

## MASTER

### Learnings from frugal innovators in LMIC healthcare markets

business model experimentation to overcome the challenge of accessibility, scalability, and viability : A multiple-case study on the need and use of business model experimentation in the process of finding viable business models for frugal innovations in LMIC healthcare markets

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# Learnings from frugal innovators in LMIC healthcare markets: Business model experimentation to overcome the challenge of accessibility, scalability, and viability.

A multiple-case study on the need and use of business model experimentation in the process of finding viable business models for frugal innovations in LMIC healthcare markets.

*A master thesis by Jelle Schuitemaker [s1364677]*

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# ABSTRACT

Healthcare in LMIC has been facing major challenges in the last decades, weakening the LMIC healthcare markets. As the healthcare system is the backbone of a society, these challenges enforce the spiral of poverty. Frugal innovations for these LMIC healthcare markets hold the potential of bridging the challenges occurring in these markets with new technologies such as telehealth, big data, and rapid diagnostics, strengthening the LMIC healthcare markets significantly. However, analyzing these innovations, still, too many of these highly needed innovations do not end up realizing their potential. In the long term, many of these innovations seem to fail in finding long-term viable business models that make them able to scale and increase impact. The local adoption and implementation of these innovations create a challenge in accessibility, hindering scalability. Business model experimentation has proven to be the approach innovators use to design strong and viable business models. The extensive use of business model experimentation can be found following a multiple case study, analyzing four frugal innovators in LMIC healthcare markets. This research finds how frugal innovators follow cycles of experimentation. The innovators start with ideation, drafting a founding vision, leading to assumptions, and start testing these assumptions using experimentation practices. In the ideation phase, practices such as design thinking, the Business Model Canvas, and the Iron Triangle can help draft the assumptions to be tested. For business model experimentation, methodologies such as the Lean Startup framework, discovery-driven planning, and related practices are applied. The experimenting with assumptions results in either mismatch, leading to new assumptions, or results in learnings applied to the viable business model. Finding too many mismatches can lead to a dry-out of resources or the need for a pivot. Successful experiments lead to changes and tweaks in the business model. The studied cases have shown that most of these changes appeared in the Business Model Canvas's front-end, resulting in a better match with their target customers, using new channels, improving their value proposition, and an improved revenue model.

Overall, this research increases the understanding of viability, scalability, and accessibility relating to frugal innovation's success. For this, the strong use of business model experimentation by frugal innovators in LMIC healthcare markets is shown to be critical. Using the discovery-driven planning methodologies' reverse income statement is proposed to support the innovators in reaching this viability. Assessing viability in an early stage can create a mindset of scalability and accessibility early on, integrating these requirements strongly within the innovations. This leads to more long-term viable innovations and solving these LMIC healthcare markets' challenges.

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We live in a turbulent time, with the COVID-19 crisis still going strong, creating many victims both mentally and physically. When initiating my thesis at the beginning of 2020, I had never expected the topic of healthcare to be so extremely relevant. But as we focus on LMIC healthcare markets, similarly big infectious diseases have been weakening these LMIC markets for decades. This unequal divide in the world is something that motivates me to keep working on creating a change.

In the last two years, I was actively searching for the bridge that my studies in Innovation Management could make to create that change. It took me some hurdles of first starting a fair clothing brand that didn't take off, followed by me joining a team of social innovators here at the TU/e. With this team, I experienced how social innovations and tech for good could make this impact that I was longing for, but I could not fully give myself yet. Moving on, I met a team of inspirational, ambitious, crazy, passionate, and purpose-driven people who sparked my passion—creating a change in the LMIC healthcare sector, as this is where the world's needs are.

But to get this ball rolling, in the first place, I have to thank my thesis supervisor Annelies Bobelyn and my second supervisor Madis Talmar, who both worked on my (long) thesis drafts until something valuable was found. As I know that working from home and the COVID-19 created many challenges for both of you, I am even more grateful for the great help, flexibility, critical views, short- and long sessions, and overall guidance that you provided. Your efforts really helped me to develop myself personally and academically. Thank you! Furthermore, I would like to appreciate the time Dr. M. Cloudt has put into assessing my thesis, contributing to my graduation.

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I truly believe that frugal innovations can solve some of the biggest healthcare challenges that LMIC faces. If these innovations are created viably, major steps can be taken towards fair and accessible healthcare for everyone. So, working on these innovations is what the world needs to make a change. And yes, it is time for change, and I want to be the change that I wish to see in the world!

Sincerely, Jelle Schuitemaker, 's Hertogenbosch, 2021

*"For I can do everything through Christ, who gives me strength." (Philippians 4:13)*

# TABLE OF CONTENTS

|  |            |
|--|------------|
| <b>ABSTRACT</b>  | <b>II</b>  |
| <b>ACKNOWLEDGEMENTS</b>  | <b>III</b> |
| <b>1. INTRODUCTION</b>   | <b>1</b>   |
| 1.1 Problem Identification                                       | 2          |
| 1.2 Research Objective & Questions                               | 3          |
| 1.3 Structure of the report                                      | 4          |
| <b>2. SCIENTIFIC BACKGROUND</b>                                  | <b>5</b>   |
| 2.1 Creating Viable Business Models                              | 5          |
| 2.1.1 The background of viable business models                   | 5          |
| 2.1.2 Strategies and practices of business model experimentation | 7          |
| 2.2 The Context of Frugal Innovations in LMIC Healthcare Markets | 11         |
| 2.2.1 What distinguishes LMIC healthcare markets?                | 11         |
| 2.2.2 What distinguishes frugal innovations?                     | 13         |
| 2.2.3 Synthesizing the contextual factors                        | 15         |
| 2.3 Implications for research                                    | 17         |
| <b>3. METHODOLOGY</b>  | <b>18</b>  |
| 3.1 Research Approach  | 18         |
| 3.2 Selection of Case studies                                    | 19         |
| 3.2.1 Process of selection                                       | 19         |
| 3.2.2 Introduction to the cases                                  | 20         |
| 3.3 Data Collection  | 21         |
| 3.3.1 Semi-structured interview                                  | 21         |
| 3.3.2 Observation and secondary literature                       | 22         |
| 3.4 Data Analysis  | 23         |
| 3.4.1 First cycle explorative coding - deductive                 | 23         |
| 3.4.2 Second cycle descriptive coding - deductive                | 24         |
| 3.4.3 Visualizing the data using the BMC and Iron Triangle       | 25         |
| 3.5 Research Quality   | 26         |
| <b>4. RESULTS</b>  | <b>27</b>  |
| 4.1 Within-case Analysis   | 27         |

|   |            |
|---|------------|
| 4.1.1 Delft Imaging   | 27         |
| 4.1.2 Atomo Diagnostics   | 33         |
| 4.1.3 CarePay   | 39         |
| 4.1.4 Healthy Entrepreneurs   | 45         |
| <b>4.2 Cross-case Analysis</b>  | <b>51</b>  |
| 4.2.1 Working on the right value proposition  | 52         |
| 4.2.2 The creation of a viable business model   | 54         |
| 4.2.3 Patterns of business model experimentation  | 56         |
| <b>4.3 Answering the Sub-questions</b>  | <b>59</b>  |
| 4.3.1 Contextual factors: The challenges of LMIC healthcare markets and frugal innovations                  | 59         |
| 4.3.2 How do innovators come to viable business models  | 59         |
| <b>5. DISCUSSION</b>  | <b>63</b>  |
| <b>5.1 Viable Business Model Creation</b>   | <b>63</b>  |
| 5.1.1 Discussing the mains finding towards the ideal business model experimentation methodology             | 63         |
| 5.1.2 Validating the main assumptions: Early-stage viability hypotheses testing & discovery-driven planning | 67         |
| 5.1.3 Concluding the theoretical contributions  | 68         |
| <b>5.2 Practical Contributions</b>  | <b>69</b>  |
| <b>5.3 Limitations and Further Research</b>   | <b>69</b>  |
| 5.3.1 Research limitations  | 69         |
| 5.3.2 Suggestions for further research  | 70         |
| <b>6. CONCLUSION</b>  | <b>71</b>  |
| <b>REFERENCES</b>   | <b>73</b>  |
| <b>APPENDIX</b>   | <b>83</b>  |
| <b>Overview of Appendices</b>   | <b>83</b>  |
| <b>Appendix I. Business Model Canvasses case studies enlarged</b>   | <b>84</b>  |
| <b>Appendix II. Tables with relevant quotes by founders</b>   | <b>88</b>  |
| Background quotes Delft Imaging   | 88         |
| Background quotes Atomo Diagnostics   | 89         |
| Background quotes CarePay   | 91         |
| Background quotes Healthy Entrepreneurs   | 95         |
| <b>Appendix III. Interview protocol</b>   | <b>99</b>  |
| <b>Appendix IV. Business model experimentation modelling enlarged</b>                                       | <b>112</b> |

# List of Figures

|  |    |
|--|----|
| Figure 2-1. Business Model Canvas  | 6  |
| Figure 2-2. DFV hypotheses in Business Model Canvas  | 7  |
| Figure 2-3. Focus on uncertainty management in different methodologies (Masoori & Lackeus, 2019) | 10 |
| Figure 2-4. Five building blocks of the Lean Startup by Shephard & Gruber (2020)                 | 11 |
| Figure 2-5. Iron Triangle of healthcare  | 17 |
| Figure 3-1. Cycles of coding   | 24 |
| Figure 3-2. Final coding categories  | 25 |
| Figure 4-1. Business Model Canvas Delft Imaging  | 28 |
| Figure 4-2. Iron Triangle Delft Imaging  | 31 |
| Figure 4-3. Building blocks Lean Startup at Delft Imaging  | 32 |
| Figure 4-4. Business Model Canvas Atomo Diagnostics  | 34 |
| Figure 4-5. Iron Triangle Atomo Diagnostics  | 37 |
| Figure 4-6. Building blocks Lean Startup at Atomo Diagnostics                                    | 38 |
| Figure 4-7. Business Model Canvas CarePay  | 39 |
| Figure 4-8. Iron Triangle CarePay  | 43 |
| Figure 4-9. Building blocks Lean Startup at CarePay  | 44 |
| Figure 4-10. Business Model Canvas Healthy Entrepreneurs   | 45 |
| Figure 4-11. Iron Triangle Healthy Entrepreneurs   | 50 |
| Figure 4-12. Building blocks Lean Startup at Healthy Entrepreneurs                               | 51 |
| Figure 4-13. Iron Triangle cross-cases   | 53 |
| Figure 4-14. Business Model Canvass cross-cases  | 54 |
| Figure 4-15. Lean Startup building block cross-cases   | 56 |
| Figure 4-16. Base model experiments becoming viable  | 60 |
| Figure 4-17. Addition wrong assumptions  | 60 |
| Figure 4-18. Founding vision   | 60 |
| Figure 4-19. Full model experiments becoming viable  | 61 |
| Figure 5-1. Modes of change by Van de Ven & Poole (1995)   | 65 |
| Figure 5-2. BM Viability in Ideation and Experimentation   | 66 |

# List of Tables

|  |    |
|--|----|
| Table 3-1. Overview of Basics cases analyzed                     | 19 |
| Table 3-2. Questions semi-structured interview                   | 22 |
| Table 3-3. Overview of data sources and collection               | 22 |
| Table 3-4. Quote motivation founder Atomo                        | 24 |
| Table 3-5. Quote value proposition example Healthy Entrepreneurs | 25 |
| Table 4-1. Quote Motivation behind Delft Imaging                 | 28 |
| Table 4-2. Quote MVP value proposition Delft Imaging             | 29 |
| Table 4-3. Quote All-inclusive Value Proposition Delft Imaging   | 29 |
| Table 4-4. Quote viability business model Delft Imaging          | 29 |
| Table 4-5. Quote experiment revenue model Delft Imaging          | 30 |
| Table 4-6. Quote Understanding the market Delft Imaging          | 30 |
| Table 4-7. Quote Importance of Quality Delft Imaging             | 31 |
| Table 4-8. Quote Making mistakes Delft Imaging                   | 32 |
| Table 4-9. Quote early market entrance MVP Delft Imaging         | 33 |
| Table 4-10. Quote strategy planning Atomo                        | 34 |
| Table 4-11. Quote MVP testing Atomo                              | 35 |
| Table 4-12. Quote Strategy shift Atomo                           | 35 |
| Table 4-13. Quote business models Atomo                          | 36 |
| Table 4-14. Quote desirability feasibility challenges Atomo      | 36 |
| Table 4-15. Quote advice Lean approach Atomo                     | 38 |
| Table 4-16. Quote founding and validation story CarePay          | 40 |
| Table 4-17. Quote Marketing and sales CarePay                    | 40 |
| Table 4-18. Quote Brand credibility CarePay                      | 40 |
| Table 4-19. Quote pivot CarePay                                  | 41 |
| Table 4-20. Quote diffusing to Nigeria CarePay                   | 42 |
| Table 4-21. Quote Customer pull CarePay                          | 42 |
| Table 4-22. Quote disruptiveness brand CarePay                   | 43 |
| Table 4-23. Quote advice starting innovators CarePay             | 43 |
| Table 4-24. Quote Value proposition Healthy Entrepreneurs        | 46 |
| Table 4-25. Quote experiments Healthy Entrepreneurs              | 46 |
| Table 4-26. Quote Value proposition #2 Healthy Entrepreneurs     | 47 |
| Table 4-27. Quote marketing channels Healthy Entrepreneurs       | 48 |
| Table 4-28. Quote scaling strategy Healthy Entrepreneurs         | 49 |
| Table 4-29. Quote market uncertainty Healthy Entrepreneurs       | 50 |
| Table 4-30. Quote scaling-up Healthy Entrepreneurs               | 50 |
| Table 4-31. Quote Entry market Healthy Entrepreneurs             | 51 |
| Table 4-32. Overview relevant theories cross-cases               | 52 |

# List of Abbreviations

| Abbreviation | Description                        |
|--------------|------------------------------------|
| AD           | Atomo Diagnostics                  |
| BMC          | Business Model Canvas              |
| CHW          | Community Health Worker            |
| CP           | CarePay                            |
| DFV          | Desirability Feasibility Viability |
| DI           | Delft Imaging                      |
| HE           | Healthy Entrepreneurs              |
| HIC          | High-income countries              |
| IPO          | Initial Public Offering            |
| IT           | Iron Triangle                      |
| LMIC         | Low- and middle-income countries   |
| MNE          | Multinational enterprise           |
| MVP          | Minimum Viable Product             |
| NGO          | Non-governmental organization      |
| SME          | Small- and Medium-sized Enterprise |
| WHO          | World Health Organization          |

# 1. INTRODUCTION

One of the most donor-funded, promoted, and researched markets related to poverty and inequality are the low- and middle-income countries (LMIC) healthcare markets (Bloom et al., 2014; Peabody et al., 2006). As the World Health Organization (2003) states, the healthcare situation in many LMIC enforces the spiral of poverty, forcing the poor to stay poor. The 2020's COVID-19 crisis has underlined that the healthcare system is crucial for society's functioning. In this healthcare system, many NGOs, public health organizations, ministries of health, universities, and hospitals try to find solutions for problems that have been occurring in LMIC healthcare for decades. Examples of these initiatives are the many malaria-related studies, Ebola targeted help, and the eradication of Polio (Cochi et al., 2016). Since the start of the 21st century, LMIC markets started to change rapidly, driven by innovations and trends such as the internet, mobile phones, big data, and solar power. LMIC markets skip stages, such as fixed telephony, to quickly catch up with high-income countries (HIC) due to technology leapfrogging and technical breakthroughs (Lewis et al., 2012). As new technologies such as Artificial intelligence (Ai) in healthcare, digital health ecosystems, and big data become more available, the healthcare market holds similar chances. These innovations hold enormous potential to disrupt the LMIC healthcare industry (Lewis et al., 2012; Wyber et al., 2012).

Thus far, innovations in LMIC healthcare markets have barely proven this potential, with many innovations ending up as failed attempts or short pilot projects (Leonard et al., 2019). This problem is widely recognized by the WHO, UNICEF, and other NGOs (World Health Organization, 2014; 2019). One of the main reasons for failure is the lack of a suited business model to reach scale and ensure profitability. At the same time, this business model is highly needed to ensure the innovations' viability and pursue long-term impact. Arguing that finding a strong and innovative business model, leading to the innovations' viability, is often the most crucial and the most difficult phase for these innovations (Hwang & Christensen, 2008).

The market requires these innovative business models since finding viability for the innovations is crucial and complex as the funding from governments, private investments, and buying power of healthcare in LMIC are often low, creating a diffused landscape of payers, donors, and users (Mills, 2014). Luckily, the funding landscape is changing, with examples such as the Bill & Melinda Gates foundation, investing heavily in healthcare initiatives, and various SME's and MNE's actively selling in the LMIC market (Harman, 2016).

Research has focused a lot on either business models or frugal innovations in the last twenty years, but a big gap still exists in the literature despite all this research. Barely any research focuses on the business models side for healthcare innovations aimed at LMIC together. These business models, leading to viability, are expected to hold many differences in different markets, both technically, geographically, and socially (Mills, 2014).

LMIC healthcare markets hold many differences to HIC healthcare markets, such as buying structures, buying power, and market dynamics. Also, markets differ technically in doctors not used to working with advanced technology and socially in people's trust in the healthcare systems. These differences, among others, make the challenge in finding viability unique. When examining disruptive innovators in the LMIC healthcare market, disruptiveness in the business models is found (Hwang & Christensen, 2008). This occurs because innovators face a need to innovate in the business model to reach the base-of-the-pyramid LMIC customers, which can be substantiated by the complexity of the markets in buying power buying structure and market dynamics. A deep understanding of these markets is needed to develop such a disruptive business model in these markets. Business model experimentation, fueled by

modern approaches such as the Lean Startup framework, could provide the theoretical rigor to assist LMIC healthcare innovators in creating this understanding to create these disruptive business models. This process for frugal innovations in LMIC healthcare market might go different, as these innovations and markets seem to hold very different characteristics and challenges (Eldred & McGrath, 1997; Kumar & Jain, 2002; Oderanti, 2018).

## 1.1 Problem Identification

Most medical technology and innovations are designed for high-income markets, although only 16% of the world lives in these HIC countries. The 9% of the world living in low-income countries often are left with NGOs' efforts or donated medical systems, of which up to 70% fails to function in their setting (World Health Organization, 2019). However, when screening the literature and searching databases, many companies, individuals, NGOs, and institutes creating frugal healthcare innovations for these markets can be found. When diving deeper into these innovations, many of those innovations ceased to exist. For example, of the innovations mentioned in Labrique et al. (2018), only around 50% (6 out of 12) seem to be still active by looking at their online visibility.

In many cases, papers, videos, and websites of the innovations can be found, showing that the product technically worked and could have significantly impacted healthcare in LMIC. The reason why these products ceased to exist often seems that commercializing the product was the biggest challenge, and long-term viability couldn't be achieved. No follow-up products were created, and the founders moved on. Innovations failing in their commercial phases are not solely a problem for frugal innovations in LMIC healthcare markets but also innovations at large, as many research articles already pointed out, and the disappointing success rates support (Cierpicki et al., 2000; Hartley, 2005; Frattini et al., 2012). Frugal innovations in LMIC healthcare markets might be special in this case since, in many cases, the need for innovation is very big, and a problem/solution fit can be found easily by the innovator. The innovations have strong value propositions, but connecting these to the right revenue streams with a sustainable business model leaves a big challenge (Hwang & Christensen, 2008).

As already mentioned briefly, the challenge for frugal innovations in LMIC healthcare markets lies in the commercialization phases, leading to viability. This is already substantiated heavily in previous literature studies of Lewis et al. (2012), Peters et al. (2008), Janssen & Moors (2013), and Collins et al. (2016). The rather complex environment, the different market dynamics, financial structures, and the overall complexity of the market makes many MNE's, SME's and new startups reluctant to sell their innovations in these LMIC markets (Bloom et al., 2014; Mills, 2014). For example, Lewis et al. (2012) reported that up to 47% of technology-enabled healthcare innovations in LMIC relied primarily on donor funding, and up to 22% coming from the government. These dynamics leave them questioning and researching how they can successfully commercialize their healthcare innovations for these markets, making their innovation viable in the long term. A quote describing the problem from the research of Hwang & Christensen (2008) being: *"In health care, most technological enablers have failed to bring about lower costs, higher quality, and greater accessibility."* Hwang & Christensen believe that the primary reason for this is a lack of business model innovation leading to commercial failure in the long term. More concretely, since in the LMIC healthcare sector, financing of healthcare is handled very differently than in HIC, likely, business models that work perfectly in HIC cannot function in LMIC. This means that instead of disruptive technical innovation, the main need is in disruptive business model innovation to commercialize LMIC healthcare innovation and create viability. However, when scanning the literature, not much is known about this context of business model experimentation and innovative business model design for frugal innovations in LMIC healthcare markets. The researcher expects that knowledge about this business model design and -experimentation can be captured in case studies of successful LMIC healthcare innovators.

Combining these problems and observations leads to the following problem statement:

*"Promising and highly needed innovations targeted at low- and middle-income country healthcare markets often fail in the long-term. The main reason for this is that the innovators lack the knowledge and skills to create long-term viable business models, while these business models are critical for these healthcare innovations' sustainability. Especially the settings of LMICs and the frugality of innovations make this process more challenging, reducing the chances to reach scale and long-term impact."*

## 1.2 Research Objective & Questions

This thesis explores why healthcare innovations for low- and middle-income countries often struggle with creating viable business models. The thesis deepens out the effects of the LMIC market in this situation and analyses best practices of successful healthcare innovations for LMIC. It does so by focusing on the business model side of these innovations. This leads to an analysis of healthcare innovations for LMIC and provides implications on how companies can design, experiment, and innovate in their business model to make their healthcare innovations in LMIC long-term viable. Altogether, this research can help startups and corporates create stronger healthcare innovations for these markets, improving the accessibility, affordability, and quality of healthcare overall by improving their innovations' long-term viability.

The research objective is translated into the main research question. To properly answer this main question, four sub-questions are created. The main research question is constituted as follows:

***How do starting frugal innovators come to viable business models for their innovations for low- and middle-income country healthcare markets to make their innovations profitable and scalable for the long-term?***

This research question serves the goal of this research to provide frugal innovators in LMIC healthcare markets with the tools, learnings, and best practices needed to come to viable business models that make sure that these innovations can have a big and long-term impact.

### *Part I. Creating viable business models*

For answering this main question, it is important to first understand the concept of business models, the viability of business models, and how business model experimentation can foster this viability; this is described in the first part (I). The context and theory behind viable business models are examined to get to this point, using the following sub-question.

- *SQ 1A. What is a viable business model for an innovator?*

Second, to arrive at this viable business model, innovators need to go through business model experimentation. Yet, the nature of the LMIC market introduces many uncertainties, making this process even more challenging. Therefore, the following sub-question was formulated.

- *SQ 1B. What is business model experimentation, and which strategies and practices can be distinguished for innovators? (i) How are these strategies applied in various cases of frugal innovators in LMIC healthcare markets?*

### *Part II. The context of frugal innovations in LMIC healthcare markets*

After Part I, in the second part (II), a second sub-question is drafted to get a common understanding of the challenges that the LMIC healthcare markets and the frugal innovations bring to the development of viable business models. This increased understanding of the market and the innovations leads to the

crucial implications that need to be taken into account when researching viable business models for healthcare innovations. This sub-question aims to understand how and why these markets differ so much to better understand why healthcare innovators have challenges implementing their solutions to these markets.

- *SQ 2. What specific challenges do the context of LMIC healthcare markets and the challenges of frugal innovations bring for the creation of viable business models for these innovators?*

Answering these sub-questions supports answering the main research question. This supports the goal of providing frugal healthcare innovators with the tools, learnings, and best practices needed to come to viable business models, making sure that these innovations can have a big and long-term impact.

### **1.3 Structure of the report**

The second chapter of this research describes the scientific background which this research evolves around. In this scientific background, established theories supporting this research are introduced, and various theories are linked by both a theoretical and analytical framework. The third chapter describes the methodology used. The results of the research are analyzed in the fourth chapter, elaborating the empirical part. In this empirical part, within-case analysis and cross-case analysis are done with the selected case studies leading to an empirical answering of the sub-questions. In the fifth chapter, the discussion and the key insights are discussed together with the practical and theoretical implications and suggestions for future research. Lastly, the sixth chapter concludes the research, providing implications for starting frugal healthcare innovators and concluding remarks.

## 2. SCIENTIFIC BACKGROUND

This chapter describes the literature and theoretical background of this research. First, the background of viable business models is introduced, followed by introducing business model experimentation. This background is synthesized to provide theoretical insights to sub-question 1A and 1B, needed as a starting point for answering these sub-questions. The second subchapter focuses on the contextual factors that LMIC healthcare markets and frugal innovations bring to this process of experimentation and business model viability. After an introduction, the second sub-question is elaborated from the theoretical side. Furthermore, the contextual factors are synthesized, and a model for doing so is introduced. Finally, the implications from the theory for this research and its aim are summarized. Altogether, it is concluded that further empirical research is needed in answering the main research question and its sub-questions, using this theoretical background as a starting point for doing so.

### 2.1 Creating Viable Business Models

#### 2.1.1 *The background of viable business models*

For existing-, and starting companies, entrepreneurs, and executives, understanding business models and designing these business models, is often seen as the most important task. The business model determines the way companies will do business, and without a strong and viable business model, a company is deemed to fail. But designing a strong and viable business model is not that easy as many factors come into play, and many assumptions have to be taken. That is why, for this process of designing viable business models, business model experimentation comes into play (Andries et al., 2013). With modern business model visualization tools, such as the Business Model Canvas, this process has taken flight (Osterwalder & Pigneur, 2010). By experimenting with a business model, the feasibility, desirability, and viability of the models can be tested. Approaches for doing so, such as 'the Lean Startup framework,' have increased interest among scholars in the last years. Overall, central to this paragraph is sub-question 1A: *What is a viable business model for an innovator?*

*What are business models?*

The central definition for business models is that *a business model reflects the way that an organization creates, delivers, and captures value, thereby describing the underlying logic of the organization*. This definition is used for further analysis. Following Massa et al.'s (2017), a business model's function is also the *'conceptual representations of how a business functions, entailing the visualization and conceptualization of a business model.'* The literature argues that a process of business model design occurs both across and within firms to create strong business models. Choices need to be made if a novelty-centered or an efficiency-centered business model design is chosen, focusing on creating something new or improving an existing market model. Important design elements for designing business models are the content, structure, and governance of transactions. Altogether, especially novelty-centered business models significantly influence entrepreneurs' success, arguing for an increased focus (Miles & Snow, 1978; Zott & Amit, 2007).

Business models can be visualized to quickly capture how an organization creates, delivers, and captures value. The most renowned tool for doing so is the Business Model Canvas. This canvas supports entrepreneurs in understanding and visualizing the often complex relationships active in business models, which is especially relevant in testing hypotheses (Fritscher & Pigneur, 2014; Osterwalder & Pigneur, 2010)(Figure 2-1).

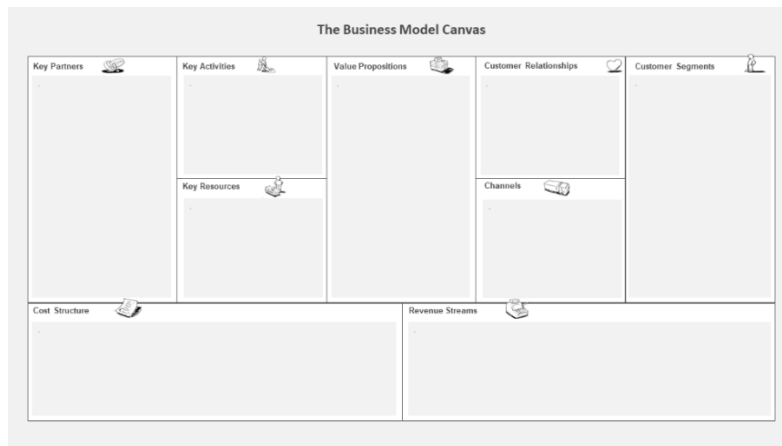


Figure 2-1. Business Model Canvas

The canvas conceptualizes a startup in more than just a product or solution; this is the first step to a repeatable and scalable business model. It captures the key partners, key activities, key resources, cost structure, value proposition, customer relationships, customer segments, channels, and revenue streams of a business. The canvas can be clustered on the right side, called the 'front-end' of the Business Model Canvas, and the left side, being called the 'back-end' of the canvas. The front-end focuses on the product-market fit, involving the customers, channels, value proposition, and revenue streams. In contrast, the back-end focuses on the key partners, -activities, -resources, and cost structure (Günzel & Holm, 2013).

Altogether, it can be concluded that understanding, designing, and visualizing business models is vital for creating success for innovators.

#### *What makes a business model viable?*

The business model's viability aspect describes if the business model, and with that, the business and innovation will survive in the long-term (Chesbrough et al., 2006; D'Souza et al., 2014; D'Souza et al., 2015; Magretta, 2002). This means that an organization needs to generate revenues to cover its costs and capture enough growth margins (Osterwalder & Pigneur, 2010).

#### *Long-term vs. short-term viability*

In theory, a difference between short-term viability and long-term viability can be found. Innovation can be short-term viable, driving enough margins and being profitable in its business case, but that does not necessarily mean it's viable in the long term. Long-term viability means that the innovation creates enough value for all stakeholders, ensuring they do not search for alternatives and keep repurchasing or using the innovation (Chesbrough et al., 2006). Long-term viability is also often labeled as a sustainable business model. For a business model to be viable, both short-term viability and long-term viability need to be aligned.

Overall, the Business Model Canvas by Osterwalder and Pigneur (2010) can be used to visualize the aspects of viability by the DFV hypotheses, using the DFV version of the Business Model Canvas by Bland & Osterwalder (2019), as visualized in Figure 2-2. This tool provides visual insights into how changes occurring in the Business Model Canvas can be coupled to the various types of experiments done by the innovators. This provides a unique view of how business model experimentation principles lead to organizational learning and overall organizational changes. As one of these principles focuses on viability, it is expected that innovators go through significant changes in these aspects pursuing viability.

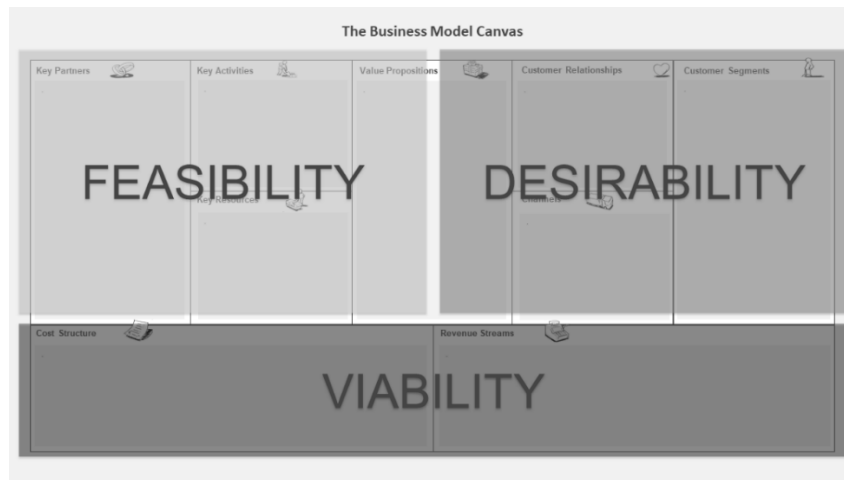


Figure 2-2. DFV hypotheses in Business Model Canvas

### 2.1.2 Strategies and practices of business model experimentation

When designing business models, a process of trial-and-error learning is applied, using small experiments to gradually come to a viable business model (Martins et al., 2015). The computational complexity and dynamic complexity of the business model urge the need for experimentation. The discovery-driven approach to business models also provides this need for experimentation. This theory concludes that '*strategies that aim to discover and exploit new models must engage in significant experimentation and learning*' (Afuah & Tucci, 2001; Zott & Amit, 2010). As disruptive innovation is often coupled to innovative business models, this discovery and experimentation are crucial for innovators aiming to disrupt. Central to this paragraph is getting a theoretical understanding of the methodologies and practices supporting business model experimentation, following sub-question 1B: *What is business model experimentation, and which strategies and practices can be distinguished for innovators?*

#### *Business model experimentation*

Over the past decade, entrepreneurship research has started to investigate the process of business model experimentation. Research on business models has substantiated strongly that business model experimentation is needed to reduce uncertainty in a business model (Bland & Osterwalder, 2019; Blank, 2006; Blank, 2013; Blank & Dorf, 2012; Osterwalder & Pigneur, 2010; Ries, 2011). As Andries et al. (2013) argue in their paper "*Simultaneous Experimentation as a Learning Strategy: Business Model Development Under Uncertainty*," ventures operating under uncertainty face challenges defining a sustainable value proposition. Using effectual logic, entrepreneurs implement and test certain elements of a business model in experiments. Negative outcomes in experiments lead to refinements in the business model and trigger the launch of new experiments (Minniti & Bygrave, 2001; Wright et al., 2004). This means that experiments' outcomes can be directly incorporated into a business model, building overall viable business models (Gruber et al., 2008).

In literature, the theory of business model experimentation is grounded in organizational learning theory, describing how organizations learn in the market and maneuver their business based on these learnings.

#### *Organizational learning theory*

Andries et al. (2013) argue that organizational learning theory has been active in explaining how organizations learn over time and propose two main experimental approaches under uncertainty. The

first approach is that organizations learn through a process of stepwise, incremental changes. Step by step, different components are tested by experiments, and it is analyzed if these steps improve performance (Levinthal, 1997). This process is defined as 'local search' or 'related search.' In this process, solutions are always in the immediate neighborhood of the existing configuration since only small tweaks are made. The second approach is that organizations learn through so-called 'distant search' or 'search through long jumps.' In this approach, organizations simultaneously test and experiment with multiple components in the process. This leads organizations to experiment with configurations at a distance from their current configurations (Levinthal, 1997). This proves that organizations can change their business model by applying 'local search' or 'distant search' to develop their business model further (Andries et al., 2013). The authors conclude that focused commitment as an approach is often used for entrepreneurial activities. Still, this focus limits business model experimentation and limits chances of finding a viable business model, hampering long-term survival. On the other side, when Simultaneous experimentation is executed in a disciplined manner, using carefully selected business models, the chance of identifying a viable business model can be increased significantly. This fosters long-term survival (Andries et al., 2013). Modern approaches such as the Lean Startup framework foster the learning-by-doing focus of an organization, creating stronger and more deliberate organizational learning. As concluded by Leatherbee & Katila (2020), empirical research on entrepreneurial methods holds a great promise in better understanding how new business ideas are formed and shaped (Leatherbee & Katila, 2020).

Complementary to organizational learning theory, the theory of discovery-driven planning can be found in literature, arguing for organizational learning in the early stages to map the main assumptions of an innovation or business (McGrath, 2010).

#### *Discovery-driven planning theory*

In literature, authors McGrath and MacMillan have focused on the theory of discovery-driven planning as a disciplined process to uncover, test, and revise a business model's assumptions (McGrath & MacMillan, 1995; McGrath & MacMillan, 2009). The method's goal is to systematically convert assumptions to knowledge and redirect its activities in the face of emerging understanding (McGrath & MacMillan, 2000, p. 243). The authors identified that innovators failed due to an excess of funding, untested assumptions, and too few opportunities to redirect when new information was found. Discovery-driven planning offers a way to move an innovation faced with many unknowns forward (McGrath & MacMillan, 1995). The theory poses creating a reverse income statement based on the envisioned margins or goals. This income statement has to be benchmarked against the market and similar products, determining how realistic it is. After this, the innovator should determine what reaching this goal means for his business operations. So, what actions, products, services are needed to achieve the envisioned goal. Based on these actions, the underlying assumptions should be mapped, with the most crucial assumptions first. Lastly, these assumptions should be translated into milestones, where on each milestone, a decision can be made whether to invest more time and money (McGrath & MacMillan, 1995; McGrath & MacMillan, 2009). Overall, the logic behind discovery-driven planning is to reduce uncertainty by systematically converging assumptions to knowledge and redirecting activities in the face of emerging understanding (Mansoori & Lackeus, 2019).

Modern literature focuses strongly on reducing these uncertainties in business models. One of the most renowned and researched methods in the current decennia is the Lean Startup framework (Ries, 2011; Shephard & Gruber, 2020). This theory is based on principles coming from the discovery-driven planning theory. It provides more practitioner-oriented tools for applying systematic testing principles and validating assumptions to direct the activities in the right direction.

As the Lean Startup framework is grounded in discovery-driven planning principles, the focus and content of the two methodologies differ. One focal point of differentiation is how iterative the models are. The Lean Startup framework focuses on a highly iterative process, including many major feedback

loops. The discovery-driven planning methodology includes relatively minor feedback loops (Masoori & Lackeus, 2019). Also, where the Lean Startup framework focuses highly on customer interactions and provides tools to do so, the discovery-driven planning methodology does this less. It focuses more on activities that need to be completed by the focal entrepreneur (Masoori & Lackeus, 2019). Lastly, discovery-driven planning is more of a scientific-focused methodology, whereas the Lean Startup framework is a more practitioner-focused methodology. This makes the Lean Startup focus more on providing tools and tactics for managing different aspects of the venture creation process (Masoori & Lackeus, 2019).

### *The Lean Startup framework*

By diving deeper into the Lean Startup framework, one finds that the Lean Startup framework originated from the theory and classes of Steve Blank and his scholar Eric Ries. Eric Ries applied the principles from Steve Blank in his own business and wrote them down in the bestseller 'the Lean Startup' (Ries, 2011). The logic behind the Lean Startup framework can be summarized as 'reducing uncertainty through a systematic approach to formulating working guesses about the idea and testing the validity of them' (Masoori & Lackeus, 2019). Shephard and Gruber (2020) summarize in their paper *'The Lean Startup framework: Closing the Academic–Practitioner Divide'* how the Lean Startup framework consists of five building blocks. The mentioned building blocks are (1) the flexible business model, (2) validated learning/customer development, (3) the minimum viable product (MVP), (4) perseverance vs. pivoting, and (5) market-opportunity navigation (Shephard & Gruber, 2020). The Lean Startup framework fits very well with existing business model experimentation literature. The framework uses market-opportunity navigation models (Gruber & Tal, 2017), the Business Model Canvas (Osterwalder & Pigneur, 2010), and models for customer development and validated learning, making it relevant to explore further. As many authors argue, the methodologies of discovery-driven planning and organizational learning theory are intertwined with the Lean Startup framework, laying the theoretical foundation (Shephard & Gruber, 2020).

