In figure 10 can be seen that causation is a top-down approach, while effectuation is a bottom-up approach.

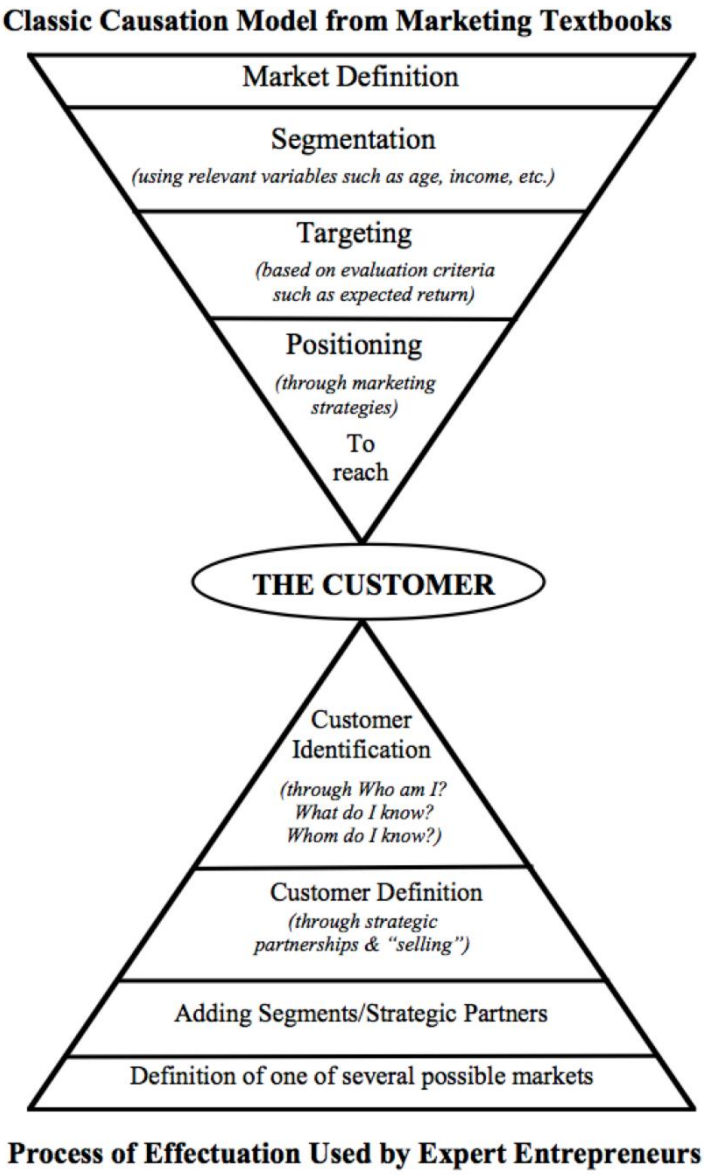


Figure 10 – The different approaches of causation and effectuation (Sarasvathy, 2001b)

To summarize: Effectuation helps the entrepreneur to think about how to make decisions when non-predictive control is required. Instead of prescribing what to do, it is more a set of heuristics that uniquely and universally applies to the specific challenges that the entrepreneurs are to face. Effectuation is like the first and second gear. An entrepreneur needs them to start the business, but eventually he will have to shift away from effectuation (Society for effectual action, 2011).

2.3 – Innovation diffusion curve and Crossing the chasm

2.3.1 – Diffusion curve

The innovation diffusion curve (or simple the diffusion curve) shows the stages that a new product goes through when introduced to the market. According to Rogers (1962) not everyone will immediately adopt a new technology, regardless of the obvious benefits. As result of years of research, Rogers (1962) identified a pattern in how people accept a new technology, which is illustrated as a classical normal distribution curve. In figure 11 the blue line represents the types of customers adopting the new technology and the yellow line represents the market share which will reach 100% when adoption is completed.

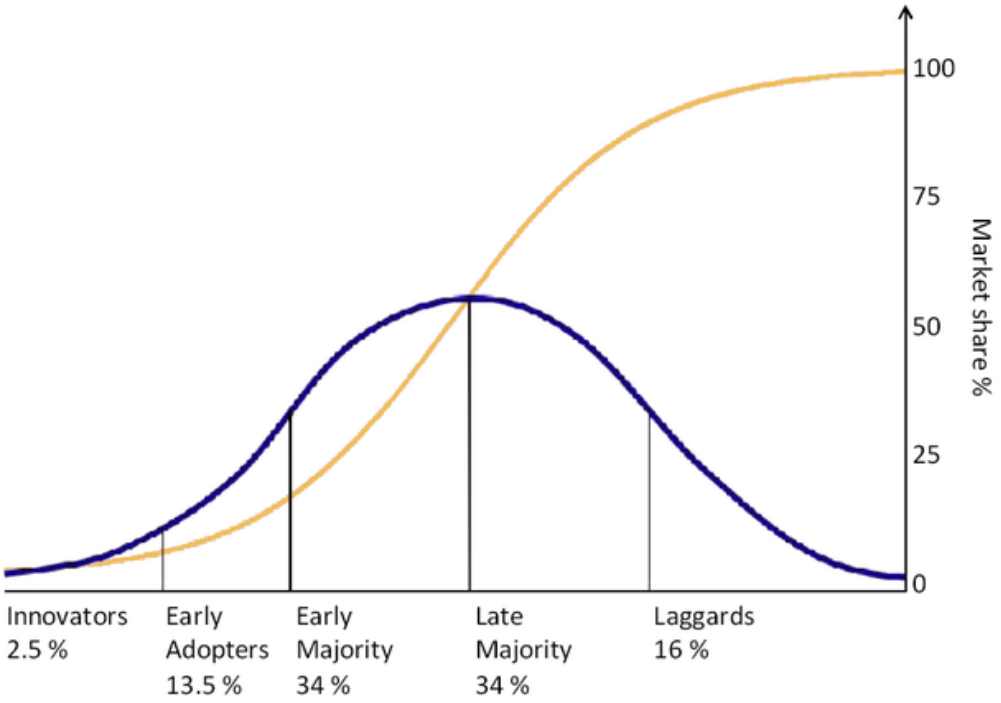


Figure 11 – Innovation diffusion curve (Rogers, 1962)

Rogers (1962) distinguishes these customer types as follows:

Innovators (2.5%): Innovators are the first to adopt a new technology, as they basically believe that the new technology is better than the existing technology. They are also called technology enthusiasts. This is the most willing type to take risks. Customers of this category could, for example, be the youngest in age, have great financial lucidity, have close contact to scientific resources, have the highest social class, or contacts with other innovators. Their risk tolerance allows them to adopt even technologies that eventually may fail, but with their financial resources they are able to absorb these failures.

Early adopters (13.5%): This is the second fastest type of customers to adopt a new technology. Early adopters, also referred to as visionaries, see a new technology as a path to competitive advantage and therefore adopt any new technology to improve their

business. They have the highest degree of opinion leadership among the other categories and are usually younger in age. Individuals from this type are typically high educated, have more financial resources, and have a higher social status than the adopter types after them in the cycle. They are more discrete in their choices of adoption than innovators. Through their judicious adoption choices they are more likely to maintain a central communication position.

Early majority (34%): Customers of this type (also called pragmatists) are conservative, but yet open to new ideas. They are active and influential in the community, but are slower in the adoption process than the first two categories in the cycle. People in this category have an above average social status and usually have contacts with early adopters, but they rarely possess opinion leadership in a system. When an innovation reaches this category, sales start to become predictable and provide high margins.

Late majority (34%): People in this category will adopt a new technology after the majority of society has adopted it. These individuals are also referred to as conservatives and will approach a technology with a high degree of skepticism. They are typically skeptical about an innovation, have little financial lucidity, have below average social status, and have usually contacts with people from the early majority and others in the late majority category.

Laggards (16%): This is the last category of individuals to adopt a new technology. Also referred to as skeptics, these customers have typically an aversion to change and hold more on to traditions. They have usually the lowest financial lucidity and are the oldest of all the other adopters in the cycle. They are also likely to have the lowest social status with very little or no opinion leadership and are only in contact with family and close friends.

According to Rogers (1962) there are five factors that influence an individual's decision to adopt or reject a new technology. These include:

1. Relative advantage: This factor describes how improved the new technology is compared with existing technologies.
2. Compatibility: The compatibility factor defines the degree to which a new technology has to be assimilated into a person's life, i.e., how hard it is to integrate an innovation into an individual's daily life.
3. Complexity: This describes the difficulty of using an innovation. If the new technology is too difficult to use, a person is not likely to adopt it.
4. Trialability: This factor gives a description on how easily a new technology can be tested or tried out. When individuals are able to experiment with an innovation, they are more likely to adopt it.
5. Observability: The observability factor defines the degree to which a new technology is visible to others. A more visible innovation is one that draws more attention.

