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A case study on the critical success factors in implementing the Lean Start-up Methodology in developing digital innovation start-ups

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A case study on the critical success factors in implementing the Lean Start-up Methodology in developing digital innovation start-ups.

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A research dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science in Engineering.

11 October 2020

DECLARATION

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To my family and loved ones, who kept on encouraging me, thank you. You made the journey easier!

ABSTRACT

The study investigates the critical success factors of the Lean Startup Methodology (LSM) in digital innovation space as the research question on which the study is hinged. The applicability of LSM to different business ideas in the same space is also investigated. As the methodology is relatively new to the local market, there is interest also to investigate how well understood and appreciated the methodology is in South Africa.

To address the aforementioned question the research was conducted in a local digital innovation centre, an incubation facility. The entrepreneurial development initiative brought entrepreneurs onboard for a yearlong LSM mentorship from idea to minimum viable product. The qualitative research methodology entailed observing the LSM classroom sessions at the incubation centre which was the primary delivery model of the methodology to the entrepreneurs. At the end of the classroom engagements, 5 startups and 5 LSM facilitators were interviewed after obtaining formal consent. Startup team interviews were conducted as focus groups. The facilitators participated in one-on-one interviews. A total of 16 participants from the incubation program consented to taking part in the study. The resulting qualitative data were analysed using thematic content analysis to extract valuable insights and derive a model of critical success factors for LSM in digital innovation space.

The study concludes that the critical success factors for LSM in the digital innovation space lie in the following themes: Validated Learning, Entrepreneur Traits, Quality of Business Idea, Build-Measure-Learn loop, and Management. Results show that LSM is equally applicable to all of the studied digital innovation business ideas and no limitations were found. The appreciation and understanding of the methodology in South Africa remain limited. Building on the findings, the study comes up with recommendations on how an incubator can maximise the quality of the overall LSM program for digital entrepreneurs.

For entrepreneurs to fully capitalise LSM in validating business models, an awareness of the critical success factors is important. Deep knowledge of the methodology is recommended to fully utilise the tools at the disposal of the LSM practitioner.

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ABBREVIATIONS

LSM – Lean Startup Methodology

LS – Lean Startup

BML – Build-Measure-Learn

BMC – Business Model Canvas

CDM – Customer Development Model

CSF – Critical Success Factor

1. INTRODUCTION

Start-ups experience very high failure rates within the first few years of operation. Cambridge Associates, after studying over 27 000 start-ups between 1990-2010, posit that the failure has not topped 60% since 2001 after a record of 79% in 2000 (CBInsights, 2018). In this case, failure is defined as not returning at least the initial investment laid down by investors (Carmy, 2018). In a Harvard Business School study of 2000 venture-backed start-ups, Ghosh (2012) demonstrates that about 75% of the cases result in failure to return investor capital. Ghosh (2012) asserts that if failure is defined as falling short of projected return on investment the rate is 95% (Ghosh, 2012). Despite the different viewpoints of start-up failure and context, the bottom line is that start-ups are risky and susceptible to failure as shown here by the high failure rates.

As indicated in the examples above, the statistics differ due to varying definitions of failure researchers use to arrive at conclusions. Peacock (2004) highlights that there are multiple definitions attached to business failure. The economic definition of failure would mean an insufficient return on investment to cover its opportunity cost. The other approach is legal failure. This involves the formal liquidation of a firm or owner's bankruptcy if it is an unincorporated business (Peacock, 2004). The commonly used definitions – due to the availability of data – involve formal bankruptcy proceedings and discontinuation of business due to many reasons (Yrle, 2000). A firm is considered to have failed if there is a significant cash burn rate leading to the inability to meet obligations to stakeholders i.e. investors, employees, suppliers, and customers (Fatoki, 2014).

In South Africa, startup failure rate is around 70% (Botha, et al., 2015). Friendrich (2018) suggests that the failure rate in South African start-ups is anything between 70-80% in the first five years of operation. According to Friendrich (2018), a lack of basic entrepreneurial skills, which are necessary for ensuring sound management of all business factors and responsibilities, is a contributing factor to failure. Lack of a substantial market (end-user demand) ultimately spells out the demise of a starting business due to prospective entrepreneurs neglecting to pay attention to understanding and validating the market (Friedrich, 2018). This is consistent with research conducted by CBInsights (2018) which concluded that the number one reason for failure is building a product that nobody wants to buy (Eisenmann, et al., 2013). Poor financial education contributes to failure as entrepreneurs will tend to neglect business

financial obligations and requirements (Burger, 2016). Business aspects like financial control, pricing models, and tax obligations are consequently neglected leading up to failure (Botha, et al., 2015).

Fatoki (2014) reviewed literature on SME failure in South Africa and deduced several useful conclusions. In the build-up to the conclusions, Fatoki (2014) refers to the Stichcombe liability of newness framework, which states that start-ups fail due to internal and external factors. Internal factors can be poor management & functional skills, incompetent teams, and poor customer services. These are controllable factors. External factors include competition, poor supply chain, and high logistics costs, increasing cost of doing business, and lack of funding. The liabilities of newness are far significant for a start-up trying to create a market (Fatoki, 2014).

Mass and Herrington (2006) report that the failure of South African new businesses is attributed to fierce market competition, small market base, and financial constraints. Mbonyane (2006) studied small local businesses and concluded that limited knowledge on legal matters, lack of funding, and poor business skills contribute immensely to failure.

Ahmad and Seet (2009) focused on understanding small business failure by interviewing 20 former business owners in Malaysia and Australia, 10 in each of the two countries. The results showed that it is critical for a business to continue to address new challenges as the business grows and changes (Ahmad & Seet, 2009). Leadership requirements step up and entrepreneurs may reach an 'executive limit' where they are unable to manage the business operation well. Professional managers will need to be hired for their skills to curb the internal leadership vacuum (Fatoki, 2014).

CBInsights, a research firm based in the USA, analysed 101 start-up failure cases by getting first-hand information from the founding teams. Top 20 reasons were then deduced from the cases. Of these, the top 5 are: products or services simply fail to meet a real market need and therefore no sales, excessive cash burn rate, lack of suitable skill sets, competition and pricing, and costing issues (CBInsights, 2018).