Altogether, the Lean Startup framework is argued to be a useful tool for innovators in designing, experimenting, and changing their business model towards viability (Blank, 2013; De Cock et al., 2020; Felin et al., 2019; Koen, 2015; Osterwalder & Pigneur, 2010; Ries, 2011; Shephard & Gruber, 2020; York, 2018).

### *Synthesizing the different practices of business model experimentation*

The process of business model design and -experimentation contributes to organizational learning theory. While running deliberate experiments and applying a learning-by-doing and trial-and-error style of innovating, the companies learn how their business model functions and how it can be improved to make it more stable and viable for the long term. The theories of distant vs. local search, simultaneous experimentation vs. focused commitment, discovery-driven planning, the Lean Startup framework, and related tools, such as the Business Model Canvas, provide strong business model experimentation strategies and practices. These methods have in common that they can be broken down into two main steps.

The first step (1) is the deliberate creation, planning, mapping, and documenting of the main assumptions and hypotheses following a business model or innovation at large. Multiple methods can be used to come to these assumptions and hypotheses. The differences in effectiveness are not yet proven significantly in the literature.

The second step (2) is to run experiments, tests, and pilots to create validated learnings on the assumptions and hypotheses. Again, various strategies and methods can be found, such as creating MVPs or running multiple pilot studies. Either failing or successful, these experiments should end up in validated learnings, which support the innovators in getting closer to a strong business model design.

Overall, the Lean Startup methodology is argued to offer the most practitioner-oriented approach for experimentation and is used for further analysis.

The goal of following these steps is to reduce uncertainty. The reduction of uncertainty differs a bit among different tools. Figure 2-3 visualizes how the Lean Startup methodology is a more practitioner-grounded tool, focusing more implicitly on reducing uncertainty, while discovery-driven planning is doing this more explicitly (Masoori & Lackeus, 2019).

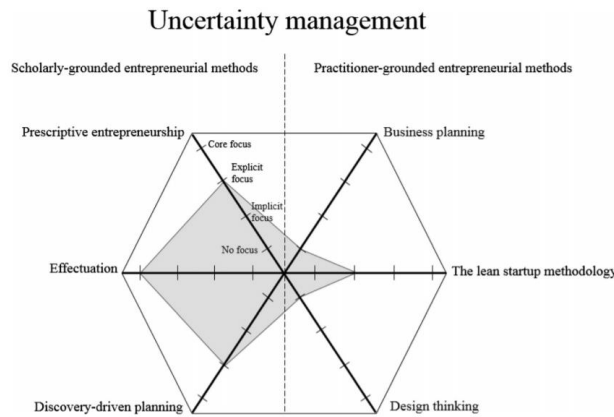


Figure 2-3. Focus on uncertainty management in different methodologies (Masoori & Lackeus, 2019)

Above all, these tools focus on reducing market uncertainty as the tools support innovators to find out how the market reacts to innovations. Market uncertainty also captures demand uncertainty, price uncertainty, cost uncertainty, and profit uncertainty as these uncertainties are directly related to the market. Following Brillinger et al.'s (2020) paper '*Business model risk and uncertainty factors: Toward building and maintaining profitable and sustainable business models*' major business model risks that can be captured using the experimentation processes are in the field of the customer, the offer, the infrastructure, the financial viability, and the environment. Based on this taxonomy, all business model experimentation models focus mainly on customer risks and uncertainty, based on the Business Model Canvas's front-end.

In the last decade, business model experimentation seems to have converted into a few main used, practitioner-oriented tools. These tools come first from design science, using Desirability, Feasibility, and Viability (DFV) as the main assumptions on which a business needs to be tested. Second, the Business Model Canvas of Osterwalder and Pigneur (2010) has become central to testing and validating parts of the business model. Third, the Lean Startup methodology, grounded and building on many earlier theories such as discovery-driven planning and organizational learning theory, has become a central philosophy.

It is argued to use these practitioner-oriented tools to learn from the innovators' processes on business model experimentation for creating viable business models. Reasons for doing so are that these tools can intertwine with each other seamlessly and provide a strong practitioner-oriented lens to make sense of the process innovators go through. As the Business Model Canvas and DFV hypotheses on the canvas are introduced, the Lean Startup framework can be introduced accordingly. The Lean Startup framework is introduced using the classification of Shephard and Gruber (2020) on the five core building blocks of the Lean Startup framework. Based on these five building blocks, the cases can be examined in their use and experiences with business model experimentation principles. The five building blocks by Shephard and Gruber (2020) are visualized in Figure 2-4.

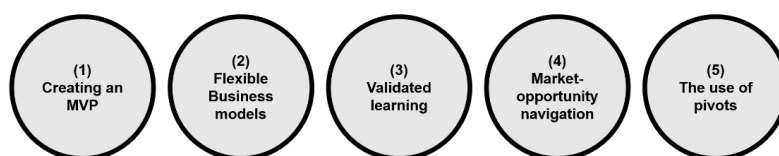


Figure 2-4. Five building blocks of the Lean Startup by Shephard & Gruber (2020)

Altogether, this literature and these models are designed by HIC innovators, mainly in the 21<sup>st</sup> century, often based on technology innovations, to offer strategists a way to consider options in uncertain, fast-moving, and unpredictable environments (McGrath, 2010). The LMIC healthcare markets and the frugal innovations might show different characteristics, raising the question if this process goes similarly for frugal innovators in LMIC healthcare markets.

## 2.2 The Context of Frugal Innovations in LMIC Healthcare Markets

As introduced, many LMIC healthcare systems have been struggling with big problems for decades. The markets are challenged by big, often infectious, diseases such as polio, tuberculosis, Ebola, HIV, and Malaria. Luckily, these diseases have been eradicated in many HIC markets by new medicines, vaccines, and modern technology. The healthcare systems put enormous pressure on the often financially unstable countries facing this burden of these diseases. In recent years, new interest was gained for an innovation trend called frugal innovations. These frugal innovations are innovations especially targeted to make existing technology and innovations less complex and more affordable. This makes the innovations more suitable for new customer groups, such as the LMIC markets. These frugal innovations hold major opportunities for solving problems that occur in these LMIC markets. The LMIC healthcare markets are at the forefront of applying these types of innovations since major technological breakthroughs such as the internet, big data, and mobile telephony can be applied in this area, solving some of the biggest challenges of LMIC healthcare markets.

This sub-chapter elaborates the context of LMIC healthcare markets and frugal innovations to analyze if these contexts make business model experimentation towards viability any different. First, a brief introduction to the LMIC healthcare markets is given, followed by a conclusion on what factors make this market different. Second, a brief introduction to frugal innovations is given, followed by a conclusion on what these innovations diversify from other innovations. Lastly, these contextual factors are synthesized to conclude if and how these contextual factors make business model experimentations different.

### 2.2.1 What distinguishes LMIC healthcare markets?

In general, the LMIC healthcare market is a big and diversified market that can differ significantly depending on the context. This study focuses on the total ecosystem of care present in certain countries, offering care to citizens, described as the LMIC healthcare market. This includes primary, secondary, and tertiary care and intertwined contingencies such as quality medicines, health insurance, and health policies (Cringles, 2002). In general, the LMIC healthcare market is one of the most crucial parts of global challenges related to poverty and income inequality. As many researchers point out, the health of a country on GDP, and the health of people physically, in these countries are directly related to the health system (Gwatkin, 2001; Mackintosh, 2003). This makes the LMIC healthcare market extremely important in solving many societal challenges since many of these challenges are related to poverty.

### *What characterizes the LMIC healthcare market?*

Research explores many different topics, relations, and constructs within the LMIC healthcare system. Most of these relationships are generalized over LMIC or specific LMIC-regions such as parts of Africa. The focus of the information included is on innovation, financing, commercialization, and generalized basic information. Examining the LMIC healthcare markets, it can be found that on (1) access to healthcare, the (2) costs of healthcare, and the (3) quality of healthcare, the LMIC healthcare markets are drastically lacking behind compared to many HIC healthcare markets (Bloom et al., 2008; Goes et al., 2019; Mills, 2014; Peters et al., 2008; World Health Organization, 2019). This can be understood using the Iron Triangle of healthcare by Kissick (1994). Improving these three terrains leads to trade-offs as improving quality can spike up the costs and can reduce the accessibility of healthcare. Some underlying problems and constraints have to do with a lack of education, skills, equipment, and resources to deliver the right quality of care. Also, access to good transportation, clean drinking water, and other system requirements make it hard to make big leaps in improving this situation and making the LMIC healthcare markets very complex in general (Bloom et al., 2014; Harding & Preker, 2002). The funding and financing landscape of LMIC healthcare markets is closely related to some of these issues mentioned before. The relative decrease in the out-of-pocket costs and the need for donor funding gives off a good sign that change is coming for the future. In literature, many authors underline that innovations such as digital health, big data, mobile phones, and ICT can significantly drive change in the LMIC healthcare landscape in the coming years if implemented well. These innovations hold the potential to increase accessibility and quality and decrease the health system's costs at large (Bloom et al., 2014; Christensen et al., 2009; Lewis et al., 2012; Stroetmann, 2018; Wyber et al., 2012).

Altogether, this paragraph illustrates the number of differences between HIC and LMIC healthcare markets, such as the link to poverty, the ecosystem constraints, the scattered financing landscape, and the big potential for innovations to make a change. These differences are very much generalized but prove the relevance for a detailed understanding of these markets and their sub-markets for innovations to be successful. Reducing the LMIC healthcare markets' uncertainty is of big importance for all LMIC healthcare innovators.

### *Key factors distinguishing LMIC healthcare markets*

When analyzing the key factors distinguishing LMIC healthcare markets, it is important to consider that although the LMIC healthcare market is huge, consisting of many different cultures, backgrounds, and situations, some generalizable principles can be found.

First, examining the overall market using the Iron Triangle of healthcare framework (Kissick, 1994), it can be concluded that the LMIC healthcare market struggles largely with their affordability, accessibility, and overall quality of care. As these factors influence each other, improving the situation in these LMIC is easier said than done. An example of this is that to make quality care accessible to remote areas, large distances need to be crossed. Many LMIC lack the infrastructure to do so easily. This makes that the affordability, as well as the quality, will go down if accessibility goes up. As the total market must be seen from a system perspective, starting healthcare innovators need to take these system constraints into account when innovating. This means that improving quality should not decrease affordability largely, or improving accessibility should not decrease quality largely. In HIC healthcare markets, the Iron Triangle of healthcare also applies, but the axes tend to influence each other in less extreme ways (Collins et al., 2016). For HIC markets, less pressure is put on the total innovativeness, and customers can already be satisfied with a 10% cost reduction or a 10% quality improvement. This has to do with the lower complexity of the market, the overall competitiveness, and the customers' financial stability (MacGregor & Carleton, 2011). Due to the strong and competitive market, improving the quality of a certain product barely influences the affordability or accessibility of the product. If it does, normal supply and demand mechanisms get into play. For innovations to LMIC healthcare markets, a much stronger need for innovativeness on all axes is needed to get into the

complex market, compete with the current solutions, and find paying customers (Burns, 2014; Mahmud, 2015). This creates stronger influences of the Iron Triangle's various axes on each other since a ten times cost reduction can influence the quality strongly. Altogether, it is important to take the stronger influences of the three axes on each other in LMIC healthcare markets into account when innovating in these markets.

Second, as the 2020s COVID-19 showed worldwide how big infectious and deadly diseases could put enormous pressure on healthcare systems at large. As mentioned above, even in HIC markets, this can result in healthcare markets getting into crisis mode, combatting these diseases. In practice, this can result in a dry-out of finances, stressed-out health workers, and postponed purchases or interventions. In the last decades, LMIC healthcare markets have been combatting numerous infectious and deadly diseases such as HIV, Malaria, Ebola, Polio, and tuberculosis (Harding and Preker 2002; Bloom et al., 2014). In many of these cases, HIC markets had the finances and possibilities to respond timely, by vaccination, distancing, or educating, while many LMIC markets did not have these possibilities. For innovators in these markets, a certain kind of flexibility and adaptability to these healthcare systems pressures is crucial to consider. Not adapting to these changes can result in a dry-out of financing and a shift in attention away from the problem aimed to solve. This can be linked to a demand-side type of uncertainty.

Third, like the burden of these big diseases putting pressures on the healthcare systems, resulting in a need for flexibility, the LMIC healthcare markets' uncertainty is also at large something to consider. This uncertainty is only partially created by these diseases' burden; much of this uncertainty can be appointed to other factors. One of the main factors mentioned in many research papers is the political instability of the LMICs (Harding and Preker 2002; Bloom et al., 2014). Political instability can lead to a supply-side uncertainty in funding, being dependent on the donors' agendas. Due to the often big shifts in power, fueled by the many fraud elections, coups, and dictators, LMIC markets can change overnight. These power shifts sometimes mean that HICs supporting LMICs with donor-funding stop parts of their funding, major NGOs withdraw their resources, and the complete financing landscape changes. Although some positive shifts in power can be found (e.g., Rwanda, South Africa), many of these shifts have negative consequences (e.g., Burundi, Congo). These types of political instability and this uncertainty at large are not or barely occurring in HIC.

Fourth, as mentioned before, the LMIC healthcare markets rely heavily on donor-funded finances, programs, projects, and knowledge. This donor funding can be up to 27 percent of the total healthcare expenditure in a low-income country (World Health Organization, 2019). Next to these big donor-funded finances, many LMIC healthcare markets also rely heavily on out-of-pocket costs from the consumers. These out-of-pocket costs can be up to 48 percent of the total healthcare expenditure in low-income countries (Mills, 2014). Designing health insurance programs for the low-income groups of the LMIC markets has been failing since these low-income consumers have to spend their budgets on basic survival needs, enforcing the existence of out-of-pocket payments. The lack of affordable health insurance programs for the lower-income groups of countries widens this healthcare expenditure gap even more. While in HIC, strong health insurance policies overcome these challenges, ensuring that out-of-pocket costs stay payable. The overall financial stability of HIC makes sure that no donor-funded programs are needed, giving HIC governments more flexibility on how to spend their budgets.

## ***2.2.2 What distinguishes frugal innovations?***

### *What are frugal innovations?*

From the analysis of the frugal innovation literature, various conclusions can be drawn. The increased interest in the frugal innovation phenomena has led to clear boundaries and distinctions on when and how to label an innovation frugal. The definition of Rosca et al. (2017) on frugal innovation is used as

a primary source for further analysis. The author states that frugal innovation is "*an inclusive approach to innovation that maximizes value for customers, shareholders, and society, while significantly reducing the use of financial and natural resources in developing countries*" (Rosca et al., 2017). Furthermore, as multiple authors argue, frugal innovations are not exclusively about products, but more importantly, they often require new business models, pricing strategies, and additional services (Davidson, 2015; Hossein, 2017; Kahle et al., 2013; Prabhu & Gupta, 2014). Altogether, using these definitions, various key challenges and implications for frugal innovations can be found.

#### *The potential of frugal innovations for LMIC healthcare markets*

Frugal innovations focus especially on creating innovations that work for LMIC markets, increasing accessibility and quality, and decreasing the health system's costs at large (Bloom et al., 2014). These innovations hold enormous potential in healthcare markets, being one of the crucial markets related to poverty (Gwatkin, 2001; Mackintosh, 2003). It can be argued that if more frugal innovations can be applied successfully in LMIC healthcare markets, strong progress can be made in reducing poverty and inequality (Bloom et al., 2014; Christensen et al., 2009; Lewis et al., 2012; Stroetmann, 2018; Wyber et al., 2012). Many innovations created purely for LMIC healthcare markets can be characterized as frugal innovations since the market brings hard requirements for frugality. However, in the current situation, most innovations used in LMIC healthcare markets are not designed for these markets but ended up there, for example, by being donated, either second hand or new NGOs (World Health Organization, 2014; 2019).

#### *Key factors distinguishing frugal innovations*

Following the introduction and background mentioned above, a conclusion can be drawn on the key factors distinguishing frugal innovations. First, for principles that apply to frugal innovations, a clear coupling to the Iron Triangle of healthcare can be made. The frugal innovations are created with the vision to improve accessibility to the innovation or solution while making the innovation more affordable (Bhatti, 2012; Basu et al., 2013; Bhatti et al., 2013; Hossain, 2017; Rosca et al., 2017). These two factors are strongly linked together as products often need to be more affordable to increase their accessibility. By doing so, the innovation becomes relevant for new, often lower-income, markets. Since these innovations need to be more affordable, a small decline in the product's quality can occur, but this is often not preferred. By reducing complex and irrelevant functions, focusing on scale, and innovating in business models, frugal innovators still keep the quality high.

In many cases, the innovation quality is still better than alternatives since these alternatives are second-hand, donated, or old technologies. Altogether, it is crucial for frugal innovators in the LMIC healthcare market to map the innovation to the Iron Triangle to compare the currently used alternatives and estimate if the innovation is likely to be desirable to the target audience. If the innovation is not innovating strongly on all axes, serious concerns should be raised if the innovation will be adopted and diffused successfully (Davidson, 2015; Hossein, 2017; Kahle et al., 2013; Prabhu & Gupta, 2014).

Second, it is substantiated by Hwang & Christensen (2008), Rosca et al. (2017), and Slater & Mohr (2006) that frugal innovations often can be labeled as disruptive innovations. The frugal innovations reach and create new markets, making new technologies, products, or services available to a new customer group. For disruptive innovations, the often mentioned challenge is that getting early customer feedback is hard. The famous quote by Henry Ford visualizes this phenomenon very well "*If I had asked people what they wanted, they would have said faster horses*" (Vlaskovits, 2011). In LMIC healthcare markets, similar principles can appear when asking stakeholders in the industry about their needs. While for disruptive innovations, getting to a new market, customer feedback is very important since no clear knowledge, data or cases are available. For the healthcare market, end-user feedback is of even greater importance as this is needed to get medical systems regulated. Prototyping and pilot studies provide mitigation strategies for getting early customer feedback. Fueled by the design principles theory,

experiments and tests finding desirability, feasibility, and viability can be run to overcome this hurdle (Bland & Osterwalder, 2019). Also, modern approaches such as the Lean Startup framework can be used to argue for the need for business model experimentation.

Third, the strong need for frugal innovations to be affordable is mentioned often (Bhatti, 2012; Basu et al., 2013; Bhatti et al., 2013; Hossain, 2017; Rosca et al., 2017). To reach this affordability, often low margins are present in the innovations. Key findings from business models of frugal innovations are first that the business models are based on low costs and relatively low margins. Second, the business models that operate successfully in the LMIC markets build on local resources and capabilities, making these local capabilities an important success factor (Rosca et al., 2017). As mentioned, to still create a viable business case around these innovations, scalability is of great importance. However, for scaling the innovations, a broad diffusion of the innovation is often needed. As Gold et al. (2013) and Hossein et al. (2016) argue, diffusing frugal innovations is very difficult, as not many innovators succeed. Diffusing these innovations is so difficult because the innovations are often created in one specific environment, with strong local dependencies on partners, culture, and geographic locations. Better diffusion strategies and policy and governmental support can enable more scalability for these innovations (Gold et al., 2013; Hossein et al., 2016). Also, an important implication for frugal innovators coming from these principles is that the innovations need to be created with scalability and diffusion in mind from the very beginning and that innovations can be tested simultaneously in various settings, markets, and with various business models (Gruber et al., 2008). As for healthcare specifically, designing with end-users is key; this has to be done with scalability in mind, making sure that healthcare innovations do not only work in certain areas, departments, or countries (Arshad et al., 2018; Hossein, 2017; Labrique et al., 2018).

Fourth, although for disruptive innovations to be successful, a strong vision, combined with an extreme focus, is needed. It can be argued that for frugal innovations, a stronger need for flexibility needs to be prevalent. This is needed because frugal innovations are often applied in uncertain LMIC markets, such as the LMIC healthcare markets. In these markets, major shifts in political stability, finance, and safety can appear overnight (Harding and Preker 2002). Also, cultures and markets among the various LMIC can differ a lot; for this reason, innovators have to stay open to keep changing their innovations to the context in which the innovation is applied. The need for being agile as frugal innovators are substantiated by Radjou, arguing for the need to think and act horizontally (Radjou & Euchner, 2016). The character of the founders of these frugal innovations, especially in healthcare, plays a crucial role since they need to balance flexibility with focus and combine this to a strong vision and willingness to change the system (Davidson, 2015; Janssen & Moors, 2013). Healthcare entrepreneurs leading the innovations often play an important role in the success of the innovation, a willingness and need to change the system, and the world for the better is strongly required to overcome the barriers that frugal healthcare innovations often experience (Davidson, 2015; Janssen & Moors, 2013). From healthcare giant 'GE' can be learned how this flexibility, focus, and vision requires adaptations in their organization to fit the innovation processes to the markets (Ramdorai et al., 2013).

### ***2.2.3 Synthesizing the contextual factors***

Synthesizing the contextual factors of the LMIC healthcare markets and the frugal innovations argues for the specific challenges these contextual factors hold over other innovations or markers. A conclusion is drawn on how the contextual factors opt for a specific need for business model experimentation in this context, and a model is proposed to capture these challenges. This synthesis is based on the second sub-question.

*SQ 2. What specific challenges do the context of LMIC healthcare markets and the challenges of frugal innovations bring for the creation of viable business models for these innovators?*

First, the (1) strong disease burden that has been pressuring the LMIC healthcare markets for centuries is an important factor to consider when innovating for the LMIC healthcare markets. This factor can be combined with the (2) strong political instability that LMIC markets at large face. Fueled by rapid power shifts, fraud elections, coupes, and related problems. With this big disease burden, political stability, and related problems, the LMIC healthcare markets are highly uncertain. Critically, for LMIC, parts of this uncertainty are not necessarily solved by more experimentation, such as political instability and disease burdens. In these highly uncertain markets, starting healthcare innovators have to navigate through the challenges and opportunities, staying flexible and not becoming dependent on one market at large. As Andries et al. (2013) argue in their paper discussing 'Business model development under uncertainty' opts for the high uncertainty in a market for a more deliberate experimentation process. Overall the uncertainty of the markets has characteristics of Knightian uncertainty, increasing the relevance of experimentation principles (Andries et al., 2020)

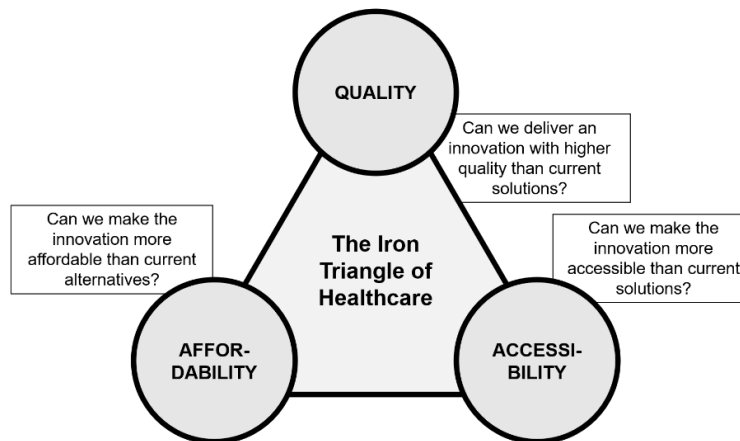
Second, as the LMIC healthcare markets can be labeled as highly uncertain, the sheer complexity of the markets can be elaborated. LMIC healthcare markets have very diversified financing structures compared to HIC markets. In these settings, up to 27 percent of the healthcare expenditure can rely on donor funding and up to 48 percent on out-of-pocket costs. Also, many LMIC healthcare markets lack strong healthcare insurance policies, and healthcare providers at large lack the buying and purchasing power to afford high-quality equipment and staff, relying heavily on donors. Altogether, this enormous dependency on donor-funded programs and the lack of strong health insurance systems create big and complex financing streams and an overall highly complex market. Understanding these financing streams, creating business models that work with these streams, and advocating for their solutions is needed for healthcare innovators in LMIC markets to be viable in the long term. This argues for a strong need to understand how this market works, especially how the financing works, and innovating in business models to tap into these complex financing streams.

Third, next to the high uncertainty and high complexity of the markets, also frugal innovations face similar challenges. As frugal innovations are often disruptive innovations, opening up a new market, reaching a new group of customers, radically innovating in the market, these innovations face a high uncertainty. This uncertainty entails if the innovation is even desirable by the new group of customers, questioning if the product will be adopted. Also, major uncertainties arise if the product is feasible to build for an affordable price to these markets and if the product can be made accessible to this new customer group. These innovation uncertainties argue for a strong need for proofing that the innovation works, followed by proofing that the business model surrounding the innovations works.

Fourth, next to the high uncertainty of the frugal innovations, frugal innovations are often highly complex. These complexities have to do with the challenge a frugal innovator faces in making the product affordable but still of high quality and highly accessible. The often very local adaptations of the product increase the complexity in diffusing the product rapidly, making overall affordability even more difficult. This complexity also translates to the innovators' character and organization, opting for a strong vision and focus and high flexibility. The variable that, in many cases, the LMIC market is not even the home market for many frugal innovators can improve the complexity as cultural differences can also play a role. This overall complexity of the innovations argues for a strong need to understand the innovation in its context. Business model experimentation can provide the tools to do so.

Altogether, the (1) highly uncertain markets and (2) overall high market complexity of the LMIC healthcare markets, combined with the (3) high uncertainty and (4) high complexity of the frugal innovations, opt for a special need for the use of deliberate tools, methods, and experiments for the innovators (Andries et al., 2013; Brillinger et al., 2020; Sainio et al., 2012). With popular business model experimentation principles, organizational learning theory can provide such tools, methods, and experiments needed to increase these innovations' overall viability (Bland & Osterwalder, 2019; Levinthal, 1997; Osterwalder & Pigneur, 2010).

Lastly, the Iron Triangle of healthcare (Kissick, 1994) is proposed to capture the unique challenges that the frugal innovators in LMIC healthcare markets face (Figure 2-5). The Iron Triangle balances the market's needs with the frugal innovators' requirements in overall affordability, quality, and accessibility; these characteristics link directly to the value propositions needed for healthcare innovations. This connects the Iron Triangle to the Business Model Canvas. The tool visualizes how choices made across the three axes are done and what methods are used to make these choices. This gives unique insights into how the frugal innovators facing uncertainty and complexity navigate the uncertain and complex markets, getting viable innovations.



*Figure 2-5. Iron Triangle of healthcare*

## 2.3 Implications for research

Overall, it can be argued that for frugal innovators in LMIC healthcare markets, business model experimentation should have a special and strong focus. This can be based on the contextual factors coming from literature, summarized in subchapter 2.2, and business model experimentation principles as mitigation strategies overcoming these contextual factors. The uncertainty and complexity of the market, combined with the innovations' uncertainty and complexity, argue for this focus.

In current literature, no clear cross-over is made between the strong need for business model experimentation for frugal innovators in LMIC healthcare markets. That is why this research aims to empirically show how business model experimentation is done differently by the innovators. It can be found how the innovators come to viable and long-term sustainable business models using a practical and theoretical approach. This process is visualized using the Business Model Canvas and the Iron Triangle of healthcare.

### *Foundations of this research*

It can be concluded from the discussed topics and scientific background that this thesis research solves multiple purposes regarding the existing literature. First, this research addresses a gap in the literature, existing between the cross-over between the specific use of and need for business model experimentation by frugal innovators in LMIC healthcare markets. Second, this research builds on existing research on organizational learning theory and business model experimentation, providing practical insights into companies' processes in finding their business model. Third, following companies' business models' changes over their commercializing stages, searching for viability, this research provides new insights into organizational change theory.

### 3. METHODOLOGY

This chapter is written to describe the methodology used in conducting this research. First, the research approach that is used is elaborated based on the research question and its sub-questions. Second, the selected cases are elaborated and introduced. Third, the methods used for collecting data on the case studies are elaborated. Fourth, the methods used for analyzing this data are described. Finally, a subchapter is written, examining the quality of this research by assessing the reliability and validity.

#### 3.1 Research Approach

The main question leading this research is a 'how' formulated question, arguing that findings that explain why certain phenomena appear can be answered best with a qualitative approach. Following Mack's (2005) article "Qualitative research methods: A data collector's field guide," and Creswell et al. (2007), research approaches can be divided into five categories: (1) narrative research, (2) case study research, (3) grounded theory, (4) phenomenology, and (5) participatory action research. The combination of this research being unpredictable contemporary research with a how question, lacking preliminary research, argues strongly for a case study approach. The case study approach is suited for this to deeply investigate the phenomena appearing, revealing some aspects of causality (Eisenhardt, 1989; Mills et al., 2009)

Next to these theoretical reasons to come to a case study design, more practical reasons for opting for this design can be given. The reasons to do so is that first, (1) the case study design gives the possibility to learn in-depth from successful frugal healthcare innovators in LMIC by deepening out their strategies used, best practices, experimentations, and complications in building their businesses. Second, (2) the case study research provides the input for deductively finding relevant practices, strategies, and tactics to support starting LMIC healthcare innovators. Third, (3) the rather complex, uncertain, and unknown nature of these LMIC markets and the innovations arising opts to qualitatively understand the gist of the why and how questions support entrepreneurs to pursue these innovations.

Altogether, the structure around a multiple-case study approach researching the frugal innovators in LMIC healthcare markets is chosen because it captures the different strategies, business model innovations, and actions used by these innovators and fits with the multiple levels of analysis of the study (Pettigrew, 1992; Yin, 1994). Collecting data in a case study can be done via documents, archival records, interviews, direct observations, participant observations, and physical artifacts (Creswell et al., 2007; Yin, 2003).

##### *Introduction to methodologies used*

In this multiple-case study research, the chosen case studies are first researched using both primary and secondary sources around the cases (Creswell et al., 2007; Yin, 2003). The combination of theoretical- and empirical insights is also used for answering the sub-questions supporting the overall research question using both inductive and deductive methods (Elo & Kyngäs, 2008).

Theoretical analysis is used to substantiate and create a basis for answering the research questions. In the existing literature, both research papers, market analysis, and case studies can be found. This existing literature is crucial for developing the understanding of the market, problem, and current innovations and serves as guidance in finding and filling the gap existing in the literature. Using the snowballing technique (Wohlin, 2014), citations and references are used to find more relevant articles substantiating the research. In the literature review done for this research, inclusion and exclusion criteria are defined. Databases used for searching the relevant articles are Google Scholar, JSTOR,

Wiley, and ScienceOpen using search terms such as "healthcare innovations," "Frugal innovations," "Low- and middle-income country healthcare," "Africa healthcare market" alongside other terms related.

An empirical analysis will be done to support the theoretical analysis with practices from the industry. This empirical analysis consists of in-depth, semi-structured interviews, combined with observations of cases. This combination creates case studies that will be analyzed and used, creating qualitative research. Altogether, four (N=4) case studies of LMIC healthcare innovations are used based on the process of selection for the case studies in subchapter 3.2.

## 3.2 Selection of Case studies

### 3.2.1 Process of selection

For selecting the case studies used in this research, various exclusion and inclusion criteria are used. Hard exclusion criteria that are defined are (1) Companies that cannot (yet) show a clear product-market fit; (2) Companies that have not yet proven their business model; (3) Companies that are not registered as a commercial business, so no foundations; (4) Companies that are created in the last three years; (5) Companies that are not active in LMIC healthcare markets, and; (6) Companies founded longer than 15 years ago that cannot actively tell and remember their first steps

Parallel to these exclusion criteria, also inclusion criteria are used. These inclusion criteria partly overlap with the exclusion criteria' opposites but are not limited to these criteria. Inclusion criteria defined are (1) Companies that are founded or initiated in HIC countries and innovate for LMIC countries; (2) Companies active in the LMIC healthcare markets; (3) Companies that can be labeled as an SME in size of revenue and number of employees; (4) Companies that clearly have an innovative value proposition, and; 5) Companies with founders actively willing to participate in the study.

In the case studies' selection process, three other companies were left out based on the inclusion and exclusion criteria. One of these companies had not yet proven a clear product-market fit. One of these companies did not have a founder/director willing to participate. One of these companies was legally a foundation, so not commercially relevant for this research.

Based on the inclusion and exclusion criteria, four (N=4) case studies were found that were conforming to all criteria set. The data sources used to compel the case studies are summarized in subchapter 3.3 on data collection. Based on these data sources, the basics (size, revenue, date of start) of the cases are retrieved and summarized in Table 3-1. The semi-structured interviews held with the founders/early directors of these cases, and the observations on these cases, lead to transcripts full of information on the commercialization, business models, and learnings of the case studies.

*Table 3-1. Overview of Basics cases analyzed*

| <b>COMPANY</b>               | <b>DELFT<br/>IMAGING</b>  | <b>ATOMO<br/>DIAGNOSTICS</b>                                       | <b>CAREPAY</b>  | <b>HEALTHY<br/>ENTREPRENEURS</b>  |
|------------------------------|---|--|---|---|
| <b>MARKET</b>                | Healthcare - MedTech  | Healthcare – Diagnostics   | Healthcare – insurances   | Healthcare - community health   |
| <b>VALUE<br/>PROPOSITION</b> | One-stop Tuberculosis screening clinics, x-ray systems, and Ai software | Innovative blood-testing devices for Malaria, HIV, and other tests | M-TIBA, Kenyan healthcare insurance platform connecting patients, clinics, and insurers | Deploying community health workers with products, education, and training in rural Africa |
| <b>YEAR OF<br/>START</b>     | 2013  | 2010   | 2015  | 2012  |

|                                     |   |                                   |                 |                              |
|-------------------------------------|---|-----------------------------------|-----------------|------------------------------|
| <b>SIZE COMPANY<br/>(EMPLOYEES)</b> | 30  | 50                                | 190             | 50                           |
| <b>SIZE COMPANY<br/>(REVENUE)</b>   | ~10 mln   | ~2 mln                            | ~2 mln          | ~2 mln                       |
| <b>HIC OFFICE</b>                   | The Netherlands   | Australia                         | The Netherlands | The Netherlands              |
| <b>LMIC OFFICE</b>                  | Ghana   | South-Africa                      | Kenya           | Uganda                       |
| <b>REGIONS<br/>ACTIVE</b>           | West Africa, East Africa, the Middle East, South America, Asia-pacific, Northern Asia | Global, mainly Sub-Saharan Africa | East-Africa     | East-Africa, (+Haiti, Congo) |
| <b>COMPANY<br/>PHASE</b>            | Scaling-up  | Scaling-up                        | Scaling-up      | Scaling-up                   |

Although the companies differ greatly in the sort of innovation done, major similarities do appear, conforming to the exclusion and inclusion criteria. All case studies are SME's (<250 employees), active in a scaling-up phase with a proven value proposition and business model. All case studies are active in the LMIC healthcare markets and show strong and proven innovations in these markets. All studied cases are founded or initiated in HIC (Australia or the Netherlands) and actively work in LMIC markets (Ghana, Kenya, Uganda, South Africa), with a center of gravity on Sub-Saharan African markets. Lastly, all companies were founded last decade and are less than 15 years old.

Altogether, these similarities are important to consider when doing cross-case analysis on the data retrieved from the case studies. Expected is that the origins, phase, size, and markets of the companies will show similar challenges for the innovators.

### **3.2.2 Introduction to the cases**

To better understand the cases studied, a brief introduction of the company and its value proposition is given. This introduction is elaborated in the Results chapter of the research.

#### *Delft Imaging*

Delft Imaging is a Dutch SME active in the field of tuberculosis (TB) screening using X-ray machines, combined with algorithms to detect TB easily. The company was (re-)founded in 2013 by Guido Geerts, an expert, CEO, and managing director in the field of X-ray systems and medical software. The company developed the CAD4TB software and algorithm and coupled this to robust and durable X-ray systems. This system together made the diagnosis of TB much easier, more affordable, and of higher quality than the previous solutions (Melendez et al., 2016; Pomykala et al., 2019).

#### *Atomo Diagnostics*

Atomo Diagnostic is an Australian SME that was founded in 2010. Atomo Diagnostics (Atomo) is active in rapid, point-of-care blood testing devices for fast and early detection and diagnosis of Malaria and HIV. Atomo has designed an innovative tool that integrates multiple steps of point-of-care testing into one device. This tool is sold for less than \$1 per test. With this tool, errors that arise when using parts of the tests individually can be reduced. This increases the tests' reliability significantly, which solves a big problem, especially with less trained healthcare workers, in low resource settings.

### *CarePay*

CarePay is a Dutch-Kenyan SME (Scale-up) creating financial technology (Fintech) solutions for the Kenyan healthcare market. CarePay created the product 'M-TIBA,' a digital healthcare wallet used by more than 4 million Kenyans, to connect health insurance (public & private) with healthcare providers and users. CarePay is a spin-out from Dutch NGO PharmAccess that makes healthcare more financially accessible to rural LMIC populations. The official company was founded in 2015, after two years of research within PharmAccess. M-TIBA's value proposition is that it couples insurers, users, and healthcare providers in one central platform, making transactions cheaper, easier, more accessible, and fair. Starting with mainly offering free or donor-funded healthcare options to low-income populations, M-TIBA is now transitioning more towards services for health insurance companies for finding a scalable and profitable revenue model.

### *Healthy Entrepreneurs*

Healthy Entrepreneurs is an SME founded in the Netherlands by Joost van Engen (CEO) and Maarten Neve back in 2012. The company is active in Uganda, Tanzania, Kenya, and Ghana, of which Uganda holds the LMIC headquarters and the majority of the staff. The company was founded to bridge the gap in reaching rural populations with quality medicines, hygiene products, and basic health education. Healthy Entrepreneurs (HE) founded the model to source for existing Community Health Workers (CHW) in rural areas, which were supplying and educating their communities. These CHW could then become Healthy Entrepreneurs by signing up to the HE program and paying an upfront fee of \$40. The entrepreneurs become the Healthy Entrepreneurs organization's salesforce, selling quality medicines and hygiene products fairly. HE keeps margins of these products, basically being a distributor to the mobile pharmacists.

## **3.3 Data Collection**

Various methods for data collection are used for this multiple-case study research. For this data collection, principles of triangulation are used to validate data on its reliability and validity. The methods used for data collection are summarized in their frequency and use in Table 3-3.