2.3.2 – Crossing the chasm

Moore (1999) explains that many startups face the problem of getting their product to the mass market. When a new technology is introduced, it goes through different stages of adoption, as explained here above. At first it will be adopted by people that love technology just for the technology itself (the innovators or technology enthusiasts). Next, a larger category of individuals will adopt the new technology, as they are visionaries and see big potential that comes along it, and therefore simultaneously will accept any incomplete feature sets and bugs (early adopters).

The next type of individuals, however, are very different form the first two as they are much more pragmatic and are only interested in complete solutions (early adopters). The category of people thereafter are even more conservative and their primary goal is to avoid risks (late majority). And the last type of people are skeptic 'late-to-the-party' buyers that are only interested in the new technology after everyone else has tried it out and proven it in the first place.

It is obvious that these two groups of categories differ from each other in the way of adopting a new technology and therefore the way to reach these two groups is different as well. According to Moore (1999) there is a wide and deep "chasm" between early adopters and the early majority that separates the two groups into *early market* and *mainstream market* (see figure 12). Crossing the chasm means after selling to early adopters to reach a new sales plateau where the next stage of growth is to take the new technology to the mass market. However, crossing the chasm is a fundamental issue that many entrepreneurs face, as the early market will accept incomplete features and early stage technologies, the mainstream market, on the other hand, will only be convinced to adopt the new technology when they are offered complete solutions and convenience and are thus much more difficult to reach.

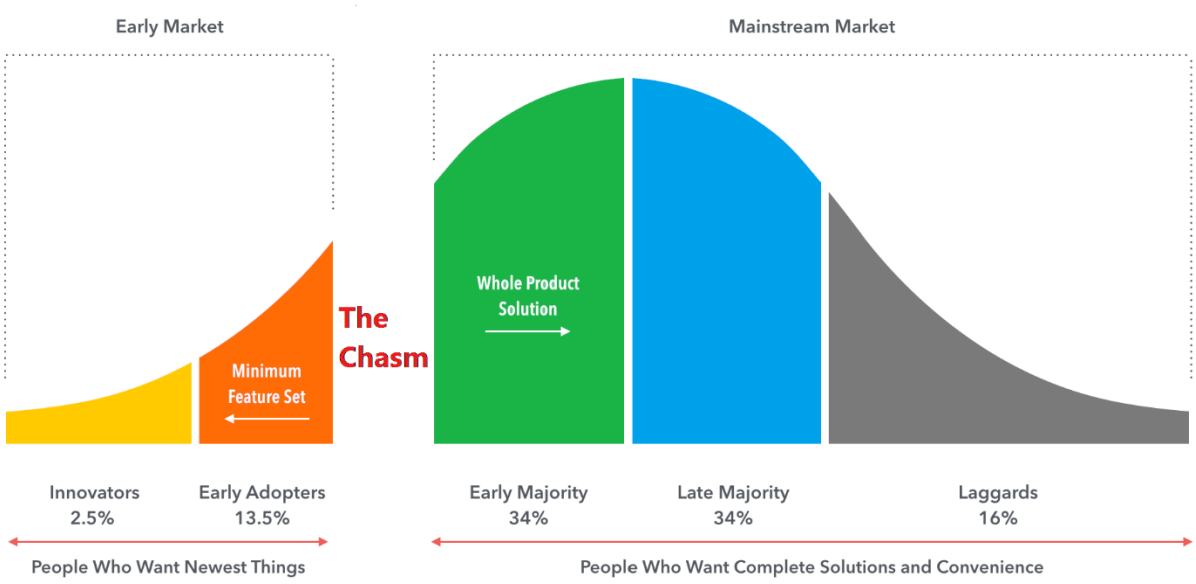


Figure 12 – The chasm (Moore, 1999)

Moore (1999) argues that in order for a company to successfully cross the chasm, it has to meet the following things:

1. Create the "complete product" – a company should only try to cross the chasm when having eliminated all major bugs and having a complete feature set;
2. Position the product in an appropriate way for the pragmatic early majority;
3. The pricing of the product should be based on competitive comparisons rather than to be value-based;
4. Select the right channels for the distribution.

2.3.3 – The bowling alley

In his later work, Moore (2004) explains a more specific strategy for crossing the chasm what he calls "the bowling alley" (see figure 13). Using this model allows an entrepreneur to develop niche market expansion scenarios, i.e., "what would happen if…".

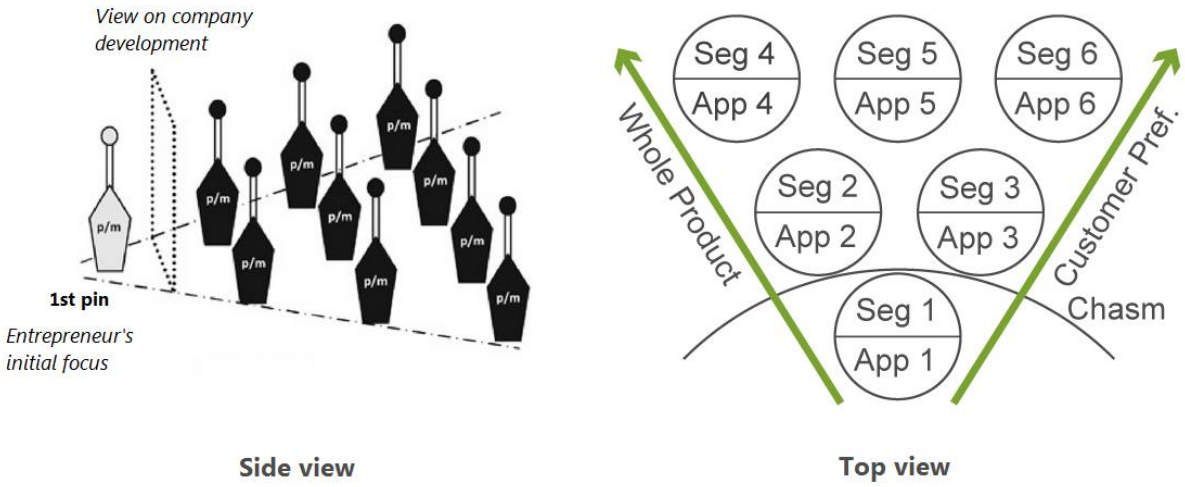


Figure 13 – The bowling alley (adapted from Nijssen, 2014; and Nielson, 2014)

The bowling alley emphasizes the existence of multiple feature sets and the goal of the model is to line up all those segment opportunities and make customizations that over time will address all particular market segments. The main goal of the bowling alley is, when crossing the chasm and starting to plan out how to build the complete product, to identify specific market segments in the early majority that will help to specify and create the complete product.

In order to gain market momentum, Moore (2004) says that a company should first target a niche (the first pin in the model) that can help to identify specific market segments. He suggests to use this concept to illustrate the challenge of selecting the first and best features of a product (the product application). Addressing the right feature set first and targeting its

related market segment should help secure the company's temporary survival and provide information and experience that will facilitate targeting other market segments, which will enhance chances of success. The wrong choice of the first feature set and niche can really slow down and limit the company's growth potential.

Each next segment (or pin) requires its own complete feature set so that its customers can consider and will be willing to adopt the new technology. However, it will be even easier to adopt when the new technology has been successfully demonstrated to a neighboring segment with satisfied customers. Eventually, the goal is to aim for the best pathway for company growth (a strike).

The first pin needs to be selected carefully. Executing well enough on the bowling alley strategy will let the product and the company enter what Moore (2004) calls "the tornado". The tornado is defined as the short period of hyper growth when building the complete product is finished and the whole market is so interested in this new technology that they want to buy it instantly. This is a period when the company needs to scale exponentially in order to keep up with this huge demand and all the focus of the company should be on shipping the product as efficient as possible. For most companies it is actually a good thing to be sucked up by the tornado, but it then it has to be operationally prepared for it, otherwise it can tear the company apart. So as long as the company is able to ship, it will have a good chance to survive the tornado.

After coming out of the tornado, the company enters the "main street" and has proven to withstand the crucial test of shipping. The main street is a period of relative calm and opportunities for growth in scale have become limited, but are now high in margin. The next important thing is to build an aftermarket program. As the new product has been widely adopted and many standards have been set, the big opportunity for the company is to leverage its market position by providing aftermarket add-ons (Moore, 2004) that improve the product and prevent customers to switch to competitors.

