Managing the development of a digital platform for Dutch healthcare companies

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ABSTRACT

Platforms - defined as businesses with network effects, thereby becoming more valuable the more users they acquire - have become economically important in our current economies. They are ubiquitously present in our daily lives and drive an increasingly share of our economies. However, most platforms cease to exists within the first five years. Therefore, the goal of this study is to gain knowledge that can increase the chances of a platform reaching its critical mass – the minimum number of users required to be commercially viable.

In this study, 66 healthcare providers, one industry collaborative, and one start-up participate in an action design research (ADR) to develop an entirely new digital platform within a commercial environment.

The research - consisting of a knowledge-base review, interviews, focus-groups, a questionnaire - was split into four stages: 1) Problem Formulation, 2) Build Intervention and Evaluation Cycles, 3) Reflection and Learning, and 4) Formalization of Learnings. This study concluded with a failure of the platform to reach critical mass.

The learnings produced by the instantiated platform and - problem are generalized, resulting in the articulation of three commercial platform design principles. These design principles aim to help the practitioner increase the chances for their platform to reach critical mass. The design principles being: Growth by Design, Mutation by Design, and Leadership by Design.

Current theories were found to be primarily descriptive and suffer from a survival bias. This, as they are largely based on after-the-fact (ex-post) research and data. Furthermore, they do not account for irrational actor behavior or commercial implications. Therefore, further research is suggested, focused on the time between platform inception and reaching critical mass.

EXECUTIVE SUMMARY

Platforms have become economically important in our current economies. Several platforms are ubiquitously present in our daily lives, however the vast majority of platforms ceases to exists within five years. This, as in addition to the usual challenges faced by new firms they also have to contend with a chicken-and-egg problem.

A literature review showed the platform literature to be fragmented. Frameworks are descriptive, and do not aid the practitioner in the commercial development of a platform. Therefore, the goal of this study is to gain knowledge that can increase the chances of a platform reaching its critical mass – the minimum number of users required on the platform to be commercially viable. There are two key milestones throughout a platform's emergence: The platform's inception - when initial participants join the platform - and the platform's ignition - when a critical mass of users has been reached.

This research showed the lack of knowledge in the early stages of a platform's formation. In particular in the pre-critical mass stage of a platform. The literature review argues that while the mechanics at play have been researched, these theories do not help a developing platform to increase its chances to reach critical mass. Therefore, for this study a collaborative platform development project with start-up company Spore.BI B.V., industry collaborative Boer en Zorg B.V., and 120 small care providers was started. By following the emergence of a platform from day one, learning from the transpired events, and generalizing the findings, an actionable set of design principles is created for future practitioners to use.

The research was split into four stages: 1) Problem Formulation, 2) Build Intervention and Evaluation Cycles, 3) Reflection and Learning, and 4) Formalization of Learnings. In stage one, through six interviews, an initial understanding of the ecosystem and the problem were constructed. An initial platform was designed to bring the industry collaborative and the small healthcare providers together. In stage two, a beta version of the platform was improved through four cycles with a total of 21 care providers. After these cycles the platform had not yet reached critical mass, and was out of resources to further develop the platform. In stage three, reflection of the iterations yielded that the start-up created a proof-of-concept to gain the pre-commitment of the industry collaborative. This enabled the creation of the alpha and subsequent beta versions of the platform. However, adoption stagnated when the industry collaborative was unable to continue subsidizing the care provider's adoption. The care providers' willingness to pay was too low for a financially viable platform. Furthermore, ignition seemed unlikely, even if new pre-commitment was acquired. The researched platform did not have dynamics that could monetize the care providers subsidized adoption. As a result of all the above, the cost analytics platform failed to reach ignition. In stage four, the learnings produced by the study are generalized. Three commercial platform design principles are articulated: Growth by Design, Mutation by Design, and Leadership by Design.

This study concludes that implementing these design principles throughout a platform's emergence can aid the practitioner in handling the complexities of platform commercialization, reduce the chances of common mistakes and improve the overall quality of execution. Thereby increasing the overall chances of new platforms to reach their critical mass.

PREFACE

Before you lies my master-thesis "Managing the development of a digital platform for Dutch healthcare companies", based on the data acquired through the interviews and evolving designs of a cost analytics platform for small healthcare companies in The Netherlands.

This study is written to fulfill the graduation requirements of the Management of Technology master at the Delft University of Technology. While I started this thesis late 2014, my entrepreneurial responsibilities, priorities and time allocation only allowed me to focus on the thesis full-time from October 2018 to April 2019.

Finalizing this research was difficult - not solely because any thesis is a significant academic effort in its own right - but primarily due to the interwoven nature of my entrepreneurial endeavors, the research topic, and the ever-increasing cost-of-opportunity weighing on my time.

It is exactly this value for time that inspired me to research platform emergence. A topic still heavily over-represented by (ex-post) survival biased case-studies on ubiquitous platform businesses like Google, Amazon or Apple. Meanwhile, fellow friends and entrepreneurs struggle for years commercializing their platforms with little actionable help from (academic) literature.

I would like to thank my supervisors Dr. L. (Dap) Hartmann and Dr.ir. G.A. (Mark) de Reuver for their significant patience and support during this (long) process. I also wish to thank all the interviewees, without their input no data nor platform would have existed to analyze and reflect upon. Lastly, I thank my fiancé, whose emotional support never wavered.

Nicolas Kramer

Leiden, 16 April, 2019

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1.1 Problem Statement

Platforms have become economically important in our current economies. Technology improvements help platforms become even more prevalent compared to traditional businesses (Edward G., 2014). Starting 2017, four of the top five public firms by market capitalization use one or more platform business models (T. Eisenmann, Parker, & Van Alstyne, 2011; T. P. Eisenmann, Geoffrey; Van Alstyne, Marshall W, 2006; Parker & Van Alstyne, 2017; Zhu & Iansiti, 2012). A digital platform economy is emerging, with the application of big data, new algorithms, and cloud computing. Companies such as Amazon, Etsy, Facebook, Google, Salesforce, and Uber create online structures that open the way for radical changes in how we work, socialize, create value in the economy, and compete for the resulting profits. (Kenney & Zysman, 2016)

Platforms are different from traditional businesses in that they have network effects. The more users who adopt the platform, the more valuable the platform becomes. The value to the owner(s) increases, users experience more benefits due to the growing ecosystem and often a set of complementary innovations and complementors also join this ecosystem. These network effects can be very powerful. Facebook being one example where it attracts users, friends of users, and so forth, without the need for a different type of platform user (Gawer & Cusumano, 2014), a so called same-side network effect.

Though a few platforms are so ubiquitously present in our daily lives, only between 60% to 80% of new businesses ceases to exists within five years. This starting-up problem is particularly difficult for (multi-sided) platforms. In addition to the usual challenges faced by new firms they have to contend with a chicken-and-egg problem. The platform can only can deliver value to one user side if there are users on the other side of the platform (Evans, 2009) (Song, Podoynitsyna, Van Der Bij, & Halman, 2008). Furthermore, new entrants generally must offer revolutionary functionality to win substantial market share in existing markets with incumbent platforms, to overcome existing network effects and switching costs of the users (T. Eisenmann et al., 2011). All this, increasing the failure rate even further.

This effect enforces even more that only a few platforms become ubiquitous. This makes for only a few influential platforms with little to no competition and winner-takes-all dynamics. This is problematic as the business and consumer world becomes more and more dependent on these platforms. The problematic grows further as many platforms work across country borders, not always adhering to local legislation and sometimes having more economical resources than that of smaller countries they operate in.

It is important to understanding how these and future platforms come into existence. They can profoundly change the way we consume a product or service, or the attitude towards work. One example is the rise of the gig economy, the concept of working for the completion of 'tasks', 'gigs', or 'rides' for pay. It fundamentally challenges our understanding of work and modern labor markets. Instead of employment relationships between firms and workers, everybody can be 'their own boss'. Enjoying both the rewards and facing the risks of independent businesses. (Graham, Hjorth, & Lehdonvirta, 2017; Prassl, 2018)

A big milestone in a platform’s lifecycle is the point where there are enough “buyers” and “sellers” actively participating that other users adopt the platform for its benefits as well. There is a minimum requirement to the number of friends already on Facebook before one chose to join, a minimum amount of readers for advertisers to want to pay for sponsored content, and enough game-consoles sold for a game-studio to choose to develop a game on it. This minimum required number of actors on both sides is generally referred to as the “critical mass” of a platform. From this point onwards, the platform can self-sustain its user growth and become a viable business.

A literature review showed the literature is fragmented. Frameworks and insights are descriptive, and don’t aid the practitioner in managing the commercial development of such a platform. There is a knowledge gap where these theories complement each other - the nexus of specialized knowledge appropriate for the creation of a digital platform. This is partly because it requires the ability to follow, control and iterate a platform from its inception, while not knowing the exact form and success of that platform. Rather than analyzing “after the fact” as most platform literature. So, the question of this study is, how do we increase the chances of new platform to reach this critical mass, so it can provide new economic value, and compete with incumbents?

1.2 Research Objectives

Research Objective

The research objective is to:

Gain knowledge that can increase the chances of reaching the point of critical mass of a platform

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Research Questions

This leads to the following research question.

RQ: *Which design principles for a new platform are influencing its commercial development to the point of critical mass?*

To support this question, the following sub-questions are developed:

To start this research, this study first looked at the theoretical frameworks that are available to guide the commercial development of a platform. This leads to the first sub-question:

RQ1: "*What are theoretical frameworks that guide a platform commercial development*"

After gaining an understanding on the theoretical frameworks this study investigates which business elements are inhibiting or supporting the commercial development to the point of critical mass of a platform. Which leads to the second sub-question:

RQ2: "*What are the primary business elements for reaching critical mass*?"

Starting a platform also implies an investment decision and strong focus in the beginning on the platform may or may not inhibit the platform from reaching the point of critical mass. This leads to the follow third sub-question:

RQ3: "*To which degree does commercial development in the early stages of a platform inhibit reaching the point of critical mass?*"

2. Knowledge Base Review & Research Framework

2.1 Introduction

The increasing economic importance of digital platforms results in a growing body of literature focused on platforms (Cusumano & Gawer, 2003; West, 2003) and their ecosystems (Basole & Karla, 2011; Fichman, 2004; Parker & Alstyne, 2008). For the purpose of this research an extensive literature search was conducted. A total of 85 papers in the field of platforms, and specifically data analytics platforms, were selected. This was done through three methods: The first method comprised searching for single broad terms like "platform strategy" or "platform openness", sorting the results based on their reference count and JIF score, papers were then selected based on their title and abstract. The second method comprised the focused research of specific topics like "small enterprises AND data analytics AND platforms", and estimating the relevance of the paper though it's title and abstract. A smaller amount of papers was encountered through snowballing – following on the reference of a paper - and by skimming through the publication bibliography of leading researchers in their respective field. All papers are ranked from zero to five "stars" based on their abstract, chapter titles and conclusion. 37 papers were ranked two or less stars; 48 papers ranked three or more stars, which were read in their entirety and annotated.

Based on the researched body of literature two primary streams of thought are recognized; the Platform Evolution stream, primarily looking at the initial emergence of a platform and how it solves the "chicken and egg" problem; and the Platform Leadership stream, looking at managing the ecosystem and leadership position of established platforms. More in-depth details on these theories are found in chapter 1.2 below

Furthermore, two points of improvement have been recognized. Firstly, they only rarely recognize, or reference each other. Equivalent or highly similar theoretical elements are not interlinked nor discussed, resulting in both complementarities and contradictions. Secondly there is a lack of a synthesized framework marrying the two streams covering distinct parts of a framework's lifetime. A framework that covers the entirety of a platform's lifetime, aiding the design and management of a platform throughout all stages of its existence.

In sub-chapter 2.2 this research will provide an initial attempt to bridge the theories by identifying the overlapping and contradictory concepts, detailing the links and dynamics between them, and elaborate criticism on each stream. In sub-chapter 2.3 a synthesizes of the theories into a single platform management framework including argumentation of the importance of such a framework.

2.2 Platform Theory

2.2.1 General Platform Theory

A common example of a platform is eBay (Osterwalder A, 2010). On eBay auctioneers can place their products for millions of potential buyers to bid, and buyers can look at the seemingly endless collection of products up for bid. This is a very difficult position to reach, not having enough buyers will discourage auctioneers from placing their items, and without items up for bid no buyers will look for a purchase on the platform. This is the characteristic chicken and egg problem many platforms face: Without one group (auctioneers), there is no reason for the other group (buyers) to use the platform. No buyers would visit eBay if no items were up for bid, and no one would place items on eBay if no buyers were to visit.

Another example is WordPress, it allows someone to create an online blog with a few clicks and no coding. You configure and adapt your own WordPress instance to achieve the blog that you want, this is possible because it was built on top of the basic building blocks and functionalities provided by the WordPress platform. These building blocks are built by developers all over the world, who contribute because of the large user base of WordPress.

The mobile operating system Android is another example of a platform. Google unveiled Android on November 5, 2007. It was the first product of the Open Handset Alliance and was the start of Google's movement towards the mobile sector (Goodwin, 2014).

> *"Android is the first truly open and comprehensive platform for mobile devices. It includes an operating system, user-interface and applications — all of the software will run a mobile phone, but without the proprietary obstacles that have hindered mobile innovation"*

-- Andy Rubin on the Google Blog (Goodwin, 2014)

The goal for Android, through the Open Handset Alliance, was to enable an open ecosystem for the mobile sphere by providing the standard as a mobile software platform. It connects the hardware of smartphone manufacturers - HTC, Nokia, Huawei, Samsung and LG; the end-users that use the phone; and the developers that produce applications for the smartphones. The same *interdependence* is encountered as previously illustrated. The lack of one group will stop the other group(s) from using the platform. Without hardware, end-users can't buy a phone, nor developers make applications. Without developers the phone will not provide the desired functionalities for the end-user compared to other platforms with a large availability of apps. Without end-users there will be no target customer for the manufacturers and developers to monetize.

In all three examples we encounter at least one group that does not actually develop their own products or services, but rather consumes the offering. The eBay buyer simply buys products, the smartphone users purchases applications, and the WordPress user "creates" his or her own website as much as one creates their own outfit when purchasing clothes on eBay. This group is referred to as the *end-user*.

Another key characteristic in platforms are *network effects* - the more users adopt a platform, the more valuable the platform becomes to the users and the owners. This effect is more than linear and is generally modeled as an exponential growth of value (Arakji, 2010; Edward G., 2014; Gawer & Cusumano, 2014). Network effects are direct or indirect: *Direct network effects* - sometimes called “same side” effects - are generated by and affect the same platform side, an example is Facebook: It attracts new users because friends of the new users are already on the platform. The more users join, the more friends of new users there will be, reinforcing its growth. *Indirect network effects* increase number of users on side based on the availability of users on the other side, an example are game consoles (Xbox, PlayStation, Wii): Game developers only develop games for a console if there are sufficient gamers that can purchase the game, and gamers only purchase a console that provides a satisfactory variety of games (Gawer & Cusumano, 2014).

When *network effects* are strong users will converge to a select few platforms, as new platform will have little appeal (e.g. who buys the first fax machine?). This is especially true when the user needs are homogeneous, but when user segments have distinct preferences, and no single platform can fulfill all segment needs, it is more likely that multiple rival platforms emerge (T. Eisenmann et al., 2011).

Network effects can also have a negative effect; too many users at one side of a platform may discourage new users from joining the ecosystem, therefore this effect does not necessarily perpetuate endlessly (Gawer & Cusumano, 2014).

Both Google and game consoles show expected platform behaviors and dynamics. Google has multiple segments to provide services: The first group is the web surfers that are looking for content on the Internet; the second group is advertisers looking to place ads to convert web surfers into clients; the third group – a less obvious group - is content owners who are looking to monetize their content through the Internet. The key resource that Google requires to provide its services is a search engine and the majority of Google’s key activities are the management, service and further development of their platform to ensure long term business viability (Osterwalder A, 2010). The majority of the costs are platform related, ranging from manpower to data-centers. Web surfers and content owners are reached through the Internet channel primarily, but advertisers require customer relationships activities in the form of account management and aftersales services.

The Xbox game console (by Microsoft) also has multiple segments to provide services: the first segment is “hardcore” gamer that expect the best graphics, audio and gaming experience; the second segment is game studios developing high-end games. Microsoft created a high-performance console to provide its offerings. This console was sold at a loss – i.e. a subsidized marquise group - through retailers and electronic stores to acquire a sufficient installed base to attract the best game studios. Microsoft then monetizes on royalties of the games sold by these studios.

Nintendo’s competing console – the Wii - has two slightly different segments to provide offerings: The first segment is casual gamers; the second segment is low and mid-end game studios. The Wii launched after the Xbox and within a year it reached the same sales volume as the Xbox. As
Figure 1 shows, the Wii outsold the Xbox, without subsidizing sales, earning revenues from both the game- and the console sales.

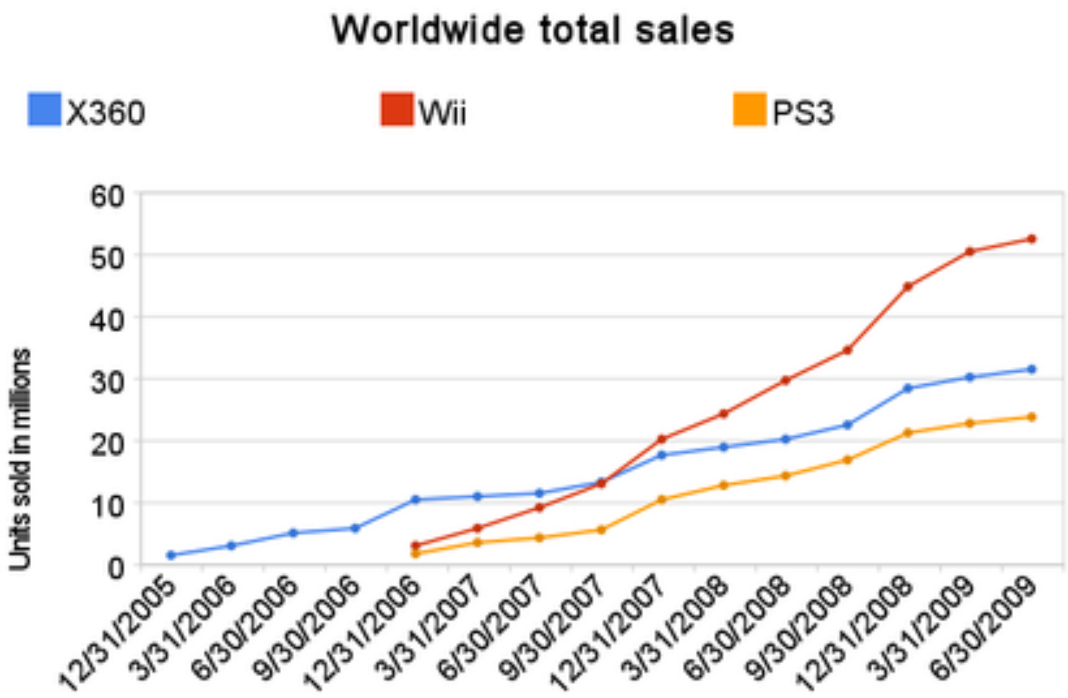

FIGURE 1 - SEVENTH GENERATION GAME CONSOLE CUMMULATIVE WORLDWIDE SALES (FANDOM, 2009)

These examples provide a simplified understanding of a platform business pattern: A platform creates value in attracting different user groups, facilitates matchmaking between customer segments, and reduces costs by facilitating transactions through the platform; The key resource required for this business model pattern is always the platform; key activities are platform focused, like management, provisioning, and promotion; the main costs incurred relate to maintaining and developing the platform; there are two or more customer segments; and each customer segment has its own value proposition and own revenue stream - positive or subsidized.

2.2.2 Platform Emergence Theory

The platform emergence stream is the body of knowledge focused on the emergence of a platform up to the point of self-sustainability. How does eBay go from no buyers and sellers, to a stable multi-million-dollar market platform? This question particularly hard to answer as the form of a platform is fully unknown at its time of emergence; platforms are amorphous and strongly influenced by unpredictable external factors (Zhu & Iansiti, 2012).

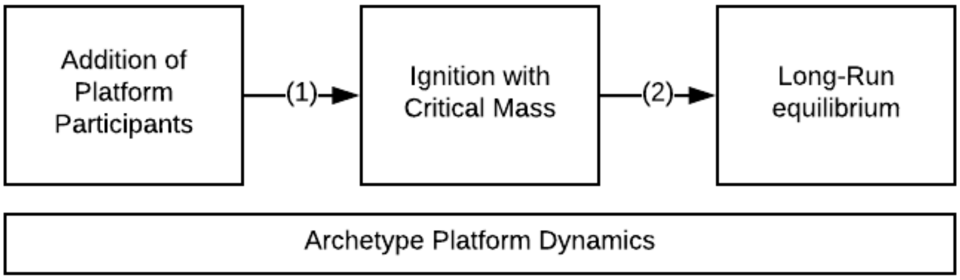

FIGURE 2 - HIGH LEVEL OVERVIEW OF THE CATALYST FRAMEWORK

The Catalyst framework aims to answer this question by proposing that platforms take form and emerges by reaching the critical mass required to make them self-sufficient and ignite their growth (Evans, 2009; Evans & Schmalensee, 2010). The catalyst framework takes its name from the analogy of a chemical catalyst: A catalyst aids the ignition of a chemical reaction when two or more components are together in the right proportions. In a similar manner, the theory stipulates that *“a platform is an economic catalyst if it creates value by bringing two or more groups of customers together and getting them to interact. Catalysts create value by reducing transactions costs faced by multiple distinct economic agents that would benefit from coming together.”* A platform is an economic catalyst as it aids value creation between multiple actors by reducing the transaction costs (Paypal), search efforts (Google), facilitating match-making (Uber, Tinder), or value exchange (eBay).

A chemical catalyst requires is a minimum amount of chemicals in a specific ratio before a reaction takes place, referred to the critical mass. In a similar manner, the catalyst framework describes that sufficient adoption of a platform by its participants is a pre-requisite for ignition, as trying to ignite without this critical mass will cause the platform to “fizzle out”. That is to say, there is not enough market activity and liquidity within the platform to permit sustainable growth.

However, deeper thinking shows how this analogy starts to break down. A chemical catalyst is unchanged in on both mass and chemical composition before, during and after the reaction whilst the catalyst theory explicitly states that a platform will start taking its form during the interactions and does not describe the platform evolution after *ignition*, instead assuming a steady state form of the platform afterwards. The catalyst theory says: “a platform’s form is unknown before ignition”, but it is exactly the pre-existing form of a catalyst that allows the reaction to be facilitated. Furthermore, the theory prescribes that a platform finds its form after reaching critical mass.

For chemical reactions the components and ratios are widely researched and documented, yet no research or measurements can be found in the last 9 years (2008 to 2017) on any ratios of platform participants. How many eBay consumers are required per each auctioneer as per evolution theory? How many PlayStation gamers per game development studio? How many Uber passengers per driver? It stands to reason that different platforms in industries function under different ratios.

Lastly, no information is given on the consequences of trying to ignite before critical mass outside of "fizzling out". It is suggested that this behavior has negative consequences for the platform, but what is the extend of it? Is it just the loss of a certain percentage of platform users, or does it mean bankruptcy?

In process to reach critical mass the platform is supported by the acquisition of users and how they on their turn bring more users onto the platform. Table 1 shows five potential entry strategies to reach critical mass, as derived from three common archetype platform dynamics shown in Appendix 6.1. However, this theoretical framework does not explicitly cover how to decide between - or combine - these strategies. Without any kind of measure or aid to determine the right strategy, an organization trying to develop a platform is not able to evaluate the correctness of their strategic choices solely based on this framework. Other literature like (Staykova & Damsgaard, 2015) does provide some guidance in the strategic choices in the platform emergence field, in particular by expanding on the timing of entry decision, and (T. Eisenmann et al., 2011; Kazan & Damsgaard, 2016) expand through a functional lens how a platform envelopment strategy works. However, they all consistently lack rigor in how emergence is accomplished, especially from a practical perspective.

There is another concept from platform evolution theory that can be of help here. There are three differences in the heterogeneity of the users can help determine the right strategies to reach critical mass - depicted by arrow (1) in Figure 2 - High level overview of the catalyst framework. The first heterogeneity is the degree that a user values the platform - some users value a product, service or technology more than other users. The second heterogeneity is that particular users on one side of the platform are valued more by the users on the other side of the platform – e.g. a famous game development studio like Blizzard is highly valued by gamers. These users are called marquee users and can be important users to attract early on. The third heterogeneity is the degree of expressiveness of a user - i.e. expressive users are more likely to influence other users to join the platform. These influencers accelerate the growth of a platform.

Determining which strategy allows you to maximize these three heterogeneities at a certain moment in time can help with picking a strategy, i.e. picking the strategy that allows the highest value of the platform, attracts the most marquees and the most influencers. Combinations are possible like subsidizing the adoption of the platform for marquees users on one side while self-supplying the other side.

TABLE 1 - FIVE STRATEGIES TO REACH CRITICAL MASS

The Basic zigzag	A basic strategy for reaching critical mass is to build participation on the two sides incrementally. The platform starts with a small number of economic agents on both sides. It then persuades agents on either side to join.
Pre-commitment to both sides	Contingent contracts can be entered into for this purpose. Customers agree to commit to join the platform conditional on other customers on the same and other side also joining.
Single and Double Marquee Strategy	In a single-sided marquee strategy the platform acquires an influential member of one side. In a two-sided marquee strategy, the platform acquires influential members on both sides. They provide value to each other as well as attract other members.
The Two Step	The two-step strategy involves getting enough members of one side on board first and then getting members of the other side on board.
Zigzag with self-supply	Catalysts may be able to jumpstart their platforms by providing one of the sides themselves at least initially.