Start-ups face a plethora of diverse challenges as briefly highlighted, the examples given are not exhaustive. Product uptake by the market is one critical factor that determines success or failure. The lifeblood of a company is in revenue generation which leads to profitability. But without a significant product uptake by end-users how will a start-up ensure its existence? The failure rates are alarming, and it is important to manage the process of start-up development differently to reduce some of the controllable risks. Traditionally, new business development starts with a business plan, getting investor buy-in, building a team, introducing a new product, and selling it. It is common to suffer major setbacks somewhere in this process which leads to complete failure (Blank, 2013).

A methodology that aims to make the start-up process less risky has relatively recently emerged and is gaining momentum in adoption. It is called the Lean Start-up Methodology (LSM). Instead of engaging in planning and intensive research, the Lean Start-up Methodology suggests that a business idea is a set of hypotheses to be tested (Ries, 2011). These are captured in a Business Model Canvas (BMC) – a tool that shows how a company will create value for investors and customers (see Figure 8 in Section 2.3). The entrepreneur "gets out of the building" to get factual information (Blank & Dorf, 2012). A minimum viable product (MVP) is assembled and deployed to quickly get customer feedback and extract valuable learnings about the product and the market. LSM reduces the cost of getting the first customers and mitigates the risk of building a wrong product. Essentially, it makes the start-up process less risky (Blank, 2013).

The purpose of this research is to study the application of LSM in start-ups that operate in the digital innovation space on their quest to come up with validated and scalable business models.

1.2 Research Background

InnoCentre (real initiative disguised herein under this name for ethical reasons) is an incubation initiative set up in Gauteng. Its thrust is on incubating digital entrepreneurs, commercialisation of research work, development of high level digital skills for professional and unemployed youth.

Digital entrepreneurs are taught LSM at the incubation centre as a framework by which to approach their entrepreneurial activities from concept to prototype, and if successful, to a fully-fledged business. Not all business ideas make it to a level of scalability and rapid take-off. It is against this backdrop that the centre is developing entrepreneurs by encouraging the LSM to reduce development costs and failure rates.

The centre recruited a cohort of 45 entrepreneurs working on a total of 25 business ideas to be developed through LSM from April 2018 to April 2019. At the end of the program, the best ideas are selected for funding or opportunities for more resources. Teams met every Tuesday for 3 hours in a classroom setup where a facilitator/lecturer teaches LSM and other related concepts.

In the start-up phase, the major challenges are developing customers and building a product that customers will want to buy as already established. This process will require to be executed with minimum resources before major investments are laid down. The task for each of the entrepreneur teams was to test their business idea in a real market environment and develop it step by step to scalability.

1.3 Problem statement

This research project studies the implementation process of LSM to look for factors that are critical for the successful implementation of the methodology in digital innovation start-ups. As start-ups are

critical in facilitating economic growth and job creation (Block, et al., 2017), it is of utmost importance to develop a deep understanding of how to translate ideas into successful businesses. This project relates extensively to the high start-up or small business failure rate in South Africa. The crux of the problem to be researched is how to reduce the risk of failure in the start-up phase and build a scalable business by applying LSM successfully.

1.4 Importance of the study

The Lean Startup Methodology has been hailed as a revolutionary approach in the development of startups. Most applications of the methodology are in software development where the principles are easy to apply. Since the methodology is relatively new, there exists a paucity of literature around some key areas of interest around the methodology. Although the methodology is hailed and deemed effective in increasing the chances of success of startups at low costs, it remains unclear what ingredients are crucial to the successful implementation of the methodology. This research attempts to fill this gap by studying digital innovation startups for critical success factors (CSFs) of this methodology in that context.

1.5 Research question

This research aims to answer the following question:

What are the critical success factors for successful implementation of the Lean Start-up Methodology in digital innovation start-ups?

1.6 Objectives

The research objectives are:

1. To develop a model of critical success factors for the implementation of the Lean Start-up Methodology in digital innovation startups.
2. To assess the applicability of the Lean Start-up Methodology in different business ideas in digital innovation space.
3. To determine the appreciation and understanding of the Lean Start-up Methodology in selected South African startups – in an emerging economy - as a tool for developing digital innovation start-ups.
4. To develop recommendations for successful incubation of digital startups using LSM in emerging economies based on the experience at a local digital innovation incubation facility.

1.7 Research propositions

1.7.1 Research Proposition 1

For LSM to be beneficial to the practitioner certain minimum requirements need to be met in the process for the methodology to be successfully implemented resulting in either a scalable business or successful invalidation of the business idea.

1.7.3 Research Proposition 2

The depth of LSM is not properly understood locally with practitioners in the digital innovation space limiting practice to a small number of the concepts the methodology represents.

1.8 Assumptions and Delimitations of the study

This study is conducted under the following assumptions and limitations:

1. It is assumed that the participants in the research have enough knowledge and experience with LSM to give relevant and useful inputs. This implies that each participant has above average theoretical knowledge and has gone through the LSM processes in building a product/service.
2. This study is limited to entrepreneurs and facilitators/mentors who participated in an incubation program at InnoCentre for a period of 12 months.
3. The experiences of the entrepreneurs and experts outside the incubation centre are valuable to the study as long as they address the objectives stated herein. However, for entrepreneurs, the study focuses on their LSM experience between April 2018 – April 2019.
4. The study is limited to LSM practitioner startups in the digital innovation space.

1.9 Summary of research steps

Figure 1 shows the steps which were followed in the study from preliminary literature review to the penultimate stage of reporting of research findings.