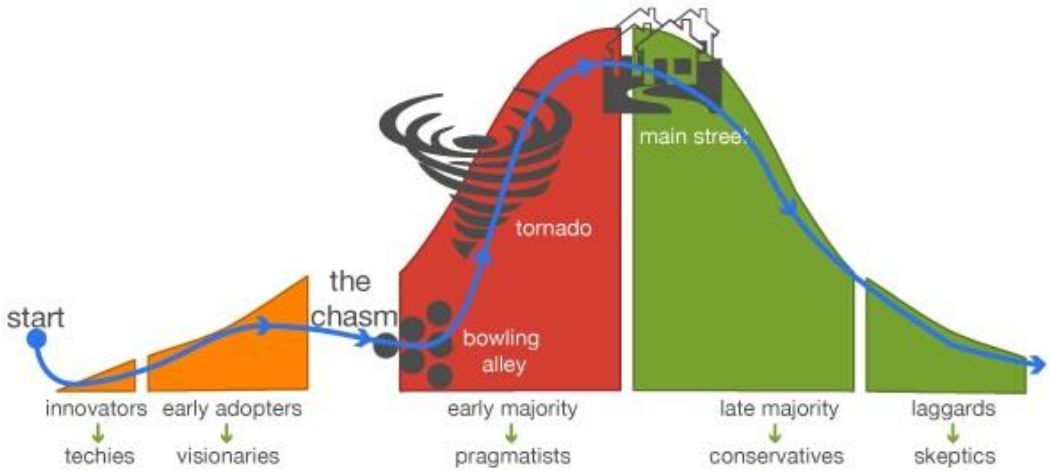


Figure 14 – The complete path on the diffusion curve (Moore, 1999; adapted by Nielson, 2014)

2.4 – Lead users

According to Von Hippel (1986) an accurate understanding of user need is very essential for developing commercially successful new products. However, current market research analyses are usually not reliable in the case of very new products or in rapid changing product categories, like "high technology" products. In his research, Von Hippel (1986) argues that in consumer and industrial market analyses these most users have a significant limitation: their own real-world experience constrain their insights into new product needs and potential solutions. It is thus unlikely that they will make new product concepts that conflict with familiar products.

Von Hippel (1986) says that studies have shown that during experiments subjects that were familiar with a complicated problem-solving strategy were mostly unable to come up with a simpler one when this was appropriate. Also, when they used objects or saw it used in a familiar way, the subjects were strongly blocked from using those objects in a new way. These studies indicate that the same effects are displayed in the real world.

In many product categories, like new car models that are often not extremely different from their previous versions, these user constraints do not lessen the ability of evaluating needs for marketing research, and the typical users are thus able to deliver valuable information to the development of new products. However, in high-tech industries things change so rapidly that real-world experience of ordinary users is often not of sufficient value to the development of such products.

Von Hippel (1986) argues that for high-tech industries a different type of users are needed and introduces the term "lead users". Lead users do have real-life experiences with new interesting product concepts and are crucial for accurate market research. Despite the fact that their insights also are constrained to the familiar, they are familiar with conditions that lie in the future and are, therefore, in a situation where they can serve as a need-forecasting laboratory and provide accurate data on future needs and/or problems. Von Hippel (1986, 2012) defines "lead users" as users of new technologies that have the next two characteristics:

- Lead users are at the leading edge of an important market trend and face needs and/or problems (not generally known to be solvable) that foreshadow general demand in the marketplace. The bulk of the marketplace will encounter these needs/problems only months or years later.
- Lead users are in such conditions that they expect to obtain high benefit from a solution to their needs/problems, and therefore may innovate ("necessity is the mother of invention").

Von Hippel & Riggs (1996) say that lead users are ahead of all the categories of users on Rogers' (1962) innovation diffusion curve. Where for the others users commercial versions of a product are available, lead users can only work with non-commercial lead user prototypes. In figure 15 *lead users* are placed before innovators on the innovation diffusion curve.

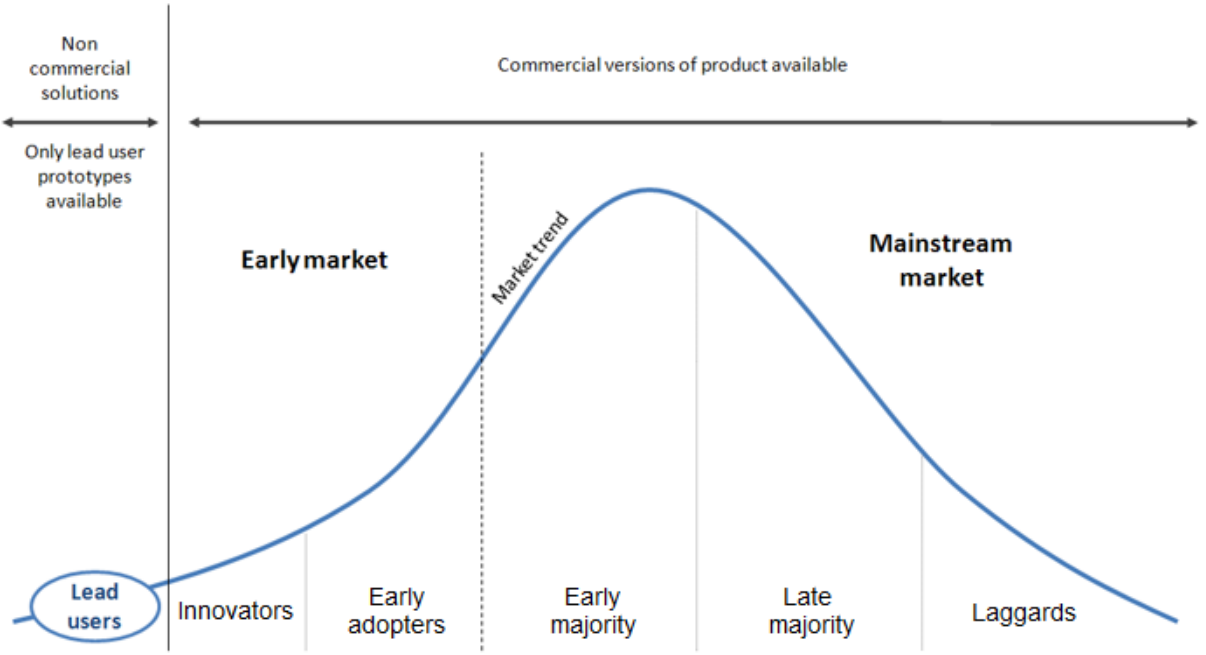


Figure 15 – Lead users added to Rogers' innovation diffusion curve (Stratégies d'innovation, 2009)

So at the leading edge there is nothing much there yet, because firms are not yet serving it, so there is a sort of lack of products. Lead users sitting at the leading edge need something the market is unlikely to have supplied it, because there is no demand up to that point and the own incentive to supply it for themselves then determines whether they are about to do anything about it (Von Hippel, 2012). As they are in the field being acted upon, lead users know better than companies whether there is really going to be market here than companies do. Lead users innovation, therefore, forms the basis for new products and services of value to manufacturers.

The important question here is: how to find the users at the front of a trend who in fact have something that is of commercial value to pick up? Von Hippel (1986, 2012) suggests a four-step process:

1) Select a specific market and specific *major* trend to think about
2) Brainstorm possible lead users *within* that target market
    - Which types of individuals or firms have needs at the leading edge of the trends?
    - Which ones have a high incentive and the resources to solve their leading edge needs?
3) Brainstorm possible lead users *outside* the target market
    - Which types of users in other fields and applications are facing a similar need but in a more demanding form?
4) Specify what you might learn from each type of lead users

So the first thing is to identify the trend. The advantage of that is that one does not have to wait for somebody else's activity to come along. Instead, it is better to drive to the head of that trend and find people there whether or not they are signaling their presence. It is, however, not easy to find the lead users. Von Hippel et al. (2008) introduced a sequential search process that efficiently identifies rare subjects and they call it *pyramiding*.

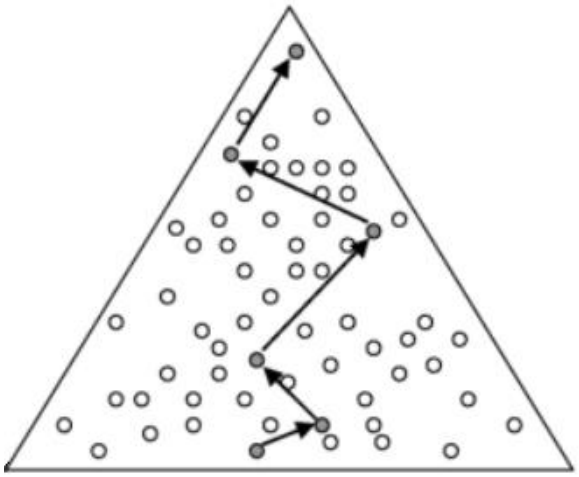


Figure 16 – Pyramiding (Institut für Entrepreneurship & Innovation, 2005)

The pyramiding method goes as follows (Von Hippel et al., 2008):

- Determine starting point
- Ask subject for referral
- Follow referrals until individual with sought attribute is found

Von Hippel (2012) describes this as picking out sort of needles in a haystack. One has to start by asking some people what the problems are in that field and how they address it. Next, ask these people how they solve this problem and whether they know who the experts are in this field ("who do you know who has a more extreme problem?" and "do you know someone who does it better?"). That is the way how one increments his way forward until finally he ends up at the leading edge with people saying "no one is better than I am at this particular thing, but outside this field, there is a principle being used and I have been trying to find a way. If I could bring that in and make it work that could actually be phenomenal". These kinds of out-of-the-box solutions on other fields are the ones that usually give the breakthroughs.