After executing these strategies and reaching critical mass the reader might ask him- or herself how a platform will then reach the long-run stable equilibrium after ignition (depicted by arrow (2) in Figure 2 - High level overview of the catalyst framework. From a catalysts perspective it is simply the consequence of ignition by definition, entering a “business as usual” paradigm. It is simply the end goal. As will be shown in chapter 2.2 on platform leadership, it requires great ongoing and strategic effort to manage this equilibrium state. It is not hard to imagine situations that create negative platform dynamics; e.g. the overpopulation of advertisers repelling new users from joining and interacting on a platform. Even if a platform emergence theory suggests a stable long-run equilibrium, platform leadership argues that it is in fact an un-stable equilibrium.

Even within platform emergence theory, different frameworks focus on different aspects of the road towards this long-run equilibrium. In order to understand the path towards stable equilibrium better, we take a look through the lens of the platform evolution framework. This framework defines the diffusion of the platform from the perspective of the platform, and the adoption of it by users from the perspective of the adopter; the platform diffuses, the users adopts. Where the catalyst framework made parallels to chemical catalysts, the diffusion framework makes parallels to evolutionary theory.

In line with the catalyst framework, platforms are seen as changing and evolving over time (Arakji, 2010) and expected to reach a point of equilibrium, called “fixation” within the evolution framework. An economically self-sustaining point where the platform has its recognizable "form". The evolution framework provides little utilitarian value on how to manage and steer a platform, but describes in more depth the dynamics governing the journey towards equilibrium. Complimenting a weak point of the catalyst framework, as explained above.

There are four evolution dynamics at interplay: *Adoption*, the platform diffusing through the ecosystem with little to no change in the platform's functionalities; *mutation*, a significant change in the platform functionalities before diffusing; *selective advantage*, a platform having features that impact the rate of reuse; and the *number of actors* in the ecosystem of the platform.

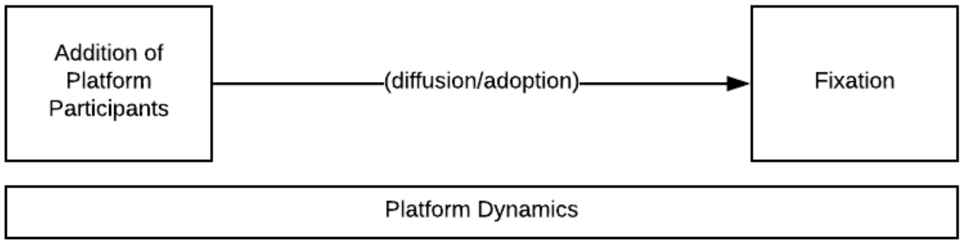

FIGURE 3 – PLATFORM EVOLUTION FRAMEWORK

Both mutation and adoption impact the likeliness of fixation. The more adoption takes place, the likelier the fixation. Through mutation of the platform (e.g. adapting products and services) it can align its offerings to add value (a selective advantage) to the users and improve its adoption. If more users join the platform without it changing, the likelier it is to ignite, and changing features to better fit the needs of your platform users will do so as well. More information on adoption is available in Appendix 6.4.

Positive selective advantage encourages fixation. The higher the selective advantage the faster fixation is reached. That is to say, the more value the platform adds to its users, the faster the platform will reach a long-run equilibrium. Adoption reinforces the effect of selective advantage, and compensates for small amounts of selective disadvantage. Even if users are somewhat negative towards implementing a platform it can still fixate due to network effects – e.g. through bandwagon attitudes or fear of missing out. Business might not want a mobile app, but as all its competitors have one, and they compete over the same customer base with smartphones, at least some will also have a mobile app developed.

Mutation in high values completely overpowers the effects of selective advantage and adoption. There is no time for adoption if a platform mutates functionalities too rapidly, negatively impacting the chances of fixation. Change your platform too much, too often, and users will not be able to keep up with the changes. Thus, a focus on incremental innovations allows the ecosystem to adapt and strengthen, as incremental innovations improve the selective advantage and thereby the fixation chances of the platform. Competing platforms Android's and Apple's App Store avoid fast paced mutation, focus on incremental features, and use different levels of open-source software, to not lose their developers and users subsequently (Fichman, 2004; Riehle, 2012; West, 2003; West & Gallagher, 2006). Changing the development architecture too much, too often, will cause developers to stop using the platform, removing value from at least one side of the platform.

Mutation in the correct amount, however, lead to higher levels of penetration as more relevant features help address a larger part of the ecosystem.

The number of actors act as multipliers to the aforementioned effects. In small ecosystems (N = 50) the rate of adoption is high, and mutation rates are low. In very large ecosystems (N = 50,000) all effects are slower; as a consequence, mutation can be a higher without overpowering selective advantage. This is somewhat counter-intuitive as small ecosystems and young platforms tend to be more agile due to lower bureaucracy and in closer contact with their (fewer) users, and large ecosystems are often maintained by corporates with lower speeds of innovation and change. But exceptions exist, like the popular social media platform Instagram, which had millions of users and was build and run by only a handful of developers.

Jointly, the catalyst- and evolution framework provide stages and dynamics through which we can look at the emergence of a platform. Both theories start from a point of conception; end their scope at a point of equilibrium; and describe strategies and dynamics through which interactions of the users and the platform take place. Some difference are the evolution framework lack of a critical-mass and ignition and the catalyst framework lack of insights on platform changes from ignition towards equilibrium.

Common criticalities arise in platform emergence theory. No publications have been found that back-track the theory findings with now known platforms. Neither framework has looked to further proof and substantiate their theory outside of secondary ex-post sources. In particular the catalyst framework has not attempted to recognize ignition points in the very platforms analyzed to inspire its conception. And as stated before, a gap is evident in the events after the end point of emergence theory and its frameworks: what happens after a platform is in long-run equilibrium? Most famous platforms (Amazon, Google, etc.) continue exerting control on their ecosystem and expanding their offerings, clearly indicating that there is more to the platform story than what we have seen here. This is where Platform Leadership Theory (2.2.3) comes into play.

2.2.3 Platform Leadership Theory

Most platforms entering a market do not become a leader in their ecosystem (Evans, 2003). Which leads to the questions: How does a platform reach a leadership position in the midst of competing platforms? And once a leader, how does a platform manage a central position that is highly dependent on the investments and decisions from other actors in the ecosystem? Research in the field of platform leadership tries to answer these questions.

Platform leaders are organizations that successfully manage to establish their product, service or technology (simply technology onwards) as a platform and rise to a position where they can influence the trajectory of the overall technological- and business ecosystem of which the platform is a core element. The total penetration of the market does not by definition make an organization a platform leader, it is the ability to exert control on the ecosystem that is fundamentally defining. This means that the act of platform leadership is not constricted the platforms that have become ubiquitous throughout an industry. Rather, it is the set of activities to improve the chances to reach such position, and how to maintain it. Platform leadership is the ability of a platform to exert control on the ecosystem.

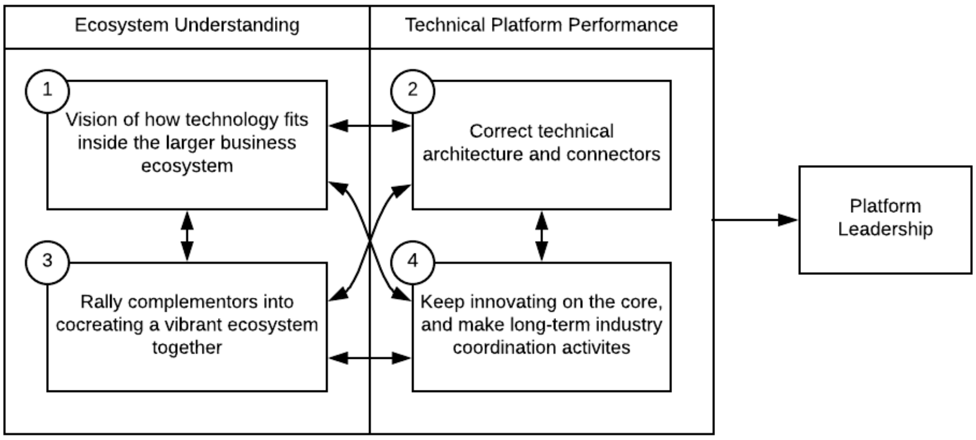

FIGURE 4 - SCHEMATIC OVERVIEW OF PLATFORM LEADERSHIP

This ability to exert control is critical as platform leaders face is a type of “Innovator’s Dilemma”. The success of a platform ties the firm to the existing customers and technologies in the ecosystem – a dynamic thoroughly explained in Clay Christensen’s book The Innovator’s Dilemma (Christensen, 1997). The interdependence in the platform’s ecosystem makes it increasingly difficult for a platform leader to radically change and contest new innovations (that are usually lower priced and less capable, but improving at a higher rate). The platform leader of one generation can lose its position to new players, or to their current ecosystem partners.

Platform leadership recognizes four levers to control its ecosystem: The *firm scope*, meaning what technologies to build in-house; *The technology design*, meaning the degree of modularity and intellectual property strategy; *External relations with complementors*, meaning the initiatives to promote investments in complementary products and services; and *internal organization processes that minimize conflicts*, meaning the processes that stop the development of complements that compete with other ecosystem partners (Gawer & Cusumano, 2014). Four strategies are designed to implement these levers within an organization. To reach and maintain platform leadership all four strategies need to be implemented – with discretion on the individual situation - (Gawer & Cusumano, 2014). The strategies are displayed in table format in Table 2.

TABLE 2 - FOUR STRATEGIES TO MANAGE PLATFORM LEADERSHIP

1. Develop a vision of how a product, technology, or service could become an essential part of a larger business ecosystem a. Identify or design an element with platform potential (i.e., performing an essential function and easy for others to connect to) b. Identify third-party firms that could become complementors to your platform (think broadly, possibly in different markets and for different uses)
2. Build the right technical architecture and "connectors" a. Adopt a modular technical architecture, and in particular add connectors or interfaces so that other companies can build on the platform b. Share the intellectual property of these connectors to reduce complementors' costs to connect to the platform. This should incentivize and facilitate complementary innovation.
3. Build a coalition around the platform: Share the vision and rally complementors into co-creating a vibrant ecosystem together a. Articulate a set of mutually enhancing business models for different actors in the ecosystem b. Evangelize the merits and potentialities of the technical architecture c. Share risks with complementors d. Work (and keep working) on firm's legitimacy within the ecosystem. Gradually build up one's reputation as a neutral industry broker e. Work to develop a collective identity for ecosystem members
4. Evolve the platform while maintaining a central position and improving the ecosystem's vibrancy a. Keep innovating on the core, ensuring that it continues to provide an essential (and difficult to replace) function to the overall system, making it worthwhile for others to keep connecting to your platform b. Make long-term investments in industry coordination activities, whose fruits will create value for the whole ecosystem

Looking at the four strategies in more detail, a subdivision can be observed. Strategies 2 and 4 in Table 2 relate to investing in the technical performance of a platform, and will not lead to platform leadership on their own. Strategies 1 and 3 force a better understanding of the ecosystem. This understanding is particularly important in content driven markets, rather than performance driven markets, that place less value on performance and technical differentiation (Edward G., 2014). The strategies impact each other, as such an order (as numbered in Table 2) is suggested when defining them. A vision of how the business and its platform fit within their ecosystem is helpful input when creating a technology architecture. When creating a piece of a puzzle (the platform), it is beneficial to know where it should fit and with what other pieces it will be connecting (the ecosystem) to increase the likeliness it will fit.

The strategies provide two outputs, an ecosystem vision and technology architecture. Which function to rally up the ecosystem complementors. Once complementors are part of the platform the fourth strategy - the improvement of the core technologies and long-term view of the platform - aids their retention. Naturally, certain technological advances could kick-start a change in the vision of the platform, and all other strategies.

Platform theory is primarily based on the few successful and ubiquitous platforms in the industry. It is the representation of research results on how to manage a leadership position, but it provides no conclusions on when the researched platforms started with these strategies in the first place, in what particular order they were executed, or how often they were revised. It stands to question how generalizable the theory is to smaller platforms. In addition, platform leadership theory does not recognize platform evolution theory and its stages, including a point of critical mass.

One of the most detailed case studies for leadership theory is Intel's CPU platform. Intel was initially a memory manufacturer that had just switched to CPU manufacturer. At that point in time had - by any measures - not reached a critical mass and was heavily developing (mutating) its CPU architecture. It invested heavily in the ecosystem when it switched to a CPU producer and executed the strategies 1,2,3 and 4. The above case is a strong example of a leading platforms that implemented leadership strategies before reaching ignition. Showing that leadership and evolution are not mutually exclusive serial extensions of each other, and can be observed in parallel.

Further evidence that platform emergence and leadership can go in parallel can be found by reflecting on the four levers to control a platform's ecosystem with the evolution dynamics: First, the *firm scope* determines the value provided to the platform users, which impacts **selective advantage** a platform has. Secondly the *technology design*, impacts both the **Adoption and Mutation**, as higher modularity allows for a wider use without changes and the openness of innovation impacts the speed of technological change. Third, the e*xternal relations with complementors* promote investments in complementary products and services; their goal is directly to increase the **selective advantage** of the platform over competitors. Fourth and final, the *internal organization processes that minimize conflicts* is another strategy directly aimed at increasing the **selective advantage** of the platform.

As shown in the previous paragraph, the strategies from leadership theory tell an organization what it can do. Emergence theory explains which mechanisms have an effect on the outcome of the leadership strategies. However, neither platform theories have proven to help organizations in the commercial development of a platform.

2.3 The Conceptual Framework

Figure 5 illustrates these relationships. In time (from left to right) there are two milestones a platform touches throughout its emergence. The platform's inception takes place; this happens by adding initial participants to the platform. Secondly, the platform's ignition with a critical mass. This milestone is reached by executing one or more of the five strategies (The Basic zigzag, Pre-commitment to both sides, Single and Double Marquee Strategy, The Two Step, and zigzag with self-supply) explained in Table 1, depicted in Figure 5 by the arrow between Inception and Ignition. These are essentially the moves a practitioner can take in their journey towards critical mass.

However, the growth strategies are ambiguous, and can technically always be implemented in any platform case. To evaluate which strategy is most fitting for the specific platform, the practitioner needs to evaluate the contingent elements of Ecosystem and Technical Platform understanding and Evolution- and Platform Dynamics.

Ecosystem- and Technical Platform Understanding provide further contextualization towards the actual situation of the practitioner. This is where the practitioner creates a plan for developing its platform and an end-vision of the future terrain looks like. A plan that guides the practitioner in picking the moves with the highest chances of success.

The Platform Dynamics include the positive and negative network effects; same-sided or not; the multi-sidedness of the market, and the way a platform can add value. The practitioner's platform will have specific dynamics that he can exploit to his advantage to increase his chances of success by incorporating them into his ecosystem and technical platform understanding.

The Evolution Dynamics (Mutation, Adoption, Selective Advantage, and Ecosystem Size) influence the speed and rate of change of the platform. These are contingent on external factors of the ecosystem in which the platform operates. They are the so-called "rules-of-the-game".

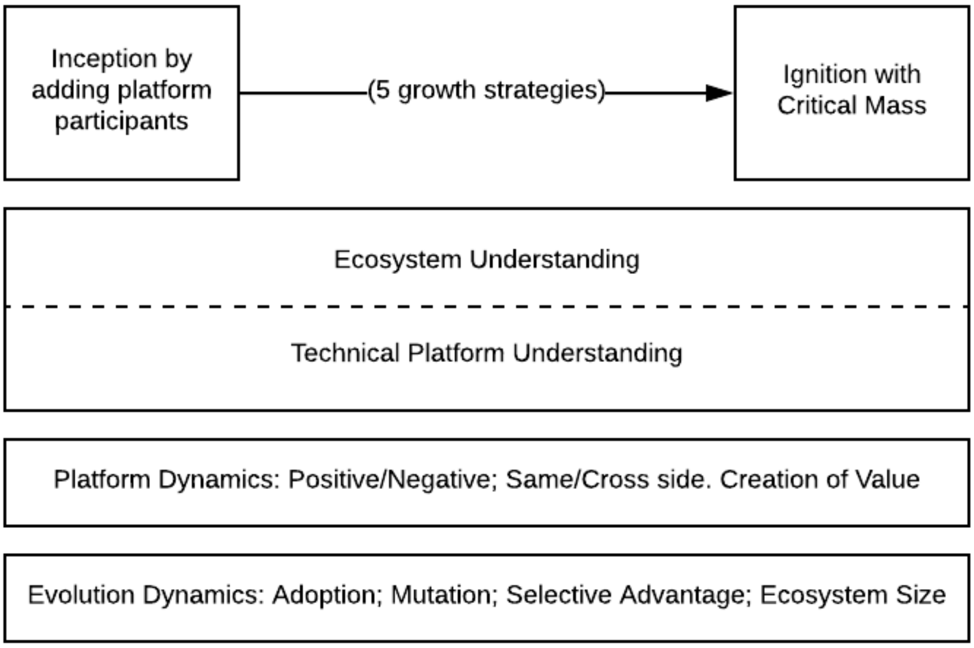

FIGURE 5 - CONCEPTUAL FRAMEWORK FOR PLATFORM DEVELOPMENT

2.4 Theory Summary

As seen in the chapters above, the body of knowledge regarding platforms is split. Current academic research distinguishes two streams or paradigms in platform research, namely platform emergence and platform leadership. However, these two streams share the same drawbacks that they explain what one can do to develop a platform, but do not help in evaluating the progress along the way, nor take commercial viability into consideration.

This theory chapter shows that research and knowledge is predominantly focused on platforms after they have reached critical mass. Particularly driven by well-known platforms like Google, Amazon, PlayStation, etc. The downside is that this introduces a big survivability bias into platform research. Granted, it is challenging to research platform emergence and leadership based on a platform that is still to prove and consolidate its position. However, this limits the results to after the fact findings and back-tracing of decisions and activities (Kazan & Damsgaard, 2016; Spagnoletti, Resca, & Lee, 2015; Staykova & Damsgaard, 2015).

Following the call for research from (Tilson, Lyytinen, & Sorensen, 2010; Yoo, Henfridsson, & Lyytinen, 2010) that recognizes a lack of knowledge and understanding in the early stages of a platform's formation. In particular in the pre-critical mass stage of a platform. As a consequence, the knowledge in literature is underdeveloped on how platforms reached critical mass, less is known on failed platforms and the reasons for failure. The literature review did not show that the researched theories help a developing platform reach critical mass and attain a leadership position, and what degree of helpfulness these theories have for practitioners.

Given the abundance of post critical-mass platform research (Zhu & Iansiti, 2012) - albeit the existence of a survival bias (Edward G., 2014) – this research shall focus primarily in the pre-ignition stage of a platform, how the theory can aid the journey (evolution) towards critical mass, and how useful this theory can be for practitioners. While the mechanics and dynamics at play have been researched and modelled (T. Eisenmann et al., 2011; Fichman, 2004), there is little known on the essential stage of platform emergence, the frameworks and influencing dynamics that aid the practitioner in increasing their chances of reaching critical mass (Tiwana, Konsynski, & Bush, 2010). Given the social and economic importance that digital platforms have nowadays, and the growing incumbent power and winner-take-all dynamics (T. Eisenmann et al., 2011; Parker & Van Alstyne, 2017; Zhu & Iansiti, 2012), it is essential for practitioners and policy makers to understand how to bring new platforms into existence.

2.5 Research Framework

In chapter 1 this study argued the existence of a survival bias in current platform theory, and a lack of knowledge in the stage before a platform reaches critical mass.

To gain a better understanding on this specific stage, a study needs to follow a to-be platform from the earliest possible moment, up to it reaching critical mass. This, because re-tracing the journey of a platform is only possible by first picking a platform to trace. By definition this is a surviving platform that contributes to the survival bias. Re-tracing also means a bigger focus on secondary data sources, and the inability for the researcher to participate in the platform's development.

Furthermore, the theory should be applied by the company developing this platform, which requires a strong involvement of the researcher in the platform's development, from a very early stage. Finding an organization with such specific ambitions and high risk-acceptance – given the high failure rate of platforms – is difficult.

An overarching research methodology should be applied. However, it should not negatively impact the chances of success of this new platform by imposing impractical limitations to the day to day business. Sufficient flexibility has to be “build-in” the methodology from the beginning, and allow for the chaotic process of entrepreneurship to take place.

One example is the Information Systems Research Framework (ISFR). The methodology of ISRF is very linear, moving from problem awareness to artifact development and evaluation without any iteration on the design. This framework has an emphasis on technological rigor over organizational relevance (Alan R. Hevner, 2004; Hevner, 2007). ISFR assumes a known reality without allowing to account for unknown-unknowns. This does not resemble the real world, where designs change and evolve – sometimes randomly or chaotically - in an iterative manner. Canonical Action Research (Davison, Martinsons, & Kock, 2004) is another research methodology sharing the same drawbacks. Therefore, these linear methodologies are not fitting for this study.

To research the development of a platform, a methodology is needed that provides enough flexibility to fit within the organizational context in which the platform is being developed. A methodology that more closely resembles practical day-to-day business development in a cyclic manner. It should be an action research methodology that allows the start of the study to be as early as the formation of the platform, and follow it in its path to critical mass, providing input, evaluating and adapting along the way. Action design research (ADR) as proposed by (Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011) is a good fit for this. It tackles the problem of linearity by allowing for interventions and evaluations throughout the process, instead of solely at the end. Allowing for faster feedback and more iterations of the system. The focus on building iterations, collecting feedback and evaluating the results makes the ADR methodology better suited for open-ended problems – like the development of a new digital platform. And therefore, the right fit for this study.

ADR consists of four stages: 1) The Problem Formulation; 2) The Building, Intervention and Evaluation; 3) The Reflection and Learning; and finally, 4) The Formalization of Learning. Each stage is characterized by one or more principles, which ensure the validity, and generalizability of the study.

Stage one – problem formulation – is a problem perceived in practice or anticipated by researchers. The input for this formulation can come from practitioners, end-users, the researchers, existing technologies, and/or review of prior research. It draws on two principles: practice-inspired research and theory-ingrained artifact. Principle 1 - practice-inspired research - emphasizes viewing field problems at the intersection of technological and organizational domains as knowledge-creation opportunities. The action design researcher should generate knowledge that can be applied to the class of problems that the specific problem exemplifies. Principle 2 - theory-ingrained artifact - emphasizes that artifacts created and evaluated through ADR are informed by theories to structure the problem, identify solution possibilities or to guide design. However, this principle only results in the initial design of theory-ingrained artifact. It then becomes the basis for cycles of intervention, evaluation and further re-shaping by subjection to practice.

Stage two - building, intervention, and evaluation - uses the problem framing and theoretical premises adopted in stage one. An initial design of the IT artifact is made, which is further shaped by subsequent design cycles. It draws on three principles: reciprocal-shaping, mutually influential roles, and authentic and concurrent evaluation. Principle 3 – reciprocal shaping – emphasizes the mutual influence the IT artifact and the organizational context have on each other. E.g. the ADR team may use its interpretation of the organizational environment to influence the design. Principle 4 – mutually influential roles - points to the mutual learning among the project participants. Action design researchers and practitioners may have perspectives that compete or that are complementary. Principle 5 – authentic and concurrent evaluation - emphasizes that evaluation is not a separate stage of the research process. Instead, shaping and re-shaping the artifacts is interwoven with ongoing evaluation. This evaluation can be formative or summative. The emergent nature of the artifact makes controlled evaluation difficult, consequently authenticity is more important than a controlled setting in ADR.

Stage three - reflection and learning – recognizes that the research process involves conscious reflection on the problem framing, the theories chosen, the emerging artifacts, and is ongoing throughout the study. This stage draws on the principle of guided emergence. Principle 6 – guided emergence - emphasize that the artifacts will not only resemble the preliminary design (Principle 3), but also its ongoing shaping by organizational use and participants (Principle 3 and 4) and by outcomes of evaluation (Principle 5). The ADR team should be sensitive to unanticipated consequences during the BIE cycles.

Stage four – formalization of learning – has the goal of formalizing the learnings of the study and draws on the principle of generalized outcomes. Principle 7 – generalized outcomes – emphasizes that generalization is challenging in ADR because of the highly situational outcomes that include organizational shaping. The artifacts form a solution for a problem.

However, both can be generalized in three steps: first, generalization of the problem instance; second, generalization of the solution instance; third, derivation of platform design.