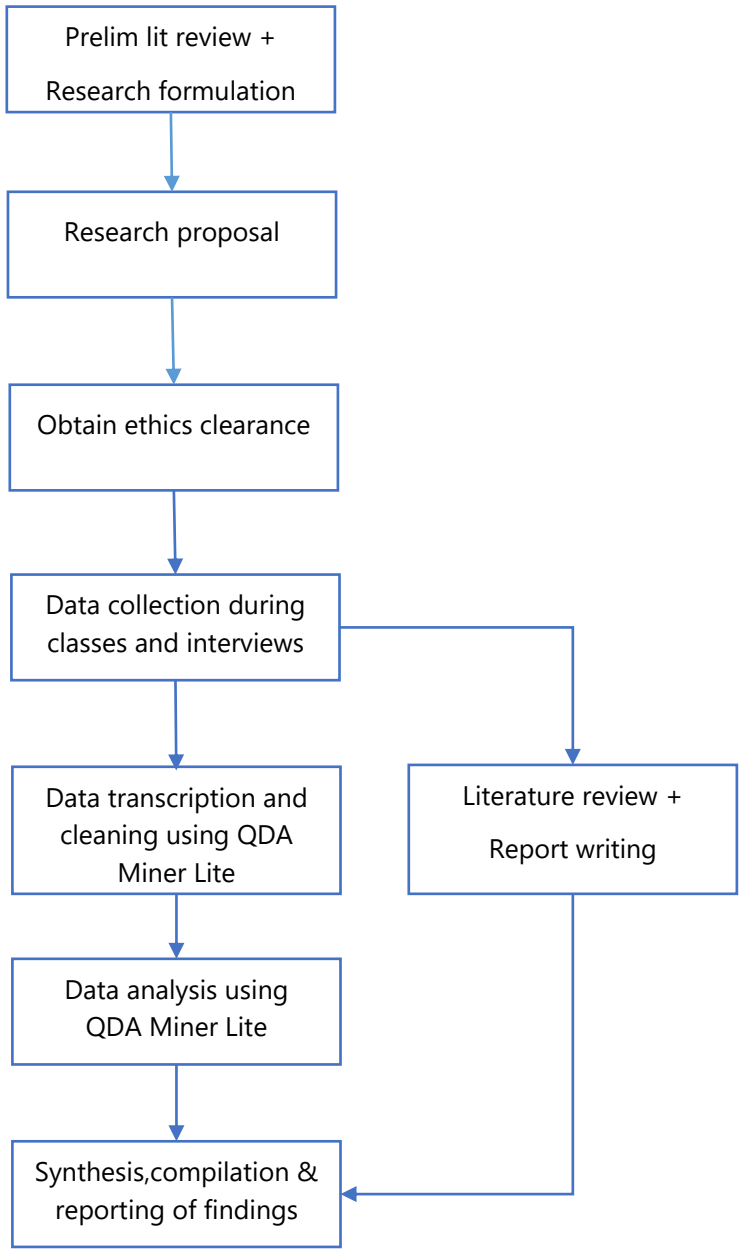


Figure 1: Summary of research progression

1.10 Structure of the research report

The research report follows the following structure:

Chapter 1 – Introduction

Chapter 1 introduces the wider topic of discussion and background on the research problem. The research question and objectives are presented together with the research propositions.

Chapter 2 – Literature review

This chapter lays out a literature survey on the Lean Startup Methodology, new product development, and entrepreneurship theory. Similar studies are reviewed. A critical assessment of LSM is provided.

Chapter 3 – Research Methodology

Chapter 3 contains a detailed write-up of the research process and method followed. All considerations that informed the chosen research design and approach used herein are discussed.

Chapter 4 – Results

Quantitative and qualitative results derived from the qualitative data collected in this research will be presented. Supporting qualitative details are provided.

Chapter 5 – Discussion and Results Analysis

Chapter 5 places the results presented in Chapter 4 within context providing a detailed interpretation of the data and how they address the objectives and propositions of this study.

Chapter 6 – Conclusion and Recommendations

Lastly, in Chapter 6 important findings of this study are presented in summary together with recommendations for further studies.

2. LITERATURE REVIEW

2.1 Introduction

The literature review will look at LSM in detail and the concepts which form this methodology. Case studies were this methodology has been applied are examined. The chapter also examines LSM in comparison to other known new product development approaches. A critical review of LSM is presented highlighting its limitations and suitable applications.

2.2 The Lean Start-Up Methodology

Ries (2011) created the Lean Start-Up Methodology & published the concept in a book entitled "*The Lean Start-up: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*". He argues, "startup success can be engineered by following the process, which means it can be learned, which means it can be taught" (Ries 2011, p3) referring to the Lean Start-up Methodology.

LSM is a scientific approach in managing start-ups with the goal of delivering a desired product to customers with speed. The approach entails the use of empirical data from testing certain business aspects and extracting data-driven learnings. Hence, it has a scientific nature to it. The Lean Start-Up Methodology aims to ensure that a business idea that is managed by following the process delivers accelerated growth (Ries, 2011) and that the risk of building a startup is significantly reduced (Blank, 2013).

The work by Gambardella, et al. (2018) supports the basis of Ries (2011) argument in which the researchers proved that following rigorous scientific and experimental approaches in entrepreneurship decision making reduces false negatives. Following intuitive approaches is therefore outperformed by rigorous scientific approaches (Gambardella, et al., 2018). LSM avoids the pitfalls of intuitive approaches given its data-driven nature.

The methodology is given credit for having introduced several concepts to mainstream entrepreneurship discussions. Examples include customer development, validated learning, minimum viable product, and pivoting (Felin, et al., 2019). The term minimum viable product was coined by Frank Robinson in 2001 with Eric Ries and Steve Blanks propagating the term and its concepts to a much wider audience from 2009 and 2010 respectively (Lenarduzzi & Taibi, 2016).

LSM provides a counter approach to the conventional way of managing a start-up. The conventional approach presents a new business idea as a forecast in an isolated business plan whereas the LSM presents a business idea as a list of hypotheses to be tested and validated rapidly in the market (Blank, 2013). To deduce the set of hypotheses, the Business Model Canvas is used to think about the business idea across nine dimensions (Blank, 2013; Mollick, 2019; Osterwalder & Pigneur, 2009). Ries (2011) argues that, conventionally, many start-ups develop a product or service which is assumed to resonate with customers' needs. Considerable amounts of time and resources are expended on the business idea without eliciting customer feedback on the product during the rudimentary phases of product development. This may lead to failure to achieve broad product uptake as customers may fail to appreciate the value proposition. When the value proposition fails, the start-up fails (Ries, 2011). However, Felin et. al. (2019) argue that the importance of customer feedback in the early phases of a startup is overstated. The argument extends to say that it is unclear why customers would have a better view of the viability of a future product particularly for new radical innovations than the startup founders (Felin, et al., 2019). According to Felin et. al. (2019), it is the duty of entrepreneurs to create products for the future, guided by a strategy from the present realities to the unknown future without assuming that customers necessarily know of their future requirements.

Figure 2 below graphically shows the LSM implementation cycle.