There are people needed that are already practicing with solutions and bring different kinds of areas that have in one way or another to do with this type of problem/matter and try to find a solution together. They will each give their solution and perhaps they can use others' solution and mix it with their own during the conversation and improve the overall solution. Von Hippel et al. (1999) call this process the *lead user workshop*. During this workshop the company together with the lead users combine their insights and experiences to design product concepts that exactly fit the needs of the sponsoring company.

In his (unpublished) work Jonkman (2016) has made a roadmap of Von Hippel's lead user innovation method. In figure 17 this is shown in steps of five.

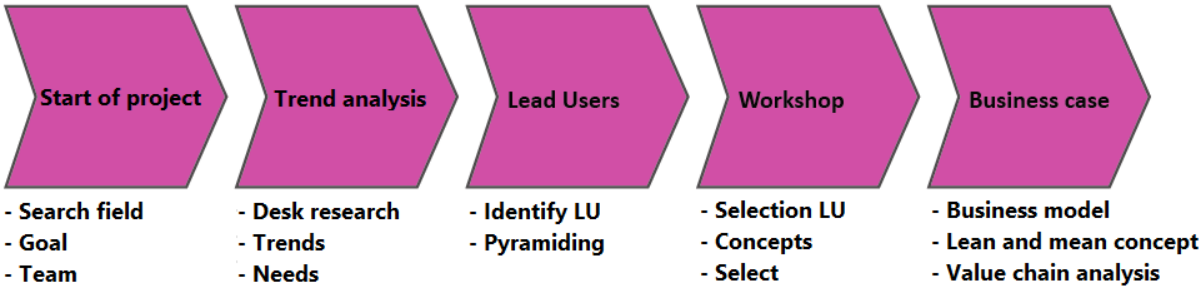


Figure 17 – Lead user method in 5 steps (Jonkman, 2016)

The first step (start of project) refers to identify a trend and set the goals. According to Jonkman (2016) the right people has to be selected to make a good team. The second step (trend analysis) is to research that trend and to find out what the current needs and problems are that the people in that field are facing. During the third step (lead users) the search for the lead users starts by using the process of pyramiding. After having identified the lead users, the right lead users are selected in step 4 (workshop). With these lead users the lead user workshop starts, where insights and experiences are combined to build product concepts that will fit the needs of the interested party. In step 5 (business case), when the right product concept has been selected, one the business model and build the desired product.

Furthermore, during the process of pyramiding, Jonkman (2016) has been able to distinguish four types of users by categorizing them with the variables *trend position* and *expected benefit* (see figure 18).

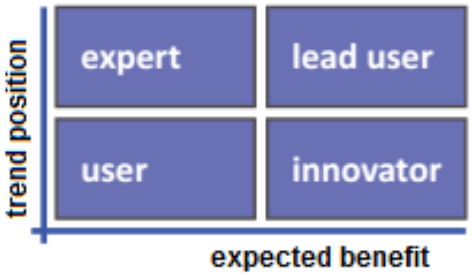


Figure 18 – The four types of users by Jonkman (2016)

With "user" all the 'normal' users are referred to. These are all the adopters on Rogers' (1962) diffusion curve except for the innovators. These users usually indicate what they currently need, but do not have or know any solution that fits their needs. They have no idea about future trends, technologies or products and therefore also do initially expect least to benefit from them. As they, however, are the majority of the users in the target market, it is eventually the goal to satisfy and meet the needs of this type of users.

The “innovators” are the first adopters on Rogers’ diffusion curve. Although they also do not have knowledge of future trends, they are the first on the diffusion curve to recognize the benefits of new technologies and products. Because they are also tech-savvies usually, they are able to build (missing) links that make the new technology or product fit into their platform. Innovators can therefore identify the adoption factors and indicate what it will take to have the market to eventually switch to the new technology or product.

The “experts”, who basically do not have to be users at all, have a lot of experience in the relevant field. These could be people working in laboratories, for example. They do not necessarily expect any benefit. Experts are able to identify the problems that occur with current technologies and what the limitations so far are. Because of their experience, they are able to recognize a trend. It is these experts that usually know the people at the front end.

The last type of users are the “lead users” and this speaks for itself.

To make this idea about lead users more clear, one of the examples of Von Hippel (2012) is given. This is about improved automotive braking systems, which is now known as ABS (anti-lock braking system). If on icy places, for example, one crams down on the brakes, the ABS will put the brakes on and off quickly so that the wheels do not lock up, but will continue to rotate and one can steer. Prior to these improved auto braking there was this issue, because everybody in the middle of the market (in the middle of the innovation diffusion curve, i.e., the ordinary people) was skidding sometimes, and when they were asked what should be done about it, they would say ‘anything’, ‘something’, ‘just do it’. This was not high in solution content, but it did indicate the trend *improved braking*.

The leading edge here, in the case of the automotive market, is the race car drivers. They are driving, in a sense, an automobile of a type and they are going to the leading edge of adhesion every time they go around a corner. And so they are the ones who figured out how to do a technique called “pumping the brakes” (manually putting the brakes on and off quickly). But then, and that is the point, one can find people that are facing the same problem in even a more extreme form. So a more extreme form of putting on the brakes and hoping the car stops is aerospace, because the airplane is a lot heavier and is running a lot faster. So the questions was: how did they stop? What was interesting is that it turned out that the standard solutions that people were using with automobiles could not be used. One cannot, for example, put sand on the runway, because that would wreck the engines. Salt could also be used, because that would wreck the bodies of the airplane. So the solutions were not on the environment, but they had to do something with the wheel itself. And they then invented automated ABS.

2.5 – Customer Development

Customer Development has its roots in somewhere mid-1990s. It started with Steve Blank, who himself has co-founded 8 companies. He found out that it was just wrong to manage startups in the same way people manage established companies, and this bothered him. After his eighth company, he noticed that there seems to be a pattern in the midst of the chaos, and it became clear that there is a better way for startups. He discovered that successful startups followed a trial and error process (knowingly or not), parallel to product development, which involved customer learning and customer discovery. He called this process "Customer Development" (Blank, 2005).

Launching a startup, or another type of an enterprise, has always been marked by a lack of certainty. What people (or the founders) usually do is writing a business plan, present this to investors, assembling a team, introducing the product and start selling as hard as they can. What often happens somewhere during these steps, however, is that suddenly these founders suffer a fatal setback (Blank, 2013). The most startups fail because too few people buy/use the product (lack of customers is the main reason for startup failures) (Blank, 2012).

What these startups (or new divisions in established companies) need, regarding to Blank (2013), is a methodology that has an important countervailing force, one that is able to reduce the risks of the process of starting a company. This methodology puts the focus on experimentation, customer feedback, and iterative design rather than on elaborate planning, intuition, and traditional "big design up front" development. The entrepreneurs must reduce uncertainties as much as possible by trying to create only what delivers value to the target customers; anything else is waste. One of the most important things here is to get the customers involved in this process of creating the product or service from the very start. In this way the entrepreneur gets a clear view of the significance of the need or problem and how the customer reacts to the solution to this need or problem.

Therefore, according to Blank (2012), the best way to start is to contact with (potential) customers, because some real facts are needed before anything can be done. In figure 19 the process of Customer Development is schematically represented.