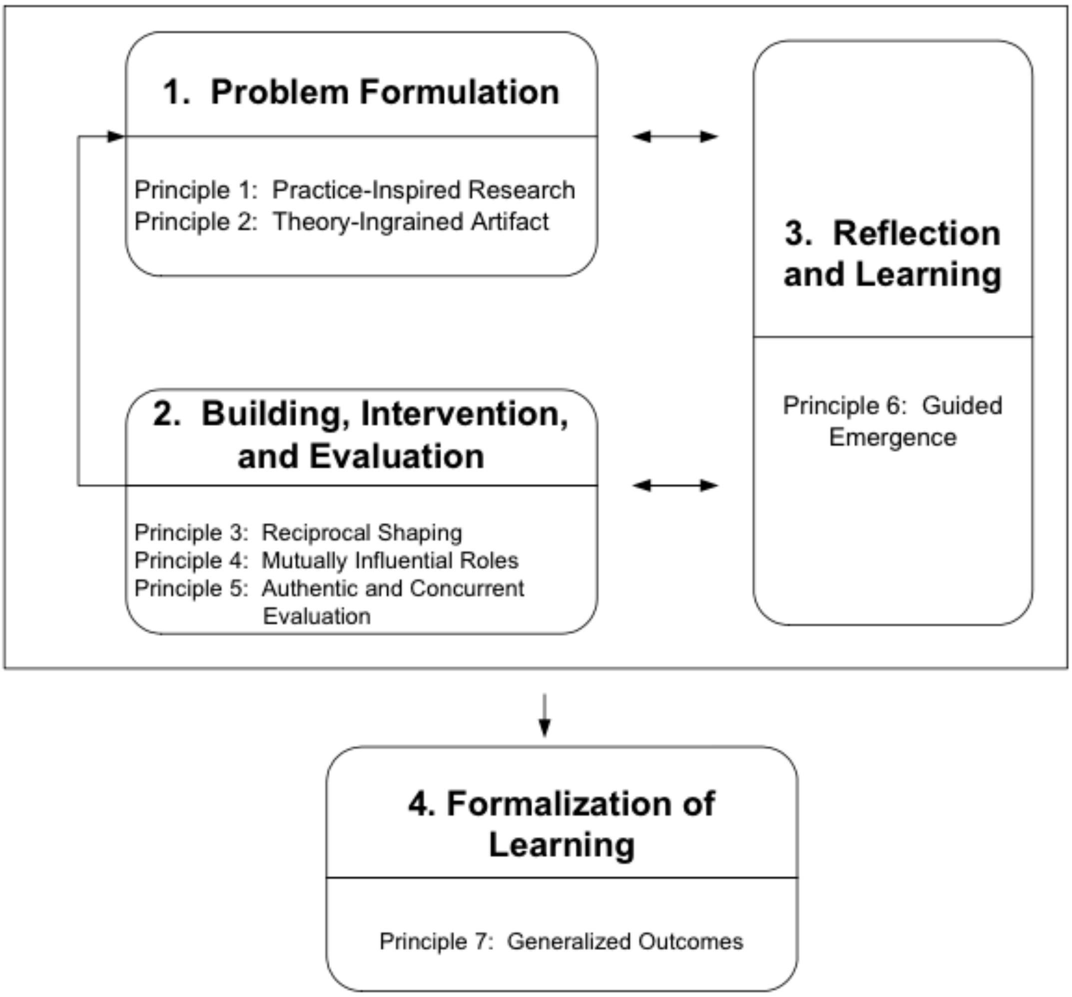

FIGURE 6 – ADR METHOD: STAGES AND PRINCIPLES (SEIN ET AL., 2011)

2.6 Methodology & Operationalization

For this study, a collaborative project called CostDigest was selected with start-up company Spore.BI B.V. and the cooperative Boer en Zorg B.V. for several reasons.

The industry cooperative and the member companies

Boer en Zorg B.V. – a cooperative with 120 member companies – is chosen for two reasons. First, they were experiencing a practical problem - providing a practice inspired case - that can be solved with a digital platform: They need to know the costs per hour of healthcare services its members provide to negotiate the fees with the municipalities that pay for this care. However, calculating this cost is a complex mathematical endeavor and cost levels differ from member to member, thus an industry wide benchmark with rich insights is needed that can only be created if many members participate. These insights can only be calculated if the data of the members and the cooperation are available simultaneously on the same system, however no member will invest in such a platform without receiving some value from it (e.g. who will buy the first fax-machine?). This is a typical same-sided platform challenge for which the theory in chapter 2.1 is applicable.

Second, they were willing to commit for an extended period of time of 6 to 12 months, providing sufficient time to build a proof-of-concept to evaluate if further investment is required. This type of prolonged engagement allows the researcher time to build trust with the participants, appreciate and understand the specific context of the case, and rise above potential preconceptions. These elements are particularly important in studies where co-creation takes place and help increase the credibility (which parallels internal validity) of the study (Lincoln & Guba, 1985). Third, Boer en Zorg has access to its members: 120 small and medium sized businesses (SMEs) varying in revenue size, revenue typology (healthcare vs agriculture), location, level of professionalization, ownership type, and customer typology. Access to this pool of participants allows for triangulation - i.e. using different SMEs to gather data on the platform solution, thereby increasing the confirmability (which parallels objectivity) of this study (Lincoln & Guba, 1985) – and the high diversity of the pool of actors resembles closely a real-life situation and therefore more representative for a different platform in a different ecosystem. This diversity brings the challenges a platform would encounter from inception to ignition. For a full list of the members see Appendix 6.6.

The start-up and the role of the researcher

Spore.BI B.V. - a start-up incubated in the TU Delft's incubator named Yes!Delft on October 2014 - is chosen because at this organization the researcher could fulfill a dual role as both active design researcher and founder of the startup. Through this dual role the researcher is an integral part of the CostDigest project, allowing for a thick description of the events and providing sufficient detail for the reader to evaluate the extent to which the conclusions drawn are transferable to other settings. Resulting in an increased transferability (which parallels external validity) of the study (Lincoln & Guba, 1985). Furthermore, through the role of start-up founder the researcher has access to a body of continuous external audits through advisors, industry captains, Yes!Delft Mentors, venture capitalists and other independent specialists. Thereby increasing the dependability (which parallels reliability) of the study (Lincoln & Guba, 1985). Lastly, the start-up has the required technical skills to practically develop a platform. Therefore, the role of the researcher is split into two distinct actors: the researcher in the role of platform designer and researcher, and the researcher in the role of start-up owner. They are treated as two distinct and separate actors and related content is always accompanied by the explicit mention of the role in which the researcher is active.

This research created a conceptual theoretical framework in chapter 1.3 and argued the usage of ADR methodology in chapter 2.1. The artifact of this study (as per ADR) is a minimum viable business product (MVBP) and is defined as a “minimally viable product (platform) that a customer will pay for, but keep the functionality as simple as possible so we can minimize risks and also continue to test the assumptions in a scientific manner” (Aulet, 2013).

The conceptual framework will be operationalized with the ADR stages as follows:

Stage 1. Problem Formulation

This stage is found under Chapter 3.1. Here, two elements of the conceptual framework are researched: The *Ecosystem Understanding*; *Platform Dynamics* and *Growth Strategies*.

No academic papers nor databases were found on this particular industry to help the researcher make decision. Therefore, data collection will take place primarily through interviews. The interview respondents are selected according to the considerations described below (Lincoln & Guba, 1985).

The *ecosystem understanding* is researched through 6 interviews. First an interview with the cooperation director. Through her broad understanding of the industry and its challenges, as well as her ten-year industry experience, she is adept to provide this study with a practical understanding of the dependencies of the carefarmer ecosystem actors.

Then, five interviews with five members part of the cooperation’s “innovation group” to gather further understanding of the operational problem. To confirm and further specify the problem and determine the level of problem variability. The innovation group consists of five members, and have some time-slots readily planned throughout the year to discuss innovative projects with the cooperation. Each interview was done separately at the location of the SME.

Lastly, the Platform Dynamics and Growth Strategies are studied through desk research, and a stakeholder analysis. Desk research was chosen because analyzing the platform dynamics needs to be done by the platform designer with knowledge of platform theory. The researcher has over 2 years fundamental knowledge, 2 years of experience as a data analyst in the healthcare industry and was awarded 3rd place worldwide for platform design in the healthcare sector by IBM. All of these function as a reflection on the results acquired for the *ecosystem understanding*.

Stage 2. BIE Cycles

This stage is found under Chapter 3.2. Here, two elements of the conceptual framework are researched: The *Technical platform understanding;* and the *Evolution Dynamics* element of the conceptual framework are researched. This was done through three focus-group sessions and a questionnaire.

The *technical platform understanding* is created through desk research, a cost-, and a technical analysis, and the technical knowledge of the researcher. Furthermore, one interview was held with the IT Director – responsible of the systems linking patient information for all the members with more than 5 years' experience - of the cooperation to estimate the fit of the platform understanding.

The first focus-group consists of the cooperation director and the five SME members of the "innovation group". The goal with this group is to confirm the initial platform design.

The second and third focus-group participants are selected with the criteria being: 10 new participants being future users of the platform from the pool of 120 members, each from a different municipality, each with a different revenue ratio of healthcare vs agriculture. The criteria are intended to make the group as diverse as possible, more closely resembling the total population of the ecosystem, which also has strong variability in revenue ratios and different municipalities to do business with. The goal of second group was formative, i.e. to find the mutations needed to the platform to be adopted. The goal of the third group was summative, i.e. to confirm that previous changes lead to a selective advantage, and the rate of mutation required decreased.

All focus groups took place in three hours, split in three segments of varying length as follows: The first segment relates to getting a user up-and-running on the platform; the second segment relates to the actual usage of the platform; and the third segment is used for a collective discussion on the experience of the aforementioned segments, and collect input that help form the future cycles. This is done to allow reciprocal shaping, mutually influential roles and authentic evaluation to take place during the focus group.

The questionnaire is used when the platform mutations are low. The goal is to evaluate the commercial feasibility for reaching critical mass, given the current platform and ecosystem. The questionnaire is given to 50 new potential users from the 120 members, after a 20 minutes visual demonstration of the platform and its usage.

Stage 3. Reflection and Learning

In this stage – found under Chapter 3.3 – the study looks at the *Ecosystem*- and *Technical Understanding* and the *Platform Dynamics* learnings acquired during the BIE cycles.

Furthermore, it reflects in peer-review methodology on the *Ecosystem*- and *Technical Understanding* through external expert opinions sourced from the body of advisors of Spore.BI B.V (Lincoln & Guba, 1985). The criteria for these semi-structured expert interviews are as follows: Firstly, the interviewee is regarded an expert on one or more related fields – as described in the theoretical chapter the ecosystem and technical platform understanding consists of: IT, industry (healthcare), finance, entrepreneurship, and law; secondly, the peer-reviews take place throughout the entire project; thirdly, the goal of the interview is to reflect on the current understandings and find potential unknown-unknowns; lastly, there is at least one expert interview in every month of the project to reflect along different stages of the platform's emergence.

Stage 4. Formal Learning

In this stage – found under Chapter 4.1 – this study looks at the holistic level of a platform design, taking the previous stages as input, and generalizing the problem instance – commercially developing CostDigest; generalizing the solution instance – the CostDigest platform; third, deriving a commercial platform development framework for future platforms considering the behaviors of the actors. This is done by reflecting the theory with the findings of this study to aid in new theory development. As this study has shown in previous chapters, the platform theories between inception and ignition are still under-developed.

Table 3 shows a summary of the four ADR stages and their principles, as well as the key results obtained and artifacts created through these principles.

TABLE 3 - SUMMARY OF THE ADR PROCESS IN THE COST ANALYTICS PLATFORM

Stages and Principles		Artifact (MVBP Platform)
Stage 1: Problem Formulation		
1. Practice Inspired Research	- Research was driven by the need for better insights into the costs of healthcare provided by care-farmers to negotiate compensation with local governments	Recognition: Shortcomings in current cost insights and reporting
2. Theory-Ingrained Artifact	- The platform frameworks used were: Platform Dynamics -, Catalyst -, Evolution - and Leadership -.	
Stage 2: BIE		
3. Reciprocal Shaping	- Long and tiresome data input iteratively addressed by shortening input in favoring ease of use above accuracy - Addition of benchmarking iteratively improved - Peer to peer learning - Possible shortage of financial knowledge of care providers	Alpha Version: The platform conceived as a design idea; aiding the understanding and component build-up of healthcare costs. Beta Version: Platform prototype designed to implement cost analytics for carefarmers including benchmarking.
4. Mutually Influential Roles	- The ADR team included the researcher, practitioners. (care providers and industry collaboratives) and external experts. - Learning, it's not just for costs, it's also regarding quality and competitiveness - Researcher acted in the roles of: Platform Designer (employee from Spore.BI), and Researcher (as MSc. student).	
5. Authentic and Concurrent Evaluation	- CostDigest was first evaluated with the director of the cooperation and then increasingly with a wider setting of end-users through the course of 6 months.	
Stage 3: Reflection and Learning		
6. Guided Emergence	- Changes to the learnings related to the ecosystem and platform technology were recognized.	Emerging Version and Realization: New learnings for the development of a cost analytics platform based on results emerging from the BIE stage.
Stage 4: Formalization of Learning		
7. Generalized Outcomes	- A commercial platform design principle was articulated, positioning CostDigest as an instance.	Generalized Version: An ensemble of design principles embodying the platform design and managerial policies for the development of a digital platform

3. Research results

The project began in November 2014, and continued for 6 months. The objective was to gain knowledge in how to develop a commercial (cost analytics) platform for the carefarming industry. Such knowledge was expected to be an important theoretical contribution because it would provide guidance to practitioners trying to develop their own digital platform. This, as presently (2019) the economic value created by digital platforms is not only very impactful in our societies, it is still increasing (see Chapter 2.1).

3.1 Problem Formulation

To build an initial ecosystem understanding, a total of six interviews were held due to a lack of available literature on platform emergence and how they come into existence. The first interview with the cooperation director was held. During this interview the following understandings were shared.

Cooperation Director

First, the activities and business of their members was discussed. The members of the cooperation are all 'carefarmers'. These are (commonly) small companies that simultaneously operate a farm and provide healthcare. They use farm resources, like the location, crops, animals and barns to provide day-activities and learning/coaching services to their patients. A typical example: a carefarm receives a group of 12 mentally challenged young adults, and coach them in responsibility and collaboration by tasking them with picking apples or feeding the cattle. Their patients have un-insurable condition (e.g. a mental handicap), and treatment is therefore covered and paid by the government. Their revenues come from both the patient care, and the sales of produce (crops, milk, artisan products, etc.).

Second, the nature of the problem was discussed. Legislation in the healthcare sector was changing (from the so called "AWBZ" to the new "WMO"), according to the director the goal of this legislative change is more decentralization and reduction of costs. For the non-insurable healthcare industry in which the carefarmers operate this has several impacts: carefarmers now need to agree on tariffs with their local municipality, instead of as a niche industry as a whole; tariffs are expected to differ between municipalities, as supply, demand and the cost to serve differ geographically as well. The level of cost insights needs to be more accurate, detailed and segmented (per region) than is currently is. For an ecosystem understanding, this suggests to be a key functionality with platform potential. As a consequence - she expressed - these uninsurable healthcare providers need to manage their costs a lot sharper to maintain a positive revenue margin. Failure to do so could force them to stop providing care services or worse, bankrupt the carefarmer. A company may have been running a profit through national averaged tariffs, but could start making a loss if their new municipal price is lower – as is likely the case. Different regions have different cost structures, especially rent (land, building) and transportation costs differ strongly across regions.

Third, the role of the cooperation (Boer en Zorg) was discussed. Their main role is to represent the interest of their members. For this particular topic it meant representing the members at their local municipalities to negotiate tariffs and help them professionalize their healthcare business. However, this has been challenging. The cost calculations are very complex, as it requires to attribute costs from the agriculture side of the business to healthcare (and vise-versa). How much of the tractor depreciation - used in planting the apple trees - does one attribute to the healthcare costs? In terms of *Ecosystem Understanding*, the cooperation is likely a key user-group and displays a need for a platform with industry benchmarks.

Last, past solution attempts were discussed. According to the director some members tried to calculate their healthcare costs with their accountants, while other members have hired specialized consultants. In both cases the endeavor was too expensive, the results only provided only a single snapshot in time, and required re-calculation for any other future (or past) moments in time. In some cases, the calculation was not accurate enough to determine the margin on the services because the information was is not available. Furthermore, the director experiences the members as withholding in regards to sharing their financial information and KPIs with anyone involved in their industry, the director's hypothesis is that this is the case due to privacy and competition concerns. This makes it difficult to collect a high enough number of cost calculations for statistically significant industry insights. The latter pointing to a trust threshold that needs to be lowered for carefarmers and the cooperation to reach each-other for their common goal. That platforms can act as a facilitator is known in academic literature, but the explicit consideration of trust as a factor in platform emergence is not researched.

Members of the cooperation

To confirm and further specify the problem, and its variability, five interviews were held with the five members of the cooperation's "innovation group". The aggregated results of these interviews are presented in table format in Table 4. The interviews confirmed several points: One, none of the interviewees knew the exact cost of care – Table 4 row 10; second, all interviewees deem the negotiation of tariffs as a problem – Table 4 row 13; third, they were all interested in industry benchmarks which are currently unavailable – Table 4 row 14.

The results of the five interviews also showed a wide variability in the revenue split of the interviewees. One interviewee estimate based on their annual reports that 10% of its revenues come from healthcare, while another estimated around 80% - Table 4 row 1. The size – in terms of full-time equivalent employees (FTEs) – ranged from 2 to 15 employees – Table 4 row 7, with the smaller companies being family owned and the biggest one part of a larger group of farms in the region. They all relied on volunteers, ranging from 2 to 15 FTE - Table 4 row 8. Deeper discussions on this topic revealed that it is common practice in the carefarming industry to rely on volunteers to fulfill regulatory requirements of a minimum number of coaches per number of patients. All (5 out of 5) interviewees agreed that it would be too expensive to hire staff for this. Arguably more problematic, the interviewees stated to be unable to pay all the staff as employees, sometimes not even paying themselves salary. This is an unhealthy business practice that sheds doubts on the current survivability of carefarmers.

Documents provided by the industry collaborative, as well as documents from the carefarmers, shows that carefarmers split their care segments across three main categories (row 2) based on the age of the patients as follows: Youth – from 6 to 18 years; Young Adult – 18 to 25 years; and Adults – 25 and over. There are also three type of activities: Day Activity, Coaching/Work, and Nightly Stay. Jointly permutating to 9 healthcare services which form the basis for the determined tariffs. However, each patient can have light, medium or heavy symptoms, impacting the practically required number of coaches per group (e.g. a group of 8 lightly handicapped children requires less coaches to safely and effectively manage versus 8 heavily handicapped children). As such, there is plentiful reason for difference in costs between carefarmers due to heterogeneity in the group making the cost model complex. In addition, the cost is likely to change over time as patients improve. The above reinforces the need for cost analytics partly explains the unsuccessful previous attempts in cost calculations.

No participants were willing to share their data with the cooperation nor their municipality, with one exception. (1 out of 5) – shown in row 15. However, all (5 out of 5) were willing to share it with a third party under two common conditions – shown in row 16: The third party should be fully independent, meaning it is not owned by carefarmers, cooperations or governmental institutions; and all data should be fully anonymized, meaning that it is impossible for any user accessing information to be able to trace KPIs, financials or other kind of insights back to a specific carefarm. Further discussion with the interviewees unwilling to share their data with the industry collaborative or government revealed, according to the care providers, that privacy and handling personal information with great care and respect is a highly accredited norm they care deeply about. Further discussion with the interviewee willing to share their financial details with the cooperation revealed that they believe to be an exception in doing so, and only do so in collaborative efforts to develop the industry. These statements further confirm the existence of a trust threshold between the parties involved, and confirms that a facilitating platform acting as a place to share the needed data whilst fulfilling the desired conditions of the users could help and be valuable for the participants.

TABLE 4 – CODING OF THE INTERVIEWS OF 5 CARE FARMERS

ID	Topic	(Redacted) 1	(Redacted) 2	(Redacted) 3	(Redacted) 4	(Redacted) 5
1	Revenue Splitcare / agriculture	10/90	50/50	20/80	30/70	80/20
2	Main Care Segments	Youth	Youth, Young Adult, Adult	Young Adult	Young Adult, Adult	Youth, Young Adult
3	Est. Profit Margin	10%	20%	-20%	15%	10%
4	Top Cost	Rent	Employees	Employees	Employees	Employees
5	2nd Top Cost	Employees	Machinery / Equipment	Animals Overhead	Animals Overhead	Rent
6	3rd Top Cost	Machinery / Equipment	Animals Overhead	Machinery / Equipment	Rent	Machinery / Equipment
7	FTE Employees	2	8	15	6	5
8	FTE Volunteers	10	15	2	2	5
9	Ownership Type	Family Owned	Owned by Farmer	Part of larger concern	Recently acquired by new farmer	Owned by Farmer
10	Know current costs of care?	No	No	No	No	No
11	Had it calculated before?	No	Yes	No	Yes	No
12	Previous Cost Calculation	n.a.	Expensive, insightful, but not helpful to compare ranges	n.a.	Only an average of the past year on a high level per group.	n.a.
13	Experience the problem of aligning tariffs	yes	yes	Yes	yes	yes
14	Interested in industry benchmarks	yes	yes	Yes	yes	yes
15	Willing to share financials with Cooperation	Cooperation, 3rd party	Only 3rd Party	Only 3rd Party	Only 3rd Party	Only 3rd Party
16	Data Sharing Condition	independent, anonymized	independent, anonymized	independent, anonymized	independent, anonymized	independent, anonymized

Through the previously discussed interviews this study identifies at least three stakeholder segments. First, the carefarmers providing healthcare services in the un-insurable healthcare industry – henceforth referred to as care providers. Second, overarching and umbrella organizations for the niche industry, like cooperation's, collaboratives and unions – henceforth referred to as industry collaboratives. Third, the municipalities that pay for the treatment of their residents diagnosed with un-insurable conditions – henceforth referred to as municipalities.

These findings trace the problem to a lack of rich insights into the cost structure of the healthcare providers, on both the single company, and industry level. Complexity for cost allocation is observed due to the interplay between healthcare and agriculture assets, and the fluctuating operational efficiency driven by patient diagnosis severity. As a result, the cost calculations are outside the scope of the general financial administration of the carefarmer, and require the usage of more advanced (financial) data analytics. As a consequence, the healthcare providers and the cooperation have not been able to calculate individual tariffs, their ranges in the industry, analyze their changes over time, gain insights into the cost structure dynamics and feel unprepared to negotiate prices with the municipalities.

Gaining an understanding of the problem through information gathering of both the industry collaborative and heterogeneous care providers, ranging from heavily care service dependent to primarily agricultural, as well as volunteer dependent to primarily staff dependent, this study has represented a high variety of the potential variants of stakeholders. The findings suggest the need for a cost analytics where the healthcare providers can provide and analyze their cost data. Furthermore, to negotiate with the municipalities the industry collaboratives need to benchmark and analyze the costs of the different carefarmers. However, these two actors do not find each other due to privacy concerns and a lack of cost analytics knowledge. As a potential solution these two needs (cost analytics and industry benchmarks) can be combined in one platform. Allowing carefarmers to gain insights into the cost driver. Simultaneously industry collaboratives can access and analyze anonymized cost data and their geographical dependencies. Helping them negotiate healthy tariffs with municipalities. Lastly, this all takes place in an ecosystem in need of cost-cutting. Care providers in particular have little financial resources available.

Ecosystem Understanding

With the above data and knowledge gathered, this study can now research the *Ecosystem Understanding* as described in the theory. The first part is the vision of how a platform could become an essential part of a larger business ecosystem. This vision can be kick-started by: a) designing an element with platform potential, which performs an essential function and is easy for actors to connect to; and b) identifying other parties that could become complementors to the platform, possibly in different markets and different uses.

The element with platform potential chosen was a data analytics algorithm that can execute complex cost modelling calculations. Performing the essential function of calculating the detailed service costs of the care providers. The healthcare providers can create an account and add their cost data to it. This element has platform potential because it enables same-sided network effects: the algorithm results become better the more data it has access to, the more valuable the benchmarks and detailed cost breakdowns become for the care providers and industry collaboratives. This is perceived as essential insight for the carefarming industry to transition to healthy municipality agreed tariffs.

The vision consists of a digital platform where care providers can transform their operational and financial data into detailed cost insights and benchmarks. Taking place in the larger ecosystem business of care providers, industry collaboratives and municipalities.

The next part of an *Ecosystem Understanding* is to build a coalition around the platform. During the interviews the vision of digital cost platform emerged (guided emergence), and the researcher in the role of platform designer articulated the mutually enhancing benefits for the care providers and industry collaboratives in the ecosystem (as per ADR Principle 1). In particular it was discussed how care providers can benefit from each other's data not only to reduce cost, but also to improve quality and establish better forecasts of the local demand. Industry collaboratives on the other hand could potentially join forces to negotiate lower bulk prices for common cost-elements (e.g. animal insurance).

In contrast with the prescriptions from the literature, the researcher did not evangelize the technical architecture at this stage of the study, as the architecture will be built in Phase 2 (the Build, Intervene, Evaluate cycles). He was – in the role of startup founder - able to acquire pre-commitment for the development of this platform with the industry collaborative partaking in this research through a financial commitment. The legitimacy of the firm (Spore.BI B.V.) was improved by sharing details of the incubation in Yes!Delft, the two years technical background and experience of the researcher as a business and data analyst for a healthcare strategy consulting firm.

Part of an ecosystem understanding is the existence and development of a collective identity. During the interviews, the care providers displayed consistently collective identity association as carefarmers. This was measurable as care providers often answered questions from both a personal and carefarmer industry perspective, and using positive collegial terms for their competitors (e.g. "for me the highest cost is x, but I know most of my fellow carefarmers have employees as their highest cost"). Therefore, this study identifies a collective identity of carefarmers in this ecosystem.

Platform Dynamics

Now that there is an understanding of the problem and a vision of the platform and the ecosystem - care providers, industry collaboratives and municipalities working with un-insurable healthcare, it is time to study the platform dynamics that apply to this case, as described in the theory.

The cost analytics platform has several positive same-sided network effects. Firstly, the more care providers join the platform the more valuable the platform becomes as one element of the platform is the cost modelling algorithm. This algorithm becomes more accurate and can provide more degrees of "slicing and dicing" the more data it has access to. One example would be a late joiner of a care provider who does insure his animals in comparison to the previously available care providers who did not, thereby introducing a new category of costs and benchmarks that other care providers did not have. This allows both members inside and outside of this category to re-evaluate the cost-benefits and risk profile of their business decisions. Another element is the industry benchmarking aspect of the platform, with more data available the benchmarking becomes more significant and richer in context. Secondly, due to the closeness and collectivity of the ecosystem, likely bandwagon and fear-of-missing out effects may take place. I.e. the more care providers using the platform – and consequently knowing what their above average costs are – the likelier their nearby competitors may want to have access to the same resources. This second effect is also likely observed in the industry collaboratives, as gaining these cost-insights would be a visible differentiating advantage for one collaborative, and others might want to follow suit.