### **3.3.1 Semi-structured interview**

Following the interview protocol from Appendix III, a semi-structured interview is the main source of the data used. This interview was for three of the four cases following initial conversations with the interviewed founders/directors, which provided the necessary focus and input in asking the right questions in the interview protocol. An extensive literature review on frugal healthcare innovation, commercialization, and LMIC healthcare markets provided this interview protocol's input. For this interview, the requirement was to interview a key player in founding the company from an idea to startup to scale-up. In three of the four cases, the (ex-)CEO & founder could be interviewed, where in one case, only a co-founder and design director was present. These interviewed founders/directors all had the credibility and experience for the semi-structured interview. The semi-structured interviews were conversations between 87 and 115 minutes long, providing at least 18 pages of transcripts per interview. The interview protocol was initially based on the Business Model Canvas by Osterwalder and Pigneur (2010). This Business Model Canvas was chosen to visualize the business model easily and show changes in the business model through the years. This commonly used, practitioner-oriented model was chosen to help the interviewees easily talk about their business model and understand the nature of questions more simply. Next to this Business Model Canvas, more in-depth questions were asked from relevant literature in frugal innovation, LMIC healthcare markets, and business model

experimentation, as elaborated by the scientific background in the second chapter of this research. Question 6.3 in Table 3-2 below provides examples of such a question coming from secondary literature.

Table 3-2. Questions semi-structured interview

| <b>NO.</b>         | <b>CATEGORY</b>              | <b>QUESTION</b>  |
|--------------------|------------------------------|--|
| <b>[1.1]</b>       | <b>Introductory</b>          | <i>“Can you briefly introduce your company, telling the name, how, why, and when the company started, and what it does?”</i>   |
| <b>[3.2]</b>       | <b>Business Model Canvas</b> | <i>“3.2 Value proposition: In the first market introduction phases, what were your products and services? What is the job you get done for your customer? What value is created/offered?</i><br><i>3.2.1 How were these chosen? What research did go into this choice? 3.2.2 Was this choice driven by customer demand or by an innovation activity? 3.2.3 Were these products developed/designed in close collaboration with the customer? (lean)</i><br><i>3.2.4 How did this change over the years?</i><br><i>3.2.5 How is this in the current situation?”</i>  |
| <b>[6.3]</b>       | <b>In-depth</b>              | <i>From Winterhalter, Zeschky, Neumann, Gassmann; Business models for Frugal innovation in Emerging markets: The case of medical device and laboratory equipment. Business models in the context of frugal innovation differ from BM in developed markets (Eyring et al. 2011; George et al., 2012; Landau et al., 2016). BM are either low-cost replicas of the Western market's business models or completely new business models.</i><br><br><i>6.3 Is the business model specially tailored to the LMIC setting, or is it a similar business model as used in Western settings? 6.3.1 To what extent? 6.3.2 What is new, which innovations are done?</i> |
| <b>[14.3-14.4]</b> | <b>Ending questions</b>      | <i>14.3 “What would you do differently if you would be starting tomorrow in the LMIC healthcare markets?”</i><br><i>14.4 “What advice would you give to starting LMIC healthcare innovators?”</i>  |

### 3.3.2 Observation and secondary literature

Before and after these interviews, for each case, at least five articles were read on subjects related to the studied cases' business model, as well as video conferences, presentations, and information sent by the entrepreneurs interviewed. In the last year, all companies are followed closely on their online channels via LinkedIn, the news, and their websites. These observations and secondary literature were used to better understand the case studies before the semi-structured interview and get into more depth when having the interview. After the interview, more sources to complement were asked and sent by two out of the four participants. Furthermore, multiple secondary literature sources and observations were used to triangulate the data. A brief summary of the data sources used is given in Table 3-3 below.

Table 3-3. Overview of data sources and collection

| <b>COMPANY</b>            | <b>DELFT IMAGING</b> | <b>ATOMO DIAGNOSTICS</b>        | <b>CAREPAY</b>          | <b>HEALTHY ENTREPRENEURS</b> |
|---------------------------|----------------------|---------------------------------|-------------------------|------------------------------|
| <b>INTERVIEWEE (ROLE)</b> | Founder & CEO        | Co-founder & ex-design director | Co-founder & CEO Africa | Founder & CEO                |

|  |     |     |    |    |
|--|-----|-----|----|----|
| <b>INITIAL CONVERSATIONS</b>                               | 2   | 2   | 1  | 0  |
| <b>LENGTH OF INTERVIEW (MINUTES)</b>                       | 115 | 106 | 99 | 87 |
| <b>INTERVIEW TRANSCRIPT (PAGES)</b>                        | 21  | 22  | 21 | 18 |
| <b>ARTICLES ABOUT COMPANY READ</b>                         | 5   | 6   | 10 | 8  |
| <b>VIDEO CONFERENCES AND PRESENTATIONS</b>                 | 2   | 3   | 5  | 7  |
| <b>OBSERVATION COMPANY VIA ONLINE CHANNELS (IN MONTHS)</b> | 15  | 10  | 10 | 10 |

### 3.4 Data Analysis

In this subchapter, the methods used for analyzing the data are elaborated. This analysis is done in three phases. First, getting an overall feeling of the data was initiated by the researcher. This was followed by a more in-depth and theory-driven analysis of the data. This analysis was followed by visualizing the data to retrieve the insights more visually.

#### *Getting a feeling with the data - inductive*

Based on the transcripts, audio fragments, and secondary data retrieved from the case studies, a process of preliminary exploration is initiated. In this preliminary exploration, the insights of the various case studies are investigated. This exploration aimed to get a first feeling of the data, analyzing the transcripts, and holistically coding interesting patterns in the data.

#### *3.4.1 First cycle explorative coding - deductive*

A first mapping of the case studies is done based on the interview protocol, Business Model Canvas (Osterwalder, 2010)(Appendix I), and other literature supporting the interview protocol (Appendix III). This first mapping was the start of the within-case analysis that can be found in the Results chapter. Based on this process, the need for a coding scheme to attract more in-depth results cross-case arose.

This process was followed by the first cycle of coding using a deductive method as a top-down approach to qualitative coding data (Elo & Kyngäs, 2008). The coding scheme is based on supporting theories such as the Lean Startup framework (Shephard & Gruber, 2020), the Business Model Canvas (Osterwalder & Pigneur, 2010), the DFV framework (Bland & Osterwalder, 2019), and additional theories on frugal innovations. Codes and conceptual groups were formed using these theories. The codes and conceptual groups that stood out in the data were on (1) Business Model Canvas, (2) business model experimentation practices, (3) the importance and character of the founder leading the innovation (Table 3-4), (4) the frugality of the innovations, (5) the importance of reference sales, (6) the importance and role of legitimacy and credibility, and (7) the influence of disruptiveness on the commercialization.

Table 3-4. Quote motivation founder Atomo

|   |                    |  |
|---|--------------------|--|
| <b>Category:</b><br><b>founder</b>      | Ex-design director | “So his daughter was born, and when his daughter was born, she had some defects and had to go to the hospital a lot, and there was a lot of blood testing, and this is where he said, ‘I think we need to improve how we do point-of-care blood testing.’” |
| <b>Code:</b> <i>personal experience</i> | Atomo Diagnostics  |  |

When taking this within-case results to a holistic cross-case analysis, major similarities appearing in the data were next to (1) overall Business Model Canvas, also on (2) business model experimentation, (3) the founders, and (4/7) the frugality and disruptiveness of the innovations. To improve transparency, many of the quotes coming from this coding are added in Appendix II.

### 3.4.2 Second cycle descriptive coding - deductive

Following this first cycle of coding, the second cycle of more descriptive coding was initiated. A theory-driven analysis is used to code the data on existing theories; this can be done following a coding scheme directly originating from literature (Schreier, 2012). This research is grounded in theory from the paper of Levinthal (1997) describing organizational learning in organizations. Based on organizational learning theory, business model experimentation literature such as simultaneous experimentation (Andries et al., 2013), the Lean Startup framework (Blank, 2013; Ries, 2011; Shephard & Gruber, 2020), and Business Model Canvas (Osterwalder & Pigneur, 2010; Bland & Osterwalder, 2019) are used. Furthermore, theory on frugal innovations and LMIC healthcare markets, such as the Iron Triangle of healthcare (Kissick, 1994), is used to pinpoint the strategies and phenomena found in data. This is initially done within-case and is later analyzed cross-case, and this process is visualized in Figure 3-1.

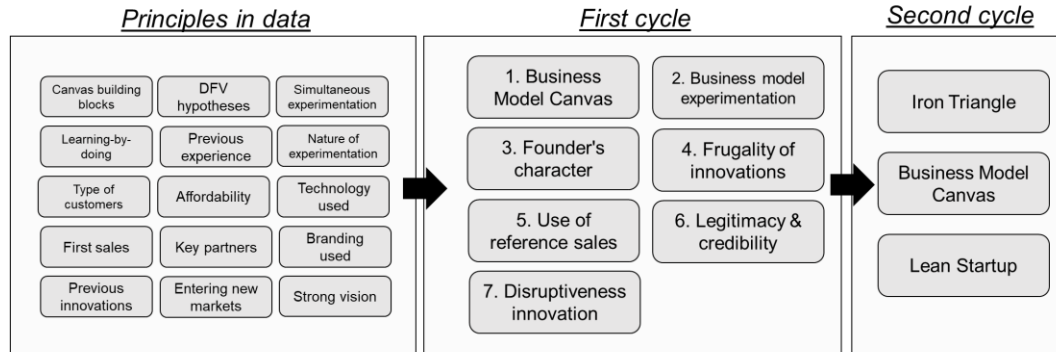


Figure 3-1. Cycles of coding

### Coding scheme

The need for a coding scheme emerged from analyzing the semi-structured interviews. From this first cycle coding scheme, 15 codes are created, which were not limited and could be further extended. As named above (Figure 3-1), these codes were grouped into seven categories to reduce the complexity and diversity. The chosen coding scheme is based on analyzing and comparing the various case studies with each other, applying subjective sense-making, and comparing these similarities to base theories and secondary literature. Following the first coding cycle, the need for a more detailed and clustered second coding scheme emerged.

After further analyzing the data and linking it to theory, three main categories with codes stood out and were chosen for further analysis based on a second coding cycle. These categories were first, the Business Model Canvas, with nine codes linking to the canvas building blocks (Table 3-5). Second, the Iron Triangle, with three codes linking to the axes of the triangle. Third, the principles of the Lean

Startup framework are used. This is done to capture the full business model and Iron Triangle of innovations to understand how their businesses function. Following this methodology, the changes or evolutions appearing in the Business Model Canvas and Iron Triangle are researched. This is done to capture how organizations learn over time, leading to the use of experimentation. Lastly, the Lean Startup framework principles are used to pinpoint this process of experimentation.

Table 3-5. Quote value proposition example Healthy Entrepreneurs

|                                |                       |  |
|--------------------------------|-----------------------|--|
| <b>Category: BMC</b>           | Founder & CEO         | “There's a real market-need filling a gap inefficiency in the supply chain in the very last mile making sure those products really reach the last mile where any public or donor-oriented organized products and solutions proved not to work. So the only thing we knew is we needed to do it differently.” |
| <b>Code: Value proposition</b> | Healthy Entrepreneurs |  |

The qualitative data analysis tools integrated into the QDA miner software are used to analyze the categories further. From these tools, the figures are created in the result chapter, based on the codes appearing in the data, showing how quotes in the interviews lead to experiments and evolutions on the BMC, Iron Triangle, and Lean Startup building blocks. This full process is visualized in Figure 3-2.

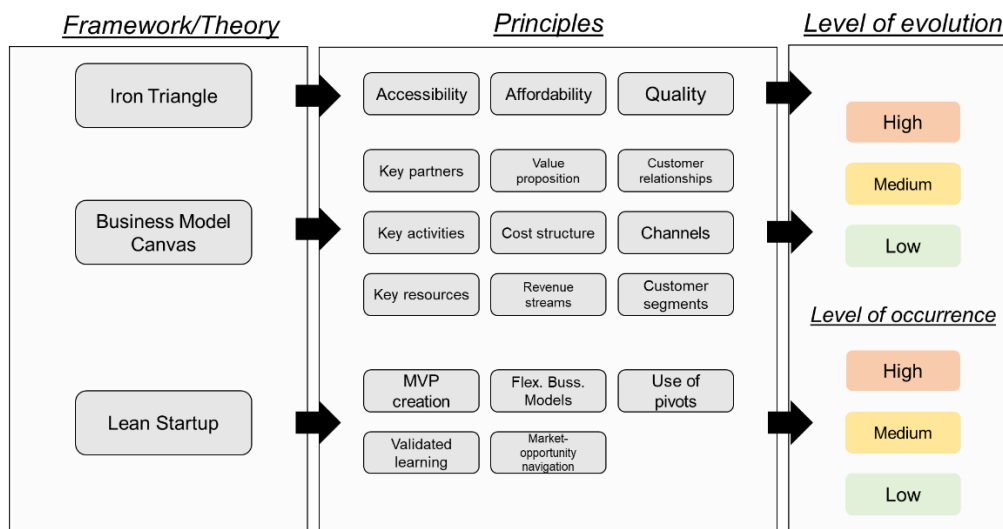


Figure 3-2. Final coding categories

### 3.4.3 Visualizing the data using the BMC and Iron Triangle

After these two phases of coding, the third phase was initiated with the goal to better structure and visualize the results that were retrieved. This third phase uses the Business Model Canvas (Osterwalder & Pigneur, 2010) and the Iron Triangle of healthcare (Kissick, 1994) to visualize the business model's evolutions and overall innovations. Furthermore, it uses the five building blocks of the Lean Startup framework by Shephard & Gruber (2020). Using a color-coding scheme with the colors green, yellow, and red, respectively, barely any change, some/medium change, and full/pivotal change were visualized (Figure 3-2). This gave a quick visualization of the evolutions happening over the years at the innovators.

Ultimately, this resulted in Figures 4-1 till 4-12 in the results chapter, visualizing the Business Model Canvas and Iron Triangle changes first within-case. This multiple-case study aims to learn from both within- and cross-case. The visualizations were brought together, enabling cross-case comparison (Figure 4-13, 4-14, 4-15).

### *Within-case and Cross-case*

The analysis of the results is split into a within-case and a cross-case section. An analysis of the changes happening in the case is done, following the Business Model Canvas and Iron Triangle in the within-case section, concluding how business model experimentation is used and how this created evolutions in the studied case. The biggest similarities and differences between all cases are analyzed based on the within-case section's analysis. This is done in the cross-case section. The cross-case sections lead to generalized conclusions based on the differences and similarities, which are discussed afterward.

## **3.5 Research Quality**

Assessing construct validity, external validity, and reliability is extra important for research following a case study approach (Yin, 2017). Some researchers argue that especially external validity is often questionable for studies using a case study design. Therefore, models to assess the construct validity, external validity, and reliability are used to analyze the overall quality and substantiate this research's scientific rigor.

First, the construct validity is elaborated. The construct validity answers whether *the knowledge created accurately describes the studied phenomenon* (Yin, 2017). Answering this question assures that construct validity can be created, which is done by incorporating multiple sources for data in the research, using triangulation methods. Following a literature review, Secondary literature and desk research are coupled to semi-structured interviews and observations, leading to strongly substantiated case studies (Yin, 2017). The multiple sources used in the case study (Table 3-3) and the strong embedding of secondary literature support the construct validity to be strong.

Second, the external validity of this research is assessed. The external validity answers the question '*if the results of the exploratory research can be generalized?*' (Yin, 2017). This paper assures the external validity first by using a multiple-case study approach with four (N=4) cases that show many similarities but still differ in their focus, innovation, resources, and sizes. These differences in the studied cases significantly improve generalizability and improve the finding of causal relations. Second, the strong theoretical embedding on the research, fueling the empirical results, makes overall generalizability stronger since data and findings from different periods, authors, and settings are included. Third, since the studied cases all exist for more than five years and are all active in many networks, studies, social media, etc., lots of data supporting the interviewees' somewhat subjective experiences can be found. This makes that their experiences can be placed within the right context, supporting the overall generalizability.

Third, the overall reliability of this research is assessed. The reliability answers the question '*if the study can be replicated by others showing similar findings?*' (Yin, 2017). The first concern that can be raised when assessing reliability is that a single researcher executes this research. The reason that this is the case is that this research is written as a master dissertation. The execution by a single researcher can result in much subjectivity in the research. This subjectivity problem is mitigated by staying close to the sources, triangulating, being transparent on the interview protocol, coding procedure, case study data, and extensively involving supervisors in the overall research. Furthermore, throughout the research, many sub-conclusions and summaries are given, creating a stapling method of findings and reducing the risk of jumping from one topic to the next. Lastly, this research focuses on transparency in the methodology and the cases used, stating names, dates, and direct quotes, making it possible for readers to follow the conclusions drawn.

## 4. RESULTS

### 4.1 Within-case Analysis

this chapter starts with a within-case analysis of each of the four selected cases' business model development process to develop a deeper understanding of how frugal healthcare innovators arrive at a viable business model. This within-case analysis is guided by the theoretical concepts discussed in chapter 2 and aims to describe the changes in the business model and iron triangle, connecting these changes to the different business model experimentation methods used.

As introduced in the methodology chapter, the studied cases and the changes occurring in their business model are visualized using Osterwalder and Pigneurs' (2010) Business Model Canvas. The Business Model Canvas colors visualize the level of changes in the business model's individual building blocks over the years. The green color indicates that no significant changes appeared in this part of the business model. The yellow color indicates small tweaks in parts of the business model, whereas the red color indicates big changes or even pivots in the business model.

The Iron Triangle of healthcare (Kissick, 1994) is used to complement the Business Model Canvas by visualizing how the innovators changed over time on quality, affordability, and accessibility. These aspects are linked to the value proposition for the cases in LMIC healthcare markets, and the models are visualized similarly to the Business Model Canvas. The colors similarly show the process of change happening among the axes of the Iron Triangle. The green color shows that a process stayed relatively stable over time, where the yellow color shows small tweaks, and the red color indicates big changes or even pivots. This visualization aims to give visual insights into how the innovators improved their innovations over time, learning from their experiences and experiments.

Besides describing what dimensions of the business model and Iron Triangle changed, this chapter also reveals how these changes came about, targeting the use of experimentation. These changes capture how innovators learn over time and tweak their business models accordingly. The five building blocks of the Lean Startup framework, based on the paper of Shephard & Gruber (2020), are used to visualize the different uses of these building blocks in their business model experimentation process. For this model, the red color means that these principles are applied heavily, where yellow means that they are applied medium, and green means that no clear signs of these principles applied can be found.

#### 4.1.1 Delft Imaging

As introduced in the methodology section, Delft Imaging is a Dutch SME active in tuberculosis (TB) screening using X-ray machines, combined with algorithms to detect TB easily.

##### *Business model and experimentation*

The Business Model Canvas is visualized in Figure 4-1 (Appendix I). Major changes occurred in this business model between 2013 and 2020, as these were the years that Delft Imaging started to switch from an explorative project towards a serious company.

From the visual representation of the Business Model Canvas of Delft Imaging, it becomes clear that the major changes (yellow) in the business model over time appeared in the front-end of the Business Model Canvas, being the right side. These changes are elaborated following illustrative quotes from the founder of Delft Imaging.

## The Business Model Canvas – Delft Imaging










|  |  |  |  |   |
|--|--|--|--|---|
| <b>Key Partners</b>  <p><u>INITIAL</u><br/>Main partnerships from previous industry network and companies were crucial since mainly focused on sales and total solutions.</p> <ul style="list-style-type: none"> <li>• X-ray system manufacturers</li> <li>• AI/software manufacturers</li> <li>• Big NGOs in field of TB</li> <li>• Partnerships with ministries of health</li> <li>• Suppliers of sub-parts of the system</li> </ul> <p><u>NOW</u><br/>Similar, but with reduced importance of individual partnerships. "Never become tied up to a partner"</p> | <b>Key Activities</b>  <p><u>INITIAL</u><br/>Networking, finding new projects, initiating these projects, delivering product, service etc.</p> <p><u>NOW</u><br/>Similar, bit more focus on innovations to generate new products.</p><br><b>Key Resources</b>  <p><u>INITIAL</u><br/>Funding coming from: (1) Founders investment (2) Government grants (3) Early revenue<br/>People: Started with small team and grow person by person.</p> <p><u>NOW</u><br/>Similar, no big investors on board nor scale-up funding</p> | <b>Value Propositions</b>  <p><u>INITIAL</u><br/>X-ray system with CAD4TB solution for:</p> <ul style="list-style-type: none"> <li>• More accurate screening</li> <li>• More accessible screening tools</li> <li>• Quick results</li> <li>• Lower costs for screening</li> </ul> <p><u>NOW</u><br/>All-inclusive solutions tailored to settings and wishes, with:</p> <ul style="list-style-type: none"> <li>• All the above +</li> <li>• Trucks for field testing</li> <li>• Education/training for staff</li> <li>• Solar panels for energy</li> <li>• Broad range of related services and products</li> </ul>                      | <b>Customer Relationships</b>  <p><u>INITIAL</u><br/>Many time spend in direct contacts to LMIC healthcare officials and NGOs</p> <p><u>NOW</u><br/>More time spend on HIC relationships and higher levels of customers (mainly to avoid bureaucracy and bribery)</p><br><b>Channels</b>  <p><u>INITIAL</u><br/>Many customer visits, office close to customers for last-mile-delivery, using tender platforms and networking to end-up in the right places</p> <p><u>NOW</u><br/>Similar but with better knowledge on what works and what does not work</p> | <b>Customer Segments</b>  <p><u>INITIAL</u><br/>Very divergent groups:</p> <ul style="list-style-type: none"> <li>• Direct to hospitals</li> <li>• Direct to governments</li> <li>• Tender projects</li> </ul> <p><u>NOW</u><br/>Two main segments:</p> <ul style="list-style-type: none"> <li>• Small projects initiated by a mixture of government, county, hospitals, NGOs</li> <li>• Big projects, mainly funded and initiated with HIC governments and the World Bank (once every 2-3 years)</li> </ul> |
| <b>Cost Structure</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Total project costs for building, delivering, installing systems</li> <li>• Overhead costs for sales, marketing, travel, office</li> <li>• R&amp;D Costs for developing new innovations</li> </ul> <p><u>NOW</u><br/>Similar costs but more structured and clearer, with a much better understanding of what is viable or not.</p>  |  | <b>Revenue Streams</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Small experiments selling to various customers, such as direct to hospitals, to certain governments etc.</li> <li>• 1 big initial project in Ghana which payed upfront for service and overhead, further many successful and unsuccessful attempts</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Clear smaller projects with margins</li> <li>• Bigger projects with service contracts and implementation for continuity</li> <li>• Revenues from: Pay-per-use, Software license, total project, servicing</li> </ul> |  |   |

Figure 4-1. Business Model Canvas Delft Imaging

### Value proposition

Delft Imaging's founding started back in 2004, as the founder decided to buy out the companies that he was leading from the mother company, Delft Instruments. He included the new company 'Delft Imaging systems,' fascinated by tuberculosis screening's history and possibilities. Being independent of 2004 onwards, the founder started to do a research trip to understand this meaning of tuberculosis screening better. Here, the entrepreneur started thinking of the possibilities of innovation for the first time. In 2007, the entrepreneur started to make the idea of Delft Imaging Systems concretely as a side-activity, just investigating, doing some trials, and putting more time and effort into it. By 2010, the founder was clear about the potential of tuberculosis screening by X-ray and started working on the artificial intelligence solution he believed was necessary.

Delft Imaging started to work on their innovation, driven by humanitarian values and caring about the still 1,6 million deaths by tuberculosis each year (WHO, 2019). The startup defined the values their innovation had to consider: high quality, affordable, and easy-to-use. These values provided the input for the first value proposition.

Table 4-1. Quote Motivation behind Delft Imaging

|  |   |
|--|---|
| <b>Founder &amp; CEO Delft Imaging</b> | <p><i>"This motivated me to find a solution and the solution we could find it has to be cheap; it has to be 100 percent secure... ..So I want to have a solution that if you buy it it's quality of the western world and you don't need high skill personnel, because that was the situation. So we eventually came up, and this is a process of years. So if you look at the solution now, you would think we thought about it, and then we figured it out. No, we tried it wrong, we tried something else wrong, we tried something else."</i></p> |
|--|---|

This strong founding vision created the boundaries and requirements on which Delft Imaging started to work. Following a learning-by-doing methodology, the vision of what the product should do became a reality by creating a first simple value proposition.

Table 4-2. Quote MVP value proposition Delft Imaging

|  |  |
|--|--|
| <b>Founder &amp; CEO Delft Imaging</b> | <i>"The first value propositions were relatively simple, so I sold an x-ray product and instead of analog I sold digital x-ray products, and that was about it... ...so just our digital x-ray system and thought what do we have and how do I get the image to the doctor?... ...wherever we are in a field, and I have a digital x-ray system I can send the image to the doctor nice - because at that time it wasn't great or perfect - that we could do this technologically. But, of course, it was not the solution."</i> |
|--|--|

Interestingly, this first value proposition did not yet align with the founder's vision as this solution was relatively simple and still needed a physical doctor. So Delft Imaging started to design more and more advanced value propositions. This entailed a simplified version of Thorax machines, designed for hospitals and much cheaper than available systems. The first idea of the real solution came about while implementing and testing these systems. In this process, the company found out that a better system was needed and started to design such a system with a German company. Also, the company started to design their innovative solution, being a digital doctor using artificial intelligence technology. Following this process of implementing and experimenting, the view of the total solution became more and more present.

Table 4-3. Quote All-inclusive Value Proposition Delft Imaging

|  |   |
|--|---|
| <b>Founder &amp; CEO Delft Imaging</b> | <i>"But the real, total solution came what we're doing now, the one-stop TB container: solar panels on the roof, artificial intelligence, a site with a lab, this concept is now completely adapted worldwide... ...try to completely understand what a product owner has as an issue: what do you really want to solve and how can you solve that in this environment where you don't have a lot of resources and not enough capacity? If you really understand what all the issues are and you can find a solution for this, and this solution was not only the digital x-ray, it was not the x-ray with artificial intelligence; no, it was the total solution as we have now. And we can still expand this, and we're still doing."</i> |
|--|---|

Altogether, the company grew from very simple solutions that were tested in the market, such as the doctor at a distance, to an advanced value proposition that tries to solve all the customers' issues surrounding tuberculosis screening.

From the way that Delft Imaging grew their value proposition, it can be learned how the case balanced a strong founding vision and direction to work towards, creating simple products that solve parts of the problem. Delft Imaging started experimenting in the market from a very early stage, focused on getting learning-by-doing information on how to grow their value proposition. A strong and all-inclusive solution came about through this process, building a strong value proposition for the company.

#### Revenue streams

As Delft Imaging started testing and refining its value proposition, the company included experimentation with its revenue streams. From past experiences at previous companies, the founder knew that selling a software license would not work since selling it would not bring the company enough stability. The LMIC market was not well organized. After some trials, the company came up with a pay-per-use business model to get a more stable income.

Table 4-4. Quote viability business model Delft Imaging

|  |  |
|--|--|
| <b>Founder &amp; CEO Delft Imaging</b> | <i>"It was a key issue in what I knew we had to do to make it long-lasting and profitable, and the key issue is to put in artificial intelligence and I didn't want to sell it as a license. I had done a medical IT company... ...and it was so difficult to get stability in this software company so in the western world where you could sell a service as well, it was relatively well organized, but mostly if we went into export I could sell a software license for 10.000 euros and they were using this for the next four or five years... ...So we went to this pay for use. At least if they use it then after a while they have to buy extra and this gave me more stable income."</i> |
|--|--|

Figuring out this working model was very important to get the first funding since it proved that the company could create new revenue streams that were scalable. In this process of finding this business

model viability, multiple experiments and tests were done with revenue streams. An example is how Delft Imaging tried selling X-ray systems with an upfront fee of 60% and an installment of around 40% spread over the next three years.

Table 4-5. Quote experiment revenue model Delft Imaging

|  |   |
|--|---|
| <b>Founder &amp; CEO Delft Imaging</b> | <i>“For example, one thing we tried, we knew there's not enough money and we had a hospital who wanted to have a digital x-ray so we said we would supply a digital x-ray, they just pay 60 percent to cost and the other 40 percent they pay in the next three years. We thought that could be a nice model so we supplied it and the first three or four months went okay then they stopped paying. We had a lot of issues and this is so insecure, it's so unstable it's not the way to go.”</i> |
|--|---|

This experiment showed Delft Imaging the instability of providing such a loan/installment to the hospitals and taught that this was not the way to go. These experiments were highly necessary for Delft Imaging to test their business model assumptions and know what works well and especially what does not work well in the early years. The pay-per-use model was there to stay, as it was the method that Delft Imaging applied for creating a recurring revenue stream, being less dependent on project-based revenue streams.

Altogether, as Delft Imaging's learnings grew over time, the value proposition and the customer segments and relationships changed with it. As new customer segments and customer relationships meant that the new revenue models needed to fit these customers, the total front-end business model evolved alongside.

#### *Customer segments, customer relationships, and channels*

In this process, customer segments started from more direct sales to county governments, hospitals, or big tender procedures; Delft Imaging is now more in control of these processes. They steer where money is spent on what and advocate for the eradication of tuberculosis worldwide.

Table 4-6. Quote Understanding the market Delft Imaging

|  |  |
|--|--|
| <b>Founder &amp; CEO Delft Imaging</b> | <i>“But what changed is we learned more and more about how the business model really looks like. So my first solutions were traditional: I tried on a tender, and I had no clue how the international financing was organized. Nowadays, ...we really understand how the market works... ...So here also, if you look at it looking backward, thinking that's a nice business model I had no clue I was in this business model when we started, so when we started it was standardized, we just answered to tenders, but nowadays the bigger projects we prepare a bit more because we try to listen... ...we first wrote in on some tenders and sometimes a tender was from the United Nations but we didn't realize or was from the local government, we also were targeting some hospitals. We eventually figured out it wasn't just price synergy, so the more we thought about the complexity etc., the more we also saw how this market was organized. Nowadays, since we know how it's organized, we can a bit more influence this as well. We now inform the financial organizations or some institutions on new developments so they can use it in their view on the market.”</i> |
|--|--|

As Delft Imaging started to understand the market, their customer segments shifted from more direct to hospital sales or more localized tender procedures to more international tenders. Relationships shifted more to talking to governments and networking with key opinion leaders, where previously this was more in direct contact with the end-users. This process changed many things of the business model's front-end, using new channels to find customers to build new customer relationships with the new stakeholders.

Altogether, as the founder mentions in his quote in Table 4-6, the company learned what the business model looked like, following an extensive learning-by-doing experimentation process. This process created needed tweaks and changes in the business model, growing towards viability. The business model's major uncertainties that drove these changes can be related to the complexity and uncertainties of LMIC healthcare markets. Finding the right customer, combined with the right payers and the right revenue streams, has been the key challenge. Running experiments, making mistakes, and learning how

the market is organized created the business model's needed adjustments. This meant fitting the right customers to the right value proposition and coupling these to the right revenue streams to achieve viability.

*Key partners, key activities, key resources, cost structure*

On the remaining aspects of the Business Model Canvas, barely any strong changes are recognized. In the building block of the key partners, the dependency on the early starting partners, such as Oldelft and Canon, faded over time, with Delft Imaging creating products by itself. In the cost structure, most budgets are spent on salaries, sales, and R&D, where the company is still investing in R&D to create more follow-on innovations. In the key resources, no major investments were attracted as the company is growing steadily and sustainably. The number of people employed in both the Netherlands and Ghana grew steadily over time as the company grew. As key activities, Delft Imaging still focuses strongly on understanding the problem, creating good solutions to the problem, advocating for these solutions, and running the operations.

*The evolvement of the Iron Triangle*

The Iron Triangle of healthcare (Kissick, 1994) can be used to further zoom in on the changes occurring in the value proposition of Delft Imaging. This is done in Figure 4-2 below.

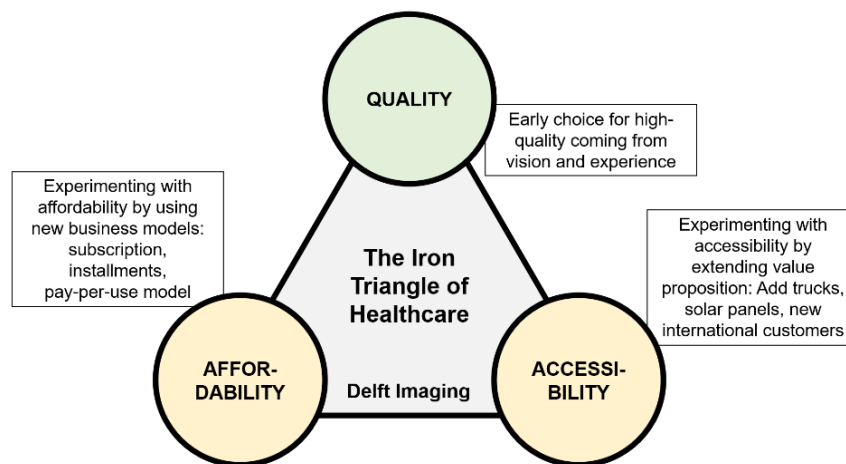


Figure 4-2. Iron Triangle Delft Imaging

First, on the aspect of quality, the Iron Triangle visualizes how the choice for ‘western quality’ for the Delft Imaging systems came from the founder's vision and experience (Table 4-1). Starting up and following a strong learning-by-doing process, the company started with a simple market solution (Table 4-2). However, using strong partnerships, Delft Imaging kept their vision of providing high-quality systems from the start, using their partnerships wisely.

Table 4-7. Quote Importance of Quality Delft Imaging

|   |  |
|---|--|
| <p><b>Founder &amp; CEO Delft Imaging</b></p> | <p><i>“I think the quality for the start was relatively okay because the companies we’re working with are always high quality companies, and my experience with Oldelft in the western world was: you better invest in a very good product at the start, so you have no issues in the field, and that’s even more the case for Africa, so go for the Mercedes quality because if it’s in the fields it’s much more difficult to repair, to serve and maintain, so it’s better to invest in the product. So we had almost no issues. That’s actually the big reputation we have at the moment. We are working currently on a nice project in Ghana, about ten X-ray systems, and although we are more expensive than the competition they want our system because they have seen the first ones what were delivered five or six years ago are still running, so high quality that was directed from the start was perfect.”</i></p> |
|---|--|

The focus on quality became central to the value proposition of Delft Imaging and is mentioned as a key differentiator from competitors.

Second, on the accessibility of the innovations, a more experimental process of innovating can be found. The founder of Delft Imaging explains how they step-by-step improved their value proposition, making their innovation more and more accessible, for example, by adding trucks and solar panels. The founder describes this by rooting for understanding the problems of the product owners: *“try to completely understand what a product owner has as an issue: what do you really want to solve and how can you solve that in this environment where you don’t have a lot of resources and not enough capacity?”* (Table 4-3). The many tweaks and iterations in the value proposition are strongly linked to Delft Imaging trying to make their innovation as accessible as possible. However, adding and extending the value proposition more and more, affordability needs to be considered.

Third, in terms of affordability, a process of experimentation leads to learning how the market functions and designing revenue models that fit with this. This process is described by Table 4-4, 4-5, and 4-6, where experience (Table 4-4) and experiments (Table 4-5) lead to understanding how the market financially functions (Table 4-6), leading to affordability and viability. As Delft Imaging switched to more international financing streams, the company could benefit from stronger budgets for their all-inclusive solutions. Influencing the process of how money is spent (Table 4-6), the company could advocate for budgets that fit with their vision and price of how the solution should be implemented.

#### *Process of getting to business model viability: Learning-by-doing*

Through the quotes elaborating how Delft Imaging grow their business model, a strong process and focus on learning-by-doing can be distinguished.

Table 4-8. Quote Making mistakes Delft Imaging

|   |  |
|---|--|
| <p><i>Founder &amp; CEO Delft Imaging</i></p> | <p><i>“...we have to be active in the field, you really have to make these mistakes because if you're not making mistakes you're not doing it well because then you're doing nothing, you're playing too safe so you really have to be in the field. Of course, if you constantly make bad mistakes then you're probably not also fit for the job. So we were earning money and then we invested in some activities; some were very good so we have bigger projects and some were not so good that we lost. But eventually we're a healthy company.”</i></p> |
|---|--|

This process of making mistakes is important to create the organizational learnings needed to find viability. Following this process, the company Delft Imaging took more and more form over the years, knowing what to do, where to be active, and how to sell. This created the focus on undeveloped countries, breakthrough innovations, making a great impact, and high quality standards, solving real problems.

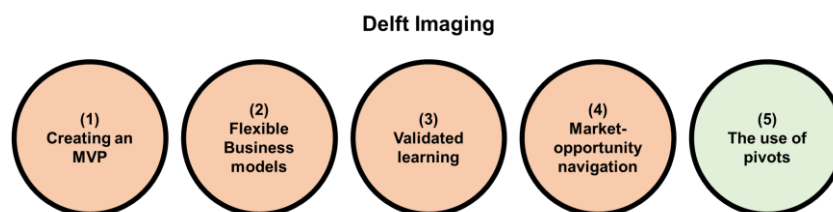


Figure 4-3. Building blocks Lean Startup at Delft Imaging

Based on the Lean Startup building blocks (Ries, 2011; Shephard & Gruber, 2020), Delft Imaging shows high use of principles described in the Lean Startup. The innovators started with a simple value proposition, creating an MVP (Table 4-2). The multiple experiments show how they tested multiple business models, fitting with their project-driven business. This shows strong validated learning, killing models that did not work (Table 4-4, 4-5, 4-6). Based on Delft Imaging’s rapid diffusion of the product,

scaling from 2 countries in 2015 to 29 countries in 2019 (Millionlivesclub, 2020), it can be concluded that the company navigated extensively through different market opportunities by not staying focused on one single product, nor one single market. Lastly, the learning-by-doing nature of getting to business model viability resulted in a relatively high number of small experiments, reducing the need for big pivots.

Altogether, the founder of Delft Imaging argues that what makes his company unique is its market experience and the relationships needed for sales in this market. He argues that their entrepreneurial mindset by not fully planning and controlling everything but staying flexible helps them navigate the African market. Summarizing with Delft Imaging's learnings, providing implications to starting LMIC innovators, the founder argues for early customer interaction, testing the product in practice, and not innovating for the perfect ideal. Also, he argues for finding strong finances at the beginning from non-dilutive funding options as the government offers.