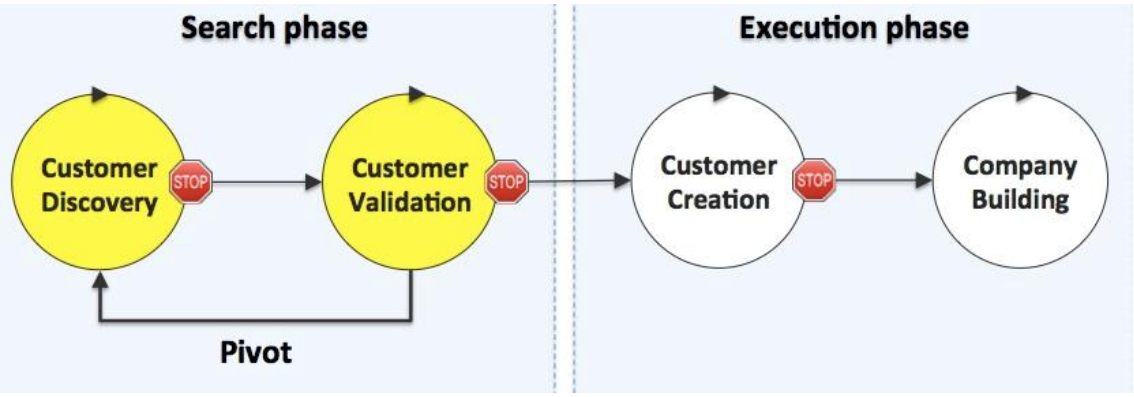


Figure 19 – The four steps of Customer Development (Blank, 2005)

One of the ways to organize the facts is with the Business Model canvas (see appendix B for detailed explanation). Blank (2012) says that this is used to *organize our thinking* around a series of thoughtful first guesses (hypotheses) and to *get out of the building*, as there no answers inside the building. Instead of building every possible feature on "day 1", you are actually going to incrementally and iteratively interact with customers, test each portion of the product and see if what you are building has a home outside the building.

The Customer Development methodology is a 4-step process, as can be seen in figure 19. Blank (2012) describes them as follows:

1. Customer discovery: This is where you construct your hypotheses and *get out of the building* and start testing your assumption about whether other people have the same need or problem you think they have.
2. Customer validation: You see if your proposed solution actually matches what you think the customer problem was. If this is not the case, a *pivot* will save your job. A pivot is a substantive change and means you have to go back and set new hypotheses.
3. Customer creation: This is about creating end user demand and scale.
4. Company building: Build your company for scale by transitioning from customer development into a functional organization that is oriented for constant and rapid execution.

Blank (2012) focuses in particularly on the first two steps, because they are related to Product/market fit.

Customer Development can be used together with product development. Blank (2015) has made a diagram for this that he calls the *hypotheses-experiments-tests-insights loop* (see figure 20). This is used to build the *minimum viable product*, a product with just enough features in order to quickly and iteratively get customer feedback. As you get more feedback, more features can be added (Blank, 2012).

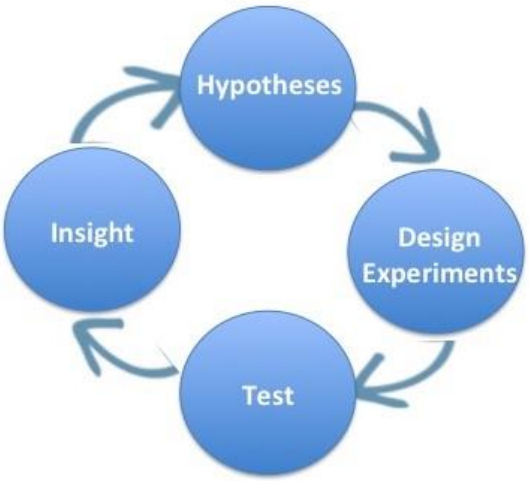


Figure 20 - The *hypotheses-experiments-tests-insights* loop (Blank, 2015)

2.6 – Product/market fit

2.6.1 – Introduction

Product/market fit is a term introduced by Marc Andreessen (2007). He says that when looking at a broad cross-section of startups, two obvious facts will jump out. The first facts is that there is a large variety of successful startups, some of them insanely successful, some of them highly successful, many of them somewhat successful, and of course quite a few fail completely. The second fact is that there is a great divergence of quality and caliber for the three core elements of each startup: *team*, *product*, and *market*. For any given startup, the team will range from excellent to flawed, the product will range from outstanding artistry to hardly working, and the market will range from booming to sleeping. The question that arises here is which of them does correlate the most to success, or which one of them is the most dangerous, a bad team, weak product, or a poor market?

Andreessen (2007) defines the quality of the *team* as the suitability of the management, engineers, and other key staff. The quality of the *product* is defined as how impressive it is to at least one customer or user, i.e., how easy the product is to use, how feature rich it is, how fast it is, how extensible it is, and how much (or actually how few) bugs it has. And the *market* size is defined as the number, and growth rate, of the potential customers or users.

Many of the entrepreneurs and venture capitalists would say *team* is the most important out of the three, as in the beginning of a startup the most is known about the *team*, while there is no product built and no market explored yet. We are also surrounded by slogans as “people are our most important asset” and the answer that the most important is *team* just feels right. On the other hand, when engineers are asked which one of the three is the most important, many of them would say *product*. This seems obvious, as it is a product business: companies invent products, customers buy and use the products. Without the product there is just no company and a great team or a great market would be of no use without a product. However, according to Andreessen (2007) the most important factor in a startup’s success or failure is *market*. The reason is that in a great market (a market with a lot of potential customers) the market will pull products out of the company. The quality of a product is, however, not defined by how appealing it is to lots of customers. Andreessen (2007) says that product quality and market size are totally different, yet they cannot be without one another.

2.6.2 – The #1 company-killer is lack of market

The market needs to be fulfilled and it will be fulfilled by the first coming along viable product that satisfies those market needs. This product does not have to be great, it basically just has to work. Hereby it does not matter for the market how good the team is, as long as it can make that viable product (Andreessen, 2007). When there is a great market, the team can easily improve.

On the contrary, in a bad market you can have the best product and the best team and it will still not matter, you are going to fail. The company will try hard to find the right customers who do not exist for its great product, but the team will eventually demoralize and quit, and the company will go out of business. A great team will only be better than a mediocre team when working on the same product and market. Although sometimes great products create huge new markets, this is a best case scenario, regarding to Andreessen (2007). But also here it does not matter how good the team is, as long as it is good enough to build the product that will satisfy the quality the market requires. However, this does not mean that one should neglect the quality of the team. When a good team meets a bad market, the market wins. When a bad team meets a good market, the market wins. And when a good team meets a good market, something special happens.

2.6.3 – The only thing that matters is Product/market fit

Andreessen (2007) says that the only thing that matters is to get to *product/market fit*. Product/market fit means to be in a good market with a product that satisfies that market.

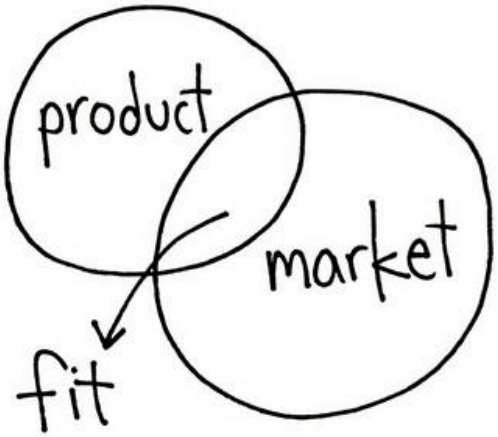


Figure 21 – Simple illustration of Product/market fit (Andreessen, 2007)

It can easily be noticed when there is no product/market fit. This is when customers are getting no real value out of the product, usage of the product is not growing fast, sales cycle is taking too long, word of mouth is not spreading, a lot of deals never close, and press reviews are not that positive about the product.

But it can also easily be noticed when product/market fit is happening. Customers are buying the product as fast as it can be build, money from sales is piling up in the company's checking account, hiring new staff happens as fast as possible, investors show up, and so on.

A lot of startups fail before product/market fit even ever takes place. In fact, that is the reason why they fail. Andreessen (2007) believes that the life of a startup consists of two parts: *before*

product/market fit and *after product/market fit*. When a startup is before product/market fit, the focus should be extremely on getting to product/market fit. This includes changing out people, redesigning the product, moving into another market, raising more money, and whatever more is required. A successful startup is one that has get to product/market fit. This startup, however, has probably gone through a lot of difficulties and problems, but has nevertheless become successful. Conversely, there are is a large number that seems to do all things good, having the right models, processes, and policies, yet they fail, because they could not find product/market fit.

Successful companies may come up with many reasons why they became successful that probably had nothing to do with it, as usually people are not very good in understanding causation, but almost always the actual reason for successful companies is product/market fit (Andreessen, 2007).

2.6.4 – Business Model canvas

The Business Model canvas (see figure 22) is a tool that can be used to achieve Product/market fit. A business model describes how a company delivers value to one or more customer segments and the architecture of the company and its network of partners for creating, marketing, and delivering this value in order to make profitable and sustainable revenue streams (Osterwalder, 2004). Product/market fit is a match between *value proposition* and *customer segments* (Blank, 2012).