There are also cross-side network effects present. The more care providers present on the platform, the more valuable the platform becomes for industry collaboratives on two fronts: On the one front, if the care providers are members of the collaborative, this collaborative is incentivized to join as it provides insights on its own members; On the other fronts, if the care providers are not part of the collaborative's members, the data provides ground for comparison between collectives - e.g. do my members have more expensive care than the rest of the industry?

Lastly, this study observes the existence of some sequentially in the provided value. Initially the platform provides value in the form of cost analytics, and with the addition of more care providers the platform will grow with the addition of industry benchmarking for both care providers and industry collaboratives.

3.2 BIE Stage

The BIE stage is initiated by envisioning a platform that provides a safe environment for care providers to upload their financial and operational information. With this information, detailed cost insights are provided and industry benchmarks are generated. Industry collaboratives on their turn can access anonymized information and use these insights to help their affiliated members. This is done for the study to have an initial artifact platform to follow from inception to potential ignition. Allowing the researcher to knowledge into the elements that come with developing a commercial platform and the impact on survivability along this evolution.

Building on this initial need for a cost analytics platform, the researcher expanded his knowledge in the field of data analytics, to aid the design of such a platform. A summary of the relevant literature on data analytics, cloud computing, big data and Hadoop can be found under Appendix 6.2 and 6.3. Reflecting on current technology, there are two types of analytics products available: on-premise, and self-service. They differ in terms of total cost of ownership, required in-house expertise and their pricing model - shown in Table 5, row 1 and 2). A care provider that opts for an on-premise system – shown Table 5 in row 1 - will need to build in-house IT infrastructure, purchase licenses, and have access to personnel to operate and maintain the system. Reflecting on the results of Chapter 3.1, it is unlikely that a care provider is able to afford an on-premise solution, in particular due to the need for specialized labor. The next scenario is for a care provider to opt for a self-service cloud analytics solution - shown in Table 5 row 2. This option removes the need for in-house infrastructure and licenses. However, it still requires in-house expertise to develop and maintain the analytical models to mine the data into the insights. Although the annual costs of cloud-based analytics platforms are lower compared to the in-house counterparts, they still do not fulfill two of the requirements for the envisioned platform: Firstly, it is unlikely - as the results of chapter 3.1 have shown - that a care provider has access to the required human resources to design and built such complex cost modelling algorithm. Secondly, the platform would still be owned by a single non-neutral ecosystem participant. This latter point also holds true for industry collaboratives and municipalities, for both on-premise and self-service platforms. These two requirements are critical for a cost analytics platform to exists within the specific ecosystem of carefarming - as per the Ecosystem Understanding in chapter 3.1 - and enable the Platform Dynamics explained in Chapter 2.2.

TABLE 5 – DIFFERENCE BETWEEN ON-PREMISE, SELF-SERVICE (D. A. SERVICES, 2015) AND SPORE.BI'S ANALYTICS

Type	TCO / y	IT Infrastructure Provided	Cost Models Provided	Pricing Model	3rd Party Ownership	Data anonymity
On-Premise Platform	100k	no	No	Upfront	No	Not Guaranteed
Self-Service Platform	10k	yes	No	Monthly	No	Not Guaranteed
Cost Analytics Platform	1k	yes	Yes	Monthly	Yes	Guaranteed

To fulfill the key elements extracted from the Ecosystem Understanding created in the problem formulation phase, this study opts to extend the self-service platform offering (as shown in table x - row 2) with cost models and a neutral 3rd party ownership that guarantees the anonymity (table x – row 3). By taking ownership of the cost analytics model (3rd party ownership), the platform lowers the threshold of expertise required to gain the needed cost insights, as according to the director of the industry collaborative - and the care providers themselves - they do not possess the specialized knowledge to do this. Second, controlling the data and displayed insights allows the platform to guarantee anonymized results. And lastly, by being developed by a neutral 3rd party, safeguarding users on the platform from data misuse by both industry collaboratives and care providers. With this, a new platform design is created that could solve the problems of the ecosystem as studied in Chapter 3.1.

For the cost analytics platform to provide the cost insights and industry benchmarks, three so called "pillars" would need to be developed. These pillars are a mental aid to separate the distinct technical functions categories the platform requires, and are shown in Figure 7: Built-In ETL, the Analytics Engine; and the interactive dashboards.

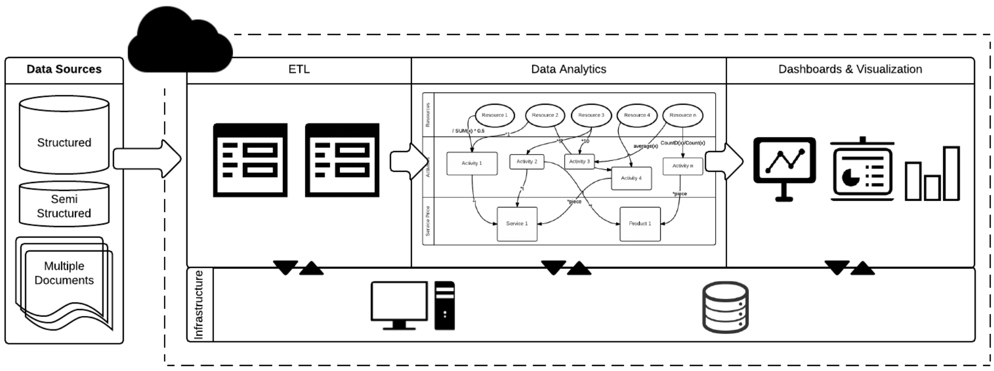

FIGURE 7 - SCHEMATIC OVERVIEW OF THE INITIAL DESIGN OF A COST ANALYTICS PLATFORM

The first pillar - depicted as the top left square of Figure 7 - is the extraction, transformation and loading (ETL) of a care provider's data, here all the data is collected from different data sources (e.g. a CRM and bookkeeping) and processed in such way that it is made ready for use in the analytics models. The second pillar - depicted as the top middle square of Figure 7 - is the analytics engine, this is the environment where analytics models are developed and modular functions are stored for reuse. The third pillar - depicted as the top right square of Figure 7 -are the dashboards, here the results are presented in an accessible and intuitive way in order to be consumed by the SME. These three pillars are supported by a common foundation - depicted as the bottom rectangle of Figure 7: A cloud infrastructure similar to that of a self-service platform.

Each pillar has distinct performance requirements, determined by their functionality, this is resembled in the cloud infrastructure as shown in Table 6. Matching these performance requirements accordingly instead of providing homogeneous resources for all of them, will lower the infrastructure costs as the user does not pay for performance that is not utilized.

TABLE 6 - CLOUD INFRASTRUCTURE CHARACTERISTICS DEPENDING ON SOLUTION PILLARS

Cloud Category	ETL	Analytics	Dashboarding
Main Characteristic	High volumes & Capacity	Performance & Speed	Scalability and affordability
Connectivity	High Speed	Low Speed	Average Speed
Elastic Scaling	Based primarily on Storage	Based primarily on CPU	Based primarily on response times
Load Balancing	Yes	Yes	Yes
CDN	n.a.	n.a.	Optional
Hardware System	High Capacity HDDs for low costs (HDD)	High read/write speeds (SSD)	Sufficient read/write for affordable costs (HDD)
Compute	Average	High	Low
Data Base Storage Type	File Based	High Performance Columnar storage (Cassandra)	Light-weight Relational row storage (PostGre)

The ETL - shown under Table 6 column 1 - runs batch scripts that import all the data when new care provider connects, and incremental updates from there on. The write speed of such an activity can be handled by performance storage such as HDD (Hard Disk Drive) file-based storages, which are less expensive than an SSD (Solid State Drive). The dashboards - shown under Table 6 column 3 - are likely to be accessed on particular times primarily and intermittently. Therefore, the dashboard pillar only needs to temporarily store the displayed insights. As interaction is driven by the human user - in comparison to computer algorithms - which can be handled by performance storage such as HDD. The analytics - shown under Table 6 column 2 - runs continuously, and requires fast read/write type of storage, that HDD cannot provide due to technical limitations such as wear and tear of the read heads, to access temporary calculations and variables to produce the cost insights. Therefore, with regards to analytics, SSD file storage is the only current suitable option.

ETL does not require any particular database to run, it can work with a simple file system, which is the least expensive type of database. The dashboards require more performance due to the interactivity with the human user, therefore a row relational database (such as MySQL or PostGre) suffices. In contrast, the Analytics requires a column relational database due to the higher read-write and calculation speeds (such as Casandra). To further reduce the price-point the platform design will implement open-source technologies like PostGre, and Ruby on Rails.

Finally, placing each pillar on its own elastic scaling group – that is, a group of servers that can automatically scale up or down, depending on the usage load - allows for the independent up and downscaling of resources. Keeping the resource usage minimal when the platform usage is low, but providing sufficient on-demand capacity when users utilize the platform simultaneously. Depending on the activities of the user, the different pillars will be used in different intensities. Jointly, the above design considerations keep the platform development costs as low as possible without compromising its (calculation) capability and scalability. Keeping the costs low is important as shown in Chapter 3.1 given the Ecosystem Understanding of a price sensitive market.

The aforementioned pillars provide a modular technical platform design. However, platform users - like the care providers - need to be able to bring in their data from outside the platform, as shown in figure 15 by the arrow between "data sources" and the ETL pillar. The ETL Pillar is built with the capabilities to consume data from APIs or accept uploaded files in common export formats. This way platform users have a defined interface with the platform and the platform design is modular and connectable as prescribed by the theory in Chapter 2.2.3.

A proof of concept of the platform was developed in excel. Excel was chosen for its visual nature, allowing for input, an illustrative journey through the principles of the cost algorithm, and basic dashboarding. The excel prototype was used in combination with the technical platform to facilitate the interview and discussion regarding the viability of the platform with the IT director of the cooperative.

Interview with the cooperative IT Director

During the interview with the cooperative IT director two main understandings were shared: First, the director held a positive attitude towards the technical design. He stated that care providers user different bookkeeping systems, as they are prescribed and used by their accountants. Therefore, allowing for the upload of common accounting export files, which are mandatory by Dutch law, is a consistent way to allow the care provider and other future users to upload financial details onto the platform. The operational and patient data is currently held in only one system (Qurentis), but that could change in the future as the ecosystem and tariff payouts develop. He suggested this platform could potentially take up that functionality as well, but it being better usage of resources to first focus on the most valuable aspects of the platform first. These points are in line with platform theory that also suggests a Technical Platform Understanding should evolve while maintaining a central position and provide interfaces for other companies / systems. Second, the IT director validated the end-to-end flow of the platform through the proof of concept by filling in operational and financial details of healthcare providers which resulted in credible and results based on his experience with the member care providers.

The two aforementioned points confirm the Technical Platform Understanding at this stage. Together with the previously created Platform Understanding and Platform Dynamics, this study can now continue with the intervention and evaluation phases.

Cycle 1

With an initial Ecosystem- and Technical Platform Understanding created, as well as Platform Dynamics determined, it is time to evolve the cost analytics platform through build, intervention, evaluation cycles as defined in Chapter 2.6. Each part of the cycles (current and future) are represented as follows:

- Building – Lead by the researcher in the role of start-up founder and developer
- Intervening – Lead by the platform users (care providers and industry collaborative)
- Evaluating – Lead by the researcher in the role of researcher and designer

This to study and evaluate the *Evolution Dynamics* discussed in the theory based on the instance case of the cost analytics platform.

Building

To kickstart the first cycle an alpha version of the platform was built. The study starts with an alpha version as per principle 3 of ADR of reciprocal shaping (see Chapter 2.5) by allowing the mutual influence of the organizational context and the IT artifact. From an organizational point of view, the risks of the platform development require spreading for both the industry collaborative and the start-up. To accommodate this, first a Minimum Viable Platform (the alpha version) with a reduced scope is developed for intervention and evaluation with the care farmers. The reduced scope was discussed between the platform users and was determined to be a web-version of the proof-of-concept, a fully manual input, and limited dashboarding capabilities only covering care provider insights.

Intervention

The alpha version is discussed with the platform users (care providers and industry collaboratives) in the form of a focus-group session. Focus-groups are chosen as a methodology because they allow for discussion and mutual influencing among the participants, which fits well with the prescribed principles of ADR of **reciprocal shaping** and **mutually influential roles** (Chapter 2.5). This first focus-group consisted of the cooperation director and the five SME members of the “innovation group”, and were chosen for their close collaboration in providing input and details during the Problem Formulation phase (Chapter 3.1), as well potentially becoming early users part of the ecosystem of the platform. A confirmation of the value of the platform from this group and their adoption of the platform is a strong first step in adding marquees users that can facilitate the adoption of future users.

The focus-group session consisted of three parts. *The first part* is focused on the input of the data. Through self-testing by the researcher the required time clocked was 45 minutes. Assessing that the care providers would require some more time due to their lower IT proficiency compared to the researcher a time allowance of 60 minutes was estimated. *The second part* is focused around the consumption of the results as displayed through the dashboards. A time allowance of 5 minutes for a general explanation and 10 minutes one-on-one time between a participant and the researcher was anticipated. *The third part* is focused on a joint discussion by all participants, covering their (positive and negative) experiences with the platform and formative suggestions or requirements for the further continuation of the platform development. Communication around the focus-group planning revealed that participants were willing to participate for 3 hours with some potential delays. As such the remainder of 60 minutes was estimated for the third part.

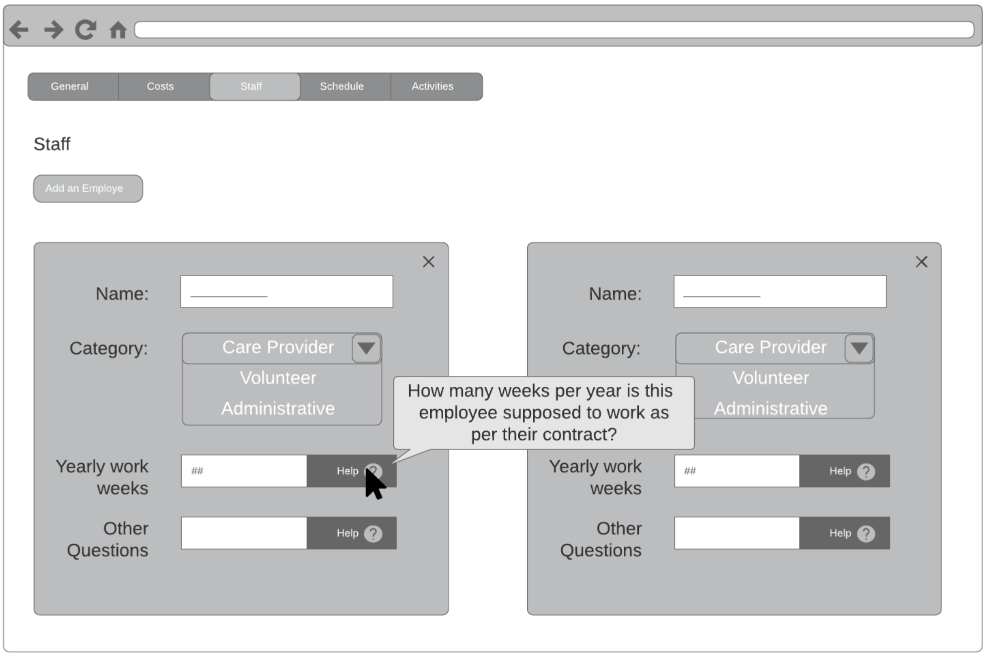

FIGURE 8 – DATA ENTRY FOR THE ALPHA VERSION OF THE COST ANALYTICS PLATFORM

In the first part all participants, except the collaborative director, filled in their data through a web-interface, Figure 8 shown above is an example of the type of data the care providers needed to fill in. The data entry consisted of five different pages, each with at least form inputs, accompanied by a label and a more detailed explanation accessible through a nearby help button. The filling of data took between 80 to 90 minutes for all the participants to finish – 30 minutes longer than anticipated. All participants verbally expressed it to be perceived as long and cumbersome. On hindsight this could have been prevented, as the difference in IT familiarity between the care providers and the researcher is more in the range of multiples (e.g. 2x) rather than a percentage (25% more), as a learning point further time estimations should allow for a multiple of time, instead of simply rounding up to the nearest hour. They shared that reading every input field, understanding exactly what was being asked, and then finding this information for entry was mentally taxing and repetitive. It was not one particular element that took long, but rather the large number of fields to fill in.

In the second part all participants they participants consumed the results presented in the form of a web-dashboard. By hovering over elements the care-provider would see the cost in euros, and clicking on on elements allowed for filtering and drilling down. All participants were able to access the dashboards, which showed to work correctly on all different laptops of the participants.

Mutual learning (principle 4) between the participants took place by when the researcher passed by each participant for a short unstructured discussion. Requesting the participants to explain what his or her care costs results, if these results seemed plausible, and if there were any notable results. All care providers were able to find their care costs and found the results plausible and within the margin of expectation. However, all participants noted the lack of benchmarks in their results. As a result, the care providers placed their laptops next to each other and toghether with the industry collaborative director started comparing results, notable differences and the potential causes for them.

In the third part of the session the industry collaborative director and care providers discussed their experience and – through authentic evaluation - recognized anticipated and unanticipated events. It was unanimously anticipated that the input would still be long and tedious, and experienced negatively. It was unanticipated that the current state of the dashboards (without benchmarking) would already provide enough insights for comparative discussions. Furthermore, the care providers expressed an unexpected positive experience exploring their cost structures. In particular how the costs and activities were related to each other, allowing them to better understand the financial consequences of care activities. One example: One care provider was – through exploration – able to come across an unexpectedly high costs for clothing linked to her children care services. Knowing this, she was able to identify the cause being the purchase of expensive plastic boots for the children to wear at the farm.

Evaluation.

In continuation with the ADR cycles and principles, this study finalizes the evaluation phase through the principle of authentic evaluation. In particular of the summative form reflecting on *evolution theory.*

Two points on selective (dis)advantage were observed. Firstly, the lack of an automated data input method negatively impacted the usage and value of the platform. Secondly, the cost insights induced positive reactions from the care providers. Two changes (mutations) are suggested to aid the adoption of the platform: The addition of automated data entry, and the addition of benchmark insights.

The addition of automated data entry and benchmarking could increase the selective advantage of the platform in the eyes of the industry collaborative and care providers and help increase the adoption through network effects (e.g. more care providers on the platform results in more meaningful benchmarks).

Cycle 2

Building

To start the second cycle a beta version of the platform was build. Similarly, as in the build phase of the first cycle, only incremental improvements were developed to spread the organizational investments and risks into the IT artifact (as per principle 3 – reciprocal shaping). With the results of the previous cycle and allowing for mutual influence of both the IT artifact (platform) and the organizational context, two key improvements to the platform were developed.

The first improvement regards the data entry. Now care providers can upload a bookkeeping export file to the platform (which all bookkeeping systems can export by law). The care provider will then be shown a pre-filled allocation of the cost elements. He can then accept the auto-allocation, or drag-and-drop elements into the corrected place.

The second improvement regards the addition of basic benchmarking. When accessing the cost insights in the form of web-dashboards, the platform user will see his results next to the benchmarked average of all the users combined. Figure 9 shows an example of such dashboard, where the black bar represents the market average (bechmark), and the light blue bar the result of the platform user.

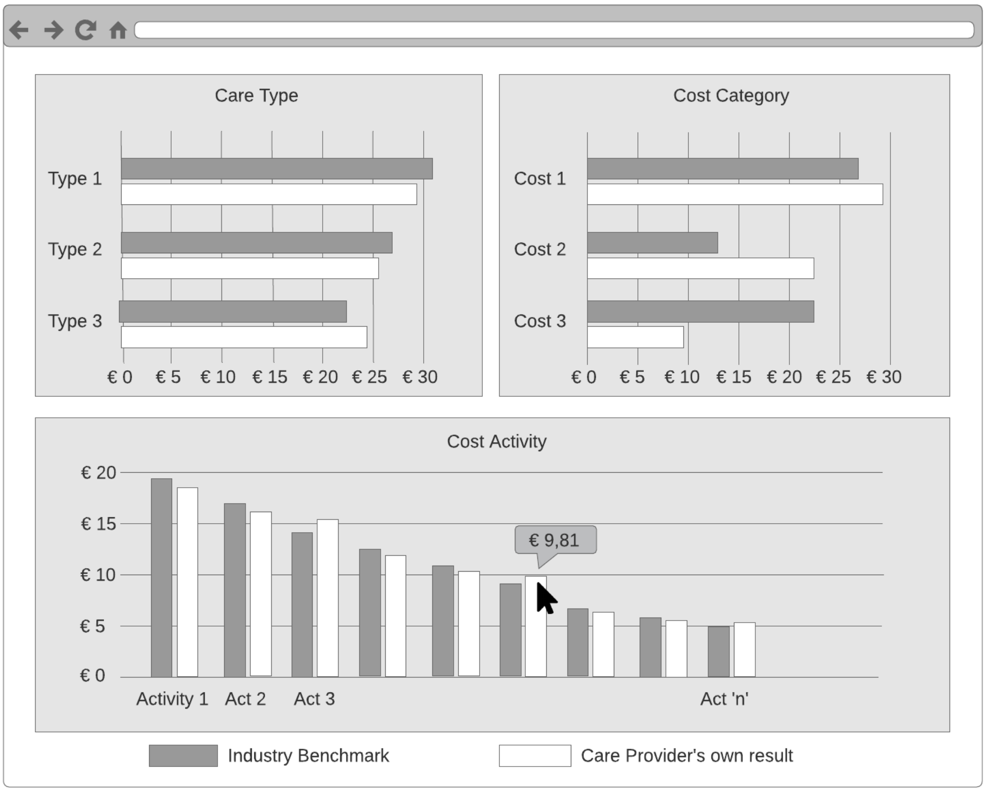

FIGURE 9 - SECOND TRIALS INSIGHT DELIVERY THROUGH DASHBOARDS

Intervention

The beta version is discussed with the platform users (care providers and industry collaboratives) in the form of a focus-group session, and chosen by the same reasoning and criteria as the firs cycle. This second focus-group consisted of the cooperation director and ten new care providers. The selection method, criteria and goal are as explained in Chapter 2.6 – Methodology & operationalization.

The focus-group session consisted of three parts, similar to the first cycle. *The first part* is focused on the input of the data. Through self-testing by the researcher the upload and operational data input time was 15 minutes. Assessing that the care providers would require some more time a time allowance of 30 minutes was estimated. *The second part* – of 60 minutes - is focused around the consumption of the results as displayed through the dashboards. A time allowance of 5 minutes one-on-one time between a participant and the researcher was anticipated, allowing for some contingency. *The third part* is focused on a joint discussion by all participants, covering their (positive and negative) experiences with the platform and formative suggestions and requirements for the further development of the platform. A final 60 minutes are reserved for this.

The focus group was attended by eight care providers and a representative of the industry collaborative. One care provider cancelled beforehand and another cancelled last minute due to unforeseen work circumstances.

In the first part all participants - except the collaborative director – uploaded and filled in their last month's data through the web-interface. As per reciprocal shaping (principle 3), all eight care providers had received an export file of their bookkeeping from their accountants. Six via e-mail and two via a usb-drive specifically. The file upload worked for all participants, and took under 5 minutes to be accomplished. The operational data input took between 20 and 30 minutes, depending on the participant. During a short talk with the care providers (as part principle 5) whom finished faster they shared that the input was perceived as "tiring" and requiring a lot of "focus" as to not make any mistakes. This statement was further affirmed by participants finishing later.

Mutual learning (principle 4) between the participants (including the researcher) took place when the care providers encountered an operational input that allowed for a blank field, or fill in zero. Blank or zero are not equal in meaning on the digital cost analytics platform. An employee that worked zero days is telling the platform that the employee exists and could work more days in the future. An empty employee field means there is no such employee to start with. Furthermore, there can be costs linked to an employee that has not worked, like training costs, sick-pay, or overhead. The care providers that did not know this learned the difference, and the researcher gained a better understanding of the level of clarity and simplicity desired by the platform users.

In the second part all participants consumed the results presented in the form of a web-dashboard. The working of the web-dashboard is identical to the dashboard used in Cycle one with one key distinction. Now the care provider can also see the average result of all 13 platform users (five from the first cycle and eight from the current) as a benchmark. Similar to the first cycle, all participants were able to access the dashboards, which showed to work correctly on all different laptops of the participants. The participants were able to explain what his/her care costs results, found the results plausible, and had no unexpected experiences pointing to errors in the platform. In contrast to the first cycle, the participants did not experience lack of benchmarking and did not compare results one-on-one with each other. Instead the participants spend the hour exploring their cost structure and double-checking interpretations with the researcher.

In the third part of the session the industry collaborative director and care providers discussed their experience and – through authentic evaluation - recognized anticipated and unanticipated events. The anticipated event is how the cost platform influenced the organizational context of the care provider. All care providers discussed the export file with their accountants. Namely the format required, in what interval, and what the potential added costs could be. They all shared to have concluded that the export was simple and could be provided at no extra costs on a monthly basis by their accountants per e-mail.

The un-anticipated events surfaced through the mutual influence of the focus-group participants (principle 4). The care providers re-iterated the “draining” experience of requiring deep focus for 20 to 30 minutes. Given the input is for a cost analytics platform, they wanted to fill in everything correctly and avoid mistakes that would impact the results. Furthermore, the participants learned from each other’s behavior that once the input phase is finalized, they primarily look at salient elements and comparisons with the benchmark.

Subsequently, the researcher observed and compared the different individual results and concluded that much of the operational data input required only amounts to under a few percentages of the costs across all eight care providers. The effort for those input fields is disproportionate to the added accuracy of the calculation. Further discussion with the participants helped the Industry Collaborative learn that – contrary to its initial belief - they can use less accurate results to aid in the tariff negotiation. This, due to the added context and exploration provided by the platform through the slicing, filtering and cost categories, compared to a static number. The care providers acknowledged that a reduction of 50% of the operational input outweighs the loss of 5% accuracy in the cost’s calculations, considering the ease of use gained.