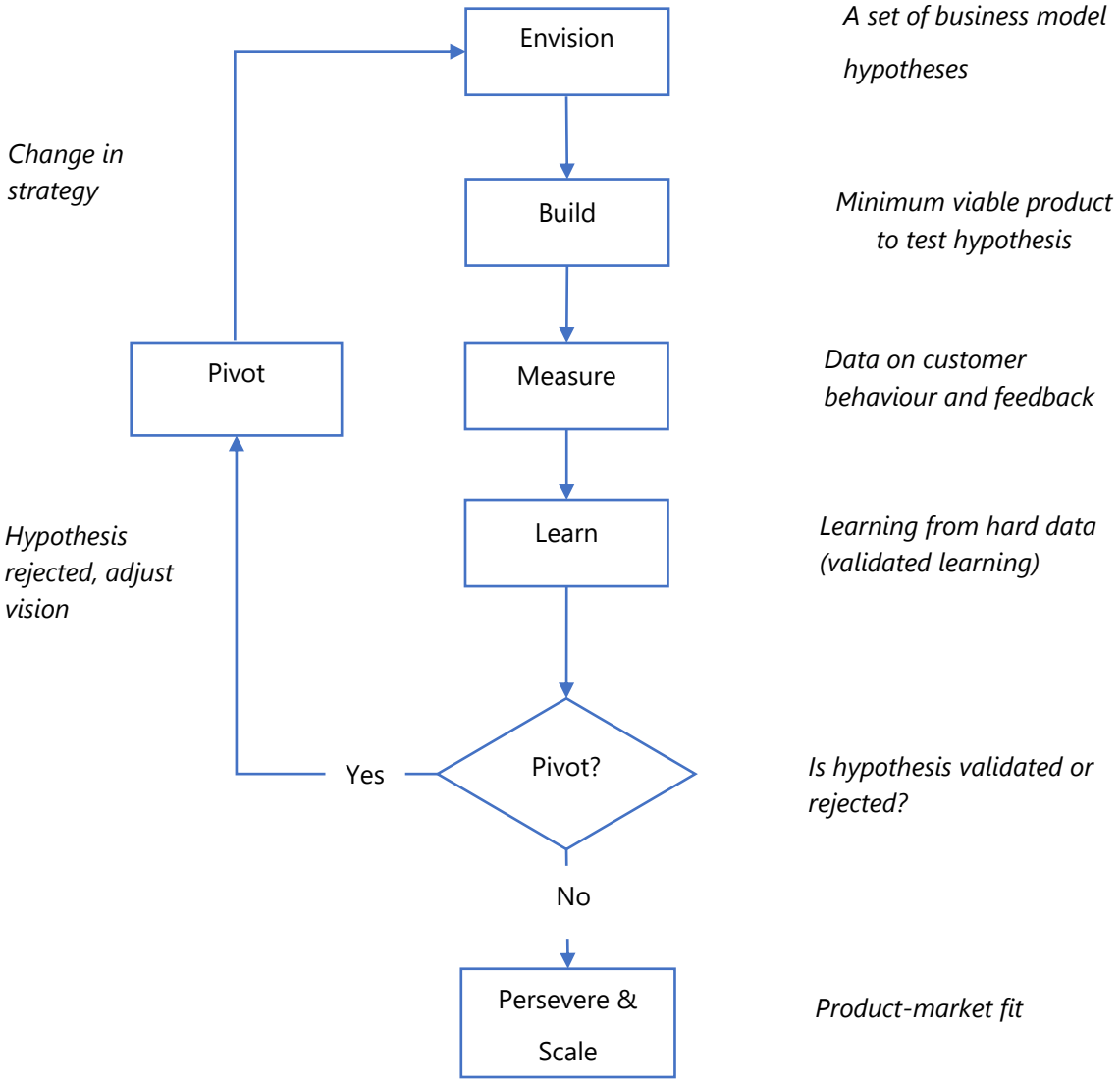


Figure 2: LSM process (Edison, 2015)

Central to LSM is the Build-Measure-Learn (BML) feedback loop (see Figure 3 overleaf). After figuring out what problem is to be solved the next step is to develop a minimum viable product (MVP) which starts the learning process. The MVP is used to elicit feedback from prospective customers – the early adopters – by creating product-market combinations in search of sustainable demand (Mollick, 2019). Measurement of performance metrics to determine, for example, product uptake rates should be in place at this stage. Learning about the market and product is based on real factual data from customers (Ries, 2011).

Data from the market is used to inform the decision to pivot or not. Pivoting is a structured course correction which incorporates customer inputs, to test a new hypothesis about the product, engine of

growth, and strategy, if necessary. Otherwise, the start-up can 'persevere' in the initial direction (Ries, 2011; Blank & Dorf, 2012). As a result of applying LSM, the expected outcome is that the refined value proposition is better aligned to customer expectations, reducing the risk of start-up failure using the least resources (Girgenti et al, 2016).

2.2.1 Five LSM Principles

The Lean Start-Up way of thinking is guided by the following tenets (Ries, 2011):

1. Entrepreneurs are everywhere: Ries defines a start-up as a "human institution designed to create new products and services under extreme conditions of uncertainty" (Ries, 2011, p.8). This means that entrepreneurship can be practised in any set up which fits this definition. As a result, LSM is applicable in any company size (start-up or established i.e. inclusive of intrapreneurship), in any industry or sector (Ries, 2011).

2. Entrepreneurship is management: Start-ups are institutions not just product(s) or service(s) under development. Thus, start-ups require a new management approach, which is matched to the high degree of uncertainty inherent in start-ups (Ries, 2011).

3. Validated learning: The existence of start-ups is not limited to products or services, serving customers but also to learning the art of building sustainable business models. Validated learning can be verified scientifically by frequent experimenting and testing of each component of the start-up's vision (Ries, 2011).

4. Innovation accounting: This principle is focused on improving entrepreneurial outcomes and holding entrepreneurs accountable. In particular, how to measure progress, setting up milestones, and prioritisation of work (Ries, 2011).

5. Build-Measure-Learn: According to Ries (2011), the BML loop sums up the activities of any start-up i.e. to develop products or services, to measure customer response, and to determine when to pivot. Start-up processes should aim to speed up the BML feedback mechanism depicted in Figure 3 below.

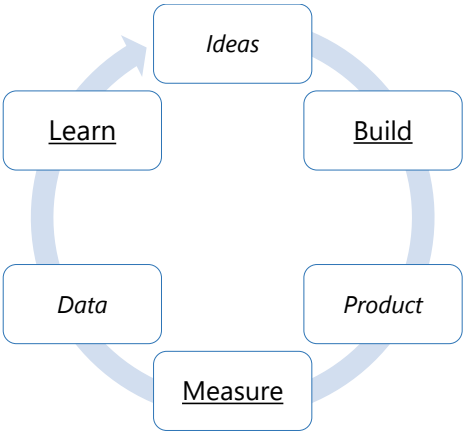


Figure 3: Build-Measure-Learn Feedback Loop (Ries, 2011)

2.2.2 Lean Start-up case studies

LSM has been successfully applied in startup and established firm environments. The results have been tremendous as the following case studies demonstrate.