Table 4-9. *Quote early market entrance MVP Delft Imaging*

|  |  |
|--|--|
| <b>Founder &amp; CEO Delft Imaging</b> | <i>"... if you could make the problem a bit simpler, to have your product less complex, so don't go for the perfect ideal, so if you have something that you think could it be interesting... ...do you have something that's maybe already good for the market? Do your first sales and do your first steps and try to get as much financial support from government. We have so many organizations that want to support these kinds of projects, get as much external money in as possible and then still it's difficult because you need a lot of money and it takes time. And maybe have your first step together with an existing organization that's already there without depending on them. ...So I used as much as possible of that kind of money and then I tried to get my first sales, and then you also learn a lot from your first sales, what works and what doesn't work."</i> |
|--|--|

Concluding that the rapid diffusion of the product from Delft Imaging, combined with the stability and credibility that the company created over the years, argues for the success of the company in deploying and utilizing its business model. Combining Ai, software, and hardware, plus the network, partners, and experiences in this field, offering total all-inclusive solutions to customers in a rather complex environment of international relations, ministries of health, and diversified finance streams make Delft Imaging unique. In this case, it can be argued that both the complexity of the technology as the complexity of the market creates the sweet spot for Delft Imaging's business model. These complexities were overcome to the advanced learning-by-doing and experimenting nature of the business, driven by the founder's experience, background, and character.

#### 4.1.2 Atomo Diagnostics

As introduced in the methodology section, Atomo Diagnostic is an Australian SME that was founded in 2010. Atomo Diagnostics (Atomo) is active in rapid, point-of-care blood testing devices for fast and early detection and diagnosis of Malaria and HIV.

##### *Business model and experimentation*

The Business Model Canvas is visualized in Figure 4-4 (Appendix I). Major changes occurred in this business model between 2013 and 2020, as these were the years that Atomo went to the market, coming from a long trajectory of development.

From the visual representation of the Business Model Canvas of Atomo Diagnostics, it becomes clear that the business model significantly changed over the years following commercialization. These changes are elaborated following illustrative quotes from the ex-design director of Atomo.

## The Business Model Canvas – Atomo Diagnostics








|  |  |  |  |  |
|--|--|--|--|--|
| <b>Key Partners</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• IDE as development partner</li> <li>• Manufacturing partner and facility in China – build to scale</li> <li>• Small partners in distribution and sales</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Similar but less dependency on IDE for development anymore, still working together in manufacturing</li> </ul>   | <b>Key Activities</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• Designing, manufacturing, selling, distributing, improving the product</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Similar but on a bigger scale, and with different customers &amp; partners</li> </ul>  | <b>Value Propositions</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• Rapid diagnostic device for quick HIV testing</li> <li>• Improve sensitivity and reliability of tests</li> <li>• Reduce errors in testing</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Existing value proposition +</li> <li>• Platform for rapid diagnostic testing devices</li> <li>• Patents in the field of rapid testing</li> <li>• OEM development of testing devices</li> </ul> | <b>Customer Relationships</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• Own sales agents in Africa, actively selling the product and building relations</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Sales B2B via distributors, maintaining relations to these distributors is main priority</li> </ul> | <b>Customer Segments</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• More direct relationship towards end-users or direct to customer</li> <li>• Segments, mostly innovative countries that had a high HIV burden</li> <li>• Product needed to be tested in markets where problem with sensitivity and reliability was predominant.</li> <li>• Need for first markets to set examples and create academic support for solution</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Need product is proven, extra layer for distribution is added</li> <li>• From B2B&gt;B2C to B2B&gt;B2B&gt;B2C</li> <li>• Customers are now big pharma and medical companies</li> </ul> |
| <b>Cost Structure</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• Big focus on R&amp;D in first years</li> <li>• Many patents, research, and experiments</li> <li>• Cost to set up manufacturing line</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Many costs in manufacturing and manufacturing facilities</li> <li>• Simple in-out calculations, costs for operations</li> <li>• Increased overhead costs, big staff, more offices etc.</li> </ul> | <b>Revenue Streams</b>  <p><b>INITIAL</b></p> <ul style="list-style-type: none"> <li>• Mainly product transactions in smaller bulk purchases</li> <li>• 1 clear stream of revenue, mainly for proving success of product</li> </ul> <p><b>NOW</b></p> <ul style="list-style-type: none"> <li>• Multiple streams:</li> <li>• OEM manufacturing for specific clients and needs</li> <li>• Big bulk sales with big pharma distributors</li> </ul> |  |  |  |

Figure 4-4. Business Model Canvas Atomo Diagnostics

### Value proposition

After a personal experience, the founder of Atomo, John Kelly, decided that there was a need to innovate in point-of-care testing. Chosen this direction, John Kelly and the team of partner IDE started to explore the world of point-of-care testing. Quickly they found out that there was no market for improving point-of-care testing in the Western world since this market was dominated by big MNE's, creating a pivot before even starting up. The focus shifted towards the LMIC markets, following some strange errors found by a study by the WHO. The founding team started observing the problem occurring in practice and started to think of ideas that could solve this problem. They started designing solutions that could solve the problems, but some major hurdles appeared. The first hurdle was that they could not make the ideal product initially since this would become way too expensive. Also, before proving that it worked, barely anybody believed in the concept.

Furthermore, the product had to be competitive in price since it was a large volume, low margins type of product. Lastly, to sell the product, the approval of the WHO was needed. Products in this field were bought via a WHO list that would only consider three metrics: lab sensitivity, lab specificity, and price. The product of Atomo could not compete on this list if the pricing was not competitive.

Table 4-10. Quote strategy planning Atomo

*Ex-design director Atomo Diagnostics*

“...So first we identified a minimum viable product... ...But we were able to develop it with our own limited funding and then we said let's go and bring this to market and prove that we can do this, that we can remove these usability errors in the field and then maybe we get noticed... ...we need to build it and we need to prove it and the only way they will see that it works is if we actually sell products, that people want to buy this. So our strategy was to build it, bring it to market, start selling it in one or two channels that we built ourselves... ...Now we had a big hurdle and that was that these tests are less than one dollar, because you just pay for strips and this thing has to be one dollar as well because we looked at the model that countries in Africa were buying this and basically it was NGO's or countries who were buying 100,000 tests once. ...So, we had to be less than one dollar and that's pretty hard if you everything integrated, and you have built tools and you want to have a return on investment.”

Following a strong design process, guided by partner IDE, Atomo knew that an affordable manufacturer had to be found, which could create a product for less than \$1. By helping a Chinese manufacturer get certified for manufacturing medical devices, the company created a manufacturing partnership in which this criteria of >\$1 could be reached. In these phases, Atomo could go from design to first sales quickly. They found a big first client that was crucial for showing that the product could work and make an impact. The Bill & Melinda Gates Foundation picked this up and guided the company going from a non-ideal MVP towards a full product that could disrupt the market at large.

Table 4-11. Quote MVP testing Atomo

|                                      |  |
|--------------------------------------|--|
| Ex-design director Atomo Diagnostics | <p><i>“And we started to look for a partner that could set up a distribution channel in South Africa and we found a big partner [X]... ..so that was one of the first clients we had. ... we could show that we could get the product regulated, we could get it approved on the WHO prequalification list and we had people buying it and using it and we were better in post market surveyance data. And it worked because suddenly we got noticed by these bigger companies and we also got noticed by the Bill and Melinda Gates foundation and the Bill and Melinda Gates foundation said you know this is nice, your minimum viable product but what we need is we need this one.... ..So that removed the limitations for the World Health Organization and also for governments to say you can now use it as a self-test... ..So the Bill and Melinda Gates foundation helped us because they funded the next generation product.”</i></p> |
|--------------------------------------|--|

The Bill & Melinda Gates Foundation's support meant that a new value proposition was created in which laypeople could also use the Atomo product, so as a self-test, instead of the product being only regulated to be used by healthcare professionals. But to get such a self-test regulated, an extensive and expensive (>1 million Dollars) process of tests, validations, and trials were needed. These trials should prove that the product could be used and interpreted accurately by laypeople without errors. This was a real breakthrough as competitors of Atomo deliver so-called ‘bits in a box’ consisting of a paper strip, a lancet, a pipette, and a bottle, which need to be used in the right way and order to have an accurate testing result. Contrary, the value proposition that Atomo is offering is that the company integrates these multiple steps of the testing procedure into one product. While doing so, the company drastically reduces in-field errors for point-of-care testing. Overall, the value proposition had to be turned into viable revenue streams to create the envisioned business. Hence the large volume, small margins market where Atomo was active, the sales from Atomos own channels mainly functioned as a proof of business, showing that B2B customers wanted to pay for their solution.

The Bill & Melinda Gates foundation believed in this vision and saw that this was possible, so they provided a grant and loan to go through this process of regulations, creating the next generation product. In this process, the company could grow quickly towards a strong brand for self-testing. The directors of Atomo pivoted from the idea of an early exit in which they would sell their company and know-how to one of the big healthcare companies towards building Atomo further. They did this by becoming an Original Equipment Manufacturer (OEM) via their platform technology's licensing. This brought the company from idea to startup to scale-up.

Table 4-12. Quote Strategy shift Atomo

|                                      |  |
|--------------------------------------|--|
| Ex-design director Atomo Diagnostics | <p><i>“Suddenly more countries in Africa are employing in field tests and suddenly we have the market of self-testing, so we also need some of that and rather than buying it Atom... we saw that there was a lot of demand and we started selling our platform to these competitors so they could use it under their name and that is actually what we are doing now. And one of the scenarios was we are going to develop Atomo and then we exit but we pivoted and we are now not looking to exit Atomo, but we are now supplying platforms, to big distributors out there, who already have sales channels into 50, 60, 70 countries.”</i></p> |
|--------------------------------------|--|

With this new OEM platform and strategy, Atomo deploys two business models for different customer segments.

## Customer segments, customer relationships, revenue model, and channels

Table 4-13. Quote business models Atomo

|                                      |  |
|--------------------------------------|--|
| Ex-design director Atomo Diagnostics | “we actually have two business models now. One is we still have our own channels... ..And then we also have our platform without a test inside and we sell that OEM to pharmaceutical companies or diagnostic companies out there. ...so the revenue from our own channels, it was key for the business because it was allowing us to demonstrate to potential customers that this works, it's safe, it's regulated and people want it. So, desirability is proven, feasibility is proven, and viability is proven of the business... The biggest revenue is coming from our customers, OEM customers, who buy our platform and are able to sell it in 20-30 countries immediately through existing sales channels. So, the majority of revenue comes out of OEM now.” |
|--------------------------------------|--|

Currently, Atomo keeps deploying these two business models since the OEM trajectories are long, extensive, and not yet fully long-term proven. Their initial business model is now functioning using a distributor, making it a secure revenue stream for the company and providing the validation needed to convince OEM clients of its relevance. For scaling-up, the OEM platform model is the way to go. Atomo knows that it can only so far using its channels and that the big companies with strong distribution chains and customer relationships need to take over to grow further. These are the new customers for Atomo, and these customers start searching for their customers, using channels such as tender processes. The business models' main channels are the direct sales of the Atomo tests to these bigger companies and more longer-term- and extensive relationships with distributors.

### Key activities, key resources, key partners, cost structure

Key activities for Atomo in these early years and the years following were first, creating the product with the right functions, performance, and price. Second, validating the solution with studies proves that the solution worked and ensured that the solution could be regulated. The third was the sales and marketing, also with the bigger OEM clients.

Table 4-14. Quote desirability feasibility challenges Atomo

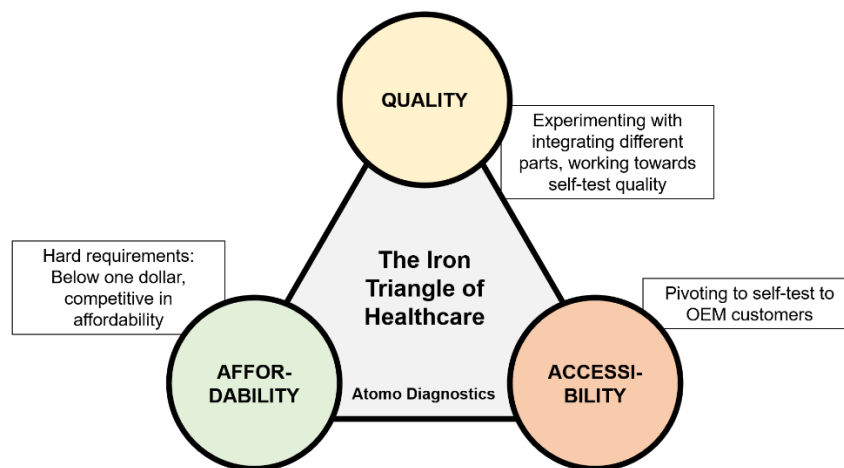
|                                      |  |
|--------------------------------------|--|
| Ex-design director Atomo Diagnostics | “So the most important thing was that we could design and build something that demonstrated that we could bring that in-field performance up. So, there were two major components. One was designing it and building it and getting it made for the right cost of goods ...And the second activity that the team did was focused on the in-field studies, the validation studies, and they had a very strong focus on useability because that's what we needed to do, remove user errors. So, we did a whole lot of use testing. We started with some formative studies so 20 people, 30 people and we did those in Johannesburg and Cape Town. And we went to Africa with prototypes, tested, made videos... ..third the component which was very important was the sales and marketing and making sure that we would find these OEM clients, or the customers of our OEM clients, and engage with them.” |
|--------------------------------------|--|

To have the flexibility and power to fulfill the new OEM clients' needs and keep up the scaling pace, Atomo worked closely with IDE. The IDE company functioned as an external R&D facility supporting Atomo in all technical facets of their products. This partnership with IDE was extremely important in the beginning stages. The importance partially declined, but still, a strong partnership is maintained. Other crucial starting partners were ‘test-strip manufacturers’ that delivered an important component of the product. These manufacturers were both suppliers, competitors, and clients, making these relationships hard to maintain. The numbers on HIV became a central focus in diffusing the product and choosing the markets in which Atomo had to be active. Based on these numbers, Atomo started focusing more and more on LMIC markets. South Africa was chosen based on a combination of a salesperson who was already active in South Africa, combined with the country being quite progressed with HIV testing, the good accessibility of hospitals, and the ease in certification. For this process, some strong resources were needed. The Bill & Melinda Gates Foundation's resources and investments only followed after the first years in the market, by 2016 and 2017. From 2009 till 2013-2014, Atomo was not making any revenue and had high costs developing their solution. Initial investors in these stages

were mainly angel investors, the founder himself, and partner company IDE. Bootstrapping methods were applied, and major costs were cut by keeping the R&D organization lean, letting employees invest, and winning some development grants. Founder John Kelly has been really important in building the business. His experience and drive were crucial for Atomo to succeed. This focus, in the end, worked out well with parties such as the Bill & Melinda Gates Foundation participating. This philosophy to design the product for the lower-end market was translated in many design decisions taken. Altogether, Atomo created a product that became a real gamechanger in the LMIC rapid diagnostics market.

### *The evolution of the Iron Triangle*

The Iron Triangle of healthcare (Kissick, 1994) can be used to further zoom in on the changes occurring in the value proposition of Atomo Diagnostics. This is done in Figure 4-5 below.



*Figure 4-5. Iron Triangle Atomo Diagnostics*

From the visualization of the Iron Triangle of Atomo Diagnostics, a clear experimentation process can be seen.

First, on the aspect of affordability, before even starting with experimenting with affordability and pricing, the company already found out that not much flexibility was possible in their affordability. Being in a competitive market where high volumes and low margins are present, directed by the hard requirements coming from the WHO's qualification lists, the company faced a hard requirement of making their product below one dollar (Table 4-10). Although rules from that lists have changed, and products and markets changed a bit, the products of Atomo still face high competitiveness. Having this hard requirement of one dollar meant that Atomo started to experiment with delivering a non-ideal quality through a minimum viable product (MVP).

Second, on the aspect of quality, the MVPs quality was much higher than current alternatives, reducing in-field errors strongly. The company could grow towards a higher quality by receiving more investments, gathering proof validating the product's need and value (Table 4-10, 4-11, 4-14).

Third, in accessibility, reaching the end-users and customers of Atomo changed heavily in the process of Atomo. Initially, the founders wanted to sell their product directly to the big players without success, so they started doing it themselves. Following this process, first, they created their own sales channels, and when proven successful, they signed contracts with bigger distributors. The product introduced a new methodology for improving the quality of rapid diagnostic testing. Laws needed to be changed to get this new methodology certified, substantiating the product's game-changing, disruptive nature. Improving their overall accessibility and viability, they pivoted their business model's focus more and more towards OEM clients, creating a platform for new products based on the Atomo technology. This made their products and technology worldwide accessible (Table 4-10, 4-12, 4-13).

### Process of getting to business model viability: Staged validation and Lean Startup

Through the quotes elaborating how Atomo grows their business model, a strong process and focus on Lean Startup frameworks and a staged validation process can be found. The interviewee gives a strong plea to starting innovators for LMIC healthcare markets to start small and prove that it can be done, using Lean Startup frameworks and an MVP.

Table 4-15. Quote advice Lean approach Atomo

|                                      |   |
|--------------------------------------|---|
| Ex-design director Atomo Diagnostics | <p>"I think what really worked for us is starting small, building it, and proving that it can be done. And it does require that you take on all of the responsibility at the small scale. ...So have a look at your product functionality and see, can I still have a viable product if I remove some of the challenging developments?...<br/>         ...Yeah, that's my advice to a lot of start-ups, where... Very often if the founder is tech-driven there is a tendency to have all the features in your product and then go to market but, yeah, applying the LEAN approach and going to market with something... ...get the buy-in and convince people to do the next one.<br/>         ...For us that was a crucial decision with the not optimal product but start selling it."</p> |
|--------------------------------------|---|

Though the healthcare regulations make this a bit more difficult, a strong balance needs to be sought between a market-ready product that is still in an early stage.

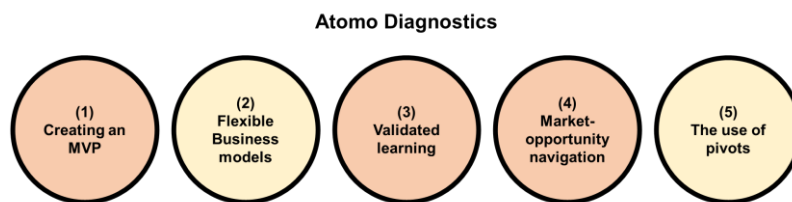


Figure 4-6. Building blocks Lean Startup at Atomo Diagnostics

Based on the Lean Startup building blocks (Ries, 2011; Shephard & Gruber, 2020), Atomo Diagnostics shows high use of principles described in the Lean Startup, explained by Atomo's strong process of ideation, validation, experimentation, and finally scaling. The founders took many ideation routes, validating what solution was needed and how this could be created (Table 4-10). A special hurdle for this was to convince the current tenders, buyers, and industry to change how the tests' sensitivity and specificity were conducted and evaluated (Table 4-10, 4-11). This meant that the first six to eight years of existence were spent in experimentation, research, development, testing, and validating, and little sales were done in this process. Types of experiments done by going to market with their MVP were in validation and testing assumptions. More controlled experiments, needed to get their product certified, were done together with the Bill & Melinda Gates Foundation (Table 4-11). These types of experiments were official pilots and clinical trials using MVPs, creating highly validated learnings. These experiments ultimately led to law changes as Atomo proved its game-changing value, and focus could be shifted to mass-market selling and distribution of the product. This meant that the focus shifted from small distribution chains going from Atomo to a sales agent to end-users, towards longer distribution chains, putting intermediate distributors in (Table 4-13). This shift created many changes in the business models' customer segments -relationships, channels, and revenue streams. This shift in the many business model elements could be labeled a small pivot or big tweak. The end-users business model stayed fairly similar as the product is a high-volume, low-margin product. But markets and opportunities were navigated strongly, creating diagnostic devices for new diseases such as COVID-19. The IPO of the company, going public mid-2020, meant that much new money and value became available for building the company further on the new path that was started, supporting the small pivot.

Altogether, the uniqueness of Atomo and its business model is not necessary for the transactions nor the revenue model, nor the actors. Atomo is a clear example of a revolutionary product deployed in a traditional market, business model, and supply chain. The disruption of Atomo can be significantly labeled to the product innovation, and the research and patents are backing this innovation. The way

that the product changed the service of conducting blood tests is an effect coming from this. Learning from how the company grew towards viability, the nature of proving this product innovation is central. Atomo went through an extensive ideation phase to test and validate the product; when this was validated, investors and B2B customers were sought to scale towards viability. The undergoing pivot of focusing more on OEM customers is the next step towards exponential scaling and long-term viability.

### 4.1.3 CarePay

As briefly introduced in the methodology, CarePay is a Dutch-Kenyan SME (Scale-up) creating health insurance technology solutions for the Kenyan healthcare market.

#### *Business model and experimentation*

The Business Model Canvas is visualized in Figure 4-7 (Appendix I). Major changes occurred in this business model between 2016 and 2020, as these were the years that CarePay went to the market and initiated its pivot.

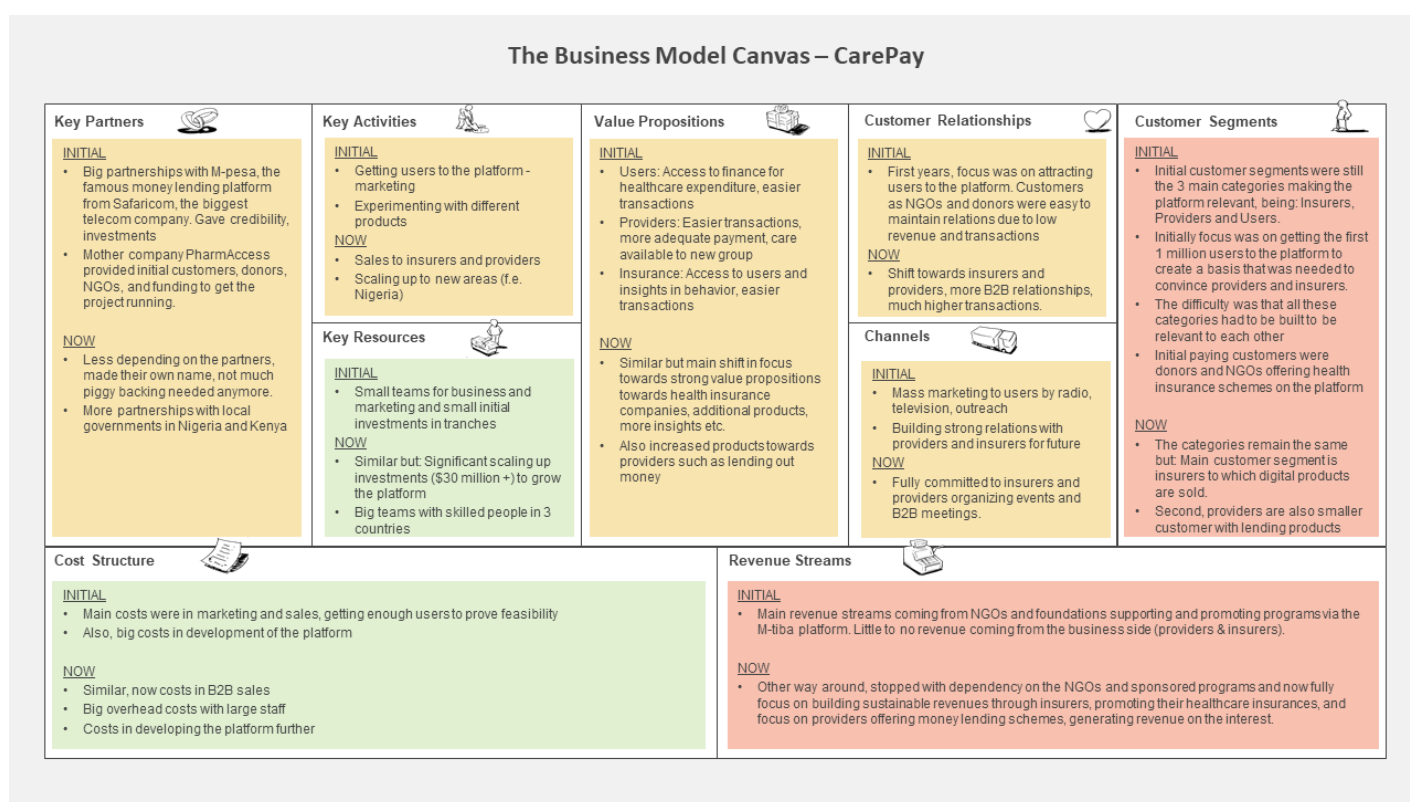


Figure 4-7. Business Model Canvas CarePay

From the visual representation of the Business Model Canvas of CarePay, it becomes clear that the business model went through some major changes over the years. These changes are elaborated following illustrative quotes from the founder of CarePay.

#### *Value proposition, key activities, and channels*

Back in 2013, a team from NGO PharmAccess started working together with Safaricom, Kenya's largest telecom operator and the company behind the popular microfinancing and money transferring tool M-PESA. After two years of research, this team spotted an opportunity for creating a company, a founding team was formed and the company CarePay was created. This company started with four

people in an office in Kenya. In these early years, the new team of CarePay started experimenting with customers in Nairobi's suburbs daily. The team kept on doing this until a market-ready product was created. Since their product was software-based and could be downloaded to phones, rapid experimentation could be done to come to a viable product.

Table 4-16. Quote founding and validation story CarePay

|   |   |
|---|---|
| <b>Founder<br/>&amp; ex-<br/>CEO<br/>Africa<br/>CarePay</b> | <i>"...So, me and my colleagues we were in this certain sort of suburb for low income area of Nairobi almost on a daily basis in the first two years. We were working with about 50 sort of users, mostly women who were using our wallet, our prototype in their savings groups... So we were there all the time just to get primary feedback from them and finetune and learn how they would use what they liked and didn't like. So then it was really a small team ...sort of obsessed with getting first-hand information and understanding how to improve the product."</i> |
|---|---|

The first digital healthcare lending product was the start of the CarePay platform. The actors of the platform, being the (1) participants, (2) payers/insurers, and (3) providers, are targeted with various products. The three proven business models that generate the current revenue are (A) a fixed fee per registered insurance per person on the platform, (B) a third party administration process, where insurers outsource key processes to CarePay, and (C) digital lending of money to healthcare providers based on future transactions. The three customer segments were the initial reasons that CarePay started, supporting low-income people in getting access to quality healthcare by arranging their finance and payments. However, convincing these insurers was a big hurdle for CarePay at the start. To convince these insurers, CarePay started off focusing first on connecting users to the platform, offering them all sorts of lucrative healthcare products. Reaching a big user base quickly, the company started to sign more and more healthcare providers. When these two components of the platform reached mass, the company started focusing on the insurers.

Table 4-17. Quote Marketing and sales CarePay

|   |  |
|---|--|
| <b>Founder<br/>&amp; ex-<br/>CEO<br/>Africa<br/>CarePay</b> | <i>"...we didn't manage to convince insurers at the start to do business with us. ...So we did two things in the beginning, one is we launched a large health savings product together with Safaricom, this huge telecom company, where we didn't need an insurer to back us or to partner with us. So there was no revenue model behind it ...but it was mostly to get a foot in the door with a large group of hospitals and also to get our brand name out there, to sign up a lot of users as well, so we signed up about a million users within the first year... And the second thing we had some relatively lucrative donor funded programs, so with non-profits, foundations and stuff who were paying for the healthcare of large groups of low income people... ...And then we used the scale that we built up in those years and the technology that we built up in those years to go back to the insurers and say "Guys, do you see now it works, let's do business together". And that's what we've been doing for the last two and a half years or so mostly. ... we still have that savings product in the market, so it's working, ... we still have some donor-funded programs on the platform which we service, but our focus is more on the insurance clients."</i> |
|---|--|

The company's key activities were software development, provider management, onboarding, and marketing and sales to users. These activities shifted overtime when the company moved away from attracting participants towards attracting payers, such as the insurers. This was a big shift from B2C to B2B. Attracting these participants, CarePay used multiple smart marketing tactics and strategies. Their consumer brand M-TIBA was named after the already popular and widely used M-PESA brand, using similar colors and referring to it. The company could use this branding because it was co-founded by Safaricom, the company behind the M-PESA product.

Table 4-18. Quote Brand credibility CarePay

|   |   |
|---|---|
| <b>Founder<br/>&amp; ex-<br/>CEO<br/>Africa<br/>CarePay</b> | <i>"And if your value proposition is about having people trust you with their money... ...we wanted to fast-track getting that trust, and a good way to do that was by partnering with the Safaricom company, which is the number one trusted brand in the market and M-PESA, their mobile money service, is maybe even the more powerful brand than the mother company Safaricom. So what we did in our branding, where M-PESA stands for "M" is mobile and "Pesa" means money in Swahili, the local language, we came up with M-TIBA where "M" again is mobile and "Tiba" means treatment."</i> |
|---|---|

Altogether, following a process of how platform businesses are created, CarePay needed to convince all platform actors that their platform added value. CarePay used online marketing channels to reach these actors, combined with more local and traditional mass-market channels. For Kenya, a combination of radio campaigns with prizes for signing up and physically reaching out to communities signing people up was very effective. Examples of such campaigns were offering free donor-funded health services on the platform for people who signed up and experimenting with rewarding prizes. For example, every 100th person who signed up got one year of free health services. The strong branding of the M-TIBA brand helped a lot in being recognized and getting out there. M-TIBA signed up around 900.000 users in the first year and could scale this to 4.000.000 users (2020) in the years following. Going to insurers, a more substantial group of more expensive hospitals was needed, so another 2000 hospitals were signed up. In bursts, a critical mass needed for the platform to be relevant to all three parties was created. When users reached the platform, the experimentation continued with A/B testing on offering different services, insurances, and options. The partnership with Safaricom and M-PESA was really important for the beginning phases of CarePay. It gave the credibility needed to be trusted in this market.

Experimenting with different products to the platform's different actors, CarePay slowly started to shift its focus to new customer segments.

#### *Customer segments, customer relationships, revenue models, key resources, and cost structure*

The first revenue streams of CarePay came from donor-funded projects, but the company knew that this was not a long-term stable revenue source. The transition from these relatively easier early revenue streams towards the harder B2B revenue streams was an important transition to make. Although these donor-funded projects provided a strong revenue base, the uncertainty of the continuation of projects was high, making these revenue streams unstable for the company. The company has been acting agile in finding the right revenue streams and working together to cut costs. The co-founder describes this mentioning a challenge for frugal innovators: *“the business climate you work in, you are forced to be extremely creative in finding solutions that work and that are also affordable enough.”*

Recently, CarePay made a pivot focusing more on the health insurance companies to find a stable and scalable revenue source. Employing 190 people and having a revenue of around 2 million, the company is far from break-even. Still, it is scaling up quickly, with investors positive on the course of the company. Investors wanted to invest in the company because it deploys a disruptive platform business model known for scaling fast and big.

Table 4-19. Quote pivot CarePay

|   |   |
|---|---|
| <p><b>Founder &amp; ex-CEO Africa CarePay</b></p> | <p><i>“We had an interesting pivot... ..We’re now focusing much more on the private sector, which forced us to invest a lot of money in getting the right hospitals connect to the platform, and we also went down in revenue. And now we see the revenue growing very fast in the segments that we believe in. So yeah, for the coming years we expected to grow very, very fast to, yeah, order of magnitude ten or twenty million dollars in two- or three-years’ time... ..So we were in a way forced to become a bit more B2C, so business to consumer in the first years ...in the last two and half years we’ve been much more B2B focused... ..Our business model is really like with many technology platforms, you have very high sort of fixed cost because the software development is just something you can’t really take shortcuts on, as well as we have to connect thousands of hospitals... .. But the marginal costs of growing are very small, so it’s very good to scale, then you should be able to make a profit at some point and fund your own business instead of asking shareholders to put in extra capital.”</i></p> |
|---|---|

As the pivot initiated new revenue streams, the underlying business model is expected to monetize the strong platform built in the years before. The founder argues that no real shortcuts could be taken in this process. To find out how this pivot needed to be made and where the focus needed to be, CarePay started experimenting with the platform's various actors.

Growing the company, CarePay was both supported as well as held back by major industry trends. The rise of mobile telephony in Kenya had already happened when starting up in 2015, and the company continued on a failed attempt of their biggest partner Safaricom. Although Kenya is a very innovative country, the insurance market is not and is still lagging. This can have something to do with the risk-averse nature of people working in the insurance industry. So, disrupting this industry has been a huge challenge for CarePay. The M-TIBA platform's approach and success are widely recognized as a strong solution to healthcare financing in LMIC. The approach and expertise of CarePay were also picked up outside Kenya, where a county in Nigeria was one of the first big clients for a total solution and platform similar to the platform in Kenya. CarePay won a tender process for implementing their solution in this Nigerian county, referring to their Kenyan market experiences.

Table 4-20. Quote diffusing to Nigeria CarePay

|  |   |
|--|---|
| <b>Founder &amp; ex-CEO Africa CarePay</b> | <i>"So PharmAccess, our partner in Kenya, also has a big office in Nigeria, they were advising the Lagos State government on health insurance. And of course, then the question of technology comes up and the state asked them like "Do you know any companies who could do this?" They said "Well, we work with CarePay in Kenya, you have to decide for yourself, but we can invite them", which they did... ..And then become of indeed, the reference case in Kenya and the proven track record of managing millions of users and thousands of hospitals is what made them chose our solution. So yeah, that was in the end maybe the best marketing."</i> |
|--|---|

Diffusing to Nigeria sets a strong example of how frugal innovations can be diffused when successful and how the references of strong cases create these opportunities. As CarePay is working closely with the local ministries of health and governments in Nigeria, similar principles do not apply to Kenya. Due to the often shifts of attention at the ministries of health, still similar to the donor market, these customers are not yet a stable business source for the company. This private vs. public challenge in Kenya is something that CarePay strategically weighted. A strong choice to focus on this private market is currently chosen to create long-term financial stability. By working closely with the insurers as a customer group, new product ideas and opportunities are created, using push and pull principles.

Table 4-21. Quote Customer pull CarePay

|  |  |
|--|--|
| <b>Founder &amp; ex-CEO Africa CarePay</b> | <i>Working together with insurance companies: "So we have that more and more where they approach us, where they say "We've been thinking about this" or "We want to get to this price point, can you help us manage that so we can actually lower the price?" or "Can you help us connect to those hospitals who are cheaper than others?" But also, the other way around is happening, so we also are also constantly thinking of new ways of reaching larger groups of people at lower cost, so we also engage directly with insurers when we have those ideas."</i> |
|--|--|

Altogether, the customer pull validates that the pivot CarePay did is starting to work out, as the company is attracting strong B2B clients that are eager to create value together.

### *The evolvement of the Iron Triangle*

The Iron Triangle of healthcare (Kissick, 1994) can be used to further zoom in on the changes occurring in the value proposition of CarePay. This is done in Figure 4-8 below.

The strong pivot that CarePay made does not directly translate to the visualization of the Iron Triangle. A reason for this is that the platform of CarePay always has focused on three actors. The shift in focus from users to payers did not change the innovation largely but caused mainly a shift in the business model.

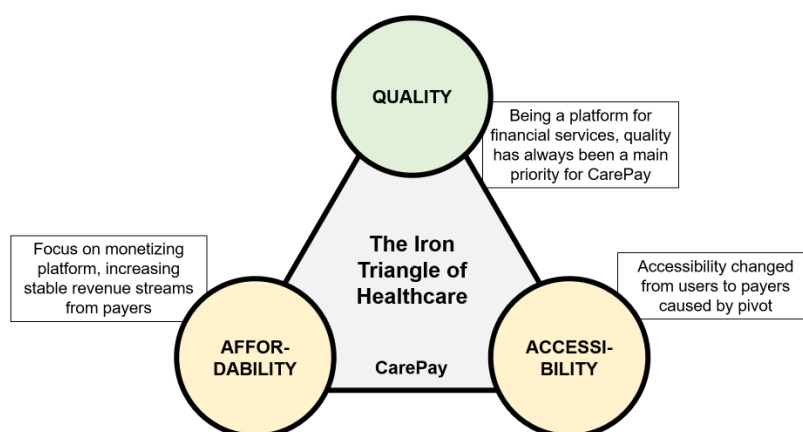


Figure 4-8. Iron Triangle CarePay

First, in affordability, small tweaks can be seen as the platform's overall affordability changes since CarePay is more actively searching for stable revenue streams. This is caused by the improved value proposition to the payers (Table 4-17, 4-19). CarePay focuses more on stable revenue streams, creating a decreased focus on sponsored health insurance products for the lower-income groups.

Second, also the accessibility changed a bit due to the new products offered via the platform. The platform became more focused on offering health insurance products, becoming more relevant to the health insurers, and fewer to lower-income groups that could not afford such services (Table 4-19). Also, by diffusing to Nigeria, the accessibility of the technology of CarePay became more widely available (Table 4-20).

Third, in quality, being a platform handling transactions and taking care of people's money, a strong focus on quality has always been central to CarePay, started with a long trajectory of experiments and building trust through strong marketing and using the M-PESA brand (Table 4-17, 4-18).

#### *Process of getting to business model viability: Lean Startups and pivots*

Overall, the M-TIBA product and the company CarePay have been massively disrupting the Kenyan healthcare market. This disruption is also substantiated by Fortune in the 'Fortune Change the World index' by listing partner Safaricom as one of the top 10 world-changing brands, mainly for their leadership in health insurance products.

Table 4-22. Quote disruptiveness brand CarePay

|  |   |
|--|---|
| <b>Founder &amp; ex-CEO Africa CarePay</b> | "So as an example, just a few weeks ago you have this Fortune Change the World index of the Fortune magazine, and Safaricom became seventh in the world just after Alibaba and Zoom, I think, and some other well-known brands. And they were seventh because of M-TIBA, that was basically the underpinning of the, say the jury of the contest, that by pushing the boundaries of their mobile money service into healthcare and getting now through us four and a half million people to save and be insured for healthcare, they were seen as one of those top 10 changing the world companies in the world." |
|--|---|

Following the process of how CarePay got to this point, the founder advises frugal innovators in LMIC healthcare markets to (1) think with scale in mind, (2) stay flexible in the market, and (3) design for a crisis, mimicking the way people survive in these low-income settings.