Evaluation

As in cycle one, in continuation with the ADR cycles and principles, this study finalizes the evaluation phase through summative authentic evaluation (principle 5) reflecting on *evolution theory**.***

Two points on selective (dis)advantage were observed. On one hand, the current time required to fill in the operational input negatively impacts the user experience of the platform, increasing the effort to adoption and thereby seen as a selective disadvantage. On the other hand, the rich context provided on the cost insights through the web-dashboards and its cross-section and filtering has shown to provide value to the platform user above their initial expectation. One could argue this to be an indirect selective advantage point for the platform, as existing users are more likely to positively express themselves about the platform. However, potential new users are not aware of this benefit – as they have not experienced this unexpected exploratory value – before their adoption of the platform.

The above suggests a mutation, as the ease-of-use of the operation input needs improvement to counter the selective disadvantage created. In terms of adoption, there are now 13 users on the platform. However, it is unknown if they will continue to use the platform.

Cycle 3

Building

To start the third cycle a beta v2.0 of the platform was build. As in the build phase of the previous cycles, this build phase develops improvements addressing the mutation suggestions posed in the previous cycle's evaluation. These improvements are done in an incremental manner to spread the organizational investments and risks into the IT artifact (as per principle 3 – reciprocal shaping). Two key improvements to the platform were developed.

Firstly, the operational input experience was improved by reducing the number of required input fields. The operational data required from the care providers cannot be imported in an automated manner, with some information purely residing in the knowledge and experience of the platform user. This organizational context influences the mutation of the platform towards reducing the number of input fields required, as smallest incremental development to the platform to improve the platform user's experience (Principle 3). Through an analysis of the cost data of the current 13 platform participants, the researcher identified a handful of cost categories that each attributed to less than 1% of the total costs of care. Given the cost of care per daypart of the users ranges broadly between € 20 and € 30, these categories jointly attribute under € 0,60 cents in total (on average). However, they attribute about half of the total input fields required, therefore taking around half the required time to fill in (assuming a somewhat equal time per input field). A conference call was planned with all platform users, out of which 7 attended (including the collaborative director). The above point regarding reducing the input time at the cost of some accuracy was discussed and unanimously accepted (Principle 4 – Mutually Influential Roles).

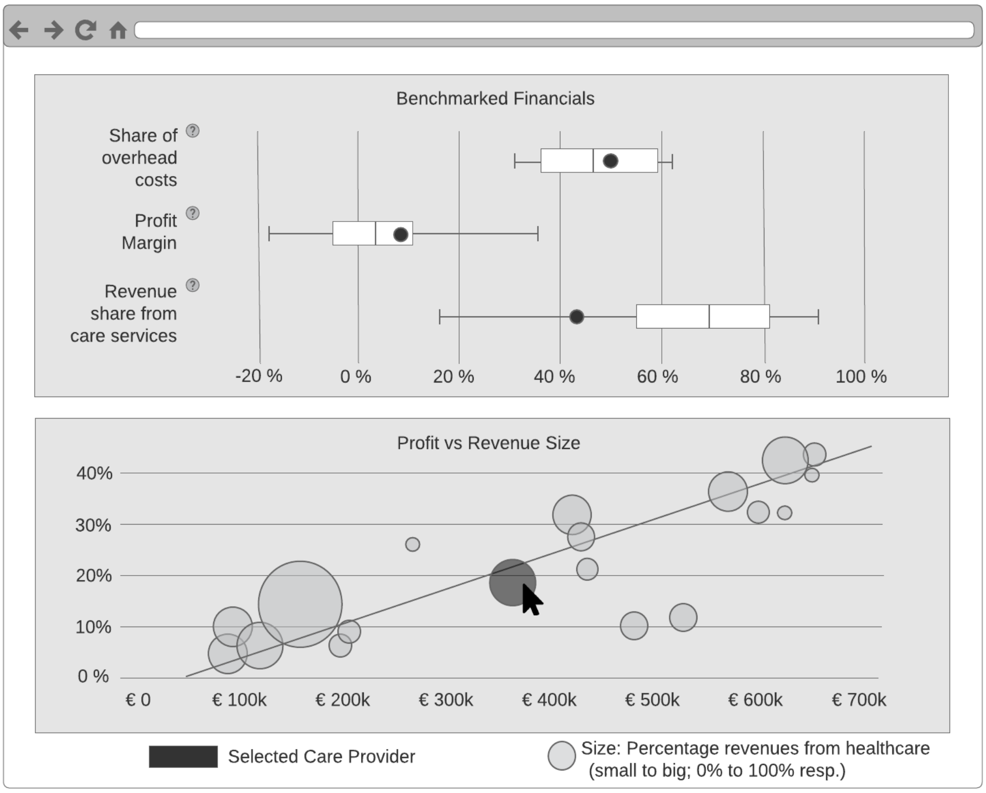

FIGURE 10 – EXAMPLE BENCHMARK DASHBOARD FOR INDUSTRY COLLABORATIVE AND CARE PROVIDERS

Secondly, a more detailed benchmarks dashboard was added. The industry collaborative requested an own account and dashboard, as to start discussing how to use the platform internally and how it would impact their organizational processes. This reciprocal shaping (Principle 3) resulted in the addition of the dashboard as shown in Figure 10 above. In the top graph different KPIs (e.g. care profit margin) are displayed in a horizontal box-plot. The values correspond to the usual box-plot points. In adition a color-coded circle is added for the current selected care provider's value. The most important function of the bubble plot graph is for the industry collaborative to be able to select a different care provider. Each bubble represents a care provider on the platform and his cost data. Clicking on a different bubble would highlight it and update the top graph results according to the newly selected care provider. A care-provider however, only sees his own data and cannot select other bubbles than his own.

Intervention

The beta v2.0 was discussed with the platform users (care providers and industry collaboratives) in the form of a focus-group session, and chosen by the same reasoning and criteria as the previous cycles. This third focus-group consisted of the cooperation director and ten new care providers. The selection method, criteria and goal are as explained in Chapter 2.6 – Methodology & operationalization.

The focus-group session consisted – as the previous cycles - of three parts. *The first part* is focused on the input of the data. Through self-testing by the researcher the upload and operational data input time was 5 minutes. Assessing that the care providers would require some more time a time allowance of 15 minutes was estimated. *The second part* is kept identical to previous cycles (60 minutes), as it has shown to provide sufficient time for insight exploration and consumptions, but not too long and strenuous for the participants. *The third part* is, as the second part, identical to the previous cycles (joint discussion). A final 60 minutes are reserved for this.

The focus group was attended by eight care providers and a representative of the industry collaborative (the director). Two care providers cancelled beforehand. One care provider is represented by a couple (husband and wife) and is counted as one care provider / user of the platform.

In the first part all participants - except the collaborative director – uploaded their last month's data and filled some operational inputs manually through the web-interface. The file upload worked for all participants and took under 5 minutes to be accomplished. The operational data input took between 5 and 10 minutes, depending on the participant. No intermediary discussions were held due to the short time-window between the first and last platform user finalizing the input phase.

In the second part all participants consumed the results presented in the form of a web-dashboards. An example of such dashboards was shown in Figure 10 above. In agreement with previous cycles, all participants were able to access the dashboards, which showed to work correctly on all different equipment of the participants. The participants were able to explain what his/her care costs results, found the results plausible, and had no unexpected experiences pointing to errors in the platform. However, in contrast to the second cycle, the participants did compare results one-on-one with each other (as during the first cycle). During discussion about this behaviour (principle 4) the participants shared that it helped them understand the results better when they could see different examples. They expressed that they understood the box-plots as explained by the platform, but it made things more contextual to see a few examples.

This (third) cycle was the first time the collaborative representative could access dashboards and the benchmark data from the care providers. She spent about 45 minutes exploring the dashboards, the information and context provided and simply "browsing" through the platform to get acquainted. The sub-sequent 15 minutes she spent trying to gain an initial feeling of an industry assumptions the collaborative was operating on: Do larger (more revenue) care providers have a higher profit margin due to economies of scale? She tackled this by selecting "big" bubbles (the bigger the bubble, the higher the total care revenues), and looking at the changes in the the dashboards and taking notes. In a conversation with the researcher she shared that through the platform she gained insights that suggest revenue size does not seem to correlate with profit margins, which could point to little economies of scale (i.e. being a bigger care provider does not help save costs, increasing the profit margin).

Furthermore, one of the care providers saw his costs were mostly around the third quadrant. He acknowledged this, as he stated that he provides high quality care using quality resources, and thus expected his costs to be high on the benchmark. A clarifying example: Most care providers with services for children would have back-up indoor activities for literal rainy days, these include arts and crafts. Usually the costs are crayons, paper and other basic supplies, where in this particular care provider's case the costs were actual pottery equipment and game consoles (nintendo).

In the third part of the session the industry collaborative director and care providers discussed their experience and – through authentic evaluation - recognized the following points during the focus group: One, it was summed that the analytics results require the knowledge of a care provider - or at least someone with knowledge of day-to-day care operations – to interpret. This knowledge provides the needed context to interpret the results. Two, it can be helpful to sit next to each other and compare results, this form of peer to peer learning helped the platform users better understand their own results and implications thereof. Three, the participants noted that they understood the platform can only help pin-point possible cost-improvements, however it does not know or share how these improvements can be implemented. Knowing your animal care costs are high is one thing, but actually figuring out what you can do to improve it will require more than the cost platform can provide. One formative suggestion was to allow and stimulate the discussion around certain topics on the platform (e.g. a forum) to enable care providers to exchange knowledge on how to do things better and/or more cost efficiently.

Evaluation

As in the previous cycles, this study finalizes the evaluation phase through summative authentic evaluation (principle 5) reflecting on evolution theory.

From the perspective of *selective advantage* three points were observed during this cycle. Firstly, the comments made by the industry collaborative representative suggest an advantage for the platform through the ability to explore hypotheses. Secondly, no noticeable selective advantage is observed through improved onboarding. In cycles one and two the participants suggested mutations (during the formative evaluation) that could improve the onboarding, however in cycle 3 no explicit positive feedback is provided regarding the onboarding. Third, a same-sided network effect was observed when care providers compared and discussed the results provided by de cost platform. Furthermore, participants engaged in peer-to-peer learning and discussion facilitated by the platform's dashboards. A *Mutation* was suggested by the care providers. In platform terms they expressed the need to lower the interaction and knowledge exchange threshold care providers currently experience. This to help them take actionable steps on the insights gained from the cost platform. From an *Adoption* perspective, the platform now hosts 21 care providers (the 5 initial innovators, 8 care providers from cycle 2, and 8 care providers from cycle 3) as well as one industry collaborative.

Cycle 4

The fourth and final cycle takes a different form. The evolution of the platform through the cycles reached a point where future mutations are primarily focused on entirely new functionalities and value (e.g. a forum), or small functional improvements of the existing features (e.g. more options for filtering for industry collaboratives). Therefore, as described in Chapter 2.6 – The methodology, a questionnaire is used when the platform mutations are low.

Building

The start-up and the industry collaborative have been investing in the development of the platform. To reduce the risk of potential further investments in the platform, a better understanding of its likeliness to reach critical mass was needed by both parties. Through both mutually influential roles, and reciprocal shaping between the IT artifact and the organizational context, the researcher in the role of start-up founder and the collaborative director decided that the upcoming care providers symposium hosted by industry collaborative would provide a good stage to evaluate this.

For this purpose, the researcher – in the role of platform designer - built a presentation showcasing the cost analytics platform (referred to as CostDigest in the presentation and questionnaire) to present at the symposium event. Given the fast-paced organizational context of the symposium, there would be 30 minutes for the presentation, and only 2 or 3 minutes for attendees to fill in their questionnaire before the next event on the agenda would start. Given the limitations, the parties involved agreed on three questions, shown in Table 7 below.

TABLE 7 - QUESTIONNAIRE DURING SYMPOSIUM

Question Code	Question	Type
Q1	Will CostDigest add value to your business on a monthly / quarterly basis?	1 (not at all) to 5 (very much) scale
Q2	Is CostDigest simple to use for you?	1 (not at all) to 5 (very much) scale
Q3	How much are you willing to pay for CostDigest? (eu/m)	Open number in Euros per Month

Looking at Table 7, Q1 is intended to evaluate if the care providers perceive to receive value from the platform; Q2 is intended to evaluate if the care provider believes he/she can use the platform succesfully to gain the value provided; Q3 is intended to evaluate the financial viability of the platform, as there are costs to technically develop and maintain the platform. Furthermore, it was chosen to keep the questionnaire anonoymous as to limit a socialy desirable answers bias induced by the context of the symposium.

This study chose a 5-point Likert scale for Q1 and Q2, and an open numerical answer for Q3 as these types allow the researcher to acquire an overall (significant) measurement of sentiment around the cost platform topic through t-tests.

Intervening

The intervention takes place during the Boer en Zorg symposium. Here attendees are required to register for a “talk” or “workshop”, which last either 30 minutes or 60 minutes. The cost platform was placed on the event options under “Better insights into your care costs and find opportunities to reduce care costs, with CostDigest”.

The intervention itself is split in two phases. In the first phase a central presentation of 30 minutes is given regarding the platform. The contents of the presentation were prepared as follows:

1) 5 min - Introduction to the problem: The need for better cost insights for tariff negotiation and improvements in operations.
2) 10 min - Overview of the platform: From how to get started, to using the dashboards
3) 5 min - Example Insight 1: Childcare barely enjoys economies of scale
4) 5 min - Example Insight 2: Impact of an on-site farmer’s shop
5) 5 min - Q&A + request to fill in questionnaire

In the second phase the attendees fill in the questionnaire which has been placed under their seats (including a pen) beforehand.

The first phase started 5 minutes late due to an overrun of the previous talk. Furthermore, the researcher was requested to not pass the 25 minutes mark, as the tight schedule could not afford further stacking of overruns. As a result, the presentation was held as planned, however no Q&A session was held at the end. The researcher chose to cut the Q&A instead of one of the examples as previous cycles showed that contextual and actual situations helped the care providers understand the platform better. Furthermore, if the researcher managed to go through the presentation a bit faster, sometime could potentially be gained for Q&A at the end.

The second phase was chaotic, as attendees moved in and out of the event room. The researcher was able to collect 45 filled in questionnaires, leading to the results as described below and Figure 11. The price average for all 45 entries was € 12,10. The questionnaire results shows the questionnaire results in plot format. The horizontal axis plots the value of Q1: Will CostDigest add value to your business on a monthly / quarterly basis? (Table 7). The vertical axis is used to plot the value for Q2: Is CostDigest simple to use for you? (Table 7). Each possible combination of Q1 and Q2 are plotted at Q1;Q2 coordinates as a bubble where: The label represents the average of Q3 (How much are you willing to pay for CostDigest - Table 7) for that point, and the total count. For visual aid the average price is also represented in color coding, from red (min, € 0) to blue (max, €16,25); and the bubble size is proportional to the count. For a total population of 120 care providers, a sample of 45 entries corresponds to an error margin of 11.6% in a reliability interval of 95%. This error translates into a bit more than a single euro in the pricing estimation, and will not be of impact to future financial decisions.

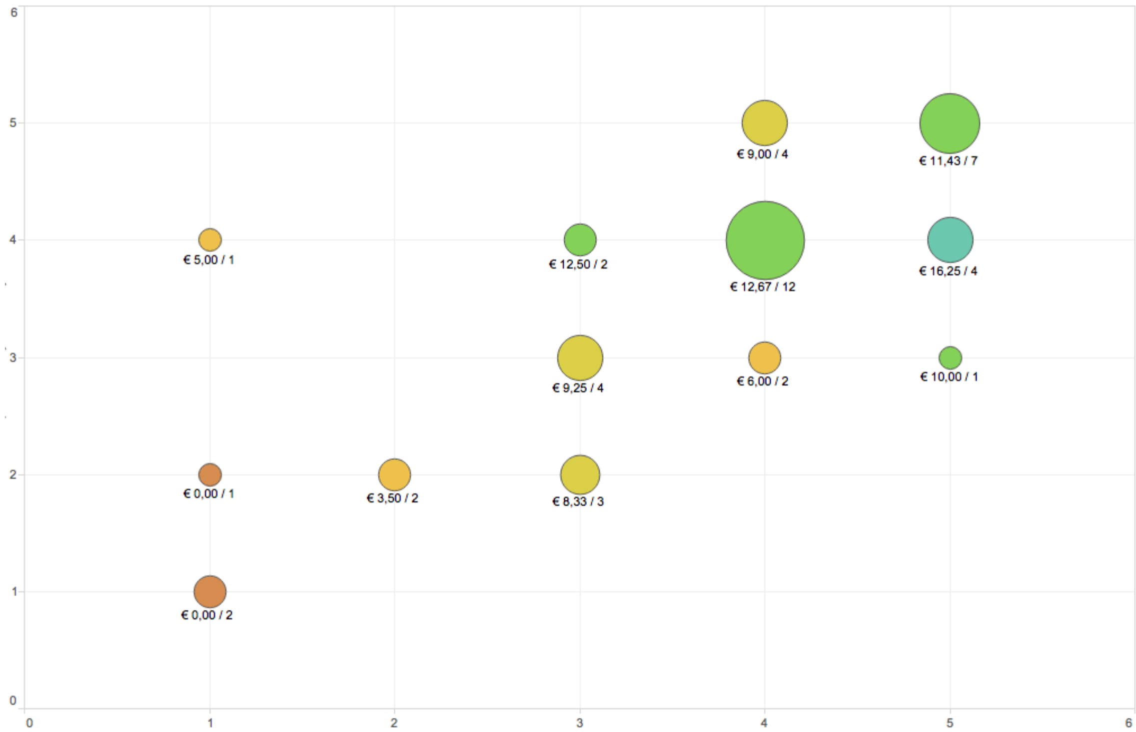

FIGURE 11 – QUESTIONNAIRE RESULTS. LABEL FORMAT: [AVERAGE PRICE] / [NUMBER OF ENTRIES]. COLOR REPRESENTS AVERAGE PRICE AND SIZE THE NUMBER OF ENTRIES. ERROR MARGIN 11.6% FOR 95% RELIABILITY INTERVAL FOR A POPULATION OF 120 MEMBERS.

Furthermore, an ANOVA for two groups is calculated. Group "Negative" comprised of all results with a Q1 or Q2 lower than 3; and group "Positive" comprised of all results with Q1 or Q2 bigger than 3. The neutral votes (N = 4) of Q1 = 3 and Q2 = 3 are removed from this analysis as they can arguably be allocated to either group. Table 8 shows the data descriptives; Table 9 shows that the Homogeneity of Variance is not significant; the ANOVA results are $F(1,35) = 19.149$, $p < 0.001$; confirming the expected, that a positive inclined care provider is willing to pay more to use the platform.

TABLE 8 – DATA DESCRIPTIVES OF QUESTIONNAIRE RESULTS

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Negative	10	3.70	3.974	1.257	.86	6.54	0	10
Positive	27	12.33	5.724	1.102	10.07	14.60	5	25
Total	37	10.00	6.536	1.075	7.82	12.18	0	25

TABLE 9 - HOMOGENEITY OF VARIANCE RESULTS OF QUESTIONNAIRE DATA

		Levene Statistic	df1	df2	Sig.
Willing to Pay (in €)	Based on Mean	1.352	1	35	.253
	Based on Median	.519	1	35	.476
	Based on Median and with adjusted df	.519	1	29.278	.477
	Based on trimmed mean	1.242	1	35	.273

Evaluating

As in the previous cycles, this study finalizes the evaluation phase through summative authentic evaluation (principle 5) reflecting on theory. The goal was to evaluate the commercial feasibility for reaching critical mass, given the current platform and ecosystem.

The questionnaire results suggest that the majority of the care providers find that the analytics solution is helpful (a selective advantage), and perceive it as simple to use (selective advantage).

60% of the care providers are located in the top-right quadrant of Figure 11 (27 out of 45), and have in general terms a positive disposition towards the cost platform. And 22% (10 out of 45) are negatively inclined. The ANOVA test confirms the expected, that positive inclined care providers are willing to pay more to use the platform, compared to negatively inclined ones.

With these results the researcher in the role of start-up founder, and the collaborative director held a meeting to discuss the further development of the platform. By extrapolation of the development costs of the previous cycles, it was estimated that running and mantaining the cost platform alone (excluding sales costs, overhead, and all other business costs) would amount to at least € 44,000 per year. For the current ecosystem size (120 care providers and 1 industry collaborative), this would translate to a price of about € 30,- per month.

This price is 3x to 6x what positive care providers are willing to pay – as suggested by the questionnaire. Given the frugal nature of the ecosystem, it was deemed unlikely (by the director and the researcher in the role of start-up founder) for the platform to be adopted by the care providers are willing to adopt a platform with a price point several multiples above their payment willingness. The platform's economics in it's current form constitute a strong selective disadvantage.

If the care provider is not willing to join the platform for a certain pricepoint, and this point cannot be lowered given the platform was already designed to be as cost effective as possible, then only strategy left is for the care provider to be subsidized (see Chapter 2.2.2). The director of the collaborative added that in a time of governmental cost cuts, it was unlikely for the municipalities to help subsidize the platform. Therefore, given the current ecosystem size, the only form of continuation towards critical mass is for the industry collaborative to subsidize the adoption of it's members. The industry collaborative had purchased 30 accounts at € 30 euro per month for the first three cycles, effectively subsidizing € 17,90 per month per account, or 60% of the costs (taking the average willingness to pay from business owners of € 12,10 per month). However, the industry collaborative expressed to not possess more financial resources to support this sustainably.

A ‘back-of-the-envelope’ calculation was discussed between the parties: On ballpark 9 of the 45 questionnaires gave at least a score of three or lower. Assuming everyone else would adopt the platform at a price of 15 euros per month (both very positively biased assumptions), would require 300 care providers on the platform, and around 375 care providers in the ecosystem. As such, the next possibility for continuation of the platform would be to position it within a bigger ecosystem by attracting other industry collaboratives and their member care providers. However, these collaboratives were only able to meet and potentially participate near the end of the calendar year due to their focused efforts to adopt the new legislations. This delay for continuation would deny the cashflow requirements of the start-up developing the platform, and was deemed too high an opportunity cost by the researcher in the role of startup-founder. As a result the continuation of the cost platform was canceled.

3.3 Reflecting and Learning

In this stage the study looks at the *Ecosystem*- and *Technical Understanding* and *the Platform Dynamics* learnings acquired during the BIE cycles. Furthermore, it reflects in peer-review methodology on the Ecosystem- and Technical Understanding through external expert opinions (for details on the sourcing and criteria see Chapter 2.6).

Reflecting on the *evolution dynamics* of the cost platform throughout the cycles, this research observed several mutations. Two mutations regarded the improvement of the data entry (ETL pillar as shown in Figure 7). One, the addition of more automation for the data entry stage; and two, the reduction of non-automatable inputs required for the cost analytics. Two more mutations regarded the improvement of the dashboarding (interactive dashboarding pillar as shown in Figure 7). Firstly, the addition of basic benchmarking data. (versus the average), and subsequently the addition of more advanced and contextual benchmark dashboards (including minimum, maximum, quartile and median values) for both care providers and the industry collaborative. All the mutations focused on the user experience - where the most incremental improvement could be gained - driven by the interplay and reciprocal shaping of mutual influence between the IT artifact and the organizational context (principle 2). As a result, no mutations took place at the core (analytics) of the platform.

The adoption of the platform was driven by the focus groups attracted by the industry collaborative. Theory suggests low adoption rates as long as mutations are frequent, however, increasing the ecosystem size counters this effect somewhat. Reflecting on the expert's panel firth suggestions (see below sub-chapter External Validation) to address horizontal (cross-industry application) markets, some overlap is observed.

The starting *platform dynamics* observed can be split in same-sided positive network effects, and cross-side network effects. The same-side network effects regarded care-providers adding their data to the platform, thereby improving both the benchmarks and the accuracy of the results. This on its turn would make the platform more valuable for both care providers (same-side) and the industry collaborative (cross-side). The main cross-side dynamic was the platforms' neutral position, lowering the threshold to share sensitive information in an anonymous way, for the entire niche industry to benefit.

Through the cycles this study observed that the threshold to share data was lowered – as previously care providers did not do so, and through the focus groups a total of 21 care providers (five from the first cycle, eight from the second, and another eight from the third cycle) did share their sensitive data – and benchmark quality did improve with the further addition of care providers. However, the accuracy of the algorithm was reduced as a consequence for further lowering the threshold for data sharing. Specifically, in Cycle 2 the researcher in the role of platform designer opted to reduce the number of manual inputs required, as the estimated gain in selective advantage would be higher that the loss through lowered algorithmic accuracy.

All these dynamics were observed and reflected within the initial ecosystem of 120 care providers and their industry collaborative.

The initial *ecosystem understanding* built up by this study showcased a niche healthcare industry in need for the specific insights of their care costs. This insight was required to have more pricing context and quicker cost-evaluations during tariff negotiations with the local municipalities. However, reflection upon the intervention phases of the four cycles uncovers that the care providers have a deeper lack of insights in costs. Their questions during the intervention phases showcases how these care providers request help to transform the gained cost insights into actionable business efforts. The platform transitioned from a singular focus of providing insight into the costs for negotiation purposes, into a more general cost exploration platform to reduce costs. A mutation was requested by these care providers to enable them to collaborate and share how gained cost insights were transformed into actual cost reductions by fellow care providers (cycle 3). Such a change would re-position the platform within the ecosystem in a more central role, and would intrude into the current role and responsibility of the industry collaborative by enabling care providers to self-organize and knowledge share. No rallying of complementors was observed throughout the cycles by any of the participants. The industry collaborative and the care farmers did not invite or requested other companies to join the platform, and the start-up did not play an active role in rallying complementors for the platform either.