Dropbox:

Dropbox is a global company that provides a file hosting service offering, cloud storage, file synchronisation, and client software. Drew Houston, one of the founders, applied LSM to manage the start-up process of Dropbox. Upon implementation of LSM, product iteration became faster. This facilitated early and frequent testing of the needs of the customers. By understanding customers better, the number of users increased from 100 000 to over 4 million in 15 months (Ries, 2018).

Wealthfront:

Wealthfront, established in 2009, facilitates access between investors and top investment managers. The company selects investment managers and scale their accessibility using technology. Wealthfront practices continuous product deployment and testing based on LSM principles. Now Wealthfront manages in excess of $200M and processes transactions amounting to $2M/day (Ries, 2018).

General Electric:

After realising the need to drive innovation with speed and alignment to customers' needs General Electric introduced an initiative called FastWorks in 2013. The initiative derives its framework from the LSM following a training by Eric Ries at one of General Electric's facilities. FastWorks seeks to drive quicker product output, learning and adjusting the design in a tight short loop. Different departments in the business were used as early adopters of new product ideas and in certain cases old products were modified into MVPs to quickly show the new ideas (Kindergan, 2017). This initiative is a major shift from

how General Electric has been revising its products, typically following a 5-year waterfall development cycle. FastWorks has proved that speed is a competitive advantage in the technology space (Power, 2014).

General Electric had to align its supplier relations, finance team and leadership roles and responsibilities to the speed FastWorks demanded (Power, 2014).

The results of this LSM approach in an established firm has been halved new product development costs, halved development times, and doubled sales rate (Power, 2014).

2.3 LSM Conceptual Framework

The Lean Start-up Methodology comprises of several smaller conceptual units. According to how Ries (2011) progresses on elaborating LSM, the methodology is condensed as presented in the conceptual framework in Figure 4 below developed by de Wet (2013). Key concepts in the framework are defined overleaf and how Ries applies them in the LSM process.

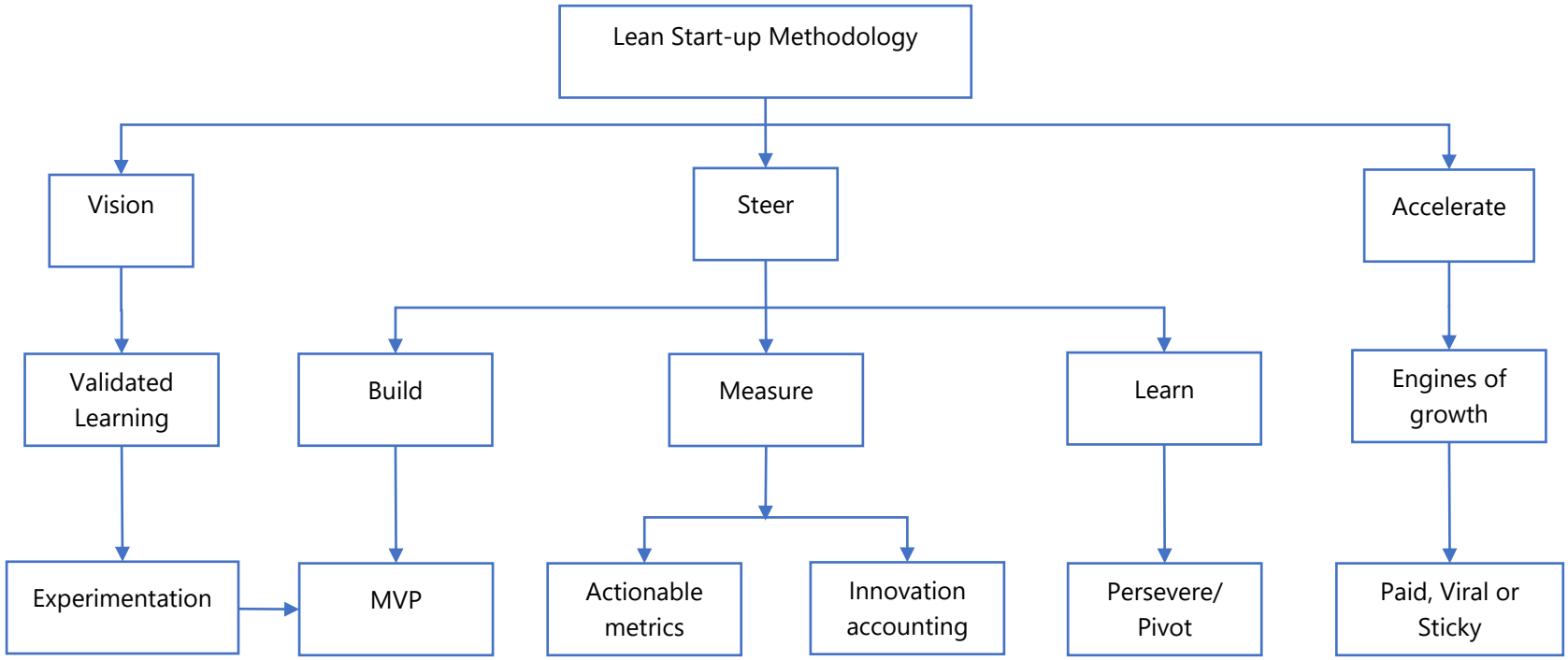


Figure 4: LSM conceptual framework showing the big ideas of the methodology (de Wet, (2013) as adapted from Ries (2011))

2.3.1 Minimum Viable Product

A minimum viable product (MVP) is a stripped-down version of the envisaged final product that triggers a full turn of the BML loop using a minimum amount of resources – effort and development time. At this stage, the product lacks most of the features that may be required in the final product. The MVP needs to be delivered to potential customers or early adopters to start the process of getting customer input and reactions. The entrepreneur can even try to sell the prototype at an early stage. The function of the MVP is to test the fundamental ideas and hypotheses of the business model (Ries, 2011).