Table 4-23. Quote advice starting innovators CarePay

|                                    |  |
|------------------------------------|--|
| <b>Founder &amp; ex-CEO Africa</b> | "I think to really think with scale in mind or design with scale in mind... ...it's good to not fall into the project trap... ...the risk is that you also design not a company, but a project. And that's something, very, very different. ...if you really run a company and design a company, you try to make something that lasts forever until something drastically changes... ...I think that's a really key distinguishing factor between not only us, |
|------------------------------------|--|

**CarePay** | *of course there's others, but a lot of other initiatives in this space, that a lot of people look at it as a project, that's also how they're financed, and then even if you have a very successful project for three years, when the money has run out and you haven't thought about year four, then it all stops. And I think that's a key piece of advice, it's closely linked to thinking about scale from the start, it's also about thinking about durability, let's say. ...And in low and middle income countries I think another key thing is to be able to pivot, like we did, and in a way to keep options open because the GDPs are very small in all these markets, and things change really, really dramatically... ...So, if you really are too much focused on this one particular customer segment or whatever and something goes wrong, you are in a way screwed. So, trying to be very creative and keeping options open, while of course being focused, right? This is the hardest part about running a start-up, if you're never focused, you never get anything done. So trying to design, design for crisis is quite a good tip. And that's why I mean that you can at least pivot, that you're not too heavily invested in only one thing becoming successful. ...That's a way to survive. It's in a way mimicking how people survive here in these countries, it's by being extremely openminded and flexible and agile in a way and not count too much on things happening the way they always happened, because they don't in these countries. So also, as a business you somehow need to mimic that, if you see what I mean. It's very different than running a business in that sense in the Netherlands, for example."*

This advice and quote illustrate how CarePay grew towards its viable business model. Initially, the company had a long process of testing and experimenting in the market, using mock-ups and MVPs to get extensive customer feedback. In this process, the first real product was launched, which was designed for scale and the first step towards the platform. The recent pivot of CarePay shows the flexibility needed for the market and the need to design for a crisis.

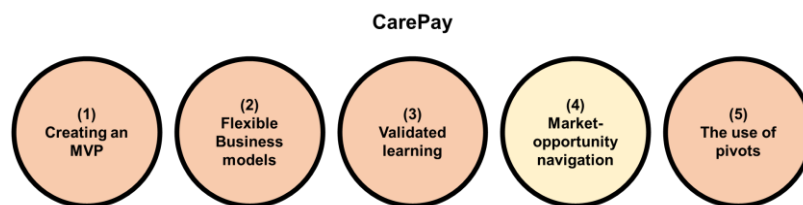


Figure 4-9. Building blocks Lean Startup at CarePay

Based on the Lean Startup building blocks (Ries, 2011; Shephard & Gruber, 2020), CarePay shows high use of principles described in the Lean Startup. As mentioned above, the innovators started with simple mock-ups and products as MVPs, being obsessed with early-market feedback. The founder strongly argues for staying flexible in business models, which fits the African market (Table 4-23). Within CarePay, not much market-opportunity navigation took place; the company did navigate various products through its platform but did not make long-jumps to new markets. The recent start in Nigeria could be such a future long-jump. Altogether, the strong recent pivot that CarePay has undergone shows the strong use and openness to pivot at the company.

As CarePay deploys a platform-based business model, the company was faced with this business model's challenges. When creating a platform business model, the company links various actors together through this platform. Famous examples are Airbnb, linking travelers to home owners who want to rent a space or Uber, linking cabdrivers to people searching for transport from A to B. The challenge when starting such as platform is like the chicken-egg dilemma (Van Alstyne & Parker, 2017). CarePay, with their platform M-TIBA, tries to connect three actors to their platform. Like other platform business models, for CarePay, the same chicken-egg challenges arose, needing a critical mass of users to convince providers and insurers, and the other way around (Table 4-17). From these platform-based business models can be learned how they invest heavily in creating the conditions for scale, and when their value is proven, scale rapidly and exponentially.

Altogether, conclusions can be drawn that the success of CarePay was initially created by the strong founding partnerships that fueled the organization. The challenge of connecting the platform actors took a long breath. Eventually, this was overcome successfully using smart small value propositions to all actors, such as donated health insurance programs for low-income groups. By experimenting with new

products to different categories of the platform's actors, CarePay found what works and what does not. These insights created a major pivot that is currently invigorated with investments and positive results. Although this business model's viability after the pivot still needs to be proven, customers show strong signs that value is created, making investors eager to invest \$45 million in their latest 'Series A' investment round, which closed November 2020 (Juma, 2020, November 4).

#### 4.1.4 Healthy Entrepreneurs

As introduced in the methodology, Healthy Entrepreneurs sources Community Health Workers (CHW) in rural areas and employs them as Healthy Entrepreneurs, selling quality medicine and hygiene products supplied by Healthy Entrepreneurs.

##### *Business model and experimentation*

The Business Model Canvas is visualized in Figure 4-10 (Appendix I).

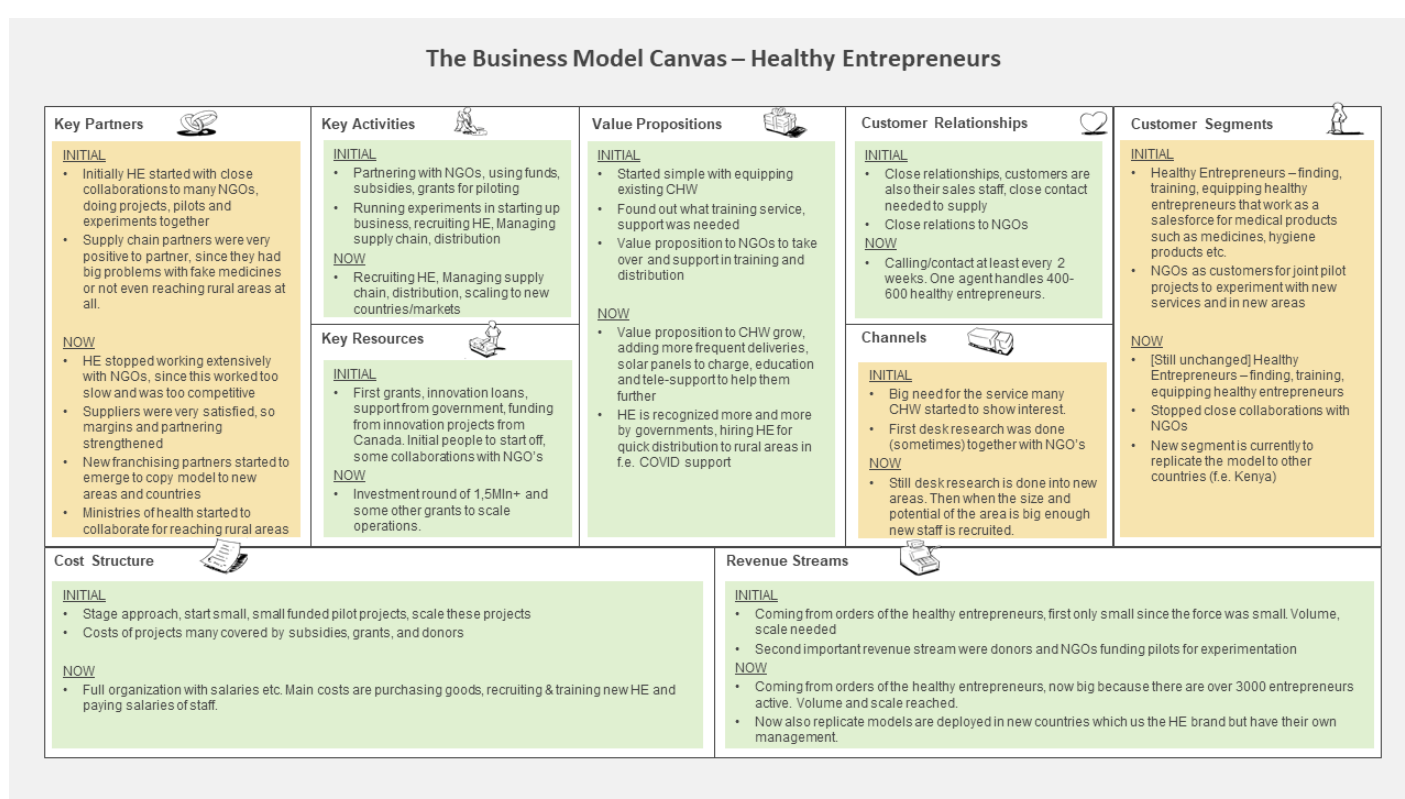


Figure 4-10. Business Model Canvas Healthy Entrepreneurs

Major changes occurred in this business model between 2016 and 2020, as these were the years that Healthy Entrepreneurs went to market. When examining the Business Model Canvas of Healthy Entrepreneurs, it becomes clear that HE did not make major changes in its business model, especially compared to the other cases. These changes are elaborated following illustrative quotes from the founder of Healthy Entrepreneurs, starting with the process of getting to the initial value proposition.

##### *Value proposition and key partners*

Healthy Entrepreneurs was founded by the founders' joint experience in the lack of distribution of quality medicines and hygiene products to rural Africa. Previously, founder Joost van Engen worked for the International Dispensary Association (IDA Foundation) to distribute essential white-label

medicines to international NGOs and the so-called central medical stores in developing countries. These NGOs and stores are officially responsible for distributing pharmaceuticals, or 85 to 90 percent of the population. He learned the whole system doesn't work. So where it was supposed to be 85, 90 percent, where in practice, only 10, 15 percent of the population was reached. From that moment of realization on, he knew that customers in the most remote, hard-to-reach areas should be served. Based on his previous working experience, he knew that this was possible. When traveling through the Philippines, he started to see how the solution could function and got more inspiration for what the solution should look like. These combined experiences led him and a colleague (Maarten Neve) to found Healthy Entrepreneurs in 2012.

The company founded, Healthy Entrepreneurs, organizes and deploys a network of so-called community health entrepreneurs consisting of existing community health workers. Community health workers are a part of the national health system, being the lowest level of service providers offering basic healthcare to anyone in the population. These community health workers can also provide several services without meeting a medical officer or medical doctor. Major problems were occurring in the previous system as it was highly fragmented, project-driven and opportunity-based. By a clear value proposition supporting the Healthy Entrepreneurs, the organization tries to solve these problems. Services offered are most important (1) supplying the entrepreneurs with quality products, but also (2) training them to deliver better care, and (3) equipping them with tools to improve their access to care. Doing so, the company started small and simple by just organizing the supply chain. This proposition grew with the addition of training and more products and services.

Table 4-24. *Quote Value proposition Healthy Entrepreneurs*

|  |   |
|--|---|
| <b>Founder &amp; CEO Healthy Entrepreneurs</b> | <i>"I started very much the business in 2012 by organizing supply chain distribution and products. Over time I learned there was also a need for training and now over time we learned daily health we are able to offer many more services which are currently not available and people need to travel for... We continue developing additional products and services we can offer through our channel. Usually, technology in a way actually bridges the gap of both lack of available capacity but also lack of money for people travelling. ...if you take \$100 a year a rural family in Uganda can spend on basic health, 55 percent or \$55 of it is on transport costs to acquire access to a service provider and only \$45 is actually spent in reality on the service itself. So we're bringing closer to people. We are able to save them at least 55 percent of the spend their spending on basic health which is a saving itself. Plus some more for us because we also sell them at a lower price we're able to generate up to 89 percent of monthly savings. ...So if you take those numbers and you multiply them with the number of people we're able to reach it's a very interesting case."</i> |
|--|---|

With this model, Healthy Entrepreneurs positively impacts the entrepreneurs they employ and the entrepreneurs' reached rural areas. In these rural areas, people spend most of their yearly healthcare budget on travel costs. These travel costs are significantly reduced by the entrepreneurs delivering care to their rural areas. The financial impact this makes on the lowest income groups of the regions where Healthy Entrepreneurs is active is what makes the difference. The company had to design a unique model to ensure that this value could be offered, so they started initial pilot studies.

Table 4-25. *Quote experiments Healthy Entrepreneurs*

|  |  |
|--|--|
| <b>Founder &amp; CEO Healthy Entrepreneurs</b> | <i>"...we actually created a joint venture in Haiti with the key objective that the venture was together with some local Haitians and some American investors aiming to both organize wholesale and at the same time also a distribution channel through a network of community health entrepreneurs. The aim is actually in the first designs of this organization to combine the distribution through wholesale and a network of entrepreneurs since they all needed the same type of products. ...In practice, over time we realized organizing wholesale organization, that the wholesale offering and deploying a number of entrepreneurs was actually way too complex so we were unable to manage that efficiently and properly so we decided to actually focus and get rid of the complete wholesale"</i> |
|--|--|

The first customer or partners that Healthy Entrepreneurs started working with were grant providers interested in Healthy Entrepreneurs' plans. This partnership led to the first joint market surveys and

research with two NGOs in both Haiti and Congo. Together with American investors, Healthy Entrepreneurs created the first joint venture in Haiti. These American investors wanted to organize wholesale and distribution through a network of community health entrepreneurs. Experimenting with these wholesale and distribution businesses through the joint venture in Haiti, Healthy Entrepreneurs found out that the wholesale market was too complex and competitive. They chose to focus on distribution and deployment and not on wholesale. Overall, the project in Haiti did not work out as planned, as Healthy Entrepreneurs lacked control over the project. It became a failed project, taking up a lot of time and effort. Years later, the company went back to Haiti and was involved in a new successful project. This experience showed what things worked and what things didn't work out in Healthy Entrepreneurs' early business model.

While starting up, the company showed two sorts of business models, the first being in close collaborations with NGOs, working together in supplying and training to remote areas. The second one being the deployment of and distribution to community health workers. Currently, the second business model is the only still strong and viable business model used. The experiences working together with NGOs have not been effective for the company in the longer term. The company started focusing more on their customers, the Healthy Entrepreneurs, calling themselves completely customer-oriented. The value offered to these customers is very broad and goes via a sort of franchising model.

Table 4-26. *Quote Value proposition #2 Healthy Entrepreneurs*

|  |  |
|--|--|
| <i>Founder &amp; CEO Healthy Entrepreneurs</i> | <i>"So what we do, we offer them our portfolio in a franchise model... They are recruited in a particular area where we believe there's market potential. ...We offer them an opportunity to make an investment, so they make an investment of around \$40... ...In exchange they are identified they have passed a test, they were recruited, we have assessed them and we also are convinced they're able to be a very good partner in our network. We are able to offer them five days' training at the start... After the fact there's training they also know how to use a smartphone with two apps so they get a smartphone including the solar panel... ...We empower them completely to build up their business. I think in many cases it's an offer they cannot refuse... ...there is more need and more requests to work with us than actually the number of partners we are willing to accept."</i> |
|--|--|

The model contains that the organization scouts new areas in which they want to expand their operations. These areas are chosen on the density of the population and the access to healthcare providers. In these chosen areas, new entrepreneurs are sought. Findings these entrepreneurs have never been hard since an 'offer they can't refuse' is offered to them, providing much more value than they need to pay for. These new Healthy Entrepreneurs are recruited, trained, and equipped with the tools they need to succeed. From this moment on, the entrepreneurs start building their microbusinesses selling quality medication and hygiene products and educating people in rural areas. The entrepreneurs are supplied twice a month with new products and are trained regularly to perform better and more effectively. The products offered to the entrepreneurs started with the basics, being training, the medicines, and hygiene products, combined with a tablet and solar panel. When scaling the company, new products were added over time. These products added extra value to the customers of the entrepreneurs.

Healthy Entrepreneurs learned a lot about their key partnerships in this process and started off doing more independently instead of trusting on joint ventures or strong NGO partnerships. Their value proposition stayed fairly the same, apart from testing if they could start a wholesale business. Currently, the company is expanding its value proposition steadily by offering more additional services such as doctors at a distance.

#### *Revenue model*

In the revenue model, the company lives from the margins made in distributing their products. The company margins are around 23%, and the margins for the Healthy Entrepreneurs in the field are around 35%. Only products which sell in the field are offered to the entrepreneurs unless they are free of charge

products such as condoms, oral contraceptives, and injectables. As with many distribution business models, this business model depends on its scale to be profitable. With smart drop-off points and geographical distributions, the organization is becoming more and more profitable. In 2020, the company had a big investment round raising 1,5 million Euros. These investors considered Healthy Entrepreneurs profitable enough to invest, although the company did not break even yet.

### *Customer segments, customer relationships, and channels*

When starting up, finding the first entrepreneurs that wanted to become Healthy Entrepreneur was an interesting challenge. The first persons to sign were the hardest since no proof, examples, nor guarantees could be given.

*Table 4-27. Quote marketing channels Healthy Entrepreneurs*

|  |  |
|--|--|
| <b>Founder &amp; CEO Healthy Entrepreneurs</b> | “...they immediately understood the need, so until today we're filling an enormous need... ..Well, we were like spot on so, yeah, that's it. We went to communities and we said to those communities we're going to work so it was together with the NGO we worked with. They also had particular target areas, interventions areas and they offered us access to that market so they paved kind of the road. ...the area was fine and there was a lot of need so they immediately understood what we were up to and it wasn't so difficult to explain, to be very honest. We trained people and those people actually are so enthusiastic and took it over. It's like that... ..We... ..map information where we can see serious potential markets for the entrepreneurs. We go there, we're able to talk with the authorities to explain the model and 9 out of 10 or maybe 39 out of 40 they're very interested immediately...” |
|--|--|

This process of signing up the first persons was less complex than expected, and the team found out that their proposition was spot-on. The community health workers saw the need, and the salespeople's enthusiasm took over to the early entrepreneurs. When currently signing up new people, similar things are seen. The team enters a new area, where the partners often already know Healthy Entrepreneurs' brand, the model is explained, and 39 out of 40 times, everybody is interested. The newly signed up entrepreneurs are trained in five days staying in a local hotel. When all set up and ready to go, the entrepreneurs get their own sales officer as personal contact to maintain the relationship and talk about possible new products. Also, there is a call center for additional questions, and the company is currently experimenting with telemedicine for diagnosing diseases. A sales officer handles 400 to 600 entrepreneurs which he connects with at least once every two weeks.

### *Key activities and key resources*

In the key activities, Healthy Entrepreneurs was initially focused on including the private sector in their model. In scaling up, they found out that this was not a viable way to go about it. Also, they found out that the trust within the market was damaged by previous attempts and initiatives that only initiated some projects but never returned.

For Healthy Entrepreneurs, NGOs temporarily disturbing the market are seen as main competitors, undermining their business model. However, for Healthy Entrepreneurs to start and get where they are, partnerships and collaborations were needed. The company used partnerships with NGOs and their foundation to receive certain grants needed for the first pilot studies run in Haiti, Kenya, and Congo. With these initial investments and grants, the founders started together. In the years, an international team of Dutch, Ugandans, and other internationals grew. Many of these employees have been very loyal to the company from the early stages till now. These people have been giving leadership and guidance to the company in the last years. Currently, only two people are still working from the Netherlands as the majority of the operations and organization is shifted towards Uganda. The founder's choice to move to Uganda has been a very important one for improving the company's on-the-ground operations, reaching the scale needed. The company now raised serious investments to scale its operations and grow with 10.000 new Healthy Entrepreneurs. With these expansions, the company aims to reach all of Uganda and start in Kenya and Burundi.

Table 4-28. *Quote scaling strategy Healthy Entrepreneurs*

|  |  |
|--|--|
| <b>Founder &amp; CEO Healthy Entrepreneurs</b> | <i>“We raised investment money for scaling up 10,000 new entrepreneurs in Kenya and Uganda and we also recently raised other investments to replicate our model and to do replication of Healthy Entrepreneurs in Uganda and three other geographic areas, and through this replication in case we are able to execute successfully, we are able to cover in three years from now the whole country... So this replication strategy is also going to be key for Burundi because Burundi is considered as another geographic area of Uganda so it will be a replicator active who will actually operate on our behalf but following a contractual agreement instead of an ownership structure. This is definitely the way forward for Healthy Entrepreneurs this replication solution where we can use the same model in other areas faster than organizing it all ourselves. It's a next exploration.”</i> |
|--|--|

Their strategy for scaling faster in the coming years would be to replicate their business models and to find ambitious partners that want to roll out these business models in their countries and areas. To do this, Healthy Entrepreneurs has some major decisions to take in what contracts to make with which parties. The company tries to stay flexible and wants to ensure that the company can take over its operations if certain entrepreneurs fail. For the companies created through this replication model, a business on its own needs to be built, employing local staff, solving problems locally. This replication strategy is needed to overcome cultural boundaries. Also, the maximum span of an organization limits to 5000-6000 entrepreneurs. For creating these replication businesses, strong entrepreneurs need to be found. Currently, finding these entrepreneurs has been hard. Next to these partners, Healthy Entrepreneurs also has a dependent relationship with both suppliers and local governments. Healthy Entrepreneurs offers suppliers a unique entrance to a unique market for their products, so the suppliers have been very keen to build long-term partnerships. Also, Healthy Entrepreneurs offers local governments strong support, for example, with distributing COVID-19 response materials. Partnering with local governments has not been very hard for the company as long as they focused on solving their problems and helping these governments forward.

#### *Cost structure*

Healthy Entrepreneurs had its major costs in running pilots, market research, and experiments in the cost structure. Both the product as well as the business model needed to be developed. Doing so, many of the initial costs were on projects developing these components. Investments were spent securely when the next stage is reached using a staged approach for approaching new markets. More and more costs were taken on recruiting, training, and supplying the Healthy Entrepreneurs when the company started to transform from development to operations. The new investment needed for recruiting the next 10.000 entrepreneurs makes this need clear. The operational expenses are now taking up the main costs for the organization.

#### *The evolvement of the Iron Triangle*

The Iron Triangle of healthcare (Kissick, 1994) can be used to further zoom in on the changes occurring in Healthy Entrepreneurs' value proposition. This is done in Figure 4-11 below.

First, the Iron Triangle of Healthy Entrepreneurs visualizes barely any changes in quality and affordability. In the process of founding Healthy Entrepreneurs, the founders had a strong vision, coming from experiences and a clear need in the market on what the quality and affordability of their services should look like (Table 4-24, 4-26). Over time, the company could improve affordability to the trained CHW's even more and provide a higher and more extensive level of education and training without significantly changing their service.

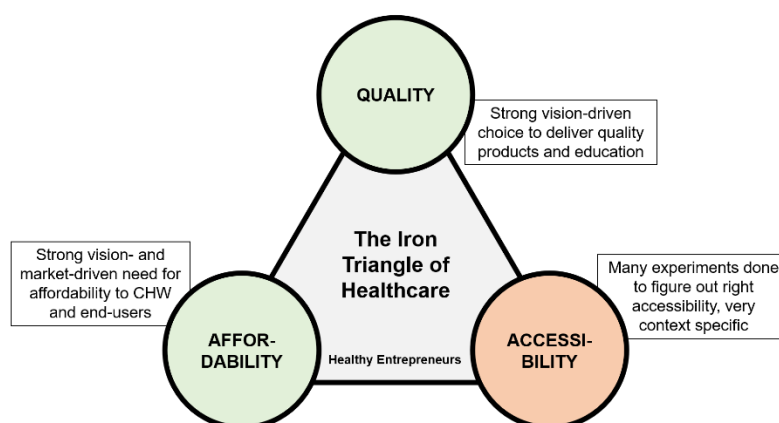


Figure 4-11. Iron Triangle Healthy Entrepreneurs

Second, on accessibility, a more extensive process was needed in making their innovation work, contrary to the clear need for quality and affordability. In finding this accessibility, Healthy Entrepreneurs ran multiple experiments, for example, with the wholesale model, partnering with NGOs in different geographic areas (Haiti, Burundi) and including the private sector (Table 4-25, 4-28, 4-29). The difficulty of the Healthy Entrepreneurs model was the context-specific differences that created many difficulties along the way. For example, when starting in Congo and Burundi, the team experienced that these companies were in practice much harder in deploying the solution than expected. Due to a coup connected to the presidential elections in 2016, the company had to stop its operations in Burundi. The coup caused a dry-out of donors, attention, and interests in the country. Currently, the organization is getting back to Burundi as up to 75% of Burundi's supply chain goes through Uganda.

Table 4-29. Quote market uncertainty Healthy Entrepreneurs

|                          |   |
|--------------------------|---|
| <b>Founder &amp; CEO</b> | <i>"So we started in Burundi, we had an operation in Burundi we actually had to end because in 2016 in Burundi the presidential elections where the president had a coup and he didn't leave and so that country became completely political and so there was no more investment money available, there was no more donor money available, no one was interested in the country and so it was not an environment we could work in. We're, now going back to Burundi."</i> |
|--------------------------|---|

The company's many experiments and perseverance ultimately led to finding a model that works in Uganda, leading to the needed investments to scale (Table 4-28).

#### *Process of getting to business model viability: Staged approach and staying lean*

Examining how Healthy Entrepreneurs grew towards their viable business model, it becomes clear that the company works with a staged approach. The company does so by creating boundaries in which investments are released in different tranches, and more effort is given when experiments succeed.

Table 4-30. Quote scaling-up Healthy Entrepreneurs

|  |   |
|--|---|
| <b>Founder &amp; CEO Healthy Entrepreneurs</b> | <i>"First, we started from scratch so we had nothing so we needed to do market research and once the market research was completed we started with a pilot. The pilot completed, we got a second pilot, we got a scale up and so it was a kind of staged approach. ...Actually, now take Burundi where we return, we have some basic information already of the country but still we will first do a vendor pilot, we check again the feasibility and the legal framework. Once we have completed that one we will get into the first pilot, check how the response of the market is to here and tweak the model to make sure it's according to local context and then we can start scaling up. This is a staged approach."</i> |
|--|---|

The quote in Table 4-30 shows how the company is running multiple pilots and letting these pilots' success or failure determine the next steps that have to be taken. This process has been central to the scaling of Healthy Entrepreneurs from the start.

Table 4-31. Quote Entry market Healthy Entrepreneurs

|  |  |
|--|--|
| <b>Founder &amp; CEO Healthy Entrepreneurs</b> | <p>“...the number of interesting challenges or challenge grants, whatever, where you can actually grow together with your innovation in a kind of staged approach .....so you go step-by-step and actually you get your next investment in case you finalize in previous rounds .....So there are facilities and we use those tools better for innovation than too much collaboration with NGOs because that’s going to cost a lot of time and will actually distract you a lot. Use peers, talk with others and just don’t reinvent wheels. Wheels don’t need to be reinvented. I think the majority of the other entrepreneurs in the playing field are willing to help you so use it and also try to really use the networking events because moving outside and meeting other people and listening to others is also very insightful and helpful.”</p> |
|--|--|

In this process, the company overcame some hurdles but eventually found success in going through these stages, positioning itself ready to scale. The founder advises finding support from grant-making organizations offering staged approaches to scaling up and building a viable business. Lastly, he advises talking a lot with other similar entrepreneurs to learn from their mistakes and experiences.

Based on the Lean Startup building blocks (Ries, 2011; Shephard & Gruber, 2020), Healthy Entrepreneurs shows high use of principles described in the Lean Startup.

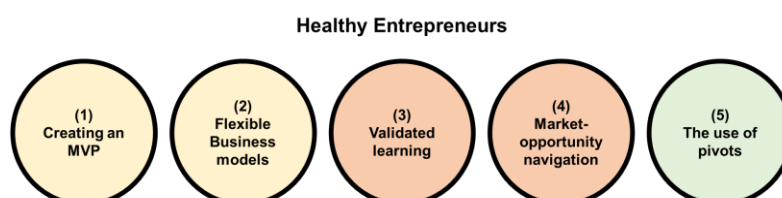


Figure 4-12. Building blocks Lean Startup at Healthy Entrepreneurs

Healthy Entrepreneurs started fairly simple, with a small value proposition, which could be labeled as their MVP; however, this does not appear in the data strongly. Running multiple experiments and starting in multiple markets, Healthy Entrepreneurs was forced into flexibility, but their business model did not change drastically. Healthy Entrepreneurs shows high use of validated learning and market-opportunity navigation in their flexibility and staged approach. Overall, no clear signs of pivots are found in the data yet; their recent investment to build a franchise model might become more like a pivot in the future.

Altogether, it can be concluded that Healthy Entrepreneurs' uniqueness is that they run experiments in multiple areas, following a staged approach, with small tweaks in the business model. They combine this with extensive customer contact and learning, speaking to all of their more than 4000 entrepreneurs at least once every two weeks. Lastly, their service's simplicity and strong branding, supply chain, prices, and community make them a real game-changer in the healthcare field, and they are widely recognized for their innovative actions in this field, for example, by the Dutch government (Ministerie van Algemene Zaken, 2020).

## 4.2 Cross-case Analysis

A thorough understanding of every venture's changes concerning its business model was developed based on the within-case analysis. Meanwhile, a cross-case analysis allows determining patterns across cases and investigating how certain business model changes are accompanied by certain types of experimentation processes and approaches. This analysis provides the input for answering the sub-questions, which supports insights into how frugal innovators in LMIC healthcare markets work towards a viable business model, using experimentation approaches.

Overall, the innovativeness of the Iron Triangle of healthcare, the business model evolutions, and the Lean Startup practices are examined. This order is chosen as the Iron Triangle, and the value proposition can be seen as the start of the business model. The experimentations can explain changes happening in the Business Model Canvas. The basic relevant theories and relationships found in the case studies' data, coming from the coding process, are summarized in Table 4-32. These results are elaborated based on the empirical insights using these models. Lastly, more elaborate conclusions are drawn explaining the evolution and changes across the cases and linking this to experimentation principles.

Table 4-32. Overview relevant theories cross-cases

| COMPANY   | DELFT IMAGING   | ATOMO<br>DIAGNOSTICS  | CAREPAY  | HEALTHY<br>ENTREPRENEURS   |
|---|---|---|--|--|
| <b>IRON TRIANGLE<br/>EVOLUTION &amp;<br/>REFINEMENT</b>             | Acc: Medium<br>Aff: Medium<br>Qua: Low  | Acc: High<br>Aff: Low<br>Qua: Medium  | Acc: Medium<br>Aff: Medium<br>Qua: Low   | Acc: High<br>Aff: Low<br>Qua: Low  |
| <b>BUSINESS<br/>MODEL CANVAS<br/>EVOLUTION &amp;<br/>REFINEMENT</b> | Value proposition<br>Customer relationships<br>Customer segments<br>Revenue streams | Value proposition<br>Customer<br>relationships<br>Customer segments<br>Revenue streams<br>Key activities<br>Key resources (!) | Value proposition<br>Customer relationships<br>Customer segments (!)<br>Revenue streams (!)<br>Channels<br>Key activities<br>Key resources | Value proposition<br>Key Partners<br>Revenue streams                                   |
| <b>LEAN STARTUP<br/>FRAMEWORK<br/>APPLIED</b>                       | MVP 1) High<br>Flex. 2) High<br>Vali. 3) High<br>Mar-opp. 4) High<br>Pivot. 5) Low  | MVP 1) High<br>Flex. 2) Medium<br>Vali. 3) High<br>Mar-opp. 4) High<br>Pivot. 5) Medium                                       | MVP 1) High<br>Flex. 2) High<br>Vali. 3) High<br>Mar-opp. 4) Medium<br>Pivot. 5) High  | MVP 1) Medium<br>Flex. 2) Medium<br>Vali. 3) High<br>Mar-opp. 4) High<br>Pivot. 5) Low |

#### 4.2.1 Working on the right value proposition

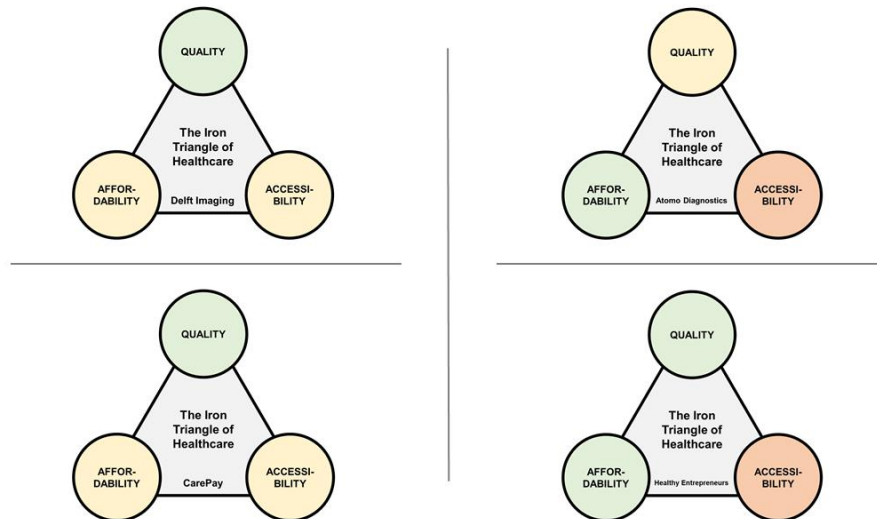
##### Founding vision

The term 'founding vision' is introduced to explain the evolution of the Iron Triangle and the nature of experimentation that can be seen across the cases. The founding vision captures the starting point of innovation, following a fuzzy front-end and ideation phase. All four cases show strong founding visions that determined the choices, direction, requirements, and innovation strategy. The founding vision came about following multiple sources of information before deliberately starting experimenting with a real innovation or solution. In the case of Delft Imaging, the founder already started thinking of his innovation back in 2004. In 2007 he decided to take it to the next level while exploring till 2012 before being fully committed. This case and other cases show that the founding vision is formed by previous experience, early conversations, a strong reason for founding, and the gap spotted in the market. In the case of Atomo, the founder did not have strong experience in the LMIC healthcare market, nor was the real gap in the market clear when founding. These uncertainties created a more pivotal ideation process for the company from the start. Overall, the founding vision lays the foundation for the value proposition in the pursued quality, affordability, or accessibility on the Iron Triangle. The founding vision, strongly linked to the founder's nature, creates the initial assumptions that a founder starts to test using experimentation. It can be argued that the stronger the founding vision, the better the assumptions.

As mentioned, this founding vision is leading in creating the value proposition, which can be assessed using the Iron Triangle of healthcare, as done in the paragraph below.

### *Iron Triangle evolution*

The choices and experiments leading to changes in the Iron Triangle are examined for each case individually in Figure 4-2, 4-5, 4-8, and 4-11. These changes are summarized for all cases together in Table 4-32 and Figure 4-13.



*Figure 4-13. Iron Triangle cross-cases*

When comparing the cases, some major learnings can be retrieved. First, in the quality dimension, it can be observed that in three out of four cases, no changes were made throughout the development of the venture. A strong vision based on previous experience often drives the choice in quality for the frugal innovators. The innovators start their businesses with a strong desire and need to deliver a quality of healthcare technology that could previously not be reached. For Delft Imaging, this meant western-quality X-ray screening, and for Healthy Entrepreneurs, quality medicines and hygiene products. For CarePay, this quality was more of a hard requirement since they needed to handle people's money. Lastly, for Atomo, this quality was more of a process in which they needed to run some experiments to find the needed quality and how this quality could be translated into their products.

Second, in the innovation's affordability, the process differs among the cases, where two out of the four cases had some small changes. Delft Imaging and CarePay have been testing and refining their revenue streams to become more viable, experimenting with different products and different payment methods. These experiments can be linked to their evolutions in accessibility. For healthy Entrepreneurs and Atomo Diagnostics, these processes were less of an experimenting nature. For both companies, hard requirements from the start were defined, driven by competition, market requirements, and vision of the entrepreneurs. Comparing the cases on their changes on the Iron Triangle, it can be concluded that a company arises from at least one strong vision and a market requirement on one of three axes, often being quality and/or affordability. Also, as accessibility is a major challenge in LMIC healthcare markets, and scalability and diffusion are major challenges for frugal innovations, all innovators experiment on achieving their ideal accessibility. Here, for innovators that do not have a hard requirement on affordability from the start, accessibility and affordability require some trade-offs, experimenting with new products and revenue streams.

Third, contrary to the strong choices from the start on the quality needed, all studies cases seem to have followed a strong process of change and refinement on their accessibility. For two of the four cases, these changes were significant. In the cases of Delft Imaging and CarePay, this was led by experimenting and improving the value proposition to fit the customer segments better. For Atomo

Diagnostics and Healthy Entrepreneurs, this was a stronger pivot-like process. Atomo tested various channels for distributing their product, and Healthy Entrepreneurs experimented in multiple geographic areas with different value propositions and partners, such as wholesale with an NGO in Haiti. Altogether, the accessibility domain of the innovation can be seen as a high uncertainty for the innovators.

### *Challenge in accessibility*

Concluding, a clear challenge in the accessibility can be found in the Iron Triangle of all the cases. The innovators evolve and innovate many times on their accessibility, refining their value proposition, finding new customer groups, and tweaking their innovation. This challenge in the accessibility can be coupled with the complexity and uncertainty of the markets. An innovation, especially in the LMIC healthcare markets, needs to fit locally with the ways of working, procedures, experience, and goals of the people working with the innovation. As the LMIC healthcare markets differ greatly from HIC healthcare markets, finding this fit is a big challenge. When this fit is found locally, scaling the innovation to more LMIC settings brings the next level of the accessibility challenge. Many LMICs can be different in their healthcare systems, payers, and level of education. The complexity lies in that for these frugal innovations to be viable, this scale is highly needed, making the accessibility challenge a strong hurdle for viability. The case study of Delft Imaging shows how the company overcame this accessibility challenge by broadening its value proposition and adding sustaining innovations to its portfolio. For example, Delft Imaging's products come in a backpack, in a truck, are implemented in-hospital, or build in their own diagnostic centers. Overall, solving the accessibility challenge influences the business model assumptions and opts to focus on experimentation in multiple markets and with multiple value propositions to fit the learnings in a scalable solution. This focus can be linked to the strong need and use of market-opportunity navigation, MVPs, flexibility, and simultaneous experimentation.

## **4.2.2 The creation of a viable business model**

### *Business Model Canvas evolution*

The choices and experiments leading to changes in the Business Model Canvas have been examined in Figures 4-1, 4-4, 4-7, and 4-10 for each case individually. The changes recognized in the case studies coming from these experiments can be found in Table 4-32 and Figure 4-14.