From a *Technical Understanding* point of view two innovation elements are of importance. On one hand the innovation of connectors, and on the other hand the innovation of the core of the platform. Reflecting on the connectors this study observed consistent innovation throughout the cycles: In cycle 1 – there was no connector to link the cost platform with bookkeeping systems (complementors); cycle 2 added a semi-automated connector; and in cycle 3 a fully automated connector was introduced. However, no innovation at the core (the analytics pillar as shown in Figure 7) was observed.

A modular design was not implemented. As discussed in Building - Cycle 1, all the components were built together as part of the MVBP. This, as splitting up the primary components required significantly more investment. And no long-term investments in industry coordination activities were observed.

During this study, the researcher observed the guided emergence of the cost analytics platform. Initially developed through a significant pre-commitment (from the start-up) *growth strategy* to deliver a proof-of-concept to the platform users. Subsequently the industry collaborative aided in the pre-commitment and joined as a marquee user as an attempt to reach critical mass. By first involving an influential member from one side of the platform (the industry collaborative), and subsequently leveraging this to get sufficient involvement from the other side (care providers) - as observed by the ongoing addition of care providers throughout the cycles. One notable instance of marquee influence is the first cycle, given the platform could only provide marginal value by design. The benchmarking value is non-existent at that stage, and the exploratory value of the interactive dashboards was still unknown to the care providers. A final attempt to swift towards a two-step growth strategy by attracting other industry collaboratives with the newly added care providers was unsuccessful.

External Validation

Discussions regarding the platform were held with external experts based on the problem formulation and subsequent cycle results. These individuals include industry veterans, venture capitalists, CEOs, board members of various companies, professionals in Legal, Strategy and Management consulting. The discussions between the researcher and the expert advisor were unstructured and primarily based on the advisor's knowledge and expertise. The main points of each discussion have been separated into the strengths and weaknesses of the platform from a technical and ecosystem understanding. The full database of the interview results can be found in the Appendix 6.5.

Feedback of the external panel can be grouped in five primary points. Firstly, a board member of the Benelux IEEE society, noted that executing these kinds of test cycles could be very short lived. By definition they require co-development and significant time investment from all the parties involved. This, in his experience, only occurs when there is considerable external pressure acting on the industry or participating companies that provides a certain sense of urgency. This can lead to the industry being economically unhealthy (low amounts of free cashflow). As a result, the company is likely lacking the financial means required to finish a project, or to de-prioritize the project. Either potential outcome is bad for the participating parties, and the likelihood of such outcome is high in his experience. Reflecting this on to this study and the care farming industry, the researcher observes that shortly after the fourth cycle concluded, the new legislation was passed by the central government of The Netherlands (called WMO, Wet Maatschappelijke Ondersteuning). At this point the participating industry collaborative expressed the lack of budget to continue the platform development, and other industry collaboratives expressed a lack of priority for the platform.

The second point questions the degree care providers are able to see analytics, or insights, as a separate product or service. Other evaluators wondered how a care provider would be able to distinguish between common reporting (visualizing their data) and insights (new data delivered in visualizations). They are both delivered through the same visual manner, and in both cases their origin is somewhat a "black box". Most software is providing at least basic reporting on the stored data. How it is expected from them to understand the difference between the available reports, and the visualized insights? Reflection on the BIE cycles further acknowledges this point. Care providers made parallels and analogies to their bookkeeping systems during the intervention phases of cycle 2 and 3 in an effort to understand the platform.

The third point shared by the experts regards overcoming a small company's tendency for short-term orientation. A change of mentality in to more long-term objectives and measures is key to understand the value of analytics. To their experience, smaller companies – like the care providers participating in the platform - are usually concerned with business as usual. Commonly thinking in shorter time-spans than required to reap the benefits of acting upon the gained insights. Insights do not deliver value in short term, and not in a direct manner.

The fourth point raised by the experts (like the managing partner of Newion Investments) regards acquisition costs - how much money and time are spent acquiring a new customer. As the CEO of Black Bear Carbon - among other external evaluators – put it: The life-time value of a customer in the small and medium sized business market is usually quite low, and the cost of acquisition is regularly 200 to 300 euro for a B2B proposition. That is to say, the revenues made on a platform user from the time a platform acquires a client to the time he stops using it, is close to the costs of acquisition and of service provided. Looking at the willingness to pay of care providers of cycle 4, a monthly fee of around 15 euros would translate to between one and two years of platform usage, only to recover the customer acquisition costs. Acquiring an industry collaborative with sufficient influence to onboard its member base could significantly reduce the acquisition cost, however this study has shown that at least the participating industry collaborative did not do so. Even if the platform is not paying the acquisition costs, someone in the value chain will have to incur them. Meaning, if an industry collaborative is acquired, it will incur the costs of acquiring (onboarding) it's members onto the platform. These costs can constitute a strong selective disadvantage for the platform.

The fifth point raised regards selling or packaging by verticals (industry niche., e.g. tulip agriculture) as opposed to horizontals (type of activity nice, HR recruitment activities), is regarded as a bad strategy. The external experts stated that it is very expensive to sell throughout a whole vertical, and moving to the next vertical takes significant efforts in re-calibrating the product, sales and marketing to fit this new vertical. A horizontal approach is advised as both the total ecosystem size can be bigger, the focus narrower (in both technology and marketing), and the impact of moving to a new horizontal are experienced as lower by the examiners as it more naturally allows for cross and up-selling – which also improve the customer lifetime value. As a consequence, the reusability of the platform's technology needs to be high, to accommodate for a horizontal market approach; the algorithm would need to work through different industries, unlike the current cost algorithm, which is very industry specific; and the platform should be built in modular components, to provide further technical extendibility and flexibility. This study observed during the evaluation phase of cycle 4 that the only continuation option for the platform was for other industry collaboratives to join. When this was not achievable in a timely fashion, the platform was discontinued for organizational and financial reasons. The platform was not horizontally positioned, enabling a broader scope of potential customers outside of the financially pressured niche market. Nor was it built modularly enough to re-use for a newly positioned platform. A more modular design could allow for cheaper similar analytics products to be produced.

LEARNING

Throughout this study the researcher has learned that through self-pre-commitment the start-up managed to create an initial ecosystem understanding and an initial technical understanding. These understandings were used (in the form of a proof-of-concept) to gain the pre-commitment of an industry collaborative which enabled the creation of the first (MVBP / Alpha) version of the platform. The marquees position of industry collaborative was then used to kick-start adoption of the care providers. Iteration cycles with the platform actors were initiated, in which only some of the ecosystem- and technical understandings to manage platform leadership were pursued through mutual influence between organizational context and the platform. Specifically, the vision of how the platform fits in ecosystem was continuously evolved. However, no complementors were rallied throughout the iterations. The technical architecture and connectors were continuously evolved through the cycles. However, no innovation at the core of the platform nor long-term industry coordination took place.

Further adoption stagnated when industry collaborative did not renew its pre-commitment – in the form of subsidizing the care provider's usage fee. External experts point out this is a likely scenario given the cost reduction pressure the industry was experiencing. In addition, the care providers' willingness to pay was too low for a financially viable platform that could survive long enough to reach ignition based on only these revenue sources. This low willingness to pay is also touched upon by external experts, whom suggest that the care providers are not necessarily able to distinguish between complex analytics products and simple bookkeeping software.

An attempt was made to move towards attracting other industry collaboratives with the current value and state of the platform (a two-step growth strategy). However, this did not work as lead and negotiation times exceeded the time in which new cashflow was required. It is arguable that another industry collaborative would not be willing to subsidize the care provider's usage either, given the same industry's financial situation. Furthermore, if new pre-commitment was acquired, ignition of the platform still seems unlikely as platforms that subsidize the adoption for one side, have mechanisms to monetize these users once on the platform (e.g. subsidize the game console, but sell games at a premium). CostDigest did not design platform dynamics that could monetize the care providers subsidized adoption. As a result of all the above, the cost analytics platform failed to reach ignition.

4. Formalization of Learning

In this stage this study looks at the holistic level of a platform design, taking the previous stages as input, and generalizing the problem instance - commercially developing a cost analytics platform), the solution instance - the CostDigest platform; and deriving a set of design principles for future platforms considering the findings of this research. This is done by reflecting the theory with the findings of this study to aid in new theory development. As this study has shown in previous chapters, research and knowledge is predominantly focused on platforms after they have reached critical mass, and driven by well-known platforms like Google, Amazon, PlayStation. As a result, the theories relating to the stages between inception and ignition are skewed by a survival bias and offer little help to the practitioner (see Chapter 2.4).

4.1 Generalization of the problem and solution

Through ADR the researcher followed the commercial development of a cost analytics platform for the Dutch non-insurable healthcare ecosystem comprised of care providers, industry collaboratives and municipalities.

This encompasses an instance problem of platform commercialization, the class problem (generalized problem) being the commercialization of a platform within any particular ecosystem (as explained in the methodology Chapter 2.6).

While the collected data and results are specifically applicable for a cost analytics platform in the Dutch healthcare sector, much of the results can be further generalized to different kind of digital platforms – e.g. analytics platforms, market places, match making apps, etc. The details and context of the Dutch healthcare sector are specific, however the need for a correct ecosystem understanding and how to iterate towards it is a generalizable process applicable to platform commercialization problems.

A platform commercialization problem is, in the most general sense, a looking glass through which we analyze the capitalization of the value created for distinct types of users that are dependent on each other in an environment where network effects are present. In this study the above holds true: An attempt to create value through the dependency between care providers and industry collaboratives to gain insight and calculate their care costs, and the network effects of increased reliability, credibility, accuracy and actionability of the insights.

The cost analytics platform (CostDigest) was developed as an attempt to solve a specific platform commercialization problem. It's design, learnings, findings, and outcomes jointly form the instance solution for said problem. Building upon the learnings that the ecosystem was in need of a cost analytics algorithm, with anonymized industry benchmarking, build and made available by an independent party (as described in Chapter 3.1): The solution instance picked an available growth strategy (pre-commitment) to create an initial ecosystem and technical understanding together with the ecosystem; these initial understandings were subsequently used to design the platform and it's dynamics (in the form of a PoC); the PoC platform was leveraged to transition to a less risky growth strategy of joint pre-commitment (by acquiring a marquee of one platform side); through this joint-pre-commitment with the marquee, adoption of users on the other side of the platform (care providers) was started; mutations took place, each time adapting the ecosystem and technical understandings of the platform, and these mutations where then evaluated with the latest ecosystem and platform understandings attempting to confirm and improve the selective advantage of the platform; selective advantage was over-estimated by the pre-committed start-up developing the platform and the participating industry collaborative. When this over-estimation became apparent the pre-commitment – in terms of resources - was reduced and adoption stagnated, as it would be financially undesirable to subsidize adoption in perpetuity; a final change of growth strategy (two-step strategy) was attempted to attract new pre-commitment with other industry collaboratives; This did not work out, and finally, the platform fizzled-out.

Holistically speaking three general learnings are disseminated: *Firstly*, a platforms journey from emergence to critical-mass is characterized by a super-position of growth strategies changing over time. The choice of growth strategies can be more biased towards the ecosystem than the platform-technology, as growth strategies are explicitly pre-selected "best-practices" for attracting users to the platform. There is not one single best-strategy, as the strategies reside in an organizational context consisting of the (incomplete) understandings of the platform participants. As a result, it is helpful to account for growth-strategy changes and additions due to platform dynamics, -mutation and -leadership. This complements current platform theory, which takes a more simplistic view towards growth strategies, implying only one is utilized at a time, that they are mutually exclusive, and does not address the bias towards ecosystem focus.

Secondly, mutations are a critical mechanism for a platform's survivability (Arakji, 2010). Mutations allow to improve the ecosystem and technical understandings to better reflect the reality. They allow the improvement of the platform dynamics to better fit the understandings and complement the growth-strategies. And they allow to improve / add selective advantages to the platform. All this, in the end, to improve the adoption of the platform in the ecosystem. That is to say, mutations can adapt the platform to the understandings, but also adapting the understandings themselves. Mutations, however, are not endless. In the commercial development of a platform the number of available mutations before "fizzling-out" are finite and depend on the organizational context (available resources, market, zeitgeist, etc.) in which the platform is developed. This limitation on mutations is not acknowledged in current platform theory. The costs, requirements and commercial impact are not considered, and mutation is defined as the steps of an unrestricted evolution. The platform challenge is therefore - simply put - attracting sufficient adoption to become self-sustaining before the resources required to mutate run out. Again, current literature consistently neglects the latter element, the finite limit of resources.

Thirdly, managing platform leadership from inception throughout emergence can increase the chances to reach critical mass. There are four leadership understandings of Gawer and Cusumano (2014) which their literature suggests a platform that has already reached critical mass should use to stay in a leadership position. However, this study shows that it is beneficial to account for these leadership aspects from day one (inception) to increase the chances to reach critical mass in the first place.

One example regards the building of a coalition around the platform. A lack of coalition building can result in the (unknowing / unwilling) exclusion of critical stakeholders, as not all stakeholders might be actual platform participants. However, they can have valuable input aiding the correct selection of platform mutations. In this study a key stakeholder of the cost analytics platform were the municipalities, however no input was requested from them, potentially missing out on critical information that could aid the fixation of the platform. The same holds true for the remaining three leadership elements: First, having a strong vision of the information system in its ecosystem, as a lack of consideration for the ecosystem allows a bias on end-user focus. This results in the platform positioning within the ecosystem to become myopic (short-sighted). Second, designing the right architecture and connectors. Not assessing the correct required modularity and technological flexibility and interconnectivity negatively affects the platforms evolution. On one hand, it limits the mutation paths the platform can choose from; on the other hand, it limits the potential positionings within the ecosystem (and the potential move to a different ecosystem all together). Lastly - evolving to improve the ecosystem. It is not only the platform that can be mutated, the organizational context within an ecosystem can be such, that it is a more secure strategy to invest in the ecosystem itself, and aid the ecosystem to mutate to better fit the platform's design.

Platform development based on the above creates a stronger involvement and alignment between the ecosystem and the platform. Which is particularly beneficial in the early platform emergence due to increased positive network effects and adoption.

4.2 Research Questions & Design Principles

Considering the holistic level of a platform design, and taking the previous stages as input, this study now derives a set of design principles for future platforms. This is done by answering each of the research questions explicitly, and reflecting the theory on the findings of this study.

RQ1: What are theoretical frameworks that guide a platform commercial development?

To start this study, the researcher looked at the theoretical frameworks available to guide the commercial development of a platform. The full results are found under Chapter 2.2. To answer the research question concisely and explicitly, the researcher identified four frameworks that jointly formed a complementary and exhaustive basis for this study.

Together, all these concepts can be synthesized in one framework containing all the business elements of a platform - as shown in Chapter 2.4. These elements are platform dynamics of positive and negative network-effects, same & cross side effects, methods of value creation - taken from general platform theory; adoption, mutation, selective advantage, ecosystem size, fixation, inception, and ignition from several platform emergence theories; and the understandings of vision, complementor rallying, architecture, and core innovation from leadership theory.

The implementation (Chapter 3.1, 3.2), and later the reflection (Chapter 3.3), upon these concepts showed that they are applicable to a platform commercialization problem, albeit the aforementioned gaps and criticisms on existing theory.

RQ2: What are the primary business elements for reaching critical mass?

With an understanding on the theoretical frameworks, this study investigated which business elements inhibit (or support) the commercial development of a platform towards the point of critical mass.

As shown in the theory in Chapter 2, reaching critical mass revolves primarily around the acquisition (adoption) of sufficient actors/users (Evans, 2009; Evans & Schmalensee, 2010; Gawer & Cusumano, 2014; Zhu & Iansiti, 2012) on the platform sides. In addition, the learnings in Chapter 3.3 show that critical mass can be seen a function of not only the required *minima of actors per side,* but also the *speed of adoption* when accounting for the commercial implications of platform development. By reflecting the dependencies of each business element, their implications and observed impact throughout this study, the following primary business elements (in bold) are observed.

The *minima of actors* are determined by the specific **platform dynamics** (what is each actor group looking from the other and vise-versa), as well as commercial requirements of the platform originating from the **ecosystem** - and **technical understandings**. The ecosystem *understandings* define the *vision* of the platform and its role within the ecosystem, as well as that of *complementors*. Similarly, the *technical understanding* determines the *architecture* and *core innovation* of the platform. Together these leadership understandings determine the commercial scope of functionality, complexity and value of the platform.

The *speed of adoption* is determined by the degree of success of the **growth-strategy**, and the **selective advantage** (e.g. same-side dynamics) the platform enjoys (Arakji, 2010). Impactful adoption was observed in this study through marquee users and subsidized users. Selective advantage on its turn has an equilibrium relationship with platform **mutation** (changes to the platform). Mutate too fast, and the ecosystem is unable to adopt. Change too slow, and the platform is unlikely to find the right ecosystem and technology understanding to drive adoption.

RQ3: To which degree does commercial development in the early stages of a platform inhibit reaching the point of critical mass?

Deciding to commercially develop a platform has financial implications on the stakeholders involved. Knowing the primary elements at play for reaching critical mass (platform dynamics, ecosystem and technical understandings, growth-strategies, selective advantage and mutation) this study determined how commercialization impacts the development of these elements, and the platform as a whole, to reach critical mass.

In a scenario where funds are unlimited (and assuming human capital is acquirable), it can be stipulated that a platform can chose to mutate endlessly. There are then only three outcomes as per emergence theories (Chapter 2.2.2): One, In the case no mutations take place, the platform will eventually fizzle-out due to ecosystem changes (e.g. new needs, new competing platforms, etc). Two, if the platform mutations are too fast or irrelevant in the perception of the users to create a selective advantage. This "break" with the ecosystem causes the platform to not be adopted, and eventually fizzle-out, as in case one. Three, the platform mutates while sensitive to the market response. At some point in time the platform will mutate into a selective advantage that improves adoption. Thereby decreasing the time required to reach ignition. As long as mutations are sensitive to ecosystem changes, it becomes increasingly likely that the platform will reach critical mass. Eventually the platform will be adopted by sufficient actors on all platform sides due to the ongoing increased selective advantage gained through sensible mutations.

The commercial scenario adds a resource constraint to the previous equation, as shown in Chapter 3.3. Practitioners will encounter a finite number of mutations, and while some mutations might enable more future mutations (by addition of extra funds, cheaper architecture, etc.), the number total of mutations is finite. Commercial development therefore inhibits the success of a platform by limiting the number of mutations available to the platform. It is within these mutations that the platform needs to generate sufficient selective advantage to advance adoption and reach critical mass.

Current theory does not include any knowledge that can help the practitioner navigate this limitation. This gap in the literature is created by working from a (semi-)endless mutation's scenario, which only holds true in some very specific commercial situations. It is, however, not the case for the majority of newly emerging platforms, and was also not the case for the cost analytics platform subject to this study. Therefore, new knowledge in the form of design principles is created in an attempt to fill this gap and aid the practitioner.

RQ: Which design principles for a new platform are influencing its commercial development to the point of critical mass?

With a theoretical base established, the impact of commercialization on a platform and its primary elements known, and a clear view of the knowledge gaps (lack of accounting for commercial implications, multiple and non-fixed growth strategies) and biases (survivability bias, overly focused on the platform, ignoring irrationality of the ecosystem, primarily after-the-fact research) in current platform theory, this study can now formalize a set of three design principles a practitioner should consider when attempting to commercialize a platform and maximize the chances to reach critical mass: Growth by design, Mutation by design, and Leadership by design.

Growth by Design

As seen in cycle 4, The CostDigest platform commercialization was halted. One key failure - expanded upon in Chapter 3.3 under the Learnings section - was the lack of foresight into the required costs (in both time, and money) to apply new growth strategies. This eventually resulted into the discontinuation of the platform, as no new ways to move forward were found.

While it is theoretically possible to ignite without explicit growth strategies, the findings in this research have shown that insufficient growth planning can result in platform failure. The growth strategy of CostDigest was evaluated in Cycle 1, and only re-evaluated in Cycle 4, leaving a six-month gap in which both technical and ecosystem understandings were further developed. This type of "blind" growth does not prevent a platform from inadvertently developing past points of no-return. Thereby putting the platform in a difficult position when the applied growth strategies stop working.

The study's results also showed that implicitly - in cycles 1, 2 and 3, and further expanded upon in Chapter 3.3 and Chapter 4.1 - multiple growth strategies were used simultaneously. Adding more adaptability and selective advantage, e.g. when moving from a single to a double marquee(s) strategy.

In general terms: A myopic and un-planned approach is inherently more prone to failure, thereby reducing the platform's chances of success. Adding more pressure on the execution of platform commercialization in other dimensions. Therefore, growth strategies merit their own design principle focused on helping the practitioner avoid this pitfall.

Growth by design suggests to plan and track growth-strategies up to critical-mass rather than identify them opportunistically. Allowing for a deeper understanding of the potential impact of platform and ecosystem changes, triggered by either organizational influence or self-induced mutations. Furthermore, making the platform better prepared against short-sightedness and more responsive to synergies with the growth-strategies.

A practitioner implementing growth by design should plan the usage of growth-strategies up to critical-mass and track the performance of these growth strategies intermittently. Thereby assessing and reviewing the current and potential growth-strategies, and not forgetting that a platform can utilize one or more growth-strategies simultaneously. Finally, a platform or ecosystem mutation may be worth-while to enable the usage of a desired growth-strategy.

Reflecting this design principle on the cost analytics platform case of this research, some improvement suggestions are prescribed. Firstly, from the moment the initial ecosystem and technical understandings were created and a pre-commitment was acquired, the platform designer should have mapped out the future growth-strategies. By tracking the growth progress closely, the platform designer could have more consciously estimate the chances to reach critical mass along the current path, and plan contingency growth plans earlier. Ultimately, the platform designer could have recognized the need to add more industry collaboratives earlier, had he implemented growth by design. Thereby engaging them with more time at his disposal and increasing the chances of the platform to survive.

Mutation by Design

Analyzing the results of this study shows a pattern. Cycle one's evaluation yielded that better on boarding and benchmarking might improve adoption. However, cycle three already showed that further improvements on the on boarding would not help adoption further. Cycle four evaluated that the payment willingness of the care providers was too low to sustain a platform business without continuous subsidizing.

The mutations were used to drive adoption, however in none of the cycles did the researcher in the role of entrepreneur consider how many mutations were available. Resulting in a mis-prioritization of the usage of limited resources. Mutations were used to capitalize on the created selective advantage of simplified on boarding – see Cycles 2 and 3. However, there was a more critical element with a higher priority that should have been addressed first: The understandings of the ecosystem - i.e. will care providers pay for the platform, or does their usage have to be subsidized continuously?

In general terms, it is likely that a platform mis-prioritizes their mutations by being overestimating their available mutations, and underestimating the required level of understanding of the ecosystem and the platform's functioning within it. Falling prey to these mistakes can lead to complete platform commercialization failure. Therefore, this merits its own design principle solely focused on helping the practitioner avoid this pitfall.

Developing a platform commercially translates into a finite number of mutations, therefore a practitioner should estimate the number of mutations available before new additional resources are required. Then prioritize which of the following two types of mutations is more critical, depending on the stage and context of the platform development:

1. Mutations as a mechanism to confirm the understandings, and selective advantage.
2. Mutations to adapt the platform technology and platform dynamics to capitalize the confirmed platform understandings and selective advantage

Mutation by design suggests to view mutation as a limited resource that can be pro-actively utilized to drive adoption, rather than a consequence of the interplay between platform, ecosystem and the actors.

Mutation by design practiced on the cost analytics platform case of this research suggests some changes in the original approach. From the moment of platform inception, the platform design should have estimated the total number of mutations available, and what key understandings needed to be confirmed. Doing this would allow a more explicit consideration and prioritization on the type of mutations to execute. However, this did not happen in the cost analytics platform, and as a result, the mutations were all prematurely focused on the adoption of the platform. Rather, the focus should have lied on the confirmation of the ecosystem (and technical) understandings, as well as solidifying the selective advantage of the platform. The platform was incorrectly evolved around capitalizing on a still shallowly understood ecosystem. Unaware of the consequences of insufficient platform understandings, and a lack of vision in terms of available mutations, caused the cost analytics platform to end abruptly. By being mindful on mutation by design, the practitioner can increase the effectiveness of their (limited) mutations, acquiring more confirmed understandings and selective advantage, thereby increasing the chances of their platform reaching critical mass.

Leadership by Design

As described in Cycle 4, the cost analytics platform commercialization was eventually halted. One reason was the lack of a rich and in depth understanding of the platform and its role within the ecosystem. As stated in Chapter 3.3 under the Learnings section, there was insufficient insight into the potential methods of monetization of the care providers. The existing long-term plan assumed that care providers would be willing to pay sufficiently that subsidization could halt. However, no ecosystem view existed where subsidizing was to be a continuous practice. This mis-alignment is rooted in a lack of understanding the ecosystem, industry collaboratives, care providers, and other ecosystem stakeholders.

The cost analytics platform also showed that leadership principles can be applied successfully early on - in particular the technology understandings (Cycle 1). The research showed that successful early development of leadership understandings is beneficial (Chapter 3.3), and neglecting them can have cascading consequences. As future growth and mutations are developed on top of partial or incorrect information.

Given the importance and impact of leadership understandings, these insights are generalized to other platforms (see Chapter 4.1), and therefore a design principle is formulated below to aid the practitioner specifically with leadership understandings.

Leadership by design suggest that leadership regarding the ecosystem and platform is utilized from the inception of the platform, instead of being strategies to maintain the equilibrium of a leadership position after reaching critical mass - as positioned by current literature (Chapter 2.2.3).