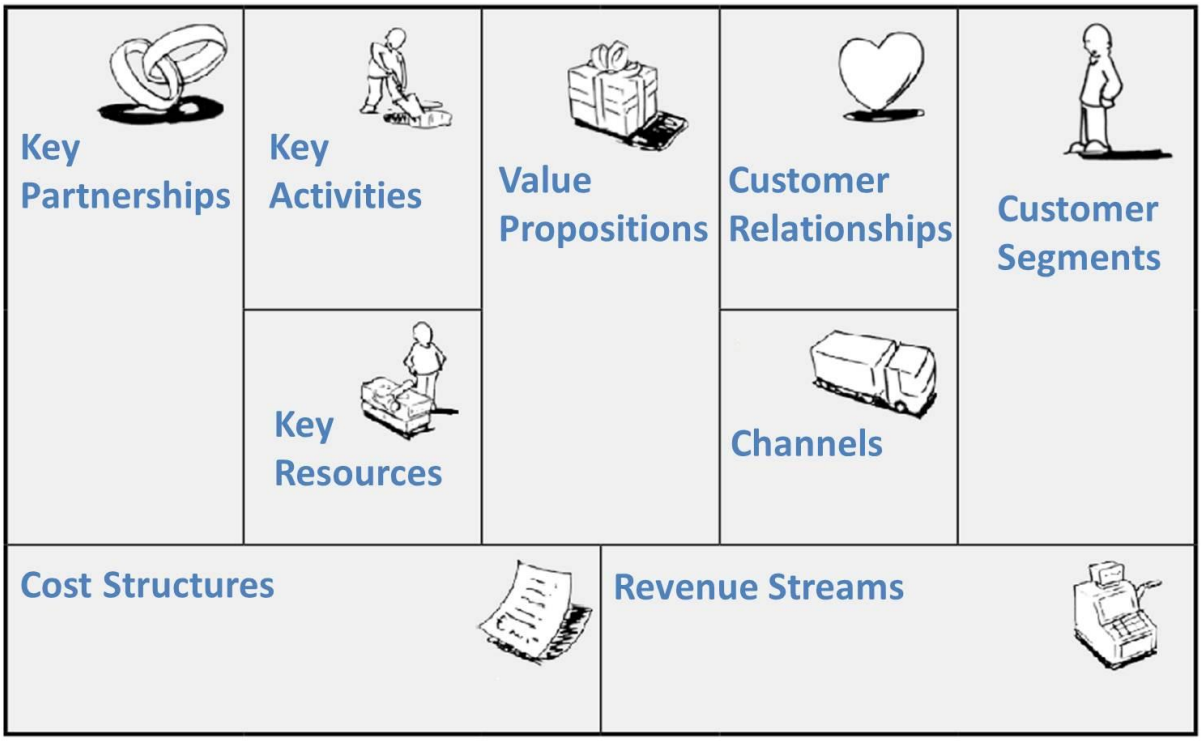


Figure 22 – The Business Model Canvas (Osterwalder & Pigneur, 2010)

3 – Method: Systems Thinking

3.1 – Introduction

In this chapter the method that is going to be used to construct the framework is explained, which will give an answer to the second sub question. As this is a qualitative research and many issues are involved, it has been decided to choose *systems thinking* as the research method. Systems thinking is very effective in solving problems that involve complex issues that are dependent on each other. It helps one to see the "big picture" rather than just a part of it. Systems thinking focuses on how things behave and interact in relation with each other.

Since in this thesis the focus is on the innovation process, in particular on the first part (Technology/customer fit), it is convenient to think of the whole process as systems. In this way it is possible to understand and improve this complex topic.

3.2 – Systems thinking

3.2.1 – System concepts

A system is defined as a set of objects or elements that are interrelated in such a way that there is no isolation between one of these elements and the others. These objects can be abstract as well as concrete. The set of relationships between objects together is referred to as the internal structure. Generally, there are, in addition to the relations between the elements or objects that are considered to belong to the system, also relations with other objects outside of the system. It is very important, therefore, where one should draw the boundary lines of the system. There are usually identifiable relations with objects or elements outside of the system. These objects together form the environment. Relations together with the environment form the external structure (De Leeuw, 2000). In figure 23 a schematic is given of how a system is build up and how the relations are within and outside the system.

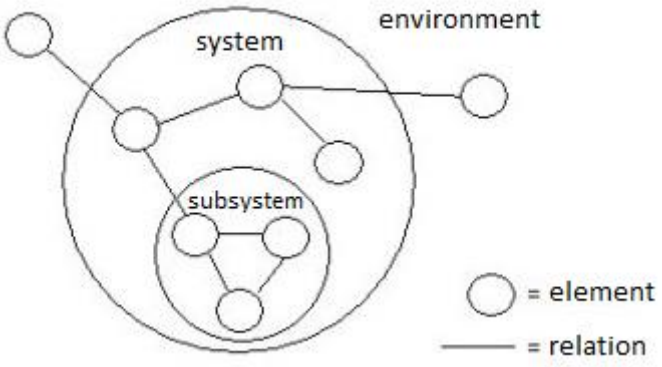


Figure 23 – System structure (De Leeuw, 2000)

According to De Leeuw (2000) in management science a systems approach always must say something about the combination of the elements, the internally considered relations, and the relations that are considered between systems and environment.

When doing research on organizations, it is often necessary to indicate that systems are limited and how one is limited to a certain part of that system. A system can be classified into three types of components: subsystems, partial systems (or aspect systems), and phase systems. In a subsystem one is limited to a part of the system, but considers all the relations within that part. In an aspect or partial system, one considers only a part of the relations. The focus is, so to speak, only on certain aspects. In a phase system the focus is on certain time factors of the system.

In analyzing and designing systems it is often useful to divide the system into different parts. This allows the complexity to be reduced. Decomposition is a subdivision in such a way, that the relation between the different parts of the system is weaker than the relation within the parts themselves.

When looking at systems, one must decide on the level of aggregation. Aggregation refers to the degree of detail. The fewer the details, the more global and the higher the level of aggregation is. Here one can make use of so called *black boxes*. Black boxes are the (smallest) parts of a system which themselves are not interesting to look at in detail, but rather the input, output and the relation between the input and output of the black box. In other words, the internal functions are not interesting, only the external relations (how does the black box react to its surroundings) are important (De Leeuw, 2000).

3.2.2 – Systems thinking

Systems thinking is a revitalizing powerful way of thinking in different economic areas. It can help to discover new answers to today's challenges and to have a better understanding of business. Systems thinking can be of value as the world of business currently is challenging and complex and is still growing more complex. It provides a way of decision-making that helps companies how to effectively handle change and fit. Systems thinking is a part of a learning organization. A learning organization is one that focuses on learning to transform and adjust continually relative to surrounding conditions (Milligan, 2015).

Maani & Maharaj (2001) assume systems thinking to be a paradigm and define it as a "world view" where everything is holistic and interconnected. Systems thinking is a method of critical thinking that enables one to analyze the relations between the components of a system, which results in a better understanding of the situation and effective decision-making. Milligan (2015) simplifies this in terms of looking at a lot of trees, other plants, critters, and the weather and how all these are related together to understand the forest.

To understand systems thinking and make its principles 'tangible', Richmond (as cited in Maani & Maharaj, 2001) attempted to define practical ways through a set of 'thinking skills'. These thinking skills serve as a sort of operational guide to think systematically and consist of the following: *dynamic thinking*, *system-as-cause thinking*, *forest thinking*, *operational thinking*, and *closed-loop thinking*. The sequence of the five thinking skills is important, as each thinking skill builds on the previous one.

Dynamic thinking allows an issue or a problem to be set in patterns and describes how they behave over time. The situation is put in the context of time scale and the historical, current, and future states are determined. *System-as-cause thinking* allows one to determine plausible explanations for the behavior patterns obtained through dynamic thinking. *Forest thinking* sees the system as a 'big picture'. It enables one to rise above functional silos and look at the system of relations that link the components together. *Operational thinking* determines how a behavior caused – it tries to identify causality and looks at the structure of relations, like *how* variables affect each other and not just that they affect each other. Operational thinking puts the emphasis on interdependency and states that there is a web of relations within a system. *Closed-loop thinking* attempts to show that causality does not run only in one direction, but rather that the elements in the system affect each other mutually. An effect has usually one or more causes. In closed-loop thinking it is important not to prioritize causes as being least or most important, but to understand how dominance amongst them will shift over time (Richmond, as cited in Maani & Maharaj, 2001). Milligan (2015) says that the reality of a situation is created by numerous interactions between objects in a system.

When examining the interactions between elements in a system, one will see larger patterns emerge and then it can be understood how the system works. If the pattern is good, decisions can be made that will reinforce it, if the pattern is bad, decisions can be made that will change the pattern. Systems thinking is an influential way of thinking that tries to simplify things and it is necessary for successful action in a complicated world. Therefore, systems thinking should be used as a starting point for concept formation (Milligan, 2015).