Apart from the definition by Ries (2011), other definitions can be found in literature which do not differ much from the definition provided by Eric Ries. Of interest is the fact that Frank Robinson is credited for the initial definition of the term in 2001 (Lenarduzzi & Taibi, 2016). The underlying thinking behind the initial definition is that an MVP is a high return on investment product created with the minimum possible effort or time to market (Robinson, 2001). This definition is underpinned by the thinking below (SyncDev, 2020):

"MVP is a mindset *of the management and development-team. It says, think big for the long term but small for the short term. Think big enough that the first product is a sound launching pad for it and its next generation and the roadmap that follows, but not so small that you leave room for a competitor to get the jump on you."*

According to Eisenmann et al. (2013), for entrepreneurs confronting extreme conditions of uncertainty and limited financial resources, it is critical to maximise learning. By launching MVPs early and often, the entrepreneur is able to put the product into the market and elicit real feedback based on real market conditions. As a result for every unit of time and effort expended learning is maximised (Eisenmann, et al., 2013).

Launching a series of MVPs results in reduced batch sizes and cycle times giving an entrepreneur two advantages. According to Eisenmann et al. (2013), frequent launches imply learning about what customers need before making significant capital and effort expenditures in building features of less or no value to customers. Following an empirical study, Anderson et al. (2017) concluded the same about frequent MVP releases in an incremental innovation model where the benefits are more pronounced. Another benefit is that test results of feature revisions released in small batches are easier to track (Eisenmann, et al., 2013).

MVPs can assume a range of complexity. In some cases, it could be a smoke test to an actual physical prototype. The level of complexity required depends on development lead times, nature of the product, supply chain lead times (for physical products) among other product-specific limitations. Deciding on

the complexity of the prototype requires judgment (Ries, 2011). In the early phases, the MVP is mostly used as a tool to bridge gaps and communicate amongst technical teams, potential users, and investors, understanding this can help in deciding the required complexity (Duc & Abrahamsson, 2016). There are two ways by which an MVP can be limited – product functionality and/or operational capability. Constrained product functionality implies offering a subset of the envisaged features of the subsequent product versions. In this case, an entrepreneur can put in place makeshift measures to give the product minimal functionality required for tests. Smoke tests that reduce functionality and constrain operations can be used such as web landing pages and letters of intent among others (Eisenmann, et al., 2013).

Operational requirements are a function of product functionality. Therefore, an entrepreneur should use constrained operations during the development of the core functionality of the product. A rule of thumb is to constrain unnecessarily costly operations by using makeshift measures as long as it does not interfere with customers' experiences and their ability to offer valuable feedback (Eisenmann, et al., 2013).

The use of MVPs (constrained either functionally or operationally) requires the entrepreneur to limit the customer set to a sample large enough to provide reliable feedback. Quantitative tests require sample sizes large enough to be statistically significant. Larger customer sets are expensive to acquire before business model validation is complete. Moreover, should a subsequent pivot fail there is a risk of damaging the startup's brand as early adopters may be alienated in the process (Eisenmann, et al., 2013).

2.3.1.1 Types of minimum viable products

There are various forms of MVPs an entrepreneur can implement to test the hypotheses about the business model. Examples are highlighted below. However, the list below is not exhaustive as MVPs can assume many different variations depending on product type (Duc & Abrahamson, 2016; Ries, 2011; Nguyen-Duc, et al., 2019):

Concierge MVP

A concierge MVP provides the functionality of a product to the customer manually. It is applied in situations where the entrepreneur wants to extract insights about what customers find valuable before developing the actual functionality.

Landing page

A landing page is simply a website where visitors are directed to from a link. This can be from an email or any other type of marketing campaign. The purpose of a landing page is to introduce the startup's

value proposition and lure the visitors into a desirable action i.e. finding value in the proposal and subsequently become early adopters. Landing pages can also be used to gauge if potential customers are interested enough in the proposal to provide their contact details. The advantage of such a landing page is that the entrepreneur can determine the number of potential customers as well as contact them to establish further leads.

Prototypes

Prototypes are physical or digital representations of the functionality of the final product and can range from low-fidelity paper prototypes (mock-up MVP) to high-fidelity prototypes (fully functional). Low-fidelity prototypes are suitable for early market tests. A high-fidelity prototype provides a more real experience of the envisaged final product.

Prototypes can also take the form of a single feature MVP. This is a prototype that demonstrates the most critical feature of the product.

Explainer video

An explainer video communicates the product value proposition (what it does) and why potential customers should buy it. Dropbox used this technique to explain its value proposition.

2.3.1.2 Problematic aspects of MVP

Eisenmann et al. (2013) argue that launching products early has the potential to expose business ideas to theft. However, early reliable feedback has much more value to the entrepreneur thus outweighing the risk of idea theft. The argument further states that ideas do not mean much unless if they are executed. By iteratively developing MVPs the entrepreneur improves on execution and depth of customer knowledge. Entrepreneurs are urged to spend most of their resources on understanding prospective customers above considering competition in greater detail (Eisenmann, et al., 2013). On the other hand, the risk of being outdone on execution by a competitor cannot be understated. For this reason, there is a warning from LSM practitioners not to make an MVP that gives a competitor an opportunity to take the idea and make significant leaps ahead (SyncDev, 2020).

Reputational risk is cited by entrepreneurs as a potential drawback of MVPs as the product may have potential shortfalls or bugs. As alluded to before, the customer set must be limited to a size big enough to allow for validation of hypotheses. This limits reputational risk in the event of quality issues (Eisenmann, et al., 2013). Ries (2011) suggests the use of a different brand name for MVP products to keep reputational risk to a minimum.

2.3.2 Actionable metrics

Actionable metrics are the opposite of cumulative (gross) statistics for measuring the performance of a product (Ries, 2011). An example of a gross metric is *total number of customers*, which Ries (2011) calls *vanity metrics* as one cannot deduce or learn much from the number. On the contrary, actionable metrics are able to link cause and effect when measuring the impact of particular action or change on the performance of a product. This is not achievable with gross metrics as they do not provide an explanation of why a change in the numbers is happening (Ries, 2011).

2.3.3 Engines of growth

The mechanisms by which start-ups grow into sustainable businesses are defined as engines of growth (Ries, 2011). Each startup has a dominant engine of growth or feedback loop that drives growth which it must identify and commit resources to (Täuscher & Abdelkafi, 2016). According to Täuscher & Abdelkafi (2016), entrepreneurs and investors have difficulties in objectively assessing the relative strengths of the feedback loops.

Startups assume one of the following three engines of growth (Ries, 2011):

The Sticky engine of growth – requires a continued and long-term use of a product or service to deliver sustainable growth. For example, telecoms companies typically use the sticky engine of growth as a customer needs to be engaged with the service or product for a sustained period. Customer acquisition rate needs to surpass the churn rate (fraction of disengaged customers) for the company to grow. The churn rate must be kept at a minimum as a priority for a company operating following the sticky engine of growth (Ries, 2011).