This design principle suggests extending each of the leadership elements with the explicit consideration of platform dynamics. That is, extend the ecosystem vision and the rallying of participants and complementors, as well as innovation on the platforms’ core and the development of a fitting architecture, with the explicit requirements and impact of platform dynamics.

1. Manage, confirm and continuously refine the platform (technical and ecosystem) understandings directly from the platform's inception
2. Evaluate with these understandings if opportunities exist to enable or enhance (new) platform dynamics

Reflecting the Leadership by design principle on the cost analytics platform case of this research highlights some mistakes during the original approach.

Firstly, while the cost analytics platform was incepted through initial ecosystem and technical understandings, the incremental learnings on these two topics was lacking. No mutations were specifically allocated to further these understandings. Had this been done, the platform designer might have understood timelier what the subsidized adoption of care providers was not sustainable, and focused further mutations to resolve this critical flaw. Current literature would not have helped this, due to the late stage (post ignition) on which it is suggested. With this design principle in mind a practitioner can now know to look to confirm and refine his or her understandings, increasing the chances of reaching critical mass.

Secondly, the exploration of enhancing platform dynamics through the understandings was lacking. An example: same-sided network effects can be a very strong platform dynamic that drives the adoption of a single side of the platform. However, no effort was made by the platform designer to explore if (e.g.) the rallying of complementors to the platform could increase such a dynamic. The accountant of a care provider could have been explored as a potential complementor. There might have been a form of selective advantage: Enabling the accountant to onboard and add advisory services based on the platform's insights, and for the care providers to benefit from structured peer-to-peer learning provided by a trusted business relation.

4.3 Critical Reflection

4.3.1 Critics on literature

Through the execution of this study, the researcher has identified several critics on the current body of literature regarding platform management and leadership.

Firstly, current theory reasons from a perspective where the platform is central, seeing the ecosystem primarily as a steady-state environment (Evans & Schmalensee, 2010; Graham et al., 2017; Kenney & Zysman, 2016). Only leadership theory allows for influence on the ecosystem (T. Eisenmann et al., 2011; Gawer & Cusumano, 2014), however all other related frameworks do not acknowledge this. Furthermore, the theories do not help a practitioner to do so, but merely define that a platform able to influence their ecosystem is a leading platform. Thus, there is no explicit practicable theory focused on the phase between inception and critical mass.

Furthermore, the aforementioned platform literature views the ecosystem and actors from a rational perspective (behavioral theory). This simplification may hold true in large numbers of users, as users “on average” can arguably be said to behave rationally. However, when it comes to the single individual actors, this assumption does not hold. This is particularly problematic in the early stages of platform development, where each actor is actively managed and leveraged for the success of the platform. These early users are single-minded and can act and be motivated by very irrational behavior. One example was observed during this study, where care providers were aware of the long-term benefits and cost reductions of the platform, however were unwilling to pay a small monthly fee for this. One suggestion that merits further research is to expand current platform theories with elements of bounded rationality as described by (Simon, 1982; Simon, Egidi, & Marris, 2008).

Finally, there is a lack of actionability all researched platform frameworks in this study, with exception of platform leadership frameworks. One example is the limited contextualization of framework elements: Evolution theory explains Mutations – however it does not elaborate on their heterogeneity. What different type of mutations exist, what useful categorizations can be made? And which are more useful to the practitioner at what stage? This study has shown there are at least two distinct types of mutations: mutations as a mechanism to confirm the understandings, and mutations to adapt the platform technology and dynamics. The consequence of overly focusing on one typology can be as significant as platform failure.

Another example is Selective Advantage. It is based on many different elements, but which common elements have the most impact? Should the adoption be viewed as options theory suggests (Fichman, 2004)? Or is adoption viewed from a resource perspective (Mata, Fuerst, & Barney, 1995) more applicable? Options theory looks at an adopter (platform user) from a rational behavioral perspective. Now, given the potentially irrational behavior of initial platform users, as observed in this study, it is arguably better to expand from a resource perspective. This perspective also complements this study’s view on seeing mutations as a limited resource.

4.3.2 Reflection on novelty and contribution

This research provides a unique view into the lifecycle of a platform. Arguably, the emergence of platforms is the most challenging phase to research. The difficulty is to follow emergence in a methodological way for a still unknown entity, where one cannot know before the actual event of emergence (ex-ante) what the platform - and the actors involved - will be. Therefore, research has been largely based on backtracking (ex-post) and conceptual models, with the analytical, methodological and accuracy constrictions inherent to this. This action design research followed the commercial development and evolution of a platform. From its emergence, towards ignition, up to its failure, and resulting in a set of design principles that aids the future practitioner in their own platform commercialization endeavors. This ex-ante design research is novel in the current ex-post dominated field (for an exception, see (De Reuver, Nederstigt, & Janssen, 2018)).

Secondly, this research has contributed in the further understanding and interlinkage of several research areas towards a more end-to-end overview of a platform's lifecycle. It has also highlighted, through a real-life case, that there are significant knowledge gaps and potential improvements in the current formulation of platform theories, and proposed improvements based on this study.

Third, this research contributes to the usage and implementation of ADR in design research in a highly practical and realistic scenario. Specifically, in the volatile and unstructured world of startups and innovation. It has shown that ADR can be implemented within a startup environment, yet providing sufficient structure for research paper and formalized learnings.

The final contribution lies in the formalized set of design principles. These design principles flow from the action design research methodology, which incorporates generalization and practical usability (Chapter 4.1) explicitly in the process. As a result, the design principles are applicable to most multi-sided platform types and are industry agnostic – in theory. However, the efficacy of the principles is un-tested, and specific industry dynamics could limit their implementation.

The current design principles are by no means mutually exclusive and collectively exhaustive. It stands to reason that more design principles exist that can be added to the current set, but were not uncovered within the scope of this specific ex-ante platform study (e.g. a market entry strategy design principle, or a platform competition design principle). In retrospect, the three formalized design principles should be considered a beach-head for further exploration. Follow-up research is needed to confirm the impact of the principles during platform commercialization, further refine their form and presentation, and study cases in other platform types and industries to uncover additional design principles for common platform challenges.

4.3.3 Reflection on the limitations

The current research exhibits several limitations.

First, the number of participants in this study was limited and focused on one particular industry. This impacts the validity and generalizability of the research results. Also, no extra data acquisition in different industries, nor large-scale data collection was used. However, this is inherent to ADR by definition and design. Therefore, should be accompanied by future research on a bigger scale and a quantitative methodology.

Second, the involvement of the researcher in different roles impacts the objectivity for academic research. While the involvement benefitted the research in the form of a richer account on platform emergence, it can also negatively impact the objectivity of the research through the subconscious biases introduced.

4.4 Future Research

Future research on this topic is encouraged to take place in the same ADR form. A new group of SMEs can be chosen – it is advised that this is a horizontal market that is larger, more diverse and spans several industries.

Arguably, the first cycle is the most challenging, as the emergence of platforms is still not very well understood. The difficulty to follow emergence in a methodological way for a still unknown entity. Therefore, future research is encouraged to further narrow the research focus on the first few cycles, and instead increase the number of potential platforms analyzed.

Following multiple cycles of a potential platform can become very insightful. In platform literature, the researcher shall need to make an educated guess of where a potential platform will emerge to follow it closely. This paper has taken the first step in that road and leaves fertile ground for further research on this topic.

Future researchers are encouraged to contact early-stage startups working on a platform. The academic knowledge can be of help to the practicing startup, and the researcher can acquire data rich of organizational context. An important element in ADR and impactful in commercial platform development.

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6. Appendix

6.1 Platform Dynamics

There are three common archetype platform dynamics:

1) *Sequential entry:* It is possible to get one group of users on board over time and then make these agents available to the other group of agents later in time. That is the situation with advertising-supported media. One can use content to attract viewers and then bring advertisers on board later. This dynamic works because there are non-positive indirect network effects between the two sides: viewers do not care about advertisers (and may dislike advertising) but come to platform for the content.
2) *Entry with significant pre-commitment investment:* One group of economic agents need to make investments over time to participate in the platform. That is the case with software-based platforms such as video game consoles. Game developers must invest in creating games for the next release of a console without knowing how many consumers will be interested in using that platform when their development is done. The video-game console platform must convince game developers that buyers will be available.
3) *Simultaneous entry of sides:* The economic agents are making decisions to join the platform around the same time and have to both join around the same time for the platform to provide value. A dating venue demands high levels of simultaneity. Heterosexual men would quickly leave a new nightclub that had no women and vice versa.

6.2 Data Analytics

Introduction and Brief History

Data analytics is the process off gaining insights out of digital information. The gaining of insights is characterized by a set of different actions: collecting data – i.e. getting your digital information from various sources; cleaning data – i.e. removing erroneous data and filling in missing values; structuring data – i.e. formalizing connections between different data, an example is adding home addresses too client names; and analyzing data – i.e. looking for patterns and correlations through visual exploration or mathematical algorithms.

Data analytics has a similar meaning to data mining, business intelligence, and business analytics; all these terms are used loosely and interchangeably. The term data mining is used in academics to describe the process of recognizing patterns in data and the terms business intelligence and business analytics are primarily used by software providers in products that aid the extraction of insights out of data. In this research, solely the term data analytics is used to aid clarity and consistency for the reader.

Bernard Marr, thought leader in big data & analytics, explains the history of data analytics (Marr, 2015). In 1880 the US government wanted to analyze the collected census data - a census is the procedure of gathering information on the members of a given population. In this period, it would have taken the US Government about 8 years to analyze this data. To tackle this problem Herman Hollerith designed the Hollerith Tabulating Machine, a punch-card machine that reduced the calculation time from a decade to just three months. Later on Herman Hollerith founded a company currently known as IBM, a company that played an important role in the development of data analytics.

Near the 1950s IBM researcher Hans Peter Luhn defined data analytics as “the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal”. IBM mathematician named Edgar Codd then introduced the concept of relational databases. Building on the work of these two men, commercial applications in data analytics began.

In the 90s digital storage became more cost effective than paper (Morris & Truskowski, 2003). This became a turning point for data analytics, as digital data volumes would rapidly overcome its analogue counterpart. Google, Microsoft and Intel quantified the amount of digital data around the world; the study concluded that there was around 350 Mb of information produced per person per year (Lyman & Varian, 2000). This study was repeated in 2003 concluding an increase to 800 Mb per person per year (Lyman & Varian, 2003). By 2010, solely for enterprise data, an average data production of 3 terabytes per employee per year was estimated (Short, Bohn, & Baru, 2011).

Data Analytics 1.0

(Chen, Chiang, & Storey, 2012) differentiated three distinct phases in the evolution of data analytics. These phases are defined by the emerging technologies, applications and research at each particular time (Figure 12 illustrates these phases briefly). This, and the upcoming two sections, will describe the key points of each phase.

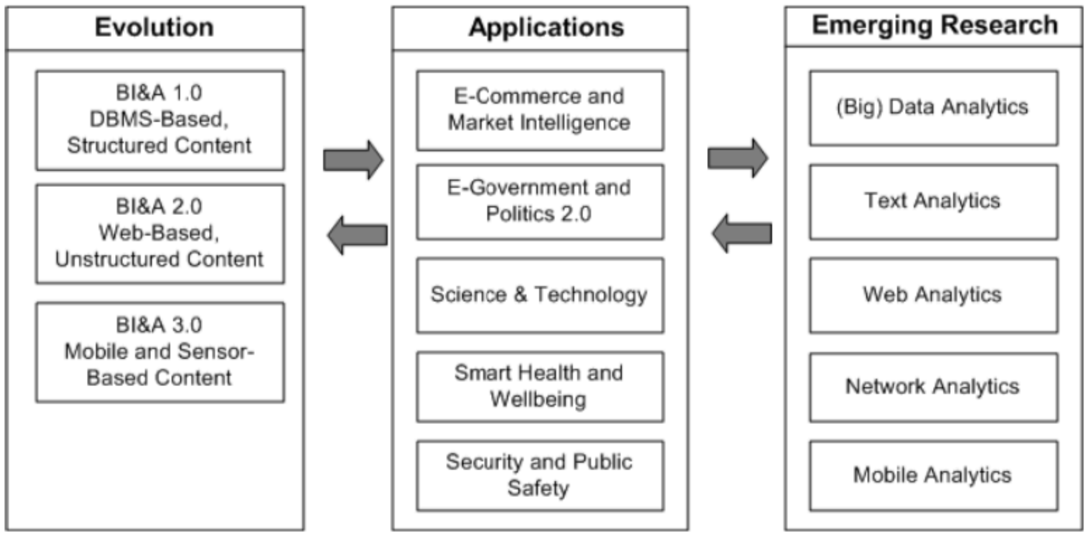

FIGURE 12 - BI&A OVERVIEW: EVOLUTION, APPLICATIONS, AND EMERGING RESEARCH (CHEN ET AL., 2012)

The first phase of data analytics – which Chen et al calls BI&A 1.0 – takes place before the 2000s and is centered on the management of enterprise databases: the Database Management Systems (DBMS). These are the databases in which companies would store their data through various systems, e.g. a company's enterprise resource planning system (ERP). As previously described, this is also the stage in which commercial relational databases and jointly relational DBMS (RDBMS) were widely adopted in the industry (Chaudhuri, Dayal, & Narasayya, 2011).

With RDBMS in place technologies and practices like ETL (Extraction, Transformation and Loading of data), OLAP (Online Analytical Processing), and reporting became common practice. By 2013, all of the aforementioned had been incorporated in leading commercial data analytics platforms offered by Microsoft, IBM, Oracle, and SAP by 2013 (Kurt Schlegel, 2013). More in depth, Gartner's magic quadrant report on data analytics has pinpointed fifteen essential capabilities for data analytics platforms. (Chen et al., 2012) have grouped eight of them in data analytics 1.0: OLAP, dashboards, reporting, interactive visualization, ad hoc querying, search-based BI, scorecards, and predictive modeling.

Data Analytics 2.0

In the years 2000s search engines like Google and Yahoo as well as e-commerce platforms like Amazon and eBay made it possible for companies to place their businesses online. Allowing them to interact with their customers directly through their browser. Aided by cookies, IP linked data, user accounts and interaction logs, very detailed and voluminous data could be collected about the customer's behavior for relatively low cost. This data became very valuable as it helped identify new business opportunities. This kick-started a new data analytics phase dominated by web intelligence, web analytics and user-generated content (Doan, Ramakrishnan, & Halevy, 2011).

The up rise of many new Web 2.0 applications leading the year 2004 like Facebook, YouTube, millions of WordPress blogs, etc. have created colossal amounts of user generated content.

This was particularly interesting for marketing purposes, where social media analytics presented unique new opportunities to interact with the customer, compared to the traditional one-way marketing. As a result, data analytics 2.0 characterizes itself by the added integration of scalable technologies in text mining, topic identification, sentiment analysis, web mining, and social network analysis with the existing (R)DBMS-based data analytics 1.0 systems (Schlegel, 2013).

DATA ANALYTICS 3.0

Where the second data analytics phase started with the rise of web services like Google and Amazon, the third phase of data analytics is introduced by the rise of mobile. As reported in the 2011 article from The Economist, in 2011 the global amount of mobile devices (480 million units) surpassed their laptop and desktop counterparts (380 million units) (Economist, 2011). The same article projected that the number of mobile connected devices would reach 10 billion in 2020.

Analogously to the consequences of phase 2.0 that brought search-, social- and ecommerce platforms, the rise of mobile devises like the iPad and Android smartphones brought new app stores and apps for multi-player games, online education, healthcare, etc. Sensor-based and internet-enabled devices become more and more predominant, from RFID and tagging technology, to home equipment like Nest’s thermostat. This “Internet of Things” (IoT), often referred to as Web 3.0, coincides in timing with data analytics 3.0.

In the review of MIS Quarterly on data analytics (Chen et al., 2012) it is stated that no commercial data analytics 3.0 systems are foreseen for the near future. This type of data analytics is characterized by mobile interfaces and visualization, leveraging location-aware and person-centered data that is capable of handling large amounts of data. Currently (2018) there are already some early examples of technologies capable of collecting, processing, analyzing and visualizing such large-scale sensor data. Hadoop is likely the most widespread and popular technology that allows for the analysis of large data sets. Though it is important to note that Hadoop is not a single technology. Rather, it is an ecosystem compromised by four core components and dozens of sub-components that either complement or substitute each other. For a short explanation on the components of Hadoop the reader is referred to the appendix.

To work with these large-scale data technologies, data analytics tools have started to add the possibility to work with Hadoop. There are three ways this can happen: First, existing and leading data analytics providers can add the newly required functionalities to work with large scale data sets; second, specific intermediary tools can be developed to fill the functionality gap between Hadoop and data analytics 2.0; or third, completely new data analytics 3.0 tools are developed.

All three aforementioned scenarios are observable. Popular tools like Tableau ("Tableau & Hadoop," 2015) and Qlikview ("Qlik and JethroData Partner to Deliver Interactive Data Discovery on Hadoop Solutions," 2015) have added support to query Hadoop based data-warehouse infrastructures like Cloudera ("Cloudera - Data helps solve the world's biggest problems," 2015) and Hortonworks ("Hortonworks : Open Enterprise Hadoop," 2015). New companies like AtScale provide interconnectivity between data analytics 2.0 tools and the big data characteristics of Web 3.0. These tools pass on the results from Hadoop in a data analytics 2.0 friendly way ("Hadoop + Tableau = Possible," 2015). Lastly, completely new data analytics 3.0 tools like Datameer are gaining popularity thanks to their native focus and capabilities in Web 3.0 ("Big Data Business Analytics and Intelligence | Datameer," 2015).

The Cloud & Cloud Computing

The cloud or cloud computing has no single definition. In this research we use the same definition as the Gartner Research Group (Smith, 2010):

Cloud computing is a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies.

There are three types of cloud service. One type is the *public cloud*. In the public cloud ownership resides with the service provider, and the tenancy of the servers is shared with other users through virtualization - i.e. multiple organizations use the same scalability and self-service architecture. Another type is the *private cloud*. In the private cloud ownership and tenancy of servers is in hand of a single organization – i.e. the user owns the entire cloud architecture. The third and last type is the *hybrid cloud*, a combination of both private and public cloud, used to leverage the higher security and control of the private cloud in combination with the scalability and affordability of the public cloud.

Some examples of public cloud providers are Amazon Web Services (A. W. Services, 2016), Google (Google, 2016) and Microsoft Azure (Microsoft, 2016). Known private cloud providers are vCloud (VMWare), HP and Cisco.

The rise of numerous new startups and SMEs are a consequence of the wide availability of cloud resources (Govardhan, 2010). Jonathan Boutelle, founder of SlideShare - a popular presentation sharing cloud service - elaborates on two advantages of the cloud compared to dedicated hosting. The first advantage is that cloud services work through success-based scaling, meaning that a company running in the cloud will only incur higher costs if their revenues are also increase. If revenues are lower, costs will lower as well. Success based scaling results in lower risks for the company. The second advantage is that a company pays the incurred cloud costs after using the resources, in contrast to usual dedicated hosting, where a company pays for the resources upfront (Boutelle, 2010).

Cloud computing and big data are closely related: Big data is challenging to collect and perform analytics on a need for need basis, being able to scale up your computing and storage resources in the cloud makes these analyses cost effective and faster to implement. Several big data challenges can be managed through cloud computing: Volume by deploying extra storage; Velocity by deploying more computing power; Variability by provisioning specialized high-speed databases.

Big Data

Big Data is so loosely used that there is no single definition of it. Some refer to big data through the three V's (Volume, Velocity and Variety) as coined by the Gartner research group:

“Big data is high-volume, high-velocity and high-variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making”.

-- Gartner Research Group

Others define it as data that is relatively too big to handle by the system. Demchenko et al (Demchenko, de Laat, & Membrey, 2014) highlight some of the wide arrange of definitions used for big data. IDC Research Group defines it as “A new generation of technologies and architectures designed to economically extract value from very large volumes of a wide variety of data by enabling high-velocity capture, discovery, and/or analysis”. Jason Bloomberg sais “Big Data: a massive volume of both structured and unstructured data that is so large that it's difficult to process using traditional database and software techniques.”

As the understanding of the big data phenomena grew, two more points were added to the description by Gartner: Variability, referring how dynamic data is - building on the insight that most data are in constant change - and linkage, referring to how data is linked and the integrity of these referrals.

Based on their research, Demenchko et al propose a more structured definition of Big Data, taking example of the NIST’s definition of cloud technology. The definition reads as follows:

> *“Big Data (Data Intensive) Technologies are targeting to process high-volume, high-velocity, high-variety data (sets/assets) to extract intended data value and ensure high-veracity of original data and obtained information that demand cost-effective, innovative forms of data and information processing (analytics) for enhanced insight, decision making, and processes control; all of those demand (should be supported by) new data models (supporting all data states and stages during the whole data lifecycle) and new infrastructure services and tools that allow obtaining (and processing) data from a variety of sources (including sensor networks) and delivering data in a variety of forms to different data and information consumers and devices.”*

-- Demchenko (Demchenko et al., 2014)

This paper uses this same definition, and gives discretion to the research on what constitutes high-volume, high-velocity and high-variety. A dataset is seen as high-volume, variety and velocity when an organization is not able to extract insights from it without implementing changes, upgrades or workarounds to their day-to-day ICT infrastructure, in accordance with the second part of Demchenko’s definition.

6.3 Hadoop

In order to explain Hadoop and its core components, we will use the example of a mundane task that resembles the challenges Hadoop solves when processing large data sets. Image you have a yellow-pages book (equivalent to our database) laying at the office. If you are wondering how many people are listed called "John Doe", the actions are quite straight forward: You (equivalent to a computer) quickly browse through the book to find the section for last names starting with a "D" and look for "Doe", then progress through the pages until you encounter the first name "John" behind it. Then you start counting all the entries of "Doe, John", soon enough you will have your answer.

This is a task relational databases are great in solving. They were built with this purpose and functionality in mind. But, let's say instead you would like to know how many phone numbers there are in the phonebook that end with "007". For you to solve this you will have to go through each page, reading each phone number at each entry, and keeping track if it ends on 007 or not. This will take a tremendous amount of time.

In order to speed up the process you decide to call up the help of your colleagues at the office. You gather twenty-six unknowing colleagues to help you with the task at hand. You then proceed to rip the phonebook in pieces, each piece being one letter of the alphabet, and giving it to each and every colleague. Next, you explain your colleagues the task: Look for phone numbers ending on 007 and count how many there are. Then report back to me.

Notably, this task will still take some time, but it will be significantly faster than the previous method. This is in its essence what Hadoop does. The four core components of Hadoop are:

Hadoop Common: Also known as the Hadoop Core (but this name can be ambiguous relating to the core components it is part of). This contains all the documentation and code of Hadoop. This is the equivalent of the actual knowledge on how to split up the yellow-pages book and a guide on how to go about the project.

HDFS: HDFS stands for Hadoop Distributed File System. This is the particular type of file system that allows for large data sets to be split into smaller distributed files. Allowing for the parallelization of the computations that is at the core of Hadoop. This is the equivalent of the stacks of yellow pages that you are giving to your colleagues, and keeping track on how they should be put back together.

YARN: YARN is the framework that allows for the job scheduling and resource management. This is the equivalent of how to give your colleagues instructions on what to look for, when to do it, and how to report back at you.

Map Reduce (MR): This is the Parallel Processing mechanism used by Hadoop to process the distributed data. The equivalent analogy is the actual counting by each of your colleagues and how they go about at doing this.

The sub-components are additions to the core components. An example is HIVE, which in essence is a Data Warehouse for Hadoop Distributed File Systems. In BI&A 2.0 a company would need a collection of different databases (a data warehouse) to collect and manage all their data. This is not any different for BI&A 3.0, where multiple HDFS are needed for many of the large data set tasks. Another example is PIG, which is a high level programming language for distributed computation. In essence it is the language in which you communicate to your colleagues what you intend to do.

Enterprise Software

Enterprise software is computer software that is purposefully designed to satisfy the needs of an organization instead of the needs of an individual. A couple of well-known examples are software packages like customer relationship management, Enterprise resource planning coma and project management. There're many types of enterprise software products, ranging from accountancy software content management systems, or even supply chain management. In fact, Business intelligence is also regarded as a type off Enterprise software. Enterprise software has been widely used and implemented in corporate's very successfully through the past decade. But several macro-economic effects like the Price of cloud computing, higher penetration of internet connectivity, the continuation of Moore's Law, which translates into cheaper computing power and cheaper storage, and more effective developing methods and code coding languages, have posted the development of enterprise software for small and medium-sized enterprises. SMEs are able to purchase advanced, and often cloud based Enterprise software for a fraction of the price that they would five or 10 years ago. This has led to an increasing adaptation of enterprise software in the SME segment.

PaaS and SaaS

PaaS stands for "Platform as a Service". It is a business model commonly seen in the cloud computing industry. Companies like Google, Amazon or Heroku provide a platform allowing customers to develop, run and manage their own applications without the overhead of managing, maintaining and further developing the infrastructure. But the archetype business model can be applied in other fields as well, as long a basis is provided on which customers can build their own applications, thereby taking over the responsibility and overhead of maintaining that basis and receiving recurring revenues from it in the form of pay per use or subscriptions.

SaaS stands for "Software as a Service", and is the logical progression of PaaS. Where PaaS delivers a platform on which applications are built, the SaaS business model delivers the application ready-made and ready for use. The provider takes care of managing, updating, maintaining and further developing the application and usually delivers the software in the form of a web-application. The end-user has no direct overhead due to the software, and pays in either a subscription based or pay per use model. Many products in the fields of MIS, ERP, CRM and BI are moving towards a SaaS model.

6.4 Technology Adoption

Technology Adoption is the field of study that looks at how technology is adopted by individuals, companies, or society. There are different ways to look at technology adoption, two examples are the Technology Adoption Model (TAM), that divides customers into four different segments and identifies a chasm, and evolutionary theory where technology is seen as an evolutionary system ruled by socio-technological behavior and the interplay between society shaping technology and technology shaping society.