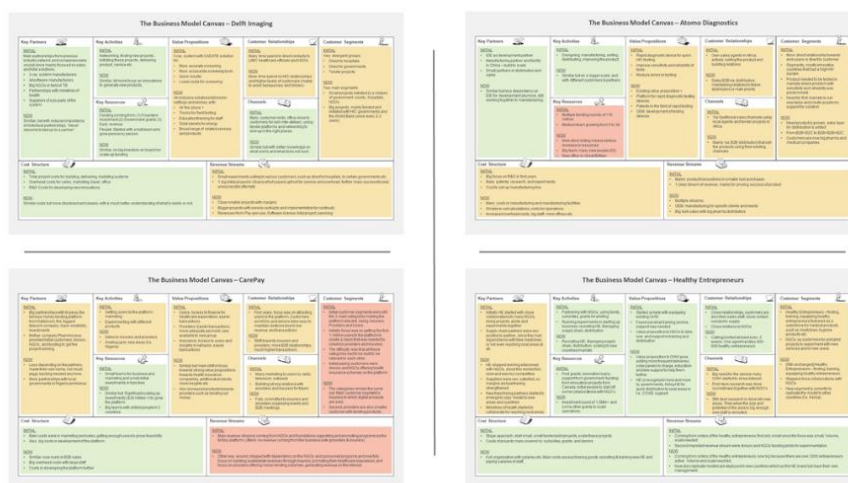


Figure 4-14. Business Model Canvass cross-cases

When comparing the cases on the evolution in their business models, some major learnings can be retrieved. First, the Business Model Canvas's major evolutions occur on the canvas's front-end, being the value proposition, customer segments, customer relationships, channels, and revenue streams. Especially the customer segments (4/4), channels (3/4), customer relationships (3/4), and value proposition (3/4) jump out. These building blocks show how the cases evolve on their desirability. Also, in becoming more viable, strong revenue model changes (3/4) can be seen. Furthermore, also a trend in a decreasing dependency on partnerships can be found, which is logical as companies grow. The cost structure, the key activities, and the key resources only change once in the four cases, not showing a trend. It can be argued that the business models of the studied cases evolve mainly on the front-end, in desirability and viability. These evolvments have to do with the search for more long-term viability, requiring stability and scale.

#### *Need for scale to achieve viability*

In conclusion, a strong pattern of searching for scale to reach viability can be seen across the cases. All cases are in scaling-up phases of their business and innovations, proving that the innovations work, ready to scale to increase impact and revenues. Interestingly, three out of four cases recently acquired new investors, pushing to increase this scale and revenue. These investors believed in the potential of the innovations and the viability that could be achieved. The need for scale to make innovations viable can be seen strongly in the cases of Atomo and CarePay, pivoting their business model to more stable and scalable revenue streams led by their new investors. Similarly, Healthy Entrepreneurs recently started pursuing a replication/franchise model to scale operations to more markets, driven by investors.

Contrary to Atomo and CarePay, Delft Imaging focuses on sustaining innovations, following their previous disruptive innovations to become viable more stably. These sustaining innovations target similar customer groups with follow-on products. For Delft imaging, experimenting with follow-on products is one of the core activities to keep a healthy business. Meanwhile, Delft Imaging is planning new disruptive innovations as they are on a mission to eradicate tuberculosis. With these follow-on innovations, Delft Imaging created a portfolio and strategy to secure their viability in the long run.

Altogether, some important things to consider when designing a viable business model are mentioned by the founder of CarePay. 'Designing for scale' is the startup mantra used by the founder of CarePay, describing the importance of creating a business model that can scale to become viable. He mentions something that has been a key problem for many frugal healthcare innovations in the last decades, being the project focus of the frugal innovations described by the term 'pilotitis' (Huang et al., 2017; O'Donnell, 2020). Describing the problem of many innovators, NGOs, and research institutes, designing pilots without a clear plan of continuation, scaling, go-to-market strategy, or a viable business model. The durability of the innovation has to be a focus from the very beginning, he argues. However, as all cases empirically substantiate, experimenting with the market's innovation is crucial for its success. This experimenting with business models means that experiments can also have negative outcomes. When an outcome is negative, a pivot is needed to steer the business to a more viable market again (Ries, 2011). The uncertainty of the LMIC markets, being threatened by diseases, political instability, and financial instability, urges innovators in LMIC markets to be very flexible. This flexibility and being open-minded is also present in the people living in these countries. It's the way these people survive. The founder argues that similar flexibility and being open-minded for innovating businesses active in these markets need to apply. This flexibility makes that innovators in these markets have to be extremely open to pivots.

From these innovators can be learned that a strategy for scale has to be integrated into the core of the innovations and business from an early perspective to see future viability. The companies stay flexible for new opportunities and grow towards viability, making small tweaks or more radical pivots. Balancing a clear view of how the innovation can become viable and staying flexible is a challenge innovators face when pursuing viability.

### 4.2.3 Patterns of business model experimentation

#### *The Lean Startup framework applied*

As methodology describing business model experimentation, the Lean Startup framework maps out why these changes occurred. When examining the Lean Startup framework applied across the studied cases, five strong building blocks are chosen to examine, based on Shephard & Gruber (2020). These building blocks are: (1) the creation of an MVP, (2) the use of a flexible business model, (3) the process of validated learning, (4) the use of market-opportunity navigation, and (5) the use of pivoting. The use of these building blocks is visualized in Figure 4-15.

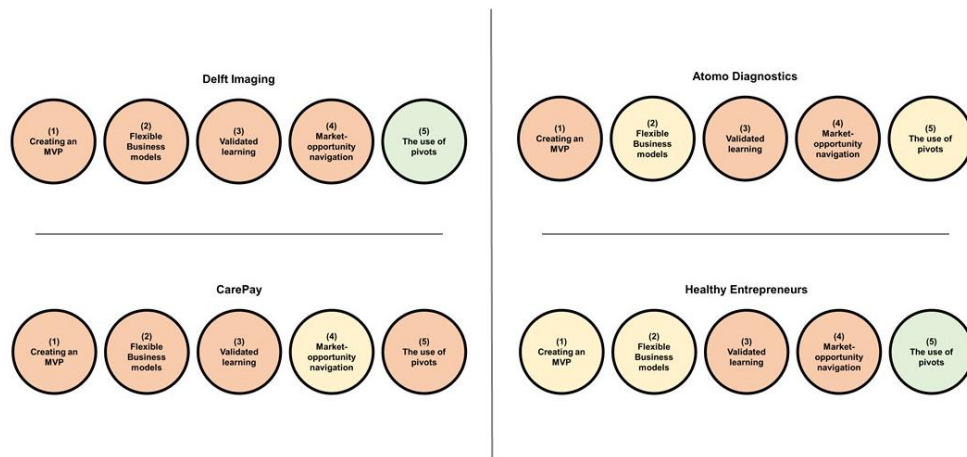


Figure 4-15. Lean Startup building block cross-cases

First, the principle of creating MVPs as non-optimal products to go to market more quickly is recognized strongly across the cases in three out of four cases. As the founder of Delft Imaging mentions, it is important to go for a less complex product that can be deployed in the market quicker to get an early validation. For the case study of Atomo Diagnostics, similar principles applied as the company took four years of testing with various MVPs, which got eventually picked up by the Bill & Melinda Gates Foundation. Similar to Delft Imaging and Atomo, also CarePay used methods to do early validation within the market. The team of CarePay went into low-income areas of Nairobi daily to gather the necessary first-hand information for improving their innovation. The use of these MVPs explains the evolution of the value propositions of the cases. Furthermore, it also explains changes in the business model's total front-end, as MVPs target innovators and early adopters. The risks of using MVPs have to be taken into account. Currently, pilotitis is one of the challenges for frugal innovators getting out of the project phase. This risk is important to consider for frugal innovators running experiments with MVPs (Huang et al., 2017; O'Donnell, 2020).

Second, the principle of creating flexible business models can also be seen in the cases. For two out of four cases, business models change medium, and for the other two, highly. The LMIC healthcare market and frugal innovations opt for flexibility in their business models at large. The high uncertainty and high complexity of the markets and innovations substantiate this need. The founder of CarePay also mentions this need. This flexibility shows the business models evolving as visualized in Figure 4-14.

Third, the results substantiate the high use of validated learning across all cases. The innovators can deliberately pinpoint the learnings they had from running business experiments. However, when examining the cases on this principle more in-depth, different validated learning approaches can be found, being either deliberate experiments or more trial-and-error based. The case study of Delft Imaging shows such a trial-and-error process that can be led back to the founder's character and experience. The case study of Atomo Diagnostics shows a more deliberate use of validated learning,

mentioning various of these experiments and learnings in the interview. Similarly, Healthy Entrepreneurs show a deliberate process of running pilot studies in various markets. Comparing the studied cases on these characteristics shows that the Lean Startup framework is applied strongly across the studied cases.

Fourth, a process of market-opportunity navigation can be recognized in all four cases, where this process is highly present in three out of four cases. The studied cases start in various markets, across different continents, and with different products. Also, the cases start opportunistic following strong opportunities, often together with strategic partners from the start. Over time, cases stabilize more, depending less on opportunities or partners. This process can also be seen through the Business Model Canvas evolution, showing changes in partnerships and the Business Model Canvas's front-end.

Fifth, the use of pivots is visible in two out of four cases and is present highly in one case. Based on the mode of experimentation used, two out of four cases use smaller, more local search types of experiments, while the two other cases use more distant search types of experiments. It can be argued that using more distant search types of experimentation can lead to more significant business model changes, being pivots. In the case of pivots, multiple aspects of the business model change, especially in the front-end. This happens in the front-end as new customer groups are targeted, with a new value proposition, new channels, and new revenue streams. The shift from CarePay from B2C to B2B and the similar shift of Atomo from product sales to more platform sales are such pivots.

#### *Learning-by-doing vs. deliberate experimentation*

The process of how the studied cases came to their business models shows that various considerations were made, based on knowledge from experiments, to decide what business model factors to pursue and how. Comparing the cases, the case study of Delft Imaging shows a strong learning-by-doing approach to a business model design. For Atomo and Healthy Entrepreneurs' case studies, these experiments appear to be designed more deliberately, following grants and setting up pilot studies. Whereas in the case of CarePay, the focus was barely on the overall business model initially, but more on the requirements needed to come to a business model, namely a platform with sufficient actors. This focus on building the platform was driven by experience in how platforms grow. The platform actors' feedback, stating what was needed to convince them to join the platform, created these requirements. These differences can be linked back to the founders' characters, the vision and requirements for the innovations, the innovators' starting point, and the overall uncertainty and complexity surrounding the innovation and market.

#### *Local search vs. distant search*

A pattern that can be seen across the cases is whether the innovators applied more local search vs. distant search. As all innovators came from HIC markets and started to innovate for LMIC markets, the type search can already be labeled more as distant search. However, examining patterns across the cases, the founders' experience in the market and with the innovations influenced the nature of the experimentation done. For example, Delft Imaging's case showed how the founder's experience in the X-ray and screening field strongly influenced the first years. He could use many existing contacts, partners, and solutions to start in the market early. For the case of Atomo, the total opposite was seen, as they did not have a good vision of what the product should look like early on, ran multiple experiments, and did multiple pivots before finding their sweet spot. For Healthy Entrepreneurs, the innovators run experiments and pilot studies in multiple countries, with multiple models and multiple partners, before finding their sweet spot, opting for distant search methods. CarePay came about, spinning out from years of research within the market, applying more local search methods. Altogether, it can be argued that the nature, experience, and means-at-hand of the founders strongly influence the nature of experimentation.

### *Simultaneous experimentation vs. focused commitment*

Similar to the use of either local search or distant search, a pattern can be found in the use of simultaneous experimentation vs. focused commitment. In the cases, the companies Delft Imaging, Atomo, and Healthy Entrepreneurs show clear signs of running multiple experiments, testing various parts of their business model in parallel, often in various markets. A staged approach can be found in doing so. In the case of CarePay, more focused commitment principles are found, and the company grows and scales quickly in doing so. The type of business, deploying a platform-based business model, urges the company to do so as the scale is needed to run experiments. In the current situation, diffusing to Nigeria and focusing on testing products to health insurers, CarePay starts to shift more to using simultaneous experimentation principles slowly.

### *Discovery-driven planning*

Analyzing the process of how the innovators experimented towards a viable business model, no clear signs of the deliberate use of discovery-driven planning can be found. However, some principles of the discovery-driven planning method can be found. First, the case studies show how they uncover, test, and revise a business model's assumptions. Second, some of the innovators show how they go through stages based on milestones and decisions. For Healthy Entrepreneurs, this method was even integrated into their process of scouting new markets. Third, as the underlying logic of discovery-driven planning is to reduce uncertainty by systematically converging assumptions to knowledge and redirecting activities in the face of emerging understanding, the innovators comply with this method at large. Critically, the creation of the reverse income statement, nor clear examples of milestones and staged created are hard to find, arguing that discovery-driven planning is not applied thoroughly or deliberately.

### *Linking the uses of experimentation*

Strong learnings can be found, linking all patterns that can be found in the cases together. First, the founding vision is leading for the types of experimentation used. The founding vision consists of the founder's nature, the reason for founding, the exploration process before founding, and the overall market gap. This overall founding vision links to uncertainty and complexity in the innovation and market, directly influencing the assumptions that need to be tested. This founding vision, especially in the founder's nature and experience, determines if a more learning-by-doing or deliberate experimentation process is followed. Also, the experience and network often determine if a more local search or distant search principles are used, whereas the uncertainty and complexity of the markets automatically opt for more distant search processes. Similarly, innovators mainly design simultaneous experiments, testing in various markets with various models. Furthermore, viability for frugal innovations means that scale is needed; reaching this scale means that the product needs to fit in multiple markets, circumstances, and environments, linked to the evolving and changing accessibility and overall Iron Triangles of the innovations.

Altogether, the combination of the Iron Triangle, Business Model Canvas, and Lean Startup principles show the cases evolving towards viability. The founding vision, providing early inputs for experimentation, and the accessibility challenge creating the most significant challenge for frugal innovations are crucial for managing this process. These phenomena fuel the process of experimentation, leading to viability.

## 4.3 Answering the Sub-questions

The sub-questions can be answered using the empirical results from the analysis done above and combining them with the theoretical results. The answering synthesizes how the experimentation process works for frugal innovators in LMIC healthcare markets and proposes a model to capture this process. First, the contextual factors, following the second sub-question, are concluded. This is followed by answering sub-question 1A. Finally, sub-question 1B is answered, leading to the discussion.

### 4.3.1 Contextual factors: *The challenges of LMIC healthcare markets and frugal innovations*

Following the first introductory chapter, the second chapter describing the scientific background, and the results chapter, an empirical conclusion can be drawn on the second sub-question.

*SQ 2. What specific challenges do the context of LMIC healthcare markets and the challenges of frugal innovations bring for the creation of viable business models for these innovators?*

The contextual factors theoretically substantiated being, (1) high market uncertainty, and (2) overall high market complexity of the LMIC healthcare markets, combined with the (3) high uncertainty, and (4) high complexity of the frugal innovations, can also be found in the empirical results. From an empirical perspective, the uncertainty (1) of the market can be found in the flexibility in responding to big and quick changes in the market, as happened for Healthy Entrepreneurs. The complexity (2) can be found strongly within the case study of Delft Imaging, taking years to learn how the international financing streams work and figuring out how to tap into them. The uncertainty (3) and complexity (4) of the frugal innovations can be found in the strong challenges the studied cases face in scaling-up and the strong quest in balancing the axes of the Iron Triangle of healthcare, searching for disruptiveness.

Diving deeper into the challenges innovators face, using the Iron Triangle cross-case, accessibility appears to be the main challenge described in paragraph 4.2.1. The challenge in accessibility links to the need for a sufficient scale of frugal innovations to become viable, combined with the often local adaption of the innovations to fit the healthcare market's ecosystem and procedures. This is partly touched by the challenge in diffusion by Hossein et al. (2016). Overall, solving the accessibility challenge needs to focus on innovators, linking accessibility to scalability, and needing this scalability to become viable. In the current research, solving accessibility for frugal innovators from a business model perspective has not yet given the attention it deserves and needs.

### 4.3.2 How do innovators come to viable business models

*SQ 1A. What is a viable business model for an innovator? And SQ 1B. What is business model experimentation, and which strategies and practices can be distinguished for innovators?*

The short answer to 'how do innovators come to viable business models?' is: they run experiments, narrowing down options, exploring what works and what does not work until learning towards viability are found. Experiments are run to reduce uncertainty, with becoming viable as the main goal. This means taking learnings from every experiment, of which the most crucial ones end up in the business model, leading to viability. The loop in Figure 4-16 is drawn to visualize this process.

This loop shows how innovators go through assumptions-experimentation cycles, letting their learnings slip into their business model towards viability. The shortfall in business model viability leads to higher needs for creating (high quality) main assumptions that can be tested. The better and more conscious these assumptions are, the better business model experiments can be created. With a delay, these

business model experiments create learnings that can be applied to new viable business models, reducing the shortfall in business model viability.

However, the loop does not show innovators' complete process becoming viable, as not all business model experiments directly lead to learnings that can be translated into business model viability. Many experiments create learnings on what does not work, creating mismatches. These mismatches lead to new assumptions, which improve in quality as innovators start knowing more. This process is visualized in Figure 4-17.

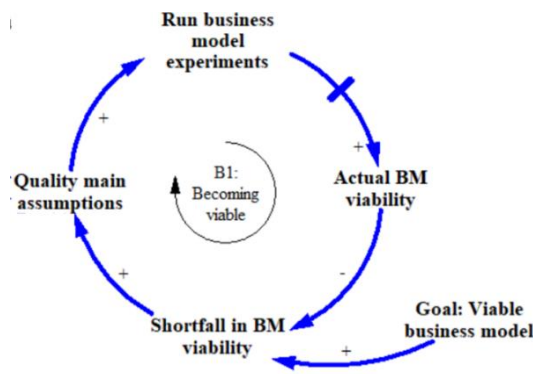


Figure 4-16. Base model experiments becoming viable

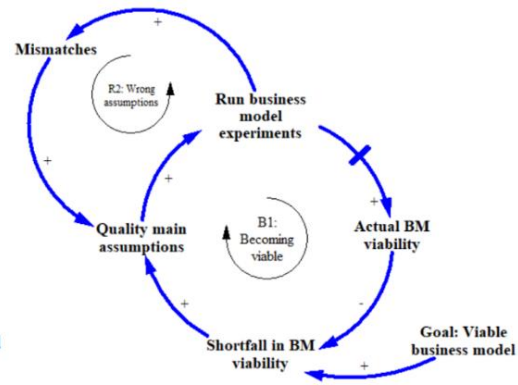


Figure 4-17. Addition wrong assumptions

The loop of wrong assumptions is a reinforcing loop that needs to be managed well, as an innovator can keep on making new assumptions and testing them until infinity. It can be argued that if an innovator keeps on making wrong assumptions, not leading to business model viability, eventually, his business will dry out of funding.

However, as the case studies show, a strong ideation process goes upfront before actually getting in the field and testing assumptions, especially for frugal innovators. This process leads to creating the 'founding vision' on which a company or innovation is built. This founding vision is fueled by things such as the reason for founding, previous experience, early conversations, and the gap existing in the market. This is visualized in Figure 4-18.

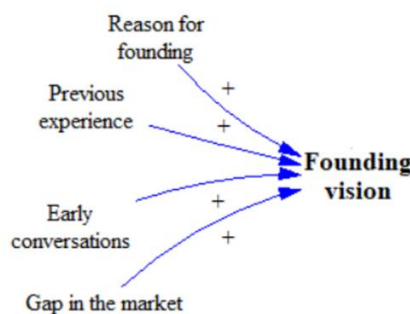


Figure 4-18. Founding vision

Altogether, the stronger this founding vision, the higher the main assumptions' quality as innovators know more and have more experience. This founding vision can be coupled to the Iron Triangle of healthcare, where the innovators make strong choices on certain axes. Although the founding vision often stays strongly present, the process of experimentation, leading to mismatches, can also influence this vision. For example, a strong choice on quality can be made following a founding vision. Still, when experimenting, it becomes clear that this quality cannot be reached, creating a mismatch, resulting in refinement on the founding vision, choosing for a little less quality. This process is visualized with the addition of the loop of vision refinement.

As the created model mainly shows a generic model that can hold for most innovators working towards business model viability, specific contextual factors can be added. For simplicity, the contextual factors are captured in 1) uncertainty in both innovation and market, 2) complexity, in both innovation and market, and 3) the accessibility challenge. Adding these factors gives the full model visualized in Figure 4-19 (Appendix IV). The uncertainty, complexity, and accessibility challenges make the process more difficult, reducing the quality of the main assumptions.

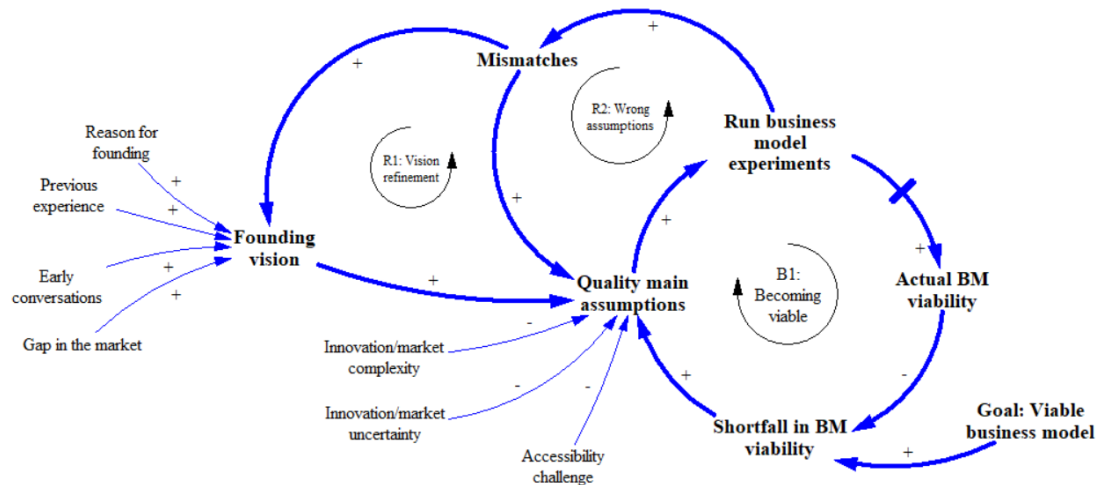


Figure 4-19. Full model experiments becoming viable

This process and visualization show that more mismatches will be made with the lower quality on the main assumptions, leading to a more difficult experimentation process and a harder challenge in finding viability. Altogether, managing the quality of assumptions to create strong experiments is crucial for innovators. With the lack of a strong founding vision, innovators are deemed to make more mismatches until viability can be achieved.

Concluding, across the cases, two different uses of the model can be seen. On the one hand are cases such as Delft Imaging, applying more of a learning-by-doing process of experimentation, going through the cycle quickly, less deliberate, and very often. This creates small tweaks in their business model and stable growth of the company. These experiments hold fewer risks as only smaller parts of a model are tested. Taking fewer risks results in fewer learnings in this process, creating a more stable than exponential growth. This process also steers more on short-term viability, making sure that innovations and implementations drive good margins. On the other side, some innovators apply more rigorous, deliberate experiments. These experiments are riskier, and when there is a failure, innovators make more pivotal switches in their business model. This type of experimentation could be argued to focus more on exponential growth instead of stable growth. Instead of short-term viability, these experiments seem to focus more on long-term viability, planning viability for future years, and not focusing too much on margin sheets. The balance between high risk, high reward, short-term and long-term viability, small tweaks and pivotal changes, and rigorousness of the experiments needs to be sought.

Overall, drawing back to the research question substantiating this research, innovators slowly grow towards viable business models following cycles of experimentation, refining their vision or assumptions along the way. The innovator's background and skills and the complex and uncertain nature of the market and innovations influence this process strongly.

Concluding on sub-question 1B, two strong distinctions can be made between the actual assumptions and the experimentation following these assumptions. As the paragraph and model visualize, the innovators go through a process of ideation. They create assumptions on how their business model should function and what it should look like. These assumptions come forth from a founding vision in

which the initial ideas for the value proposition (captured by the Iron Triangle) are listed. Following the assumptions, the innovators go through experimentation cycles. In these experimentation cycles, various strategies and practices can be found.

Following paragraph 4.2.3, innovators opt for distant search methods, combined with simultaneous experimentation principles, and a mixture of learning-by-doing learning and more deliberate experiments. Overall, the Lean Startup framework and its principles appear strongly within the cases, being flexible, using validated learning, creating MVPs, navigating through markets and opportunities, and staying open to pivoting. The method and process of discovery-driven planning seem to be used barely. However, the cases do follow some sort of staged approach using discovery-driven planning-based principles. Reasons that the methodology is not directly applied could be that the first step of discovery-driven planning, being the creation of a reverse income statement, is very difficult for these markets faced with a lack of similar companies or competitors and overall high uncertainty and complexity upfront. Interestingly, discovery-driven planning holds the potential to bridge a gap in planning for scale and thinking about viability in an early stage using the tool of creating reverse income statements.

## 5. DISCUSSION

As described in the last chapter, the case study results elaborate on various strategies, best practices, and implications in the search for a viable business model by the studied innovators. These learnings provide important insights for future innovators in this field. Furthermore, key findings on creating viable business models for frugal innovators in LMIC healthcare markets are discussed. This is followed by practical contributions to these innovators. Lastly, the limitations of this study and recommendations for follow-on studies are discussed.

### 5.1 Viable Business Model Creation

Bringing the literature and the empirical research together sheds light on how these case studies successfully found a viable business model for their innovations. This light is shed by combining the challenges that the LMIC healthcare market brings with challenges that frugal innovators face in making viable businesses around their innovations. Business model experimentation provides a framework in which founders can overcome these challenges arising from the market- and innovation difficulties. In this subchapter, the main findings are discussed based on what is known and how they can provide new insights. It discusses how the researcher has grown his understanding of the problem and what this entails for a proposed solution.

#### *5.1.1 Discussing the mains finding towards the ideal business model experimentation methodology*

Key findings are taken into consideration and linked to theory, discussing the mains finding towards the ideal business model experimentation methodology. Overall, this multiple-case study's design and the data retrieved from these case studies can guide starting frugal innovators to finding the ideal business model experimentation methodology for starting in LMIC healthcare markets. Concluding with strong directions given on when to use which approach coming from both the theoretical and empirical results;

First, due to the complex and uncertain nature of the LMIC healthcare market and the frugal innovations, business model experimentation is crucial for a frugal innovator to become successful. The method of simultaneous experimentation fits these challenges in complexity and uncertainty well. This method, grounded in organizational learning theory, opts for experimenting with multiple different business models simultaneously (Andries et al., 2013). As the uncertain markets can change quickly, this method can help in spreading chances and diversifying learnings. A strong example of the relevance can be found in the case of Healthy Entrepreneurs, where a rough shift in political stability meant that the company had to continue its learnings elsewhere. It can be discussed if this model is always the best choice, especially when comparing it to the use of focused commitment, where an innovator strongly bets on finding the product-market fit for one market after long and committed experimentation (Andries et al., 2013). This phenomenon can be found in the choice of market for CarePay, where the innovators focused on making their innovation work in Kenya. However, when critically assessing this case, simultaneous experimentation principles applied more to experimenting with multiple products to multiple product groups. This experimentation even fueled their latest pivot, focusing on the most profitable and scalable customer groups. As long-term viability is pursued, long-term survival is needed. The research of Andries et al. (2013) states simultaneous experimentation as the best method for reaching this long-term survival. All cases show clear examples of running multiple simultaneous experiments, staying flexible and open to pivot. The results seem to complement what is described in theory but add a new layer to the theory. As the theory is built on innovators in HIC markets, market

uncertainty focuses more on the unknowns, such as pricing with limited information, knowledge, and experience. In the cases of frugal innovators in LMIC healthcare markets, this market uncertainty is also fueled by limited information, knowledge, and experience. Still, it is also contingent on a macro-level of politics and the market. This contingency makes innovators aware of the instability of the markets and needs to be more open to pivot and stay flexible, navigating through these markets. Simultaneous experimentation can provide the method for baking in this flexibility and openness to pivot by examining multiple business models for multiple markets simultaneously, not betting all on one horse.

Second, the method of distant search is advised to complement the first implication since this method fits the high uncertainty and complexity of the markets and innovations. When visualizing the cases' business models using the Business Model Canvas, the canvas's interactive nature opts for this use of distant search methods. Contrary, local search is applied less deliberately, showing a learning-by-doing process and making incremental changes. Overall, many of the methods used for business model experimentation are grounded in organizational learning theory. Getting back to organizational learning theory's roots provides the needed background and learnings to place modern approaches (Minniti & Bygrave, 2001; Levinthal, 1997). Overall, organizational learning is needed to reduce uncertainties connected to business model experimentation theory (Gruber et al., 2008). Reducing uncertainties is the main challenge for frugal innovations, especially in LMIC healthcare markets. Connecting the dots, organizational learning principles need to be applied thoroughly by these frugal innovators in these markets to get to viable business models. The academic literature is still in doubt whether local search, changing one single business model component over time, or distant search, altering multiple business model components at the same time is most relevant for reducing uncertainty in the market (Andries et al., 2013). This research's empirical results show that both methods seem to function in the context, but that especially distant search seems to prevail based on the Business Model Canvasses. This has to do that experimenting with new revenue models often also leads to changes in cost structures, partnerships, customer segments, or value propositions. It can be discussed if linking the use of local and distant search to Osterwalder and Pigneur's (2010) Business Model Canvas can provide new insights on the need for distant search methods. As the Business Model Canvas shows a strongly interactive canvas, a change in one component often leads to multiple complementary changes, opting to use distant search. This bridge is currently not yet made in theory and could provide interesting insights.

Third, it can be discussed how the uncertainty and complexity following LMIC healthcare markets and the challenges that frugal innovations bring influence the studied cases to more deliberately plan and control their organizational changes, staying both focused and flexible at the same time. Organizational change theory can provide the lens to understand change occurring in the organization better. Life-cycle theory analyzing how the company evolves from Stage 1, startup to Stage 2, grow and Stage 3, harvest, could give such a lens. The challenge is balancing constructive and prescribed modes of change and balancing this with various parts of the organization, especially when it grows to multiple innovations, products, and entities (Aldrich, 1999; Van de Ven & Poole, 1995). Figure 5-1 shows that organizational change theory's implication is for the innovators to understand and plan where they are now and where they are evolving towards. This helps them to understand better how business model experimentation methods can be used to get there. Applying the theory to the studied cases, discussed can be how the investors' influence forces the innovators to focus more on scaling up and less on impacting the bottom of pyramid customers. This seems to happen in CarePay and Atomo, where the companies start to focus on exponential growth, needing investors to step in. The investors stepping in creates a certain dissatisfaction as the innovators start to make more pivotal choices to reach new goals set by the management, influenced by the investors. This opts for a possible short-term shift from life-cycle growth to teleologic change. Although this can mean for frugal innovators that their focus shifts more towards making a profit, it can be argued that more profit can mean more future impact. Concluding that this change on its own is neither good nor bad, it's how the company interacts and stays in line with its vision and mission through this change that determines the success.

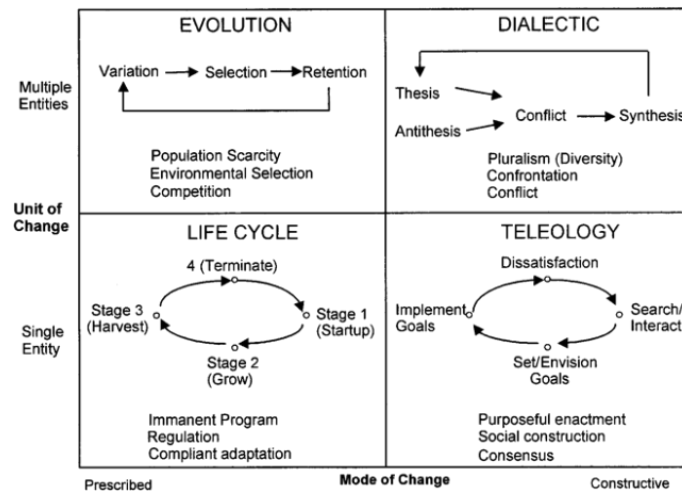


Figure 5-1. Modes of change by Van de Ven & Poole (1995)

Fourth, it can be argued that deliberately designing and running experiments is preferred above the unconscious alternative choosing deliberate trial-and-error experimentation instead of more unconscious learning-by-doing experimentation. Although the learning-by-doing method is embedded in some founders' or companies' nature, writing down the experiments and learnings can help the company in the long run as this fosters a learning organization (Ries, 2011). This learning-by-doing nature is especially present in serial entrepreneurs, opting to connect to the entrepreneur's level of experience (Lafontaine & Shaw, 2016). It is difficult to conclude from the case studies whether cases use either deliberate or more learning-by-doing experimentation, as this study cannot find the full considerations that went on in the innovators' minds to choose for certain experiments. In the case of Delft Imaging, the founder seems to be successful in applying a learning-by-doing approach. He shows an experimental nature from within his character and experience. The Lean Startup principles recognized in the case support this. Following the cycle of experimentation as visualized in sub-chapter 4.3, the strength of assumptions fueling the experiments is a strong determining factor of the success of experiments. Based on this cycle, one can argue that when designing experiments more deliberately, the strength of assumptions can be managed better, crafting better experiments. As the founder of Delft Imaging was highly experienced in the market and took years crafting its founding vision, he crafted strong assumptions, making fewer mistakes than good choices, as he argues. This complements modern approaches such as the desirability, feasibility, viability methodology (Bland & Osterwalder, 2019), and the Lean Startup framework (Ries, 2011), arguing for the power of making good assumptions creating more deliberate experiments, leading to more successes. In these theories, however, no strong distinctions are made yet on whether innovators are more inclined to using learning-by-doing or more deliberate processes of specific types of business model experimentation and how this relates to their experience. Following the research of Lafontaine and Shaw (2016), it can be questioned if the Lean Startup framework fits the previous experiences from practice best and if innovators are applying these principles more unconsciously.

Fifth, many new business model experimentation approaches can be found in recent years, coming from popular business model literature. Examples of such are the Lean Startup framework (Ries, 2011), the disciplined entrepreneurship approach (Aulet, 2013), but also tools such as the market opportunity navigator (Gruber & Tal, 2017), the Business Model Canvas (Osterwalder & Pigneur, 2010) and the design thinking approach of DFV hypotheses (Bland & Osterwalder, 2019). As these approaches all solve parts of the same puzzle, it is hard to make a distinct choice on which method to use and which method not to use. Within the experimentation done by the studied cases, clear Lean Startup framework principles can be found. The theory is not directly opting for one approach above the other; innovators

have to navigate through the theories and choose something expected to work best in their context. As multiple of these theories complement each other, making a hybrid mixture of relevant theories for various stages is advised. For making this mixture, a distinction can be made for two phases, being (1) ideation and (2) experiment design and testing. This distinction is already made in literature, supporting the need to be clear on the phases in which innovators need to use which tools in the paper *'Lean Startup and the business model: Experimenting for novelty and impact'* by Bocken and Snihur (2020).

The cycle, and model visualizing the process of business model experimentation, designed in sub-chapter 4.3, shows how innovators go through the cycles at different paces. Some innovators run smaller, more short-term focused experiments, whether other innovators run bigger, more long-term focused experiments. The first is the ideation phase, in which the company gathers all assumptions and choices regarding their Iron Triangle, value proposition, and initial business model. The second phase where innovators go through is the experimenting design and testing phase, where they actively experiment based on their chosen assumptions (Bocken & Snihur, 2020). As the Lean startup framework is argued to be somewhat ineffective for this ideation phase by popular author Felin in the press. Bocken and Snihur (2020) argue that the Lean Startup framework is not suited nor developed for the ideation phases. The method is designed for the experiment design, and testing phases following ideation Bocken and Snihur (2020) argue. The model and empirical findings support this theory. Figure 5-2 shows these two stages in the model. It can be discussed that literature has not been clear on distinguishing the stages of ideation from the stages of experimentation. As the model in Figure 5-2 shows, this distinguishment is not a strict line, as experiments can also result in mismatches leading companies back to ideation and refining their vision. An example of this can be found in Atomos' ideation phase. The founders argue to pivot before even starting up, searching for the right gap in the market. This research shows that innovators need this distinction in phases knowing which tools to use when and need that flexibility in tools to create true iterative cycles, leading to strong viability changes. Based on the founding vision, it can be discussed when innovators stop to iterate on their founding vision, but just their vision in general. A clear distinction which tools to use for the process of ideation, such as the DFV hypotheses (Bland & Osterwalder, 2019), and which tools to use when designing experiments and testing, such as the Lean Startup framework (Ries, 2011) is proposed.

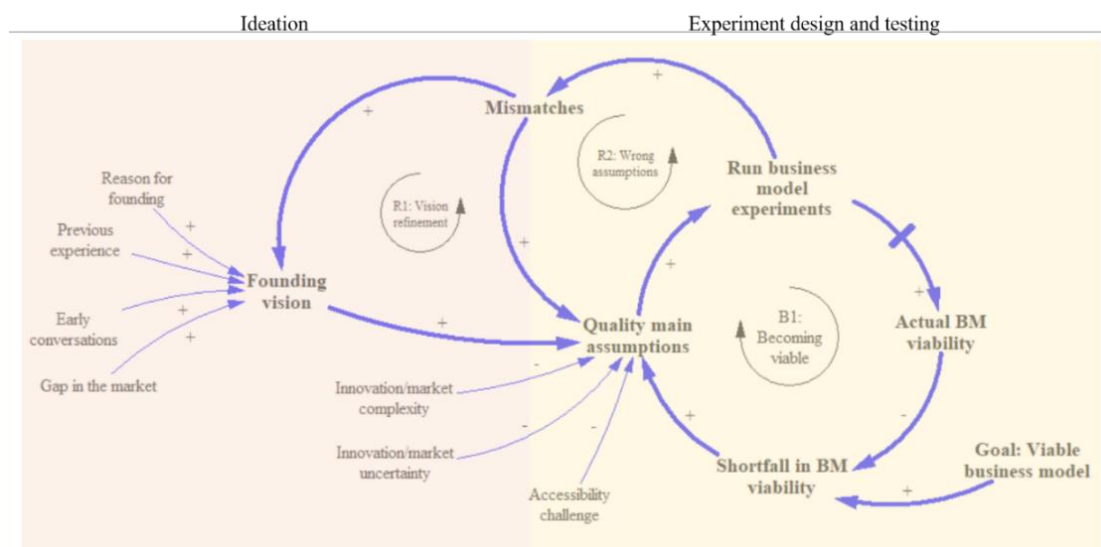


Figure 5-2. BM Viability in Ideation and Experimentation

Sixth, none of the studied cases seems to have used a deliberate discovery-driven planning methodology. However, many principles coming from the method are applied. Analyzing this method, the researcher concludes that it might fit the context very well to solve scalability challenges and think about the right scale from an early stage. As the method urges to calculate backward from the required

scale for sustainability at the beginning, innovators might be more inclined to think from the mindset of scale from the beginning (McGrath & MacMillan, 1995; McGrath & MacMillan, 2009). The discovery-driven planning method is proposed for frugal innovators starting up to integrate a strong stepwise process based on early-stage viability from the beginning. It can be discussed if the reverse-income statement as a method will fit the starting innovators well enough, as determining future profits and revenues can be a real tough challenge starting up. Possible use of this method can be that innovators reversely calculate their impact goal set, such as increasing the quality of care for 100 million patients by 2030. A practitioner-oriented method for doing so is the Big Hairy Audacious Goal (BHAG), coming from the popular book ‘scaling up’ by author Verne Harnish (Blatstein, 2012; Harnish, 2014). Based on this goal, the innovator can calculate its needed scale. This needed scale shows how many settings, countries, places the innovator needs to be active, creating a strong, calculated goal to work towards. Overall, as for frugal innovations, integrating scale from the start is extremely important. The theory of frugal innovation and business model experimentation need to come together, supporting frugal innovators. Currently, no significant methods fitting this challenge were found.