The Viral engine of growth – features very rapid dissemination of awareness of a product from person to person as a consequence of the use of the product. Growth is seen as automatic and self-driven as customers do not intentionally act as agents in advertising the product. A commonly known example of this type of loop is the word-of-mouth in which case satisfied customers propagate the product in their personal circles (Täuscher & Abdelkafi, 2016; Radas, 2005). The relationship is governed by a viral loop that can be expressed mathematically. In the relationship, a constant i.e. viral coefficient, determines the number of new customers brought in by each customer. The higher the viral coefficient the faster the product grows. A start-up that assumes this growth model should aim to increase its viral coefficient (Ries, 2011).

The Paid Engine of Growth – entails laying up investment into acquiring customers through efforts like online marketing or the use of an outbound sales team that interacts with customers. The business grows if Cost Per Acquisition (CPA) is less than Customer Lifetime Value (CLV) (Ries, 2011). CLV is

increasingly becoming an important metric in startups (Wouters & Kirchberger, 2015), as prospective businesses would want to build a customer base with a high CLV to maximise revenues.

2.3.4 Pivoting

Pivoting is a concept within LSM that deals with changing the course of the business or product strategy in a structured manner to test a new hypothesis about the product, business model and growth engine (Ries, 2011; Blank & Dorf, 2012). There are several types of pivots. The catalogue of pivots according to Ries (2011) is comprised of the following types:

- Zoom-in Pivot – is characterised by changing a single feature in the current product into a whole product.
- Zoom-out Pivot – a single feature is sometimes too small to support a whole product in which case a whole product is condensed into a feature of a much larger product.
- Customer segment pivot – is executed when a product is solving a real problem, but the customers do not fall under the segment that the company had initially planned to sell its solution to. A new customer segment is created to sell the same product.
- Customer need pivot – through interacting with customers it is possible to realise that the problem currently being solved is not important to customers. An entrepreneur can realise other related problems that are important to the customers for which the current product can be repositioned or a new product is required.
- Business architecture pivot – refers to the switch between high margin, low volume (complex systems model) or low margin, high volume (volume operations model) business architectures.
- Value capture pivot – changing the monetisation or revenue model of the business.
- Engine of growth pivot – A business can seek to change its growth model either to achieve faster or more lucrative growth. Primary engines of growth to pursue are viral, sticky and paid growth models.
- Channel pivot – A company may decide to change the way they deliver value to customers (sales channel) to achieve more effectiveness.
- Technology pivot – refers to switching between technologies to improve the way the business operates. Mostly, established companies undergo technology pivots as an innovation sustenance initiative to retain or grow an existing customer base.

Ries (2011) maintains that any growing business needs to continue pivoting even after achieving success. Pivots are strategic. Pivoting can build resilience within companies as mistakes can be identified early and LSM offers the agility to correct them (Ries, 2011).

2.4 Theoretical background

This section presents other theories and approaches to entrepreneurship and product development. By so doing, LSM is placed within the context of other approaches that may be different or similar to it giving a broader view of the subject matter.

2.4.1 Customer Development Model

Blank and Dorf (2012) propose the Customer Development Model (CDM) startup management process that is resonant with LSM. The argument is that the first objective of a startup is to validate its business model hypotheses. Blank and Dorf (2012) encourage the use of an MVP in the validation phases towards building a scalable and repeatable business model.

Figure 5 below depicts the main components of CDM.

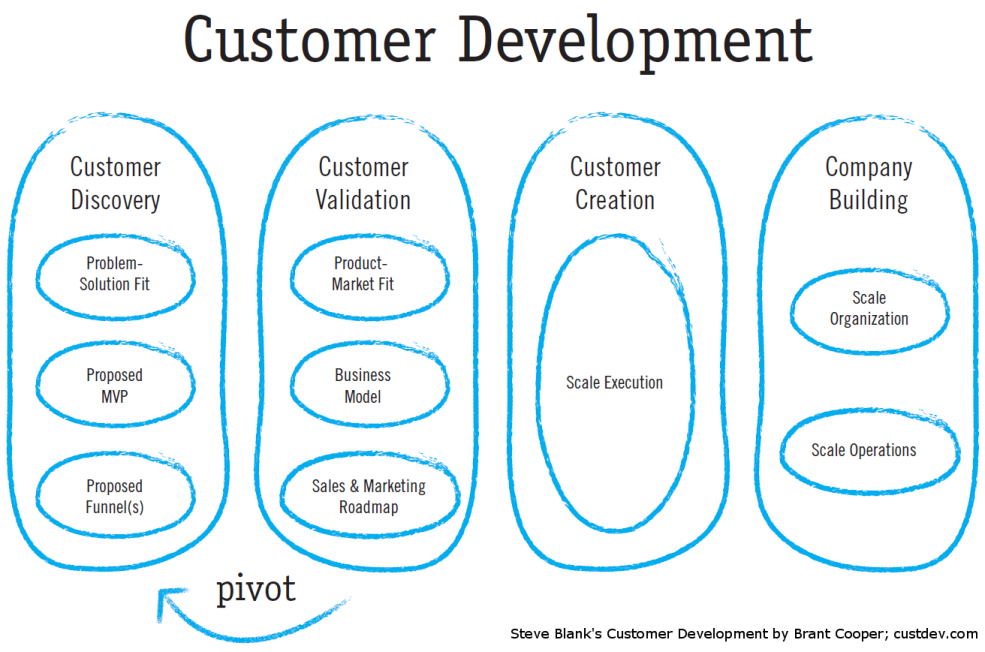


Figure 5: Customer Development Model (Blank & Dorf, 2012; Blank, 2007)

Customer Discovery typically involves understanding customer perceptions of the problem. The entrepreneur must "get out of the building" to determine the problems customers are facing and which ones of them are a top priority (Blank, 2007). Based on the feedback an MVP is designed and showcased

to potential customers. At this stage, it is possible to convince the potential customers to buy the MVP (Blank & Dorf, 2012).

In the Customer Validation phase, the startup should be aiming to validate the business model and the likelihood of scalability based on empirical data. A scalable business model is able to deliver profitable volumes (Blank & Dorf, 2012). When customers pay for the product, it proves the validity of the initial market with a repeatable sales process (Blank, 2007).

Customer Discovery and Customer Validation can be iterative between themselves until there is satisfaction that the start-up is solving a problem and that the solution can persuade customers to buy it. Without confirmation of a market that can be served with a repeatable sales process, the startup should not proceed to scale (Blank, 2007). This minimises business costs until the business model has been tested and proved valid (Blank & Dorf, 2012).