3.2.3 – Designing a framework

A framework is a skeleton which an application is built upon and it has some specific responsibilities in an application's functioning. Regarding to Booth (n.d.) designing a framework is not something small to deal with and there are many design options to be considered. Choosing the right design can mean the difference between success and failure. The most important factor leading to success or failure of a framework is probably the identification of the problem that needs to be solved. Trying to solve the wrong problem will certainly result in a wrong solution. Therefore, knowing the requirements clearly is important if any chance of being successful is wanted.

A good framework has the next qualities: *simplicity*, *clarity*, *boundaries*, and *expandability*. The *simplicity* of a framework indicates that the overall structure has to be easy to understand. The user of the framework must be able to understand and use it quickly. *Clarity* means that the framework's behavioral aspects should be enclosed, i.e., the user should not be required to know any detail about how the framework functions in order for him or her to use the framework. If this somehow is necessary, then the framework has a definite design problem. Also when the user is desiring to achieve a specific function, it should not be necessary to have to sequentially call for several methods in the framework in order to accomplish that process. *Boundaries* in a framework take care of order. Frameworks must meet some certain requirements and nothing more. When a framework crosses a boundary, complexity increases and the user is inclined to look for other tools in order to achieve their goals. When another application is needed, this should be implemented in a separate framework, giving the user the option whether to use it or not. And finally, the *expandability* of a framework indicates that it should be easy for the user to expand it by either adding new parts or groups to the framework. A framework that cannot be easily adapted will bring restrictions for the user. Therefore expandability should be a part of the design rather than to be an afterthought, in order to be sure that this possibility will apply (Booth, n.d.).

4 – Results: The Framework

4.1 – Introduction

In this chapter the Technology/customer fit framework is constructed. This is done by consistently combining and integrating the theories, models, and techniques of the theoretical framework in chapter 2, which is done on the basis of the questions set in section 1.2. The goal of this framework is to successfully go through the Technology/customer fit process in order to obtain a product concept and move to the next process of Product/market fit.

First the problems that need to be solved for the framework are identified. For the company this has already been done in the form of the questions set in section 1.2. However, to get a good impression of which type of challenges are dealt with, the question are grouped, based on the type of the questions. This will be done in section 4.2.

After the questions are arranged and the type of challenges are categorized, in section 4.3 the framework will be built. The whole innovation process is divided into three parts, namely: Technology/customer fit, Product/market fit, and Scale. The focus will be on the Technology/customer fit part. The construction of the framework is based on the *systems thinking* approach, which is described in chapter 3. This is done step-by-step, supported by the insights gathered in all the foregoing sections.

Furthermore, also a new canvas is constructed that will serve as a practical application for the Technology/customer fit framework, in the same way the Business Model canvas does for Product/market fit. This will be done in section 4.4.

Having finished the framework and the canvas of Technology/customer fit, a manual will be given in section 4.5 that will help the company how to use the framework and the canvas.

In section 4.6 different groups of users/customers are identified. Although there are different types of users/customers, some of them do show the same main characteristics. It is important to know which of these group(s) of users/customers play a main role in certain phases of the innovation process to know which of them to interact with during that phase.

Finally, a complete overview will be given of the whole framework, as a sort of summary. The Technology/customer fit framework, represented as the first system of *the environment* (the overall innovation process), consists of subsystems that in their turn consist elements. This gives an overall picture of how the components of the framework are connected and related to each other. This is presented in section 4.7.

To make a start with the Technology/customer framework, a potential user/customer will be interviewed. The results of this interview, however, are not given in the main part of the thesis, but in Appendix D for specific reasons concerning the company where this research is conducted.

4.2 – Identifying the company problems

Identifying the problems that need to be solved, according to Booth (n.d.), is probably the most important factor of a framework's success. As mentioned before, an obvious application where the technology of Company X could be used for is market Y. In section 1.2 a questions set has been formulated that has identified the most important problems Company X is currently dealing with. The framework is going to be constructed on the basis of these questions by using the theories, models, and techniques discussed in chapter 2. Most of these questions are, as can be noticed, not specifically useful for only Company X, but deal with important issues that are also related to other companies who are in the initial stages of the innovation process (who need a Technology/customer fit). To get a good picture of which type of challenges are dealt with, the question are grouped, based on the type of the questions. In table 1 the questions are grouped in a logical arrangement to express the type of challenges that companies like Company X face. This will be used as a good basis for the framework.

Questions set	Group
- What is Company X's current activity?	**Group 1: Current activity**
- What is Company X's next goal? - What can they do with their technology platform?	**Group 2: Next goal**
- Why is it interesting to enter this market?	**Group 3: Market attractiveness**
- Who are existing users/customers in this market? - Who are future users/customers in this market? - Who needs to be contacted?	**Group 4: Users**
- What are the (unsolved) needs/problems? - What are the adoption factors? - What is for users/customers important to be measured? - What are current solutions/products/systems? - Which substances can be measured and what cannot be measured yet? - What does need to be improved? - What are the hurdles? How to avoid/overcome them?	**Group 5: Needs, problems & adoption factors**
- How can Company X solve these problems? - The technology has to be developed, what is needed for this development? - What are the benefits that they can deliver?	**Group 6: Potential solutions & benefits**
- How to deal with different types of users/customers? - How/when to switch from C1 to C2 etc.?	**Group 7: Different groups of users/customers**
- What's in it for Company X	**Group 8: Market potential**

Table 1 – Identifying and arranging company problems

4.3 – Constructing the framework


Confidential


Confidential


Confidential


Confidential


Confidential

4.4 – The Technology/customer fit canvas

4.5 – The manual for the framework and the canvas

4.6 – Identifying the different groups of users/customers


Confidential

4.7 – Complete overview of the Technology/customer fit framework


Confidential

5 – Conclusion

5.1 – Conclusion

This research consisted of building a Technology/customer fit framework for new business development. Technology/customer fit, a term that is introduced in this master thesis, is about finding a match between a (new) technology and the (future) customers of the target market. This is done by identifying a (future) trend and interacting with lead users in that field to build a product concept.

Translating customer perceptions into a technology configuration to design a product concept appears from the results of this project to consist of an important process that is referred to as the Technology/customer fit phase, the first part of the innovation process. The goal of this phase is to have built a product concept, which is essential before going to the Product/market fit phase. The Technology/customer fit framework is constructed of several important theories, models, and techniques that all contribute to the appropriate functioning of the process. These were selected, because they are all related to the innovation process, in particular to the front end innovation (FEI). By consistently having combined and integrated them resulted in a framework to achieve Technology/customer fit.

To consistently combine and integrate these theories, models, and techniques into a framework, the holistic approach of *systems thinking* was used. Systems thinking made it possible to see the different phases of the innovation process as systems and it became clear how the subsystems and elements (of the Technology/customer fit system) should interrelate and how they should work over time within the context of the environment they are in.

This resulted in a framework that deals with all the important factors to translate customer perceptions into a technology configuration for building a product concept. These factors are:

- The technology platform: This consists of the company's own and is central in the framework. This is the starting point and based here on possible applications are considered and then the most appropriate is one selected.
- Lead users: Identify and interact with the right people in the field of the target market, which are the lead users. Lead user innovation forms the basis for new products and services of value to manufacturers. Other users, like innovators, experts and the 'normal' users seemed to be also important for two reasons: they lead to these lead users and provide important information as well.
- Output from users: Interact and work with the users should lead to important information about needs, adoption factors, problems and solutions with regard to the target market.
- Finally, with new insights the technology platform is extended and/or improved, delivering new benefits, to fit the target market's (future) needs.

5.2 – Contribution to theory and practice

5.2.1 – Academic relevance

The innovation process consists of the *front end innovation (FEI)*, the *new product development (NPD)* and the *commercialization* phases (FEI → NPD → Commercialization). In theory and particularly in practice a lot of attention is given to NPD (which is commonly known as to achieve Product/market fit, a term that is becoming increasingly popular), and the commercialization process (scaling up the business). However, for the FEI there is not much to be found that covers the whole process, in contrast to the NPD and the commercialization phases. Despite the fact that there are theories and models about FEI in literature, each of them only treats a part of it and it still remains an unclear process as a whole. In fact, these separate theories and models are often seen as if they belong to NPD. Companies that need to go through the FEI phase are therefore most likely only aware of the two other phases of the innovation process.

The academic relevance of this project is to fill a gap in the innovation process and to define the complete phase of the FEI, the first part of the innovation process. This is done by consistently combining and integrating the appropriate theories, models, and techniques into building a coherent FEI framework. This complete FEI process is called *Technology/customer fit* phase in this thesis. Furthermore, it is now also clear when one is ready to move from the FEI to the NPD phase, and that is when one has achieved Technology/customer fit. Technology/customer fit is achieved when there is a product concept and when having a product concept, one can go to the next phase, which is the NPD phase (in this thesis referred to as Product/market fit phase).