Seventh, The author proposes a method for business model assumptions that can support starting frugal innovators in LMIC healthcare markets using business model experimentation in the ideation phase. The method proposed is described in the book ‘*Testing business ideas*’ by Bland & Osterwalder (2019) and can be combined with healthcare's Iron Triangle (Kissick, 1994). Combining these tools balances the healthcare innovation requirements with the experimentation methodology needed to design strong and viable business models. The book of Bland & Osterwalder (2019) uses Osterwalder and Pigneurs’ (2010) Business Model Canvas and couples this to DFV hypotheses, Lean Startup framework, and other relevant theories, providing a field guide for rapid and deliberate experimentation. The Desirability, Feasibility, and Viability hypotheses answer respectively do they want this?”, “Can we do this?” and “Should we do this?” (Bland & Osterwalder, 2019). For frugal innovations coming from strong healthcare market problems, the question “Should we do this?” is often only answered from a humanitarian perspective and not from a business perspective. This answer argues for more focus on the business perspective of the “Should we do this?” question, arguing for taking on viability in an early stage.

### ***5.1.2 Validating the main assumptions: Early-stage viability hypotheses testing & discovery-driven planning***

As answering the viability hypotheses from a business perspective in an early stage is often not done well, a method for doing so is proposed.

Many innovations are done for more stable markets, with products that are often less urgent to these markets since they only create small cost reductions or quality improvement, described as incremental innovations. The viability hypothesis often comes last after answering and proving desirability and feasibility (Bland & Osterwalder, 2019). For frugal innovations, different challenges apply. Especially in LMIC healthcare settings, desirability is often much clearer as innovations should reduce certain disease burdens, mortality problems, or diagnosis errors. Business feasibility seems to be less of a problem as technological feasibility is often already proven, many donor funds are available, many potential partners exist, and resources can be attracted. It is argued that the main challenges and risks for these frugal innovators lay in the viability section, seeing many frugal innovations for these LMIC healthcare markets fail or end up as foundation and donor-funded initiatives. Although some viability questions can only be answered after desirability and feasibility are proven by knowing what problem is solved, which group of customers, and what innovation. Answering parts of these questions first is needed to drafts some important early-stage viability hypotheses.

Viability is strongly connected to the scale that the innovation can reach, which is strongly connected to how accessible the innovation can be made. So the assumption that needs to be tested in the early-stage viability is if sufficient scale could be reached in the market and if the innovation could be made accessible enough to reach this scale.

The theory of discovery-driven planning offers interesting insights into solving this challenge as the method can intertwine with this early-stage viability search. The discovery-driven planning method urges innovators to think on their innovation's desired scale (McGrath & MacMillan, 1995; McGrath & MacMillan, 2009) by starting with the reverse income statement. This first step of creating a reverse income statement can create awareness and understanding of how the innovation can become viable. In this process, the innovator states the required profits that the innovation needs to make, working upwards towards the revenue and costs associated with these profits. This creates a plan where the innovator can navigate towards and forces innovators to 'bake in viability from the start' (McGrath & MacMillan, 2009). Following checkpoints, the innovators can gradually grow towards their phases of growth. As this method is one of the grounding theories on which the Lean Startup framework is built, combining them can offer both the tools and flexibility that the frugal innovators need to test assumptions by running experiments. As mentioned, current literature lacks such a tool for the context and needs of starting frugal innovators, as discovery-driven planning focuses more on profit goals and baking in profitability and is often used and designed using MNE's. A method working with the specific needs of frugal innovations and setting impact goals, focusing on creating a scalability mindset, is proposed.

Experimentation needs an earlier focus on viability to innovate for markets where viability assumptions are the main challenge. Currently, the theory does not show strong examples or methodologies of how this can be achieved, and in practice, many innovators struggle with finding long-term viability.

### ***5.1.3 Concluding the theoretical contributions***

This study makes several theoretical contributions. Initially, few articles can be found on the challenges frugal innovators face in building viable business models for their innovations. The role and challenges of diffusion for these innovations have been covered lightly by Hossein (et al., 2016; 2020), but the full process of coming to viable business models was never covered elaborately. Following the empirical results from the studied cases and coupling these to existing theories, the author proposes an increased focus on viability in the early stages of the frugal innovations in LMIC healthcare markets. This focus is crucial for innovators to bake in scalability and accessibility from the start, needed for a sound business case. This focus makes sure that the innovators design their innovations viable from the start, increasing flexibility, understanding the market and its customers, and designing stronger business models. The uncertainties of LMIC healthcare markets, coupled with the challenges of frugal innovations, opt for a more deliberate learning process. The rising popularity of business model experimentation principles offers the tools to adopt such a process from the start of the innovation, growing from idea to innovation, to startup, to scale-up. The Lean Startup framework, the DFV framework, and the discovery-driven planning methodology offer practical tools for integrating these business model experimentation principles from the start.

Concluding, this research provides implications for starting frugal innovators in LMIC healthcare markets for designing viable business models. This contributes to the academic literature on frugal innovations bridging the gap and challenges of commercialization and supporting them in finding viable business models. Furthermore, this research contributes to organizational learning theories in showing the use of methods found in this theory.

## 5.2 Practical Contributions

For frugal innovators, finding learnings from the field can be challenging since frugal innovations are often applied locally in specific contexts, specific markets, and with specific business models. Also, successful frugal innovation cases are not widely available, especially not in the LMIC healthcare market. Successfully building and scaling these innovations is a challenge these innovators face, but the literature lacks practitioner-oriented insights into how this can be done successfully. This research aims to provide the practical contributions frugal innovators have been looking for by providing open and transparent data on four successful cases of frugal innovations in LMIC healthcare markets. In this research, many relevant implications for practitioners are concluded, providing learnings, best practices, and tools for frugal innovators in LMIC healthcare markets to get to a viable business model design.

To support practitioners in finding their viable business models and make sure that no time, effort, and resources are wasted on ideas and innovations that will never be viable, the author recommends a tool for integrating viability in an early stage. This tool should serve the purpose of closing non-viable routes quickly and supporting innovators in taking viability into account from the start. With this tool, the problem's size and urgency can be calculated, supported with total market sizes, competitors, and early customer insights. This can help innovators to think and experience their required scale, innovativeness, and disruptiveness. The reverse income statement of the discovery-driven planning methodology might offer a strong start for designing such a tool.

## 5.3 Limitations and Further Research

### 5.3.1 Research limitations

This research holds various limitations that have to be considered when reading.

First, the data retrieved on the case studies needed a look back in time, evaluating the choices made more than five years ago. It can be questioned how accurate statements looking back many years are, as people tend only to remember parts of the full process, and important nuances might have been lost. Triangulation, using multiple sources, such as old websites and articles, helped to reduce this limitation.

Second, as the studied cases, all consider innovators coming from HIC, innovating for LMIC markets can be questioned if these results can be generalized to innovators coming from LMIC settings. As for innovators coming from LMIC settings, much fewer subsidies, investments, and help will be available, creating very different challenges. Also, as all studied cases are SMEs, it can be questioned if results are generalizable to MNE's. As MNE's hold very different priorities, budgets, and levels of experience. Concluding that overall generalizability to LMIC innovators and MNE's should be questioned.

Third, as this study focuses strongly on the LMIC healthcare markets, it can be questioned if results can be generalized to other market segments for frugal innovations, such as the energy and transport sector. Furthermore, it can be questioned if results can be generalized to HIC healthcare markets, as the study focuses strongly on the innovations' frugal characteristics.

Fourth, the research is performed by a single researcher, adding single-person bias to the results. This makes that overall reliability can be questioned. Overall, by being very transparent in showing the coding and data from the results, combined with many references, the researcher aimed to stay close to the sources, improving overall reliability.

Fifth, as most of this research is built on the studied cases, it can be questioned if it provided a critical evaluation by interviewing directors and founders of a company. Directors and founders tend to present their businesses more positively. By using multiple sources to complement the statements of the

interviewees, this limitation is mitigated partially. Also, directors and founders differ in their functions, focus, and experiences, having diversified lenses for looking at their business.

### ***5.3.2 Suggestions for further research***

This section discusses some suggestions for further research.

First, it can be recommended to research the founder's role and experiences in applying business model experimentation methods. More experience seems to opt for more local search and learning-by-doing methods. It can be argued that especially serial entrepreneurs tend to have learned how to experiment more unconsciously and less deliberately (Lafontaine & Shaw, 2016).

Second, as this research focuses on frugal innovations failing to find a viable business model, the question arises which other reasons of failure can be distinguished for these innovations failing and on which multitude they occur. Furthermore, this research can also shed light on the failed frugal innovators' side to see how these innovators failed in finding a viable business model and what experimentation these innovators went through.

Third, this research only partially covers the need for an early-stage viability assessment for frugal innovators, examining their innovation potential. Further research is recommended on examining the need for this tool, the potential of this tool to reduce failure, and the further content of this tool. This could be coupled to the reverse income sheet of the discovery-driven planning methodology, providing a tool for assessing and integrating viability in an early stage.

Fourth, as the field of practitioner-oriented business model experimentation tools thickens, research on which tools to use best when can support innovators in choosing the right approaches in examining the pros and cons of the various tools. For example, a market's high uncertainty can opt for a tool that supports simultaneous experiments in various markets (Andries et al., 2013).

Fifth, paragraph 4.3.2 introduces system dynamics modeling for the process of business model experimentation. This model can be just a start of more rigorous and in-depth modeling of innovators' experimentation process leading to businesses.

Sixth, the accessibility challenge based on the Iron Triangle of healthcare is shortly introduced. This accessibility challenge, however, could be used more deeply for healthcare settings, providing the bridge between business model literature and healthcare implementation strategies, as is expected that strong and smart business models can fuel a strong implementation process.

## 6. CONCLUSION

In this research, many implications can be found following frugal innovators in LMIC healthcare markets in their quest to finding viable business models. With little research done on the challenge for frugal innovators in finding viable business models for their innovations in LMIC healthcare markets, an exploratory multiple-case study is carried out to answer the following question:

***How do starting frugal innovators come to viable business models for their innovations for low- and middle-income country healthcare markets to make their innovations profitable and scalable for the long-term?***

When answering this main question, the sub-questions provide the necessary input to come to a strong substantiation. Sub-question 1A establishes the business model as the mechanism used as *'the way that an organization creates, delivers, and captures value, thereby describing the underlying logic of the organization.'* The business model can be captured using the Business Model Canvas. Furthermore, this business model's viability aspect describes if the business model, and with that, the business and innovation will survive in the long-term. But to get to such a viable business model, as argued, an extensive process of learning is needed. Innovators need to adopt a 'discovery driven' approach rather than an analytical approach. Empirically, a model is created to elaborate how frugal innovators go through cycles of business model experimentation, moving towards viability. The difference in focus on short-term viability or long-term viability determines how quickly and extensively the innovators go through the cycle.

Answering sub-question 1B elaborates on the use of business model experimentation by the frugal innovators. Companies use business model experimentation practices to gradually learn how their business model functions and how it can be improved to make it more stable and viable for the long term. The innovators do this following the first step of mapping and planning the assumptions that need to be tested. A method used to do so is by clustering the business model in desirability, feasibility, and viability. After making assumptions, innovators run experiments such as pilots or trials, validating these assumptions. These experiments create the validated learnings that innovators need to grow towards viability. Altogether, innovators opt to use distant search methods, combined with simultaneous experimentation principles, and a mixture of learning-by-doing and more deliberate experiments. The building blocks from the Lean Startup framework strongly argue for the innovators' lean and flexible approach. The full use of the method of discovery-driven planning cannot be found in the cases but does hold potential for frugal innovators overcoming scaling challenges.

The second sub-question initially provides important contextual factors that need to be considered when becoming viable in these markets—concluding that the (1) high market uncertainty and (2) overall high market complexity of the LMIC healthcare markets, combined with the (3) high uncertainty, and (4) high complexity of the frugal innovations, opt for a special need for the use of deliberate tools, methods, and experiments for the innovators. Empirically, it becomes clear that the accessibility aspect of the Iron Triangle is the main challenge for scaling the frugal innovations, linking to the diffusion challenges frugal innovators face. Altogether it can be argued that overcoming this accessibility challenge requires extensive experimentation.

This research can be concluded by answering the research question drafted. Starting frugal innovators in LMIC healthcare markets use many business model experimentation and organizational learning principles in designing a viable business model. In this process, innovators focus on (1) extreme innovativeness for their solution, being very disruptive in their Iron Triangles, solving the customers' problems. Also, innovators focus on (2) extreme flexibility and agility in their business model designs, ensuring that necessary pivots can be made using Lean Startup principles. Furthermore, innovators need

to focus on (3) scalability from the initial stages of their ideas onwards, designing models and innovations that can diffuse across markets and broaden their value proposition. Also, (4) using simultaneous experimentation, the Iron Triangle of healthcare, discovery-driven planning, and DFV hypotheses, innovators can more deliberately plan, test, and execute their innovations, growing to viable business models, becoming profitable and scalable in the long term. Lastly, (5) the early-stage focus on viability, coupled to the challenge of accessibility and scalability, is the bridge that needs to be crossed.

Ending that frugal innovations in the LMIC healthcare markets hold the potential of strengthening these healthcare markets significantly in the coming decades. This can create a huge change towards an equal healthcare system, crucial for creating an equal world. The viability of these innovations is key to making this happen. This case study showed four innovators at the forefront of creating this change, proving that it can be done. Now the search for more innovators willing to make this change remains, uniting on the goal towards fair and accessible healthcare for everyone.

*“It’s time for change.”*

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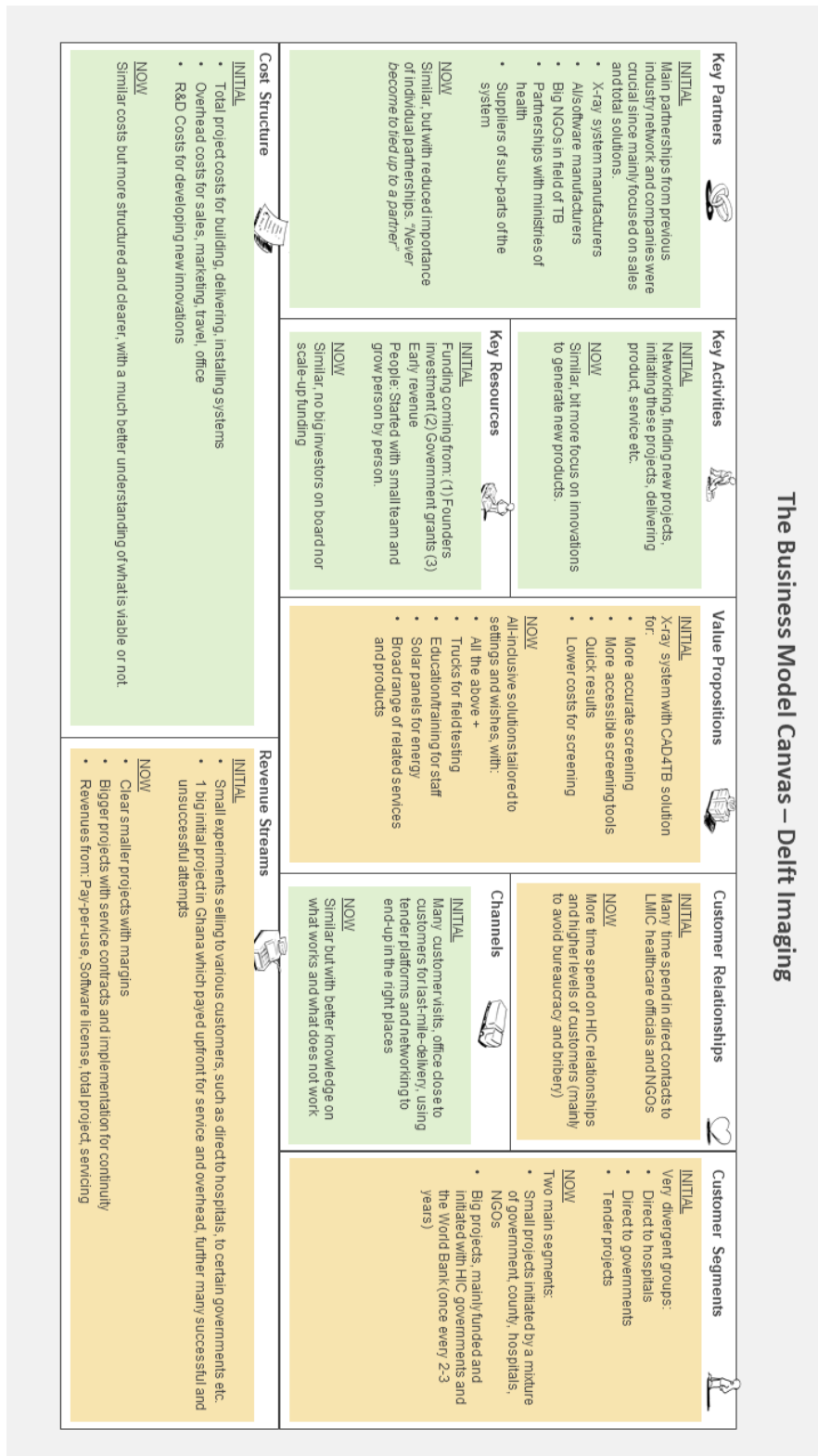
# APPENDIX

## Overview of Appendices








This section presents the following appendices used in this paper:

- i. Appendix I. Business Model Canvasses case studies enlarged
- ii. Appendix II. Tables with relevant quotes by founders
- iii. Appendix III. Interview protocol
- iv. Appendix IV. Business model experimentation modelling enlarged








## Appendix I. Business Model Canvasses case studies enlarged










## The Business Model Canvas – Atomo Diagnostics

|  |   |  |  |  |
|--|---|--|--|--|
| <b>Key Partners</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• IDE as development partner</li> <li>• Manufacturing partner and facility in China – build to scale</li> <li>• Small partners in distribution and sales</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Similar but less dependency on IDE for development anymore, still working together in manufacturing</li> </ul>   | <b>Key Activities</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Designing, manufacturing, selling, distributing, improving the product</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Similar but on a bigger scale, and with different customers &amp; partners</li> </ul> | <b>Value Propositions</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Rapid diagnostic device for quick HIV testing</li> <li>• Improve sensitivity and reliability of tests</li> <li>• Reduce errors in testing</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Existing value proposition +</li> <li>• Platform for rapid diagnostic testing devices</li> <li>• Patents in the field of rapid testing</li> <li>• OEM development of testing devices</li> </ul> | <b>Customer Relationships</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Own sales agents in Africa, actively selling the product and building relations</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Sales B2B via distributors, maintaining relations to these distributors is main priority</li> </ul> | <b>Customer Segments</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• More direct relationship towards end-users or direct to customer</li> <li>• Segments, mostly innovative countries that had a high HIV burden</li> <li>• Product needed to be tested in markets where problem with sensitivity and reliability was predominant.</li> <li>• Need for first markets to set examples and create academic support for solution</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Need product is proven, extra layer for distribution is added</li> <li>• From B2B&gt;B2C to B2B&gt;B2B&gt;B2C</li> <li>• Customers are now big pharma and medical companies</li> </ul> |
| <b>Cost Structure</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Big focus on R&amp;D in first years</li> <li>• Many patents, research, and experiments</li> <li>• Cost to set up manufacturing line</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Many costs in manufacturing and manufacturing facilities</li> <li>• Simple in-out calculations, costs for operations</li> <li>• Increased overhead costs, big staff, more offices etc.</li> </ul> |   | <b>Revenue Streams</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>• Mainly product transactions in smaller bulk purchases</li> <li>• 1 clear stream of revenue, mainly for proving success of product</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>• Multiple streams:</li> <li>• OEM manufacturing for specific clients and needs</li> <li>• Big bulk sales with big pharma distributors</li> </ul>  |  |  |

## The Business Model Canvas – CarePay

|   |  |   |   |  |
|---|--|---|---|--|
| <b>Key Partners</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>Big partnerships with M-pesa, the famous money lending platform from Safaricom, the biggest telecom company. Gave credibility, investments</li> <li>Mother company PharmAccess provided initial customers, donors, NGOs, and funding to get the project running.</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Less depending on the partners, made their own name, not much piggy backing needed anymore.</li> <li>More partnerships with local governments in Nigeria and Kenya</li> </ul> | <b>Key Activities</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>Getting users to the platform - marketing</li> <li>Experimenting with different products</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Sales to insurers and providers</li> <li>Scaling up to new areas (f.e. Nigeria)</li> </ul> | <b>Value Propositions</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>Users: Access to finance for healthcare expenditure, easier transactions</li> <li>Providers: Easier transactions, more adequate payment, care available to new group</li> <li>Insurance: Access to users and insights in behavior, easier transactions</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Similar but main shift in focus towards strong value propositions towards health insurance companies, additional products, more insights etc.</li> <li>Also increased products towards providers such as lending out money</li> </ul> | <b>Customer Relationships</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>First years, focus was on attracting users to the platform. Customers as NGOs and donors were easy to maintain relations due to low revenue and transactions</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Shift towards insurers and providers, more B2B relationships, much higher transactions.</li> </ul>  | <b>Customer Segments</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>Initial customer segments were still the 3 main categories making the platform relevant, being: Insurers, Providers and Users.</li> <li>Initially focus was on getting the first 1 million users to the platform to create a basis that was needed to convince providers and insurers.</li> <li>The difficulty was that all these categories had to be built to be relevant to each other</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Initial paying customers were donors and NGOs offering health insurance schemes on the platform</li> <li>The categories remain the same but: Main customer segment is insurers to which digital products are sold.</li> <li>Second, providers are also smaller customer with lending products</li> </ul> |
| <b>Cost Structure</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>Main costs were in marketing and sales, getting enough users to prove feasibility</li> <li>Also, big costs in development of the platform</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Similar, now costs in B2B sales</li> <li>Big overhead costs with large staff</li> <li>Costs in developing the platform further</li> </ul>  |  |   | <b>Revenue Streams</b>  <p><u>INITIAL</u></p> <ul style="list-style-type: none"> <li>Main revenue streams coming from NGOs and foundations supporting and promoting programs via the M-tiba platform. Little to no revenue coming from the business side (providers &amp; insurers).</li> </ul> <p><u>NOW</u></p> <ul style="list-style-type: none"> <li>Other way around, stopped with dependency on the NGOs and sponsored programs and now fully focus on building sustainable revenues through insurers, promoting their healthcare insurances, and focus on providers offering money lending schemes, generating revenue on the interest</li> </ul> |  |

## The Business Model Canvas – Healthy Entrepreneurs

|  |   |   |  |   |
|--|---|---|--|---|
| <div><div>Key Partners</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Initially HE started with close collaborations to many NGOs, doing projects, pilots and experiments together</li><li>Supply chain partners were very positive to partner, since they had big problems with fake medicines or not even reaching rural areas at all.</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>HE stopped working extensively with NGOs, since this worked too slow and was too competitive</li><li>Suppliers were very satisfied, so margins and partnering strengthened</li><li>New franchising partners started to emerge to copy model to new areas and countries</li><li>Ministries of health started to collaborate for reaching rural areas</li></ul></div></div> | <div><div>Key Activities</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Partnering with NGOs, using funds, subsidies, grants for piloting</li><li>Running experiments in starting up business, recruiting HE, Managing supply chain, distribution</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>Recruiting HE, Managing supply chain, distribution, scaling to new countries/markets</li></ul></div></div>  | <div><div>Value Propositions</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Started simple with equipping existing CHW</li><li>Found out what training service, support was needed</li><li>Value proposition to NGOs to take over and support in training and distribution</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>Value proposition to CHW grow, adding more frequent deliveries, solar panels to charge, education and tele-support to help them further</li><li>HE is recognized more and more by governments, hiring HE for quick distribution to rural areas in f.e. COVID support</li></ul></div></div> | <div><div>Customer Relationships</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Close relationships, customers are also their sales staff, close contact needed to supply</li><li>Close relations to NGOs</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>Calling/contact at least every 2 weeks. One agent handles 400-600 healthy entrepreneurs.</li></ul></div></div> | <div><div>Customer Segments</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Healthy Entrepreneurs – finding, training, equipping healthy entrepreneurs that work as a salesforce for medical products such as medicines, hygiene products etc.</li><li>NGOs as customers for joint pilot projects to experiment with new services and in new areas</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>[Still unchanged] Healthy Entrepreneurs – finding, training, equipping healthy entrepreneurs</li><li>Stopped close collaborations with NGOs</li><li>New segments currently to replicate the model to other countries (f.e. Kenya)</li></ul></div></div> |
| <div><div>Cost Structure</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Stage approach, start small, small funded pilot projects, scale these projects</li><li>Costs of projects many covered by subsidies, grants, and donors</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>Full organization with salaries etc. Main costs are purchasing goods, recruiting &amp; training new HE and paying salaries of staff.</li></ul></div></div>  | <div><div>Revenue Streams</div><div></div><div><p><u>INITIAL</u></p><ul style="list-style-type: none"><li>Coming from orders of the healthy entrepreneurs, first only small since the force was small. Volume, scale needed</li><li>Second important revenue stream were donors and NGOs funding pilots for experimentation</li></ul><p><u>NOW</u></p><ul style="list-style-type: none"><li>Coming from orders of the healthy entrepreneurs, now big because there are over 3000 entrepreneurs active. Volume and scale reached.</li><li>Now also replicate models are deployed in new countries which us the HE brand but have their own management</li></ul></div></div> |   |  |   |

## Appendix II. Tables with relevant quotes by founders

This section provides background quotes coming from the semi-structured interviews with the directors/founder of the studied companies. These quotes provide background information on practices of experimentation used.

### *Background quotes Delft Imaging*

Table 0-1. Quote revolutionary TB screening Delft Imaging

*Founder & CEO  
Delft Imaging*

*“We changed the whole paradigm how to screen tuberculosis. Before that they did sputum testing where actually we eradicated tuberculosis in the western world with x-ray screening but since there are not enough doctors in Africa and other developing countries, they went to sputum screening which doesn’t work, and now they go back to x-ray screening in combination with artificial intelligence. So we supply the total solution: the container which was plug and play with a digital x-ray. It was very simple to use and artificial intelligence to inform if this process is suspected. So then you have this whole triangle: financing, healthcare where you might find a solution..”*

Table 0-2. Quote Bootstrapping methods Delft Imaging

*Founder & CEO  
Delft Imaging*

*“So with Oldelft, so my old companies they grow in health. I just had all the tools to do the business but when I sold it I still wanted to do the business but I have no tool so I needed them to do what I offered. The good thing was, whatever I did in activities was good for them as well so they just have to do the installation, supply the products, so they were very much interested... .. So that’s less tools but the more within the activities at the beginning it was completely balanced, so the more I went into the activity the less independent I want to become and, of course, I still have some dependency but no strategic dependencies anymore.”*

Table 0-3. Quote stable business Delft Imaging

*Founder & CEO  
Delft Imaging*

*“And the other thing is we also are now positioned to be able to do bigger projects so we have to standardize solutions so we sell two or three systems to Papua New Guinea, two systems to Uganda, whatever, but at most they try to every two or three years go for bigger projects, that these bigger projects are supported by the Dutch government or maybe the Japanese government, and then this model is probably sustainable because on the big projects you get much more margin and then you don’t have to push that much on the smaller projects. Of course, you have always these situations now.”*

Table 0-4. Quote Importance of brand image Delft Imaging

*Founder & CEO  
Delft Imaging*

*“...but I use the name Delft because Delft had been in TB screening always an important name. Originally Oldelft but since they couldn’t pronounce ‘Ol’, Oldelft so everyone was talking about Delft, so I said to use this name and that was my reputation credibility. And for a large part we just simply built up our reputation. So it was starting small and now we have a reputation but it simply took a while. So the first products you, therefore, also have to accept the money was not so much, the margins were relatively low and you simply had to build up this reputation.”*

Table 0-5. Quote Personal drive founder Delft Imaging

*Founder & CEO  
Delft Imaging*

*"For me it's not only unrest in myself but I always have the feeling it wasn't about me - and I'm getting very philosophical - but I don't have a big ego, I know the chances of me being here in 25 years' time are very small so probably I will be dead maybe in five to ten years' time, I don't know, but I have a very strong feeling I need to do something with a purpose; I want to be in Africa with all these issues and trying to solve these problems. That gives me much more a feeling of purpose. Again, it's just personal. I always have this urge to see how can I support what is my purpose in life and one maybe is a bit stronger than the other."*

Table 0-6. Quote purpose and quality Delft Imaging

*Founder & CEO  
Delft Imaging*

*"...so if you look at Delft, the western world is a side step but, in principle, it's not our market, so we are interested in countries with poor resources so underdeveloped countries where we can breakthrough innovative solutions and have a great impact. If we can do it, that fills my need for purpose and it fills the need from the people who have restricted resources in a difficult environment. That's actually what we're interested in, so the solution has to be really good. I don't want to find a solution that's not good for people."*

Table 0-7. Quote Need to educate the market Delft Imaging

*Founder & CEO  
Delft Imaging*

*"...in the beginning people didn't understand because we were the first and it was difficult to change their way of thinking. And even nowadays I'm still surprised sometimes I have to explain how it works and what it does. We didn't do a lot of difficult marketing, we just showed our processes work... This was really something that changed the whole process. They really saw, okay, if we do this we screen much more people with TB and, therefore, it really completely changed the market. That's what we do today; it's not a marketing thing that we don't want to really sell something, it has to be drawn into the market that they need it."*

Table 0-8. Quote on intuitively planning Delft Imaging

*Founder & CEO  
Delft Imaging*

*"I'd say our experience is in understanding the way it's financed, the way the products evolve but also the experience that I know it. We plan it for probably 80 percent and the other 20 percent we estimate roughly... But that's the part I not only like but I'm good at as well because I've done this so many years because that's what I'm drawn to. This is what I like: the insecurity but knowing eventually we will find a solution. So now we are trying to sell projects and if you look at it you'd go 'Wow! did you do this before?' I would say no, but 80 percent we've done before and the rest we know how to find a solution when the problem occurs - and that always was the case. So, of course, there are always a risk that next time it will not be the case but this experience I think has become an important testament. And, of course, too, understand the process even better."*

## **Background quotes Atomo Diagnostics**

Table 0-9. Quote motivation founder Atomo

*Ex-design director  
Atomo Diagnostics*

*"So his daughter was born and when his daughter was born, she had some defects and had to go to the hospital a lot and there was a lot of blood testing and this is where he said, 'I think we need to improve how we do point-of-care blood testing'."*

Table 0-10. Quote fuzzy front-end founding Atomo

*Ex-design director  
Atomo Diagnostics*

*"so they had to pivot and before they started Atomo, they basically said let's look at the point-of-care testing where you have a test at the GP and you look for a result immediately, so you don't ship the sample to the lab. And this is when they came across a very strange matter.. ...the World Health Organization did a study and found in the field that one in three people with HIV went home thinking they didn't have HIV, and that was a massive discrepancy between what these companies are fighting about and the lab sensitivity and the in-field performance which is so low and you get such a big error. And that was also a reason for a lot of countries and World Health Organization to say it's not safe to do these point-of-care*

tests, because you have so many false positives or false negatives. So, we said let's look into it as a start-up, and see if we can make this better. And what we did was, we flew to South Africa and we started observing people... ..And then even if I had done all that right and you need to still read the right lines and you need to wait for 10 minutes and there were a lot of errors with that. So, then we said, as a start-up, why don't we take these little chemistry sets and remove all the useability errors."

Table 0-11. Quote sales and diffusion Atomo

*Ex-design director  
Atomo Diagnostics*

"So, we had our own salesperson in South Africa, and she was basically driving around South Africa trying to look for customers who want an HIV test for point-of-care testing. And yeah, I think she had a number of leads out so it could be not the nationals, it could be insurance companies, it could be hospitals or regional governments who were looking to roll out a HIV test program. So, she was sort of exploring the landscape of who's in need of an HIV point-of-care test. Actually, something I have to mention is that very quickly after we have launched our HIV self-test, we also launched a malaria test. So, we very quickly saw that we could also sell malaria test to potential players in the market, the adjustment to our product was very limited. We could drop in an existing lateral flow test, we could change the volume of blood that was collected and delivered to the test, and we could change the buffer fluid and we could immediately go to market. So, in 2013, so 2009 to 2013... We started the business in 2009 and in 2013 we were on the market with our first HIV test, and in 2014 we were in the market with a malaria test on the same platform. So, our sales team in South Africa was able to not only try and sell the HIV test but also the malaria test, and we developed the malaria test with a client who said I would like that, but then for malaria. So that's sort of how we sort of started selling."

Table 0-12. Quote LMIC office Atomo

*Ex-design director  
Atomo Diagnostics*

"but it was pretty clear the first market we chose was South Africa because that is where... You know, there is a lot more HIV testing going on in Africa. So, in South Africa, one in five people is infected with HIV... ..It's a lot, and we don't have those numbers in Australia or Europe. So, the market for HIV testing is very different in those countries and yeah, the costs is much lower but the volume is a lot higher. So, we chose South Africa because that is where you can really make an impact also with your HIV test, but we also did testing in Mozambique and Tanzania, some of the countries around there. Also, because we know... Basically sub-Saharan countries, that's where the need is. So, it was very logical for us to have an office in South Africa, so that was pretty much from the beginning, we were there. And we had a salesperson who was from Cape Town, so he worked there and after a couple of years he came to Australia but in the beginning he worked from Cape Town... ..What we saw was in South Africa, they were progressed quite a bit with HIV testing programs and the hospitals were quite accessible, we had good contacts there. And yeah, it was easier for us to access the market. Also, at that time, they didn't have like a certification for medical products but now they do, we knew it was coming. So, there was a couple of reasons why we thought South Africa would be good, but it was also a good base for us to go to other countries, from South Africa."