This research looks at technology adoption at the firm level as previously explained platform theories already address the different customers (ecosystem) and evolutionary properties of a technology. Horizontal and vertical reuse has been explained, but the theory on why a particular firm will adopt a certain technology was superficial. There are two technology adoption theories that address this:

- Adoption from a resource perspective (Mata et al., 1995)
- Adoption from an options perspective (Fichman, 2004)

Adoption from a resource perspective

Technology adoption from a resource-based perspective (Mata et al., 1995) is built upon two critical assertions: First is resource heterogeneity, i.e. the resources and capabilities possessed by competing firms may differ. Second is resource immobility, i.e. these differences can be long lasting. This research defines resources and capabilities as a company's ability to implement, use and leverage information systems. The assertions are required for the technology adoption to deliver a sustainable competitive advantage. A resource on itself cannot be a source of competitive advantage if competitors also own it. Resource heterogeneity is met if a company possesses a resource that is not possessed by competitors and can, at least temporarily, lead to a competitive advantage. But the second assertion must be met to really become a sustainable competitive advantage.

A resource is immobile if, compared to companies currently owning that resource, a competitor can't acquire a resource without a cost disadvantage for developing or using it; else the resource can only be a temporary source of competitive advantage. A resource can be immobile through: The role of history, i.e. large-scale macro-economic events, e.g. a military war; causal ambiguity, i.e. what does a competitor imitate if it's unclear what actions drive success? Or social complexities, i.e. resources that are hard to imitate, like company culture. Mata (Mata et al., 1995) combines the resource-based view with the ability of IT to become a sustained competitive advantage, uncovering four primary requirements: Access to capital, proprietary technology, technical IT skills, and managerial IT skills (Mata et al., 1995).

Adoption from an options perspective

Technology adoption from an options perspective is built upon three required conditions: First, there is no reversibility on monetary and time costs (expected potential return). Second, there is uncertainty regarding the payoff or gained value (variance of potential return). Third, there is time and cost management flexibility in the implementation scope of the technology (managerial flexibility). The higher the option value, the likelier a platform (technology) is to be adopted (Fichman, 2004).

Fichman's analysis resulted in twelve determinants distributed among four complimentary perspectives. The four perspectives are: Technology Strategy; Organizational Learning; Innovation Bandwagons; and Technology Adaptation. The perspectives and their respective determinants are shown in Figure 13. A short explanation of each determinant and its impact on the option value are shown in Table 10.

A determinant increases the option value through their impact on the three required conditions. If a determinant increases the expected potential return, the variance of the potential return, or the managerial flexibility, the determinant is deemed as having a positive effect on the option value. Determinants either have little -, some -, or significant positive impact on the option value – with the exception of "knowledge barriers" which has a positive effect on the variance of payoff and a negative impact on the expected potential return. Seven determinants are characteristics of the technology, the remaining five are characteristics of the organizational context. The technology-based determinants are: Radicalness; knowledge barriers; susceptibility to network externalities; prospects for dominance of the technology class; prospects for dominance of the technology instance; interpretive flexibility; and divisibility (Fichman, 2004). The technology-based determinants should be taken into consideration when designing a platform, and the organization-based determinants should find sufficient connection with the target market and value proposition as intended by a platform owner to maximize the option value.

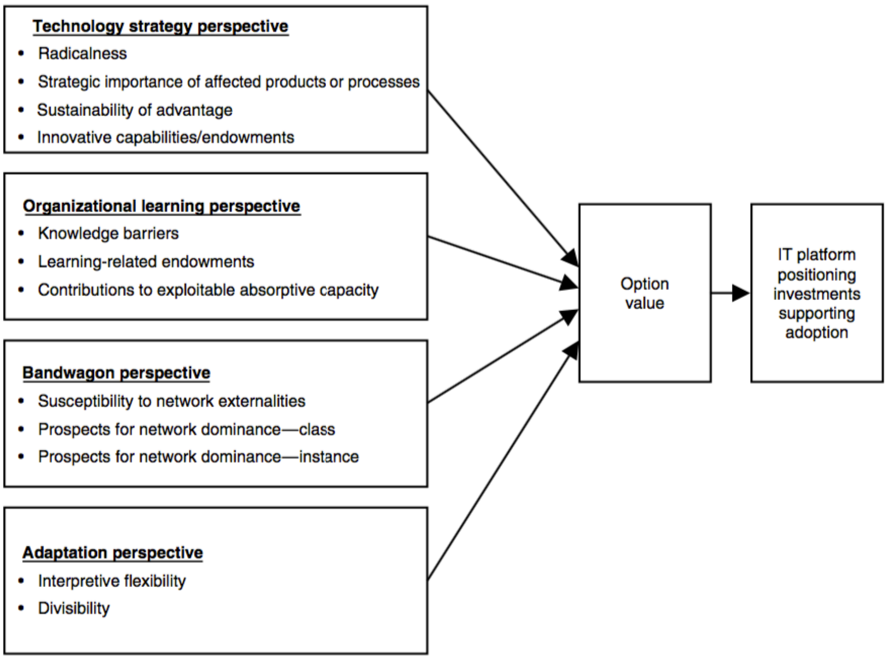

FIGURE 13 - ANTECEDENTS OF OPTION VALUE IN IT PLATFORM INVESTMENTS (FICHMAN, 2004)

TABLE 10 - DETERMINANTS OF OPTION VALUE (ADAPTED FROM (FICHMAN, 2004)

Determinant		Intermediate mechanisms			Overall effect	
Label	Definition	EV of payoffs	Var. of payoffs	Flexibility	Option value estimate*	DCF value estimate
1. Radicalness	The extent of potential improvements in organizational products or processes enabled by the technology		+		+	
2. Strategic importance of affected products or processes	The extent to which products or processes potentially improved by the innovation are central to the competitive position or value proposition of the firm		+		+	
3. Sustainability of competitive advantage	The extent to which expected improvements to a firm's strategically important products or products resist rapid duplication by competitors	+	+		++	+
4. Innovative capabilities and endowments	The extent to which an organization possesses resources (human, technical, organizational) conducive to effective deployment of the innovation	+		+	++	+
5. Knowledge barriers	The extent of the burden of organizational learning associated with adoption	–	+		?	–
6. Learning-related endowments	The extent to which an organization possesses knowledge, skills, routines, incentives, and other resources conducive to effective organizational learning surrounding the innovation	+		+	++	+
7. Contributions to exploitable absorptive capacity	The extent to which knowledge to be gained during deployment contributes to absorptive capacity in domains with long-lasting strategic relevance			+	+	
8. Susceptibility to network externalities	The extent to which a technology increases in value to individual adopters with the size of the adoption network	+	+		++	+
9. Prospects for network dominance of the technology class	The extent to which the innovation's technology class is likely to achieve a dominant position relative to competing technology classes	+			+	+
10. Prospects for network dominance of the technology instance	The extent to which the technology instance being adopted is likely to achieve a dominant position relative to competing technology instances within the same class	+			+	+
11. Interpretive flexibility	The extent to which a technology permits multiple interpretations on the part of adopters about how it should be implemented and used	+	+	+	+++	+
12. Divisibility	The extent to which a technology can be divided for sequential implementation in such a way that each incremental segment positions the firm for a positive payoff, even if no further implementation segments are pursued	+		+	++	+

6.5 Semi Structured Interviews Database

See next attached page

Date	Interviewee Name	Interviewee Position	Company Name	Company Size	Company Rev	Industry	Perceived Hurdles, weaknesses or Threats	Perceived Opportunities or Strengths	Suggested Additions	Context and Industry
29-Oct-2014	Redacted	CEO, Advisor	Black Bear Carbon	< 10		Mining & Minerals	- He questions if SMEs buy analytics as a separate product - Sales acquisition costs for an SME are about 500 to 2,000 euro per client through sales people. -- Therefore, go one-by-one to verticals is not a viable strategy in long-run. - Hotels (our current second niche market under investigation) are not niche and there are big players like Booking.com offering analytics there.	- Try a "salesforce" model, piggyback on top of a widely spread system and deliver your product on top of that. - Said that having the best visualisation and dashboard will win you the SME customers stressed it is most important aspect! - Hair dressers and restaurants are still very non-technical and can benefit a lot from analytics - Restaurant currently using a mini-ERP that could be good platform to build analytics on the top. These mini ERPs are used to connect their reservations with platforms like open-table and such	- Take max 3 focus Niche markets and work there	
29-Oct-2014	Redacted	Strategy Consultant, CEC	Alkio	< 10		Finance	* Low fee (30 eu per month), why?	* You can provide consultancy on top of the insights	* It is highly recommended to just focus on ONE market at each time * Quantification of your value helps a lot for both keep existing customers and get new customers as well as tap into the new niche market	
24-Oct-2014	Redacted	Directeur	Stichting Zorgboeren Zuid	< 10	5 - 10 mil	Healthcare	* He thinks CFs have to change their mental model of business making to a more serious strategy to survive			* CareFarmers are having a though time. The change from AWBZ to WMO is very heavy for them. Taking a lot of time and resources from them.
31-Oct-2014	Redacted	Consultant	PNO	> 300		Subsidies				
5-Nov-2014	Redacted	Lawyer	Bird & Bird	> 300	> 20 mil	Law	* Privacy issues with person data	* If managed in accordance to dutch law, you are at the world top of privacy management	* Speciallized privacy governance	
10-Nov-2014	Redacted	Director	Federatie Landbow en Zorg	< 10	1 - 10 mil	Healthcare	* It will be very hard to get the user to perceice the benefits of DA in short term * You need some sort of PR or Campagin to have users start implementing it, else they are too busy with the "business as usual"	* The value for cooperations, i.e. the aggregated level is clear.	* You need one great story of an end-user, such that end-users can empower each other to use the tool -- They need help and a believable source that the payoff will come after a year * A competitor impelemting it succesfully is a very good driver for adoption	* The CF industry is very hard. The end-users are not economically driven and have no feeling for ROI * There are big political struggles between parties. Cooperations, Federations, Members, etc. * The Federation even has a law-suit against a local government for excluding some CFs for payment
12-Nov-2014	Redacted	Lid van Bestuur	Boer en Zorg	10 - 20	5 - 15 mil	Healthcare	* Users were overwhelmed by the ammount of information received. It was a 2 hours intensive course * Users want to understand the underlying mechanisms of calculations, even if they don't understand it afterwards			
14-Nov-2014	Redacted	Mid level management	Alientt.com	1 - 10	1 - 5 mil	Grants and Funding	* It's a busy domain, ICT is quite competitive	* Fit to SMEs is a great concept		* European funds are generally not for Start-ups but for SMEs
24-Nov-2014	Redacted	Analyst	Randstad	> 3000	> 500 mil	HR and Recruitment	* To early stage, still needs some revenue to invest in		* Meet again when revs	
6-Dec-2014	Redacted	Entrance Jury	Rockstart	10 - 50		ICT		* Web Platform with High Scalability * Fits the RockStart theme and focus	* Join RockStart	* They pay 60k for 8%, but only 15k in cash
23-Dec-2014	Redacted	Rebel	Rotterdam	100	1 - 10 mil	Financial Services			* Financing by a strategic investor. IBM?	
29-Dec-2014	Redacted	VC	Filsa BV	1		Venture Capital	* How easy is it for new parties to enter in this market? Porters 5 forces, new entrant barriers? * How re-usable are analytics and algorithms? How big is the barrier to a new vertical? * Customer acquisition and retention? -- Specifically retention is of importance in SMEs, as they have low loyalty and price sensitive -- Need for sophisticated retention methods -- SMEs have a high Cost of Acquisition, so high Customer Livetime Value is important	* Strong internal management of the project * Good processes in both legal and management	* Use the power of what-if scenarios for VCs and investor market	
5-Jan-2015	Redacted	Consultant	ComputerPlan B.V.	100		ICT	* Groups of companies cannot agree on what dashboards they want, so its hard to arrange centrally -- Not necesarily as much as Tableau. Less is ok * Even for ICT guys, the added value of Analytics is unclear * Sees Spore.BI as a reporting tool		* They are looking for a Vision-Planner with more customisation options and analytics for specific cases (which to some degree does fit our scope and orientation)	
7-Jan-2015	Redacted	Lawyer	Bird & Bird	> 300	> 20 mil	Law	* As a platform there is triangle relation when buying or using things which makes the legal structure more complex -- You provide something to Partners -- Partner provide their templates to users -- You provide underlying stuff for Users		* Depending on the situation, one can chose to become the MiM, with more control and more work. Or let things be a more stable triangle	
9-Jan-2015	Redacted	Partner	EY	> 1000		Finance				
7-Jan-2015	Redacted	Managing Director	KplusV	100		Advisory	* A Parnet Channel strategy means you are dependant on the geography and spread of those partners * A need of a clear risks document is needed in order to manage them, as they are many and complex		* Add Mass Customization more clearly to the model. Meaning, just like in the car industry, you can have a particular car model. but there are thousands of options and changes you can make	* KplusV is the "Intel Inside" of entrepreneurship
7-Jan-2015	Redacted	Managing Director, VC	Newion	< 10		Venture Capital	* Need concretely to differienciate with Red Ocean of tools * What is the Blue Ocean?		* Can it be made open source?	* Patrick is one of the top ICT VCs in The Netherlands
19-Jan-2015	Redacted	Partner	EY	> 1000		Finance			* You need to have your team local and in the same place -- Cloud9 had really bad times and bankrupcy due to geo spread team	
29-Jan-2015	Redacted	Angel	Filsa BV	2		Venture Capital	* Lowest price as USP is weak. There will always be someone who will become cheaper			
30-Jan-2015	Redacted	VC	HealthInnovations	2		Venture Capital			* "You are either 'in the market' or 'on the technology'. It is very hard to be in both..." General background, also Elon Musk has a similar position. With Tesla he focused only on the technology. With paypal he shifted from technology to the market (paying for new users! literally).	
10-Feb-2015	Redacted	Partner	Remmerswal	> 50		Finance	* Is a big jump really necessary? or is incremental innovation enough? -- Most products offer basic Charting and Reporting, which is often more than enough for SMEs * Is the distinction with current products big enough for a layman to understand the difference? -- Even if they get new dashboards, can they notice the difference?		* Rarely things are a trully "new" concept. What was the past equivalent of it? -- This is somewhat related to the Antoloog (analogous predecesor of a digital technology)	
12-Feb-2015	Redacted	Consultant	ComputerPlan HQ	100		ICT	* Will the product be used as intended? Are there potential miss-uses and what are their consequences? * As a start-up you want co-development. But most Partners or sides of a two-sided market platform, have no time to do this		* Is the platform enabling a comodity or something special?	
12-Feb-2015	Redacted	Advisor	Yes!Delft	<10		Entrepreneurship			* Important to focus also on Business Side, not only the technology development	
23-Feb-2015	Redacted	Board member	IEEE	> 50		Engineering		* Focus on verticals that are under external pressure -- (Note that this verticals can also be "unhealthy" and thereby this can be a bad decision then. E.g. Healthcare with no money		
4-Mar-2015	Redacted	Lawyer	Bird & Bird	< 10		Law			* Need to add clause to end usage when "misbehaviour of usage of platform" happens	
6-Mar-2015	Redacted	YD advise	Yes!Delft	< 10		Entrepreneurship	* You need to reach Critical Mass * It's extremely difficult to sell to SMEs -- CAC is a few 100 euros per client -- Those costs have to be paid somehwere in the value chain. Even if its not You!	* SMEs can be happy with few features * Either you can upsell, cross-sell, or find another way to get more value out of the lifetime of the customer, else its not worth the acquisition.	* Charge for documentation and Maintenance * Either they need to add service to their products to keep their right of existence. Improve their products * OR, improve their relationship with their clients (e.g. banks with extra services)	* You need to prove commitment with deadlines and deliverables -- This is important in order to move forward

6.6 List of member care providers

Name of Organization	Municipality
Activiteitenboerderij Rutgers	Aalten
Zorgboerderij De Neeth	Aalten
Land in Zicht	Amersfoort
Van 't Hooiland	Apeldoorn
Wenums Veldzicht	Apeldoorn
Hoeve Klein Mariendaal	Arnhem
Zorgboerderij Tokhok	Arnhem
Boerderij Paradijs	Barneveld
Groot Kootwijk	Barneveld
Gruttohoeve / RuiterActief	Barneveld
Huize Donkervoort	Barneveld
Oud Schoonhorst	Barneveld
Zorgboerderij Klein Essen	Barneveld
Zorgboerderij 't Bakhuisje	Barneveld
Aoverstep	Berkelland
Zorgboerderij Klein Arfman	Berkelland
De Bult	Bronckhorst
MAROPE op Landgoed Zelle	Bronckhorst
D'Boerenkiel	Bunschoten
De Veldmuis	Bunschoten
Stichting zorgboerderij Hoog-Broek	Buren
Zorgboerderij Chr. Benaja	Buren
Buitenplaats Vechterweerd	Dalfsen
De Strenkhaarshoeve	Dalfsen
Het Ruitenveen	Dalfsen
Landjuweel De Hoeven	Dalfsen
Villa Kakelbont	Dalfsen
Zorgboerderij "The Ranch"	Dalfsen
Zorgboerderij Damhoeve	Dalfsen
Bij Tjoonk	Deventer
Boerderij Binnengewoon	Deventer
Boerderij Erve Remerman	Dinkelland
De Amanshoeve Zorg BV	Dinkelland
De Pruimenpot	Dronten
De Oordhoeve	Ede
De Roek Zorgbedrijf	Ede
De Veenhoeve	Ede
Eck-stra	Ede
Stichting Betach	Ede
United Souls	Ede
Woudegge	Ede
De Peppelhoeve	Hardenberg
Grenszicht	Hardenberg
Overbrucht	Hardenberg
Schottinkslag	Hardenberg
Teun's Hoeve	Hardenberg
Zorgboerderij 't Oolderluk Hoes	Hardenberg
Zorghoeve De Eregast	Hardenberg
De Schurinkshoeve	Hellendoorn
Zorgboerderij Remmersbos v.o.f.	Hellendoorn
De Hof van Sion	Kampen
Dolfijnenhuis	Kampen
Zorgboerderij De Kleine Vos	Kampen
Zorgboerderij Polderzicht	Kampen
De Huif	Lelystad
Hoeve Vredeveld	Lelystad
Zorgboerderij Lelystad	Lelystad
Blommendal	Leusden
Horsewise	Leusden
De Groote Locht	Lingewaard
Etenoha	Lingewaard
Zorgboerderij De Amethyst	Lingewaard
Erve Sleiderink	Losser
De Hettenheuvel	Montferland
Stichting Belfjor	Montferland
De Bonte Sik	Nijkerk
Harcohof	Nijkerk
Aventurijn	Noordoostpolder
Buiten gewoon! Fit-inn	Noordoostpolder
De Boterbloem	Noordoostpolder
De Zonnestraal	Noordoostpolder
Meerzoo	Noordoostpolder
ZIN Zorgboerderij	Noordoostpolder
Natuurkr8	Oldebroek
Balans Activiteiten	Ommen
De Marshoeve	Ommen
Gasthoeve De Zonnebloem	Ommen
Schöttincksflier	Ommen
Zorgboerderij Breukelaar	Oude IJsselstreek
Zorgboerderij De Bongerd	Oude IJsselstreek
Goedland	Putten
Stichting Grensverleggende Talenten	Putten
Het Hageveld	Raalte
Leer-en werkbedrijf De Enk	Raalte
Noaberhof de Stamhoeve	Raalte
Wiggers Zorgboerderij	Raalte
De Groote Fliert	Renswoude
De Kleine Weide	Renswoude
Groot Wagensveld	Renswoude
De Munnikenhof	Rheden
Het Nös	Rijssen-Holten
Hulpdiehelpt	Rijssen-Holten
MTS. Gebarenboerderij	Scherpenzeel
Pro Faktoor	Staphorst
Zorgboerderij Maatsloot	Staphorst
Erve Tijhuis	Tubbergen
Zorgboerderij Stal de Schultenhof	Tubbergen
De Koningshoeve	Twenterand
De Huiberthoeve	Utrecht
Het Boerenleven	Utrecht
Manege 't Hoogt	Utrecht
De Eekhoeve	Veenendaal
Paardenhouderij De Havezathe	Veenendaal
Huiberthoeve	Vianen
Hof Noord Empe	Voorst
Sterrenland	Voorst
De Willemshoeve	Wageningen
De Thuishaven	West Maas en Waal
De Piet	Wierden
Zorgboerderij Miklath	Wierden
Zuna	Wierden
Zorgboerderij De Zonnebloem	Winterswijk
Ons Boeren Gerief	Woerden
Woonzorgboerderij Moriahoeve	Woudenberg
Zonnehoeve Zeewolde	Zeewolde
Zorgboerderij de Pieperhoeve VOF	Zwartewaterland
Zorgboerderij Lenteheuvel	Zwartewaterland
Jot Zwolle BV	Zwolle
Talent in Zorg	Zwolle
WoonZorg Combinatie Overijssel	Zwolle

6.7 Reflection as an entrepreneur

As explained in the study methodology chapter, the researcher held a dual role of both researcher and entrepreneur: The role of researcher was dominant across the study - being the primary actor and owner of the research; consequentially, the role of entrepreneur was treated from a third person perspective, with equal standards and on the same footing as the other stakeholders and participants in this study.

However, when it comes to the topic of the development of a start-up, many more events and challenges transpired. Therefore, this section is written outside the research scope of this study, aiming for an open reflection on the events that transpired across the same timeline as the research, its findings, and other accounts. This time, from the entrepreneur's perspective, rather than from an academic's point of view. I will start off with three general points, and then reflect on the research findings and their impact on me as an entrepreneur.

Firstly, as an entrepreneur there is a big difference when you are working on a start-up for the first time. There is a large amount of new information spread over distinct topics that you need to get acquainted with very fast. A new entrepreneur needs to gain at least a basic working understanding of: law, finance, intellectual property, sales, marketing, management, leadership, psychology, and recruitment - to name a few. This makes it increasingly hard to add new in-depth theory to an already complex endeavor. The kind you need to absorb when researching a thesis.

A common thought would be to argue that a track like Management of Technology would provide many of the aforementioned basics, therefore alleviating some of the starting challenges. This however, is only partly true. Courses like corporate finance, law, sales & marketing, could seem like the most relevant, but are in fact the least valuable in my experience. This is information you rapidly have access to as an entrepreneur, and can learn on varying levels of complexity step by step when-ever you need it. It is on the other hand, courses focused on Leadership, decision making, and in general soft-skills and holistic thinking that help the student entrepreneur the most. It was multi-skilled and close to reality courses like TTiB and Ready to Startup that provided me a more valuable foundation as a student entrepreneur. Note that those courses are not track-specific.

Secondly, a critical element to the (my) growth as an entrepreneur comes from the access to experienced advisers willing to "pay it forward". This access was provided by Yes!Delft (and later ESA, O3NL, etc.), and is likely one of the most valuable assets a network can provide. It is however worth reflecting that in my experience (in both my own actions and those of fellow founders) we are often unable to fully grasp the content of the advises received, until we have made some (cheaper) form of that mistake. Therefore, the coaching impact is unlikely to be measured correctly on the first endeavor of a coached entrepreneur, but rather works as an increased level of learning from experiences.

Lastly, in my experience entrepreneurship is a skill that is learned through both knowledge and practice. The challenge is that absorbing academic knowledge and transferring it into practice is a different capability altogether. Furthermore, it differs widely how this should be done depending on the type of knowledge.

So how have the results of this research impacted or helped me as an entrepreneur?

Academic literature is so in depth and detailed, that it requires already a high degree of knowledge and capabilities to transform this information into practice. Especially in the field of entrepreneurship, where getting things done is preferable over an analysis paralysis, such depth can be more detrimental than helpful to the practitioner. This research provided three design principles (growth- , mutation- and leadership by design). The benefits of these design principles are their specificity and simplicity. They explain a certain way *how* to view something, each providing and explaining a specific mental thinking model.

The principles have proven themselves useful - in practice - several times. However, the results were crystalized post the failure of the CostDigest platform, and I do believe that having had them available at the start would have increased the chances of success. Whilst outside of the scope of this specific study, the principles have been applied in multiple IT and innovation projects in The Netherlands and abroad, my experience with them so far:

First, the usability of the principles is high. That is to say, the number of situations which externally trigger the thought of one of the principles is several times per month (in my experience). The principles showed to be applicable on most technology and innovation on a holistic level due to their origins in evolution and leadership theory. Most IT products can be viewed as a platform, even if 'just' a single-sided one.

Second, the (re)use of them is consistent and goal oriented. Applying the principle on the situation will often trigger a needed and important discussion. Like most design principles, they are often a communication tool that helps align all stakeholders involved, and focus their view in a particular direction. In the IT landscape, many practitioners are accustomed to design- and other principles. Security and privacy by design are commonly understood principles, as are Agile principles as well. Therefore, when developing a new platform with other stakeholders involved, it has been very manageable to explain growth-, mutation- and leadership by design principles. In short, the principles are easy to convey, explain, and spread within an organization, allowing the consistent alignment and usage of them.

Third, the context and explanations of the principles have shown to fulfill more of an illustrative purpose, but the principles have shown to be very applicable in a range of situations. Growth by design has been used for new features (thus on a much smaller scope scale than anticipated), mutation by design has been used in a project where financial resources where not the limiting factor, but the time for quality and integration testing made it a very critical principle to uphold. And leadership by design has been a helping principle in the internationalization and localization efforts of a new product.

In the end, much like other design principles, they function as a mental aid and as a communication language for a specific topic which is deemed of critical importance. One thing will always be hard to answer: Have I as an Entrepreneur reflected on the design principles alone, or do they primarily function to solidify my understanding from doing the entire research? It will of course be a bit of both. I do know I will continue using them for the foreseeable future.