5.2.2 – Practical relevance

Company X knows very little yet about the new product and the market they want to enter, except for the applications that are possible with their technology platform. They want to know whether they can create value with their existing technology for market Y and eventually create a new market. Company X is finding itself in the first stages where they are searching for Technology/customer fit. The practical relevance of this project is that they now have a framework that can be used to achieve Technology/customer fit and to obtain a product concept.

However, this Technology/customer fit framework will not only be useful for Company X alone, but can help any other company with the same conditions of Company X. It can also help startups and technicians/engineers that have invented a new technology, but do not know what product (or service) to build.

5.3 – Limitations

There have been two main limitations in this research project. The first one is that the Technology/customer framework has not been practically validated. Although the largest part of the framework includes theories, models, and techniques that are validated in practice, the framework as a whole has not been tested on its functionality. The main reason for this limitation is the time limit of the master project.

The other limitation is the lack of an extended manual for the Technology/customer fit framework and canvas. Even though there is a manual given in section 4.5, it is a small version and certainly not enough to serve as a handbook. To use the framework in a proper way, detailed instructions need to be given for each part of it. However, this was beyond the scope of this research project and because of the time limit it was not possible to make a more extensive version.

In addition to these limitations there are (possible) limitations in the theories, models, and techniques where the Technology/customer fit framework is constructed from.

5.4 – Discussion

5.4.1 – Lead users

The term *lead users* is often difficult and not well understood. Most of the time they get mistaken for innovators or for launching customers. During this research project there has been some confusion about this and it took a while before it became clear. Important to know is that lead users are no customers at all and they will not pay anything. For companies that are in the front end innovation phase it is necessary to first have a good understanding of lead users in order to get the best results.

Furthermore, even though the leading edge is often where new innovations come from, companies do not find the leading edge very attractive. According to Von Hippel (2012) this is because the market is small and uncertain at the leading edge. Companies are, on the other hand, very concerned with the scale issue and really want things that many people want to buy. But lead users are essential for innovative companies, as they are in the field being acted upon and they know better than companies whether there is really going to be a market there.

According to Von Hippel's study on 3M, the major new innovations come from users/lead users and incremental innovations come from inside, because the company just does not know what to do. The thing is that the producers do not know what the users want. Users tend to make the functionally new things. The producer, no matter how many engineers he has, does not know what they want. But users do know what they want and they know what they need, because they are the ones that are struggling with it. What the

manufacturers/producers basically do is waiting for adequate information. This is actually the same as what Blank (2005, 2012, 2013) is claiming.

5.4.2 – Effectuation and technology push

What was noticed during the research project in the company is that effectuation (Sarasvathy, 2001) was seen as technology push by some people. Technology push is being seen as a bad market strategy and it is obvious that market pull is the preferred market strategy. However, when more explanation was given on effectuation, they began to see the benefits of it and it was accepted as to be a 'good version' of technology push.

5.5 – Future work

As mentioned in section 5.3, the Technology/customer fit framework has not been practically validated yet. This framework (and the canvas) should be applied to a company with conditions like Company X (or a company with a new technology that is in the front end innovation phase) and validated.

Furthermore, a comprehensive version of the manual should be developed. Each of the subsystems in the framework must be explained in detail so that the company easily can understand and apply the framework to effectively achieve Technology/customer fit.

The future work for the company is to continue with applying the Technology/customer fit framework. A start has been made by having selected an application and the first potential user/customer. Furthermore, a better understanding of lead users is needed and the process (pyramiding) to search and identify them.

References

Andreessen, M.L. (2007). *Product/market fit*. Retrieved from http://web.stanford.edu/class/ee204/ProductMarketFit.html

Ansoff, H. I. (1957). Strategies for diversification. *Harvard business review*, *35*(5), 113-124.

Blank, S. (2005). The four steps to epiphany: Cafepress.

Blank, S. (2010). *Perfection by substraction – The minimum feature set*. Retrieved from https://steveblank.com/2010/03/04/perfection-by-subtraction-the-minimum-feature-set/

Blank, S. (2012). *How to Build a Startup – The Lean LaunchPad* [Udacity course]. Retrieved from https://www.udacity.com/course/how-to-build-a-startup--ep245

Blank, S. (2013). Why the Lean Start-Up Changes Everything. *Harvard Business Review, 91*(5), 63-72.

Blank, S. (2015). *Why Build, Measure, Learn – isn't just throwing things against the wall to see if they work – the Minimal Viable Product*. Retrieved from http://steveblank.com/2015/05/06/build-measure-learn-throw-things-against-the-wall-and-see-if-they-work/

Blue ocean strategy. (2015). *What is blue ocean strategy?* Retrieved from https://www.blueoceanstrategy.com/what-is-blue-ocean-strategy/

Booth, J. (n.d.). *Designing your own framework*. Retrieved from http://www.jamesbooth.com/designing_your_own_framework.htm

Cooper, R. G., & Dreher, A. (2010). Voice-of-customer methods. *Marketing management*, *19*(4), 38-43.

Gaskin, S. P., Griffin, A., Hauser, J. R., Katz, G. M., & Klein, R. L. (2010). Voice of the Customer. *Wiley International Encyclopedia of Marketing*.

Von Hippel, E. (1986). Lead users: a source of novel product concepts. *Management science*, *32*(7), 791-805.

Von Hippel, E., & Riggs, W. (1996). A lead user study of electronic home banking services: Lessons from the learning curve.

Von Hippel, E., Thomke, S., & Sonnack, M. (1999). Creating breakthroughs at 3M. *Harvard business review*, *77*, 47-57.

Von Hippel, E. A., Franke, N., & Prügl, R. (2008). 'Pyramiding': Efficient Identification of Rare Subjects.

Von Hippel, E. (2012). 2. Basing new commercial products on “Lead user” innovations [MIT OpenCourseWare]. Retrieved from https://www.youtube.com/watch?feature=player_embedded&v=31iUEuwi740

Institut für Entrepreneurship & Innovation. (2005). *Innovative systemlösungen für die automation GmbH - Innovationen durch lead user*. Retrieved from https://www.wu.ac.at/entrep/kooperationen/praxisprojekte/projekte/200506-soi-isa/

Jonkman, F. (2016). *PhD research on the Lead User Innovation Method*. (Unpublished doctoral thesis). University of Twente, Enschede, The Netherlands.

Lagzi, I., Meszaros, R., Gelybo, G., & Leelossy, A. (2013). Atmospheric chemistry.

Leeuw, A. C. J. (2000). *Organisaties: management, analyse, ontwerp en verandering: een systeemvisie.* Van Gorcum.

Maani, K. E., & Maharaj, V. (2001, July). Systemic Thinking and Complex Problem Solving. A Theory Building Empirical Study. In *Proceedings of the 19th International Conference of the System Dynamics Society 2001* (p. 101).

Milligan, S. (2015). *Systems thinking and business model innovation*. Retrieved from http://www.elitetechnologies.uk.com/2015/07/10/systems-thinking-and-business-model-innovation/

Moore, G. A. (1999). *Crossing the Chasm: Marketing and selling technology products to mainstream customers* (2nd ed.). Chichester: Capstone Puplishing Limited.

Moore, G. A. (2004). *Inside the Tornado: Strategies for Developing, Leveraging, and Surviving Hypergrowth Markets (Collins Business Essentials)*. Collins.

Nielsen, J. (2014). *Crossing the chasm: How to market, sell and improve your innovative new product*. Retrieved from http://www.theinnovativemanager.com/crossing-the-chasm-theory-how-to-market-sell-and-improve-your-new-invention/

Nijssen, E. (2014). *Entrepreneurial Marketing: An Effectual Approach*. Routledge.

Osterwalder, A. (2004). The business model ontology: A proposition in a design science approach.

Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers*. John Wiley & Sons.

Rogers, E. M. (1962). Diffusion of innovation (3rd ed.). Canada: The Free Press Inc.

Sarasvathy, S. D. (2001a). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of management Review*, *26*(2), 243-263.

Sarasvathy, S. D. (2001b). What makes entrepreneurs entrepreneurial?

Sarasvathy, S. D. (2009). *Effectuation: Elements of entrepreneurial expertise*. Edward Elgar Publishing.

Society for effectual action. (2011). *The five principles and the effectual cycle – Effectuation*. Retrieved from http://www.effectuation.org/sites/default/files/documents/effectuation-3-pager.pdf

Stratégies d'innovation. (2009). *Les lead users qu'est-ce que c'est?* Retrieved from https://strategies4innovation.wordpress.com/2009/10/29/les-lead-users-quest-ce-que-cest/

Wiltbank, R. E., & Sarasvathy, S. D. (2010). What effectuation is not: Further development of an alternative to rational choice. In *Academy of Management Conference, Batten Institute at the Darden Graduate School of Business, Virginia, EUA*.

Appendices