Table 0-13. Quote Key resources Atomo

*Ex-design director  
Atomo Diagnostics*

"We had a lot of people who were committed to building the business and also they basically bought shares in the company and there was a couple of dilution rounds, so we have a number of people from the R&D team who actually really motivated and driven and they are personally invested in the company. But yeah, I think that's more about fund raising. Cutting costs, I think we were trying to keep R&D LEAN in such a way that we were working with IDE but... Which is, maybe the hourly rate is more expensive than hiring someone but being able to pause a development and take 3 or 4 people off, that's a lot cheaper than suddenly having 9 people on the payroll. So, it made Atomo a lot more flexible and yeah. I think it was... We were trying not to cut costs but actually make sure we have enough funding coming in. So that was a major role for John Kelly to make sure that we had... We won a couple of grants by the Australian government and international grants from the Gates Foundation. We

*had an investment by the global health investment fund, so those were ways to actually make sure we didn't to cut costs, but we could speed up."*

Table 0-14. Quote Importance founder Atomo

*Ex-design director  
Atomo Diagnostics*

*"Yeah, he has been the driving force behind Atomo so without him I don't think we would have Atomo where it is now. So, he was crucial, also because he had seen... He had built a successful medical device and did an exit before, with the syringe that he sold to Sanofi. And before that he was an R&D engineer himself, so he knew a lot about product development and medical device development but also a lot building a business and then exiting. And I think he was crucial in making sure we were developing the right products and making sure that we would have all the partners to work with, and the funding. So, he was really crucial in that bit. where I could focus on making it work... ...He didn't just want to build a medical device company. He wanted to build a medical device company that made a big difference. And this is actually where a lot of med-tech companies were telling him and laughing at him in the beginning and telling him why are you doing this?... ...Developing a product for the developing world is not something that tech companies do often, most of times they develop something for Europe or for America and then after a couple years they make a cheaper version for Africa. And we were deliberately designing something for Africa, and it had to be cheap, high volume... ...And luckily we found the Gates foundation who have the same mentality, they say, design for the bottom of the pyramid, its where we want to go, we want to design for Africa and Africa needs different products than Europe."*

*"If you look at the other projects and Johns career, he is a very stable person who also very good at running a marathon and hanging in there to contribute and build a business, but not necessarily about revolution. He is not someone who is out there to revolutionize."*

Table 0-15. Quote IP Protection Atomo

*Ex-design director  
Atomo Diagnostics*

*"...So, the first MVP, the minimum viable product, we still have 10 patents in here. So there a patent around blood collection but also around the mechanism inside to make it work in the right order, and those patents were crucial for following investors. So, nobody wanted to invest in this start-up if we would not have our IP protected, or some IP protected. And the good thing is that this is quite a mechanical product so there is a couple of mechanisms inside, there is a couple of innovative features that allowed us to patent it. And that gives the investors a lot of confidence, that they are investing in something that at least 20 years to have a return in that investment and deter competitors. And then the second product where we integrated the buffer blister, again we had 5 patents around the buffer delivery and that was also something to make sure that we could keep competitors away for a while."*

## **Background quotes CarePay**

Table 0-16. Quote Customer segments CarePay

*Founder & ex-CEO  
Africa  
CarePay*

*"Yeah, you're right, so we have three customer groups, if you like. We call the first one that you mentioned, we call them the participants. So, it's not only patients, if you like, it's also people who are healthy, but may have a health insurance cover on our platform, right?... ...But they currently don't really directly pay for our services. The ones who do pay directly for services are the payers, which indeed are insurers mostly. But like I said there's also some examples where for example a non-profit could be a payer, but mostly it's insurers and yeah, a third one is indeed healthcare providers."*

Table 0-17. Quote Business model CarePay

Founder & ex-CEO  
Africa  
CarePay

*"At the moment we have sort of three proven revenue models, if you like. Two of them paid for by the payers, so mostly insurance companies, they pay a fixed fee per insured member they put on our platform. So that's one business line or revenue line. Similarly donors or other types of payers who would use a platform pay normally a flat fee to access and use our platform, and that's the biggest, the one that we recently launched and that's growing now is what we call third party administration, TPA in short, that's where those payers also outsource key processes to us. So, for example insurers have to assess medical claims and then pay those out to healthcare providers. We are now becoming an outsourcing partner to do that on behalf of insurers. Similarly, they would normally have to maintain their own healthcare provider panel, we also do that on behalf of insurers. So, all that is grouped on their third-party administration services. Again, it's the payer normally paying a flat fee, a significantly higher fee than just using the platform, but we also do a lot more work in return for that. Then the third revenue model that we have in the market and which is growing very fast is towards the healthcare providers, where we provide digital lending products, so they can borrow money based on all the transactions they do through our platform. Based on the amount of revenue they do through us, they can borrow certain amounts, electronically again, with one click of a button. And then with every future transaction a certain percentage of that transaction goes back to the financier to pay back that loan. And that's a very successful and fast-growing product and there we are not the one providing the financing, so we're not the banks, let's say, we are the in a way the agent who disperses and also collects the loan payments and the loan repayments and we get a transaction fee for that."*

Table 0-18. Quote Key activities CarePay

Founder & ex-CEO  
Africa  
CarePay

*"... it's three things, so definitely software development, it's the basis on which we built, without a functioning platform you can't do anything, so that's always been a key activity and we've always been yeah, growing that team further and further. The second is to connect all those hospitals, like I was saying, first contract them, find them, contract them, and then get the software working. So that's from the start been a key focus area, and from the moment we had this sizeable number of hospitals... ..And as soon as we had larger groups of hospitals and labs and everything in other regions, we were able to market then also that savings product in other regions. So that marketing and enrolment of users, this sort of was our third main activity at the time. So software development, provider onboarding and managing and then marketing and sales, if you like. Although it wasn't, in those early years technically sales, like I said, it was more to attract users and we were not directly making money out of it, it was more to build up the user base."*

*Interviewer: And this kind of shifted maybe a bit from sales and marketing to users, to the current revenue streams, like the health insurance companies?*

*"Yeah, exactly. So we were in a way forced to become a bit more B2C, so business to consumer in the first years, next to having some of those donors as clients, which is more B2B business, in the last two and half years we've been much more B2B focused, so indeed trying to get those insurers to convert to our platform and also with some of the larger hospitals with whom we didn't have a relationship yet, also again build those relationships and sign contracts. It's a very different dynamic in terms of what you spend your time and energy and money on. It's quite a difficult shift to make, but it looks like we're now getting there."*

Table 0-19. Quote Key resources CarePay

Founder & ex-CEO  
Africa  
CarePay

*"I think it's the mix of people we had, so it was Kenyan people first of all who had worked in health insurers and in healthcare providers before, so they not only had expertise in the industry that we were trying to change, but also networks, so they knew a lot of people. We had a grade first software developer, who's still with the company and now one of the main IT guys, let's say, in the company. So the fact that we were able to build something, even in a prototype, that was already working quite well was a key asset. And we attracted quite a lot of funding from the start, so that was crucial, I think that's often the key missing ingredient for a lot of innovations, particularly in digital health in countries like Kenya is that a lot of people are so bootstrapped that they can't really scale from the start, they can't really invest in good people from the start. And then you never give your idea, you're never able to really give your idea the real chance it deserves, let's say. And that's where we were quite lucky first of all to grow from within that existing organization, like I mentioned, it gave us already*

*a lot more credibility with healthcare stakeholders, we had some sort of start-up funding because of it, which really helped. But we were also able to attract some real growth capital at the scale which was at the time totally unheard of for comparable companies. And that allowed us to really pay people a decent salary and get people to also jump ship from larger companies where they were making a good salary, we couldn't really match them, but at least we could get close enough to convince people to dare to work with us. So that was yeah, a key thing, I think, for I wouldn't say the success that we currently have it's, right, we still have a lot to accomplish, but to at least get to the stage where we are now, we couldn't have done that without having relatively deep pockets. So, we knew we could pursue this in a way quite expensive strategy of building a platform and connecting it to so many different healthcare providers before you even have a first dollar revenue, right? That's not a luxury that a lot of companies have... ...so the two investors, like the equity investors, were closely linked to, one was closely linked to PharmAccess and the other was closely linked to Safaricom, which I mentioned, the M-PESA Foundation... ... So, I think that's a big theme in our history, that we've been borrowing in that sense credibility and recognition from our funding partners, that has worked really well for us."*

Table 0-20. Quote Channels CarePay

*Founder & ex-CEO  
Africa  
CarePay*

*"in a way in Kenya when you want to do more mass market things is to have a combination of radio – and the good thing about radio is you have like gazillion different stations with each their own region and dialect or language that they focus on. So it allowed us, again, coming back to sort of the challenge of our scaling where you have to have a sizeable number of providers, at least in a region, to be connected to your platform for you to offer something of value to users, right? Where you put this savings product. Choosing radio allowed us to also market only in those regions where we had sufficient sort of scale already and you can do radio quite in that sense cheaply relatively speaking, and also very interactively you can be on sort of popular talk show hosts' programs and stuff, just sending out a commercial. So people can really talk about it, they can dial in, they can ask questions, we had a lot of our staff who were speaking the different dialect and languages in the studio often, so you really become this sort of talk of the town. That worked really well, so radio, but always combining it with a large force of people on the ground, so agents who were recognizable in their M-TIBA shirts, who would then be able to convert sort of the interest that people may have gotten because of what they heard on the radio, they would then see people walking in the street with their brand that they just heard of. And those agents were then the ones signing up the most people for the service. They had a smartphone with our app, and they could just register people to be an M-TIBA member. People could also do it themselves, so self-registration was also a big channel, which we of course tried to push through the radio. So in the radio shows you would have these prizes and competitions that whoever registers for M-TIBA and can, I don't know, can read out loud their confirmation SMS or whatever, something that proves that they actually registered, that you could win a prize, those kind of things we also did. It was mostly the combination of getting awareness about the brand through radio, and then having people on the streets in the same areas at the same time to then convert people to really sign up, let's say."*

Table 0-21. Quote Current channels CarePay

*Founder & ex-CEO  
Africa  
CarePay*

*"and also because of our move in a way to focus more on business to business clients. So there the last few years we spent very little on business to consumer marketing, but we spent more for example on organizing industry events, right? So, we got the CEOs of the big insurance companies together on a topic or we got an external speaker. So, it's a different type of marketing. We do much more on LinkedIn now than on Facebook, to explain it sort of in a social media way, we try to reach the influencers within the big hospitals and the insurers much more directly now, while in the past we would be more focused on mass markets, consumer marketing."*

Table 0-22. Quote acquiring customers CarePay

Founder & ex-CEO  
Africa  
CarePay

*"Yeah, we had a few sort of large waves, so I think 2015 was mostly about getting the software ready, but also contracting the first thousand healthcare providers. That was a big sort of milestone. And then to get the first one million people to sign up to the savings account, which was 2016, 2017. Then we started focusing on those insurers and we had to go back in a way to sign up many more hospitals, more expensive ones that we didn't have yet. But that was again sort of putting our head down, it was 2018 a lot, 2019 too, connect yet another sort of 2.000 hospitals which we didn't have on the platform yet. And now we are more in the phase where we need more and more insured people to connect to our platform because we now have the whole hospital side, let's say, figured out. So it goes sort of in bursts of first in our case hospitals, then users, then we finally got the insurers, which meant we needed to go back to more hospitals, and now we're getting more insurers and more insured people. That's now our main aim."*

Table 0-23. Quote Disruptiveness CarePay

Founder & ex-CEO  
Africa  
CarePay

*On mobile telephony in Kenya: "Yeah, so that trend in Kenya was already, it almost had already happened when we started, both in number of people having a mobile phone or at least a SIM card and people having access to financial services on their phone. It was not 100% when we started, but already like over 80%, so really high penetration. I think the key industry trend that were important for us was the fact that when we started there was just a sort of a failed attempt by Safaricom, so this huge company together with one of the leading insurers, to come out with sort of a mobile first health insurance product for a much lower price than normal. And they had to withdraw the products from the market because the product was hugely loss making. Well, we understood why that was the case because they didn't really fundamentally change anything in the way they managed that scheme, so it was some mobile element, but behind the scenes there was a lot of pen and paper involved and a lot of opportunities for fraud basically. But that was actually an industry movement in a way, the fact that that product was withdrawn while it was marketed by two of the biggest companies in the country, that cooled off the whole appetite to experiment and innovate. And that was, I think, the industry trend that was completely against us when we started, and one of the reasons why we had to start with this savings product and focus more on these donor propositions just to stay alive and to show that we were able to scale.*

*And now we're in the, I would say in the reverse where it's been quite a while since that product has failed, that everyone was watching. A lot of other technology successes have been celebrated in Kenya in other industries. So now all the boards of these insurance companies are asking their managing teams again, like they did seven years ago, like "What are you guys doing now to innovate?", "How are you going to reach the next certain percentages of the population?", right? "You've been sitting still and..." So now it seems to be coming more to us again, this question, like "Can we work together? Can we experiment? Can we do new things? Because our boards tell us to yeah, rethink our business". So of course, this is my hope, but also it looks like the momentum is now working more in our favour than when we started."*

*On Kenya being innovative: "Definitely, yeah. I just had a lunch meeting with the CEO of one of the large insurers here and one of their board members and they shared the same conclusion that while Kenya is very innovative, the insurance industry is still very much lagging behind within Kenya, let's say. So, while the Kenyan insurance industry is maybe seen as innovative by other insurance industries around us, that says more about those other countries where it's even more lagging behind than that it's so – how do you say that – forward thinking here... ..So I think it's sort of an industry thing that yeah, people work as insurers, they need to manage risks, so of course they tend to be a bit more risk-averse by profession – and for a good reason, right? It's also their regulatory mandate in a way to do that. But it means also that I think all over the world normally insurance lags behind in terms of technology adoption, it lags behind normal financial services and for example retail, e-commerce is of course way ahead compared to insurance in most countries when it comes to digitalization and grasping these new opportunities."*

Table 0-24. Quote Scaling strategy CarePay

Founder & ex-CEO  
Africa  
CarePay

*"...mostly through those, what you would call donor projects, so we had a few large schemes where foundations, one, maybe the most powerful example was one, like a foundation of a pharmaceutical company who would normally give grants to pay for the healthcare or really low income groups, they were intrigued by the fact that they could do this now though a mobile phone, right? Normally they would just pay let's say five clinics in a poor area, they would just pay them a lump sum and they said "Well, please treat everyone in your catchment*

area”, right? With zero traceability, like zero information on what then actually happens. And now this one grew out to be a really massive program with about 50.000 people in a really, really low income area in Nairobi where all of these people got this entitlement for free primary care loaded on their phone throughout platform. And then yeah, we had full visibility, of course anonymized, but full visibility on the usage behavior, what people were being treated for, if the prescription behavior was good or bad of the doctors treating these people. And they were then basically paying us a management fee, if you’d like, to run that scheme for them. So those were typical revenue lines at the time. But this was also one of the main reasons to want to work more with also private sector companies because the big problem with grant-making organizations is that they often work in a very project-based manner, so it has a start and an end and there you can change strategies and then suddenly it’s not healthcare anymore, but suddenly they focus on education and you start from scratch again. And we really wanted to come up with revenue that would be much more sustainable and sort of permanent, that’s where focusing on businesses who spend money on this kind of services anyway and who are well, at least intending to be in business forever, is well, we thought, the smarter business strategy to stay around and to be self-financing.”

Table 0-25. Quote Partners Ministry of health CarePay

Founder & ex-CEO  
Africa  
CarePay

*Working with Ministries of health: “Yeah, we’ve kept them up to speed, let me put it like that, but our attempts to show the power of digital have not been extremely warmly embraced. But this is also a really difficult territory where ministries of health in most African countries are often financed to a large extent by international donor countries, so by the Americans, the Japanese, the EU, individual European countries. So there is a lot of competing interest to fight for the attention of the ministry of health, and a lot of also pet projects or local NGOs from those funders who need to get a chance, I mean, it’s quite a messy situation in a way. And this is again one reason, additional reason why we said we have to somehow build a business that can run on private sector. We would love to do big things with the government, we’re doing that in Lagos, like I said, and another state in Nigeria, we would love to do it in Kenya, but we should not count on it, let’s say. Because it’s a very difficult, sort of very politically motivated segment, if you like, to focus on. So it’s very hard to really predict if you’re going to be successful. But of course we’re always open, like I said, we’re not exclusive to anyone and we would love to – and we do, but – we would love to do more with the public sector, but it’s hard to navigate, and very often not very rationally motivated, why certain things get supported and others don’t... We are a bit in between, right? We are a company, yes, we want to make a profit, but we have a social impact goal. But here for now we focus more on private sector just because we think that’s the lifeline we need and then we can always, and we keep all the options open on the public side.”*

Table 0-26. Quote challenges company building CarePay

Founder & ex-CEO  
Africa  
CarePay

*“I think that we also didn’t have any really comparable companies we could say “Well, we just do what they did” or something. The model we’ve chosen, as far as we know, is pretty unique for healthcare and the originating partnership is also very unique. Indeed, the combination of a non-profit and an extremely profitable and commercial company to be the founding fathers of something that is somewhere in between of those is yeah, like you say, as far as we know, there’s not many examples, we couldn’t find them. So of course I speak to other entrepreneurs a lot here, which I learned from, I learn from those companies, but normally they are more the traditional venture capital backed technology companies where it is a few people coming up with an idea, finding money, scaling it very commercially, very different industry often. So we learn from them just on how to scale and how to do that in these environments, but the actual set-up that we have, we haven’t seen, and that makes it sometimes a bit hard to explain also to people, but also quite cool, I think, and a lot of people work with us also find that very attractive, that it’s sort of in between doing good and making something profitable, we’re trying to do both, let’s say, with drivers of real private sector, but also some drivers and motivators that you would normally find more at an NGO.”*

## Background quotes Healthy Entrepreneurs

Table 0-27. Quote founding reason Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*“After five years I was fed up. It was too much focused on money-oriented, money-driven very much entrepreneurial spirit in the company which I think was a very good spirit and also where I learned some experience. For me, I actually learned what entrepreneurship is about and also a little in the business and what is real business about, very different from working for a bank or corporate, whatever.”*

Table 0-28. Quote founding insights Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*“there has been one real insight that was in the Philippines. When I was travelling there I went to the so-called generic pharmacies, which is a chain of franchise pharmacies that serves probably 90 percent of the population in the Philippines with generic, white label medicines, and good value for money. They have been able to undercut the complete market that was completely dominated by branded manufacturers who were charging ten times more for the same product. The corporation couldn’t afford so the product system was completely failing, corruption and transparency, decentralization where this Chinese entrepreneur just brought in a complete alternative solution. When I discovered them I realized this is also something that needs to happen in Africa. Of course, the whole model, everything we do is very different but still that has been a main source of inspiration.”*

Table 0-29. Quote Market gap Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*“There’s a real market-need filling a gap inefficiency in the supply chain in the very last mile making sure those products really reach the last mile where any public or donor-oriented organized products and solutions proved not to work. So the only thing we knew is we needed to do it differently.”*

Table 0-30. Quote problems in market Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*“So it’s an existing infrastructure which is poorly functioned, poorly managed. There is no money available. It’s all very fragmented, it’s all project-driven so it’s more opportunity-based than anything else – and that’s where we come in. We use the same infrastructure and offer people a long-term relationship with us aiming and making sure they are, in fact, able to be connected and committed to us for the long-term, so we strengthen and actually structure the health system by offering access to additional training, offering access to a smartphone with at least two apps, in some cases more. Those apps provide both access to our products assortment with an option to order them online like an e-commerce solution, and at the same time we offer solutions for health education and basic consultation.”*

Table 0-31. Quote pilot experiments Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*“The aim is actually in the first designs of this organization to combine the distribution through wholesale and a network of entrepreneurs since they all needed the same type of products. There seemed to be a lot of synergies and also knowing where we came from we knew there was a need of this market potentially over the eastern part of Congo and the heart of Africa but also in Haiti so there wasn’t a lot of logic there. In practice, over time we realized organizing in wholesale organizations that the wholesale offering and deploying a number of entrepreneurs was actually way too complex so we were unable to manage that efficiently and properly so we decided to actually focus and get rid of the complete wholesale because*

*it was a market which was way more competitive than the new segment we were actually getting into. So over time it took two or three years before we really came to that decision we have specialized ourselves purely in distribution and employ a deployment of community health workers."*

Table 0-32. Quote additions to value proposition Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*"At the same time, the new service we're offering because we're offering tailored health services, we're offering services now for: hypertension, diabetes, infectious diseases, all those services at a distance, so the whole tailored health support is completely new, it's completely developed and actually adds much more value to the proposition our enterprise has in their communities so they're able to do better. That one is actually a key development. I think we also developed additional products in our assortment so it was also more competitive and so you will see trends. So it's been a complete learning process."*

Table 0-33. Quote moving to Uganda Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*"Our office in center of Utrecht although I've been operating myself until two and a half years ago before I decided to move myself to Uganda which probably has been one of the most important decisions for Healthy Entrepreneurs to be honest because we have been very effective in improving the business here while being around, which I never could've done when I was at a distance. At the same time, before we were running more projects, we were learning and we were doing more fact-finding, proof of concept studies instead of running a complete operation, so also the scale of the operation didn't justify yet moving the whole family, because that's also something we only do in case it really makes sense. Here we are and so far so good."*

Table 0-34. Quote importance long-term commitment Healthy Entrepreneurs

*Founder  
& CEO  
Healthy  
Entrepre  
neurs*

*"Where we changed, what the changes were over time is that initially we also tried to include the private sector. The private sector is not as much organized in remote areas as where we want to be, so the private sector actually is a kind of functioning system that reaches certain districts, towns and some so-called trading centers, and then still the distance even to trading centers for the majority of the communities we are serving is still long so health care provision usually is kind of an immediate response where you need to act. It's not something you can decide to go, you need immediate access; it's one of those products that you better have closer to home. So that's how we have organized ourselves and that's why we are actually building our whole network using the public health system infrastructure. So this infrastructure exists, and it's actually more and more clear it's not functioning. It's not functioning so much because it's not properly organized - you can organize it as we've shown - but the core is we actually get it organized and funded for the long run so you are building a long-term commitment instead of the short term projects. So the biggest learning for our customers, and also our customers just didn't believe us, they didn't trust us, they didn't even come back because they had never expected someone to come back, and now we became a very loyal, key important player in their lives. That's actually a very fascinating role we took... ..In fact, our main competitors are NGOs who would temporarily disturb the market, they're offering something for free but the only thing is you always know they will disappear again."*

Table 0-35. Quote key partnerships Healthy Entrepreneurs

*Founder & CEO  
Healthy  
Entrepreneurs*

*"The suppliers in our case are definitely parties who are supporting us offering their products into segments where they are not able to supply themselves, so they all acknowledge the market, also they acknowledge the market needs, they also acknowledge the role that needs to played and also the social impact of it and that's why we are rather easily able to negotiate to get the right deals. So we are actually even kind of suppliers finding all the right support, they say they prefer us, they also want this part of the business to be supplied to so we are running a business that's very different, so we are on long-term contracts. We commit ourselves. We ask suppliers to commit which is very different from an African opportunity-*

driven business. So we fulfil a need in the market and organizing this as professionals. We are able to actually bypass complete in transparent, inefficient traditional trade. It is just so costly so we are able to offer 15, 20 percent lower prices in the markets organizing it ourselves than if you go through the trade where in all channels there's inefficiency in. Imagine what it will cost for the government to organize supply chains especially in the more remote areas. They really don't have clue how to effect that. Imagine as an example, just now we got these masks for COVID. The personal preventive equipment materials, PPE, whatever, and they need to be distributed. They got donations... ..and they were delivered at the national central medical store and we were just asked can you please distribute them for us? We said yes, we are willing to. But please can you kindly come to pick them because we don't have budget to deliver them to you. So we had to send one of our trucks to go to collect. So this is exactly what this problem is about all the time: there is no budget for this, there is nothing for that. There is no proper functioning system organized, you never get a flowing supply chain... ..It was long before they understood our way of working. They were open so I think governments are, let's say, different. It has been one of my experiences in my previous job that I was able to walk in government offices easily. The majority of entrepreneurs don't walk into government offices because they think it's only corrupt. Well, that's not the case but it's more like incompetence. That in many cases is the case, so they're not able to sort out their issues so they're actually keen to get support so they're open for it. They also look for those who have opinions, they also think about policies, but having really the total picture it's very difficult. But they were not against. They have been kind of supportive although their support, especially when we wanted to formalize it, it took us three years with a report copy of one paper and only the formalization letter of our collaboration. That's more like the level we are at which, of course, takes time to build trust and everything because we're just aliens coming into their country and we're doing something that never no-one has done before so how is it possible that you do something like this? But then once they see it, we're getting somewhere."

Working together with NGO's: "They were a member of competing NGO's operating in the same field locally. They were at the beginning very much reluctant because they felt that we were stealing their business or their model or their activities, but over time they actually stopped their activities and then they realized we were continuing so over time we became more like the regular on-going business now as the new stage we have achieved, at least here in Uganda."

Table 0-36. Quote disruptiveness Healthy Entrepreneurs

Founder & CEO  
Healthy  
Entrepreneurs

"If I see what I'm facing on a day-to-day base, including now again this decision we now need to take to evacuate the offices and you realize it isn't so easy, and anything that's easy has been done already. At the same time, I really believe that at least what we're doing for now, we become more and more the reference and the model for how to actually also influence policymakers and that we will get more and more enquires to come, so making sure that investments, governance and everything are becoming more sustainable and long-term instead of all the traditional shit that actually didn't lead to too much except support of corruption and interest of a few pockets..."

"...The Dutch government also acknowledges this... ..It's literally talking about Healthy Entrepreneurs, so for the year 2020, one, they have used our example as a reference."

Table 0-37. Quote evacuation Healthy Entrepreneurs

Founder & CEO  
Healthy  
Entrepreneurs

"...So, just for your information, I just get insights now that one of the presidential candidates have been arrested and now it seems to be completely in towns so we sure need to take a decision about whether we're going to evacuate our office. Let's make sure that within the next 10 to 15 minutes we can finish this interview..."

## Appendix III. Interview protocol

This section provides the interview protocol used for the semi-structured interviews with the directors/founder of the studied companies. This interview protocol provides transparency to the origins of the quotes from the studied cases.

### The Basics

#### The Interview Basics

To understand the basics of the company better, first some general introduction questions.

[Understanding the basics of the company]

#### a. Introduction questions

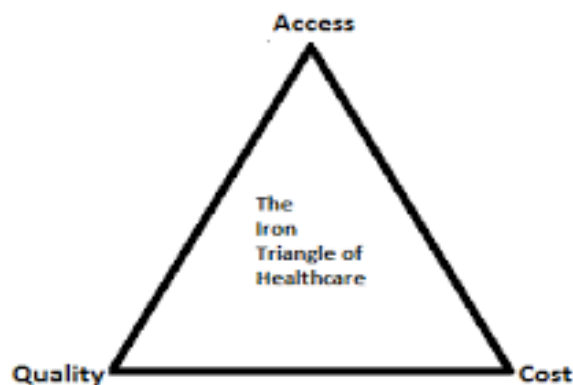
- i. Name company:
- ii. Year of start company:
- iii. (short) Reason of founding the company:
- iv. Short description of company:
- v. Type of market active:
- vi. Sub-type market:
- vii. Legal entity:
- viii. Size in employees:
- ix. Size in revenue (categories):
- x. Office HQ:
- xi. LMIC office(s):
- xii. LMIC employees:
- xiii. LMIC focus area:

[Mapping company in Iron Triangle of healthcare]

To make a visual representation on the innovativeness of the healthcare company on the axes of quality, affordability and access to care.


## Iron triangle of healthcare –

- b. How and to what extent is the company increasing the access to healthcare with the innovation?
  - i. How does this compare to others?
  - ii. How has this evolved over time?
- c. How and to what extent is the company decreasing the costs/increasing the affordability to healthcare with the innovation?
  - i. How does this compare to others?
  - ii. How has this evolved over time?
- d. How and to what extent is the company increasing the quality to healthcare with the innovation?
  - i. How does this compare to others?
  - ii. How has this evolved over time?



## [Mapping the Initial Market Introduction Phase]

|                |                |                   |                        |                   |
|----------------|----------------|-------------------|------------------------|-------------------|
| Key partners   | Key activities | Value proposition | Customer relationships | Customer segments |
|                | Key resources  |                   | Channels               |                   |
| Cost structure |                |                   | Revenue streams        |                   |



## Business Model Canvas Questions

The goal of the Business model canvas questions, want to register the changes over time in how first model looked, and how this changed to the company active today

### PHASE 1: Market Introduction

**3.1 Customer segments:** In the first market introduction phases, what were the first (top three) segments chosen to introduce the product?

3.1.1 How where these chosen? Was it opportunity driven or market research driven or differently?

3.1.2 Where these first customers/segments valuable in revenue?

3.1.3 How did this change over the years?

3.1.4 How is this in the current situation?

**3.2 Value proposition:** In the first market introduction phases, what were your products and services? What is the job you get done for your customer? What value is created/offered?

3.2.1 How where these chosen? What research did go into this choice?

3.2.2 Was this choice driven by customer demand or by an innovation activity?

3.2.3 Were these products developed/designed in close collaboration with the customer? (lean)

*3.2.4 How did this change over the years?*

*3.2.5 How is this in the current situation?*

**3.3 Revenue streams:** In the first market introduction phases, what were your first (top three) revenue streams. What did you give for free?

3.3.1 How profitable were these streams? Did this cover costs?

3.3.2 Were these customers paying correctly? On time?

3.3.3 What was the pricing of the products? What was the pricing strategy behind this?

*3.3.4 How did this change over the years?*

*3.3.5 How is this in the current situation?*

**3.4 Channels:** In the first market introduction phases, how did you communicate with your customer? How did you deliver the value proposition?

3.4.1 Was it mainly online? Or lots of offline visits?

3.4.2 What role did a local office and local agents play?

3.4.3 Who were advocating for your products and services?

*3.4.4 How did this change over the years?*

*3.4.5 How is this in the current situation?*

**3.5 Customer relationships:** In the first market introduction phases, what customer relationships were established and how do you maintain these relationships?

3.5.1 What was the role of local agents/offices in this process?

3.5.2 How often was contact established?

3.5.3 Did you listen to feedback of customers to adjust things?

*3.5.4 How did this change over the years?*

*3.5.5 How is this in the current situation?*

**3.6 Key activities:** In the first market introduction phases, what did you do every day to run your business model?

3.6.1 Customer visits?

3.6.2 Product development?

- 3.6.3 People management?
- 3.6.4 Operations?
- 3.6.5 Marketing? Sales? Leads?

*3.6.6 How did this change over the years?*

*3.6.7 How is this in the current situation?*

**3.7 Key resources:** In the first market introduction phases, what people, knowledge, means, and money you needed to run your business?

- 3.7.1 Which resources were crucial?
- 3.7.2 What size did the team have?
- 3.7.3 How much investments were done to back this?

*3.7.4 How did this change over the years?*

*3.7.5 How is this in the current situation?*

**3.8 Key partners:** In the first market introduction phases, which key partners were the partners that you can't do business without (not suppliers)?

- 3.8.1 What was the role of research institutes?
- 3.8.2 What was the role of local partners?
- 3.8.3 Did any 'piggy backing' occur by lifting on the resources of these partners?
- 3.8.4 What was the exact roles of these partners?
- 3.8.5 Why were they a partner to the organization?

*3.8.6 How did this change over the years?*

*3.8.7 How is this in the current situation?*

**3.9 Cost structure:** In the first market introduction phases, what were the top costs by looking at activities and resources?

- 3.9.1 How were costs cut?
- 3.9.2 What shortcuts were made to reduce costs?

*3.9.3 How did this change over the years?*

*3.9.4 How is this in the current situation?*

[Mapping the Value Transactions of the Initial Market Introduction Phase]

## Value transaction model

The goal of the value transaction model is to easily show how transactions took place in the initial phases and how this is happening now.

Questions to capture the value transaction model:

- e. How do you acquire your product, do you make it yourself or do you buy a (nearly) complete product from someone else (not the manufacturer)?
- f. Is your end-user directly working for your customer or is your customer reselling/re-using your solution?
- g. Do you license out your product or is it sold via a direct transaction?
- h. Is there a marketplace active where consumers can resell to companies or customers? (Uber, booking.com model)
- i. Is there a platform active that is managed purely by your organization where all consumers and customers have to go through your platform? (Google model)

*4.6 How did this change over the years?*

*4.7 How is this in the current situation?*

Capturing value of business models in one of these 5 architypes:

1. Make-sell
2. Resell
3. License
4. Symmetric multi-sided (broker)
5. Asymmetric multi-sided platform

## **Business model experimentation**

### **6.1 Strategic Switchbacks in Business Model**

Technology entrepreneurs are often unable to execute their ideal commercialization strategy, so they start with a non-ideal strategy that enables them to eventually switch back. Strategic switchbacks are strategies for start-ups to get to ideal commercialization. Pivoting is part of this. Not motivated by the failure of an earlier strategy. Subsequent strategy depends on switchback = switchback needed to come in favorable position.

- Temporary competition
  - Entrepreneur lack complementary assets to compete in market
- Temporary cooperation
  - Entrepreneur lacks credibility into cooperative agreement that is attractive

Questions strategic switchbacks:

- i. When starting in the market, was your company ready to offer a good value proposition on its own? Could this compete with existing solutions?
  - a. Were partners needed?
  - b. Was the experience available?
  - c. Were the complementary assets in place?
  - d. If not, what strategies were used to make a compatible offer?
- ii. Was the initial starting market also the market were the company wanted to operate or was a different starting market chosen to capture revenue/value? Why was this chosen? How did this evolve over time?
- iii. Was the company, when starting up, seen as credible enough to do what it was intending and communicating to do? Where partnerships used to increase credibility? How did the evolve over time? How did the company get from early adopters to the majority?

## Frugal Business Models

From Winterhalter, Zeschky, Neumann, Gassmann; Business models for Frugal innovation in Emerging markets: The case of medical device and laboratory equipment. Business models in the context of frugal innovation differ from BM in developed markets (Eyring et al. 2011; George et al., 2012; Landau et al., 2016). BM are either low-cost replicas of Western markets business models or completely new business models.

Questions frugal business models:

- j. What experience had the company/founder in similar western settings as the company is in?
- k. How did this influence the creation of the business model?
- l. Is the business model especially tailored to the LMIC setting or is it a similar business model as used in Western settings?
  - i. To what extent?
  - ii. What is new, which innovations are done?

## Business models for sustainable innovations

- m. The more collaborative and inclusive value chains are the higher the probability of a sustainable business model is. How is the collaboration in the value chain of your business?
  - i. What kinds of companies are collaborating here?
- n. The better education, training and knowledge are the higher the probability of a sustainable business model is. How is the education levels within your business and your operating field?
  - 7.2.1 How does your company influences this?
  - 7.2.2 How is your local staff schooled?
  - 7.2.3 How did you attract those people?
- 7.3 The sustainability of a business model at the BOP in developing countries is highly dependent on the local competences, resources and capabilities used.
  - How is your local staff? Functioning well? How did you get to that point?
  - 7.3.1 What local resources were used?

7.4 The more frugal innovations become reverse innovations the higher the probability of sustainability impact is. What is the Frugality of innovation? Is it more affordable? Easier? Makes uses of exiting parts and technologies?

7.4.1 How does it compare to Western solutions?

7.5 In the article “The search for the holy grail...” from Bhatti et al. (2017), the authors categorize the frugal healthcare innovations in 6 categories, namely: Infrastructure & system support, workforce training, Care delivery, product/technology, financing and policy, which categories apply for your innovation?

7.6 The involvement of local NGOs enhances the success of a business model. To what extent are Local NGO’s involved? Ministries of health involved? At what point did they get involved?

## **Business Model Development**

An exploration of business model development in the commercialization of technology innovations. Conclusion in article: 3 of the 4 case studies show that revenue model, value proposition, market segmentation, cost and profit estimations and organizational block where revised during commercialization.

Questions business model development:

- o. How did the business model change during the commercialization process?
- i. How did the revenue model change?
- ii. How did the value proposition change?
- iii. How did the market segmentation change?
- iv. How did the cost and profit estimations change?

## **Relationship Marketing**

Relationship marketing crucial for selling high-tech process innovations, 8 objectives: 1) Product customization, 2) Information gathering on Product performance, 3) Product education & training, 4) Ongoing product support, 5) Proactive political involvement, 6) Product demonstration & trial, 7) Real-time problem-solving assistance and, 8) Clarification of the products advantage

Questions relationship marketing:

- p. What kind of crucial relationships were formed in the initial idea to market phase of the innovation? How were this relations maintained?
- q. Where the first products customized to the wishes of customers?
- r. (How) was information gathered on product performance?
- s. (How) were customers educated and trained with the product?
- t. Was ongoing product support delivered?
  - i. How close was this?
  - ii. Was there ongoing problem-solving assistance?
- u. (How) were local politics involved in the process?
- v. Was the products advantage clearly clarified?
  - i. How was this measured?
  - ii. How was this communicated?

## **Business Models Taxonomy of Tech SME's**

From Libaers, Hicks, Porter (2010); A taxonomy of small firm technology commercialization; Types of business models small firms:

- Development stage bioscience – Idea trading, consulting, R&D
- R&D organization or contractor – selling R&D services
- Product solutions provider – Selling a device/solution
- Service solutions provider – selling software
- Highly specialized component supplier – selling components at high volume
- Specialized sub-contractor firm – selling small part of a system (f.e. sensor)

Questions Tech SME business models:

- w. How would we describe your company using the above mentioned taxonomy?
- i. How did this change over time?

## **Disruptive or sustaining innovation**

Questions disruptive or sustaining innovation:

- x. What kind of innovation was the first product to market? Disruptive or sustaining innovation? Why?
- i. How did this effect initial product/market fit?
- ii. Creative strategies used?
  
- y. Did any follow-up products or new products/services follow? What kind of innovations were these? Why?
  
- z. Disruptive innovations make the least demanding customers even demanding solutions over time, to what extent is this true for your company?

## **Details**

Role of IP in first phases

- aa. Is there any IP involved in the company?
- i. What role did this IP have in the first phases?
- ii. How is this IP used currently? Licensing?

### **Funding**

- bb. How was the company initially funded?
- i. When did it reach break-even?
- ii. What investment rounds were needed?
- iii. What were the types of investors?
- iv. What were the sizes of the investments?

### **Lean commercialization practices**

- cc. To what extent are lean commercialization practices used, as for example:
  - 1) Direct contact with end-users; 2) Getting references sales; 3) Flexible business models; 4) Feedback from initial buyers
- i. Was this established in the initial phases or in later phases?
- ii. Which part of these strategies worked best?

### **Trends**

- dd. When starting your company/innovation, what specific trends did the innovation play into?
- i. Which trends? Ai? eHealth? Data? Applications?

- ii. Where these trends leading in the success?
- iii. How did the company/innovation tap into these trends?

## Type of entrepreneur

Sustainable healthcare entrepreneurs can be identified in 4 types of entrepreneurs, namely: Isolated, Innovative, Evolutionary and Revolutionary. These types differ over the believes to what extent these entrepreneurs believe that they can contribute to achieving structural change.

**Table 4**  
Typology of sustainable healthcare entrepreneurs.

| # | Name   | Description of beliefs about entrepreneurial role   |
|---|--|---|
| 1 | Revolutionary entrepreneurs<br><i>"I can directly and successfully induce system change"</i> | Individual entrepreneurs may be successful in inducing system change besides developing a sustainable innovation. Although it may be difficult, it is considered a realistic and legitimate aim to try to structurally change the healthcare system. Therefore, these entrepreneurs apply strategies aimed at inducing system change directly. The idea that individual entrepreneurs are able to cause structural change legitimizes the term 'revolutionary' entrepreneurs.   |
| 2 | Evolutionary entrepreneurs<br><i>"I can induce system change through my innovation"</i>      | Entrepreneurs can only be partly effective in changing the healthcare system context because of the close interaction between structural change and innovative success. This interaction makes it very difficult to predict the long-term effectiveness of strategies aimed at changing the system. The success of the innovation itself is considered as the best indicator for determining the effectiveness of strategies that were aimed at changing the system. As a result, these entrepreneurs apply both strategies that are aimed at the innovation and at the system context. The emphasis on the interdependency between the development of an innovation and changes in the system context legitimizes the name 'evolutionary entrepreneurs'.   |
| 3 | Innovative entrepreneurs<br><i>"Entrepreneurs cannot induce system change"</i>               | Entrepreneurs are only able to contribute to the transition by developing successful sustainable innovations. They do not have the possibility to cause structural changes. Strategies are therefore always aimed at increasing the innovative success. The innovation itself is at the center of focus, which legitimizes this entrepreneurial type's name. Three different lines of argumentation were used to defend this position: <ul style="list-style-type: none"> <li>• Entrepreneurial variety is needed because individual influence is strongly limited. Structural change may only be the overall result of activities of many entrepreneurs.</li> <li>• Attempts to influence the system context have no short-term effect on the success of an innovation. This makes these attempts of secondary importance, especially when they could conflict with short-term business goals.</li> <li>• It is impossible to change the system context as an individual entrepreneur, either if they want to or not. Entrepreneurs may profit from structural changes, however, this desire becomes irrelevant due to the inability.</li> </ul> |
| 4 | Isolated entrepreneurs<br><i>"System context is irrelevant for my innovation"</i>            | Entrepreneurs believe the system context is absolutely irrelevant for the success of their innovation. They consider all attempts to structurally influence the system therefore as worthless. It is of no use to them to think of effectiveness of those attempts. Because there is no relation with the broader system context the term 'isolated' is used to describe this type.   |

- ee. To what extent do you believe that you can induce systematic change in the healthcare system?
  - i. Directly? Through innovation? An entrepreneur/company cannot do this? Context is irrelevant for my innovation?
  - ii. What is the intention of your company?
  - iii. What is the actual behavior?
  - iv. What are the short-term effects? What are the long-term effects?

## Ending questions

- ff. To summarize, what makes your company successful in the LMIC healthcare markets?
- i. What choices/actions do you think have made this success possible?
- gg. What choices in the design, experimentation and innovation in business models have created your success?
- hh. What would you do differently if you would be starting tomorrow in the LMIC healthcare markets?
- ii. What advice would you give to starting LMIC healthcare innovators?

## Appendix IV. Business model experimentation modelling enlarged