Customer Discovery and Customer Validation lay the foundation of a scalable enterprise and Customer Creation involves scaling up and developing a sales channel with end-user demand (Blank & Dorf, 2012).

In Company Building phase, more resources are committed to scale the business. Formal company structures should be put in place to run the business (Blank & Dorf, 2012). Now, the start-up can afford to invest more resources as the business model is valid (Picken, 2017).

Blank & Dorf (2012), Blank (2007), and Ries (2011) propose practical approaches to start-up management based on experimentation and empirical data. Here, we see a clear distinction of these approaches from conventional business plan and waterfall product development approaches of managing start-ups or new product development. Blank and Dorf (2012) posit that "no business plan can face customers". The argument is that no matter how detailed a business plan can be with forecast sales and revenue data, the empirical validation of the business model is a pragmatic approach that better reflects the reality on the ground. The waterfall development methodology-which is a sequential and stage-gate approach - is not applicable in startup environments as they operate under extreme uncertainty.

CDM does not differ much from LSM as LSM builds on some of the CDM principles. As such, the CDM faces the same challenges and strengths as LSM, even critics.

2.4.2 Design Thinking

Design Thinking is a user-driven innovation and new product development approach. It was developed by a design consultancy company IDEO towards the late 90s. Design Thinking is based on extensive user research and iteration cycles to yield an appropriate solution (Mueller & Thoring, 2012).

Design Thinking has been defined in a number of ways. For its applications in the business world, Brown (2009, p14) summarises it as:

"A discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity."

Melles (2010,p6) considers Design Thinking to be *"human-centred open problem solving process decisions makers use to solve real world 'wicked' problems"*.

Badke-Schaub et al, (2010) look at Design Thinking as a process of disruptive innovation to create a competitive advantage in the market by solving and designing systems or solutions to human-centred problems.

From the different viewpoints, the creation of innovative human-centred products is the key take away which is at the core of Design Thinking.

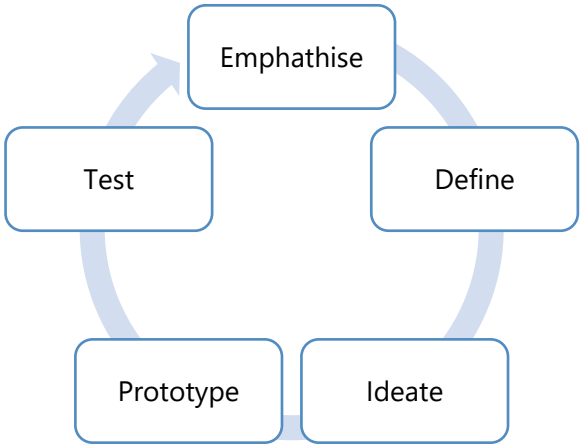


Figure 6: Design Thinking steps (Brown, 2009)

It is rooted in 5 steps depicted in Figure 6 (Brown, 2009). The steps are iterative and can be implemented in parallel or any order in coming up with innovative solutions. Through gathering data and information, one can get a wider view of the problems or pain points that need solutions. Understanding the pain points will help in forming ideas that create a desirable experience for the customer (Caprara, et al., 2017). In the ideation step, solutions are generated, and the best ones are selected for the prototyping phase. Prototypes are then tested iteratively until an optimal and innovative solution is found and is producible (Cohen, 2014).

Design Thinking aims to develop an innovative approach to discover new solutions through analysing problems and brainstorming in an open-minded manner (Cohen, 2014).

Although Design Thinking does not stem from Lean principles, it is similar to LSM in that it is also centred on identifying user needs and creating an appropriate solution. There are some similarities between the stages of the two methodologies. "Learn", "Build" and "Measure" in LSM equate to "Understand/Empathise", "Prototype" and "Test" respectively in Design Thinking (Mueller & Thoring, 2012). According to Mueller & Thoring (2012), LSM is applicable to sub-problems whereas Design Thinking is more suitable to the entire problem being solved. Figure 7 below summarises the key differences as reported by Mueller & Thoring (2012) between the two innovation approaches.

What	Design thinking	Lean Startup
Goal	Innovations	Innovations
Scope, Focus	General innovations	High-tech innovations for Startups
Approach	User-centered	Customer-oriented
Uncertainty	Solve wicked problems	Unclear customer problem
Testing	Fail early to succeed sooner	Pivoting is at the heart of the 'fail fast' concept. The sooner you realize a hypothesis is wrong, the faster you can update it and retest it.
Iteration	Yes ("Iteration")	Yes ("Pivoting")
Ideation	Ideation is part of the process, solutions are generated in the process	Ideation is not part of the process, product vision is initially provided by company founders
Qualitative Methods	Strong focus: elaborated ethnographic methods, user research, observations, etc.	Not a focus
Quantitative Methods	Not a focus	Strong focus: metric-based analysis; provides matrices, and testing
Business Model	Not a focus	Focus
Adaption of deployments	Not a focus	Five Whys Method
Typical Methods	Shadowing, Qualitative Interview, Paper Prototyping, Brainstorming (with specific rules), Synthesis, etc.	Qualitative Interview, Smoke Test, Paper Prototyping, Innovative Accounting, Split (A/B) Tests, Cohort Analysis, Funnel Metrics, Business Model Canvas, Five Whys, etc.
Hypothesis Testing	Not a focus	Focus
Prototype Testing	Yes	Yes
Rapid iteration	Yes	Yes
Target Group	Users (usually end users, sometimes other stakeholders)	Customers (distinguished between Users, Influencers, Recommenders, Economic Buyers, Decision Makers)

Figure 7: Comparison between Design Thinking and the Lean Startup Methodology (Mueller & Thoring, 2012)

2.4.3 The Business Model Generation Canvas

The Business Model Generation Canvas or simply the Business Model Canvas (BMC) is a conceptual instrument used in business model development. Osterwalder proposed it in 2009. The model is composed of objects, concepts, and the relationships among them outlining the mechanism that drives the business (Osterwalder & Pigneur, 2009). Blank (2013) vouches for the model as a tool to capture the

business hypotheses (for a new venture) instead of engaging in expending effort on planning and research. LSM incorporates BMC as a tool in the early stages of developing the business model (Ries, 2011).

Figure 8 below shows the Business Model Canvas. An expanded version is presented in Appendix A, see Figure 23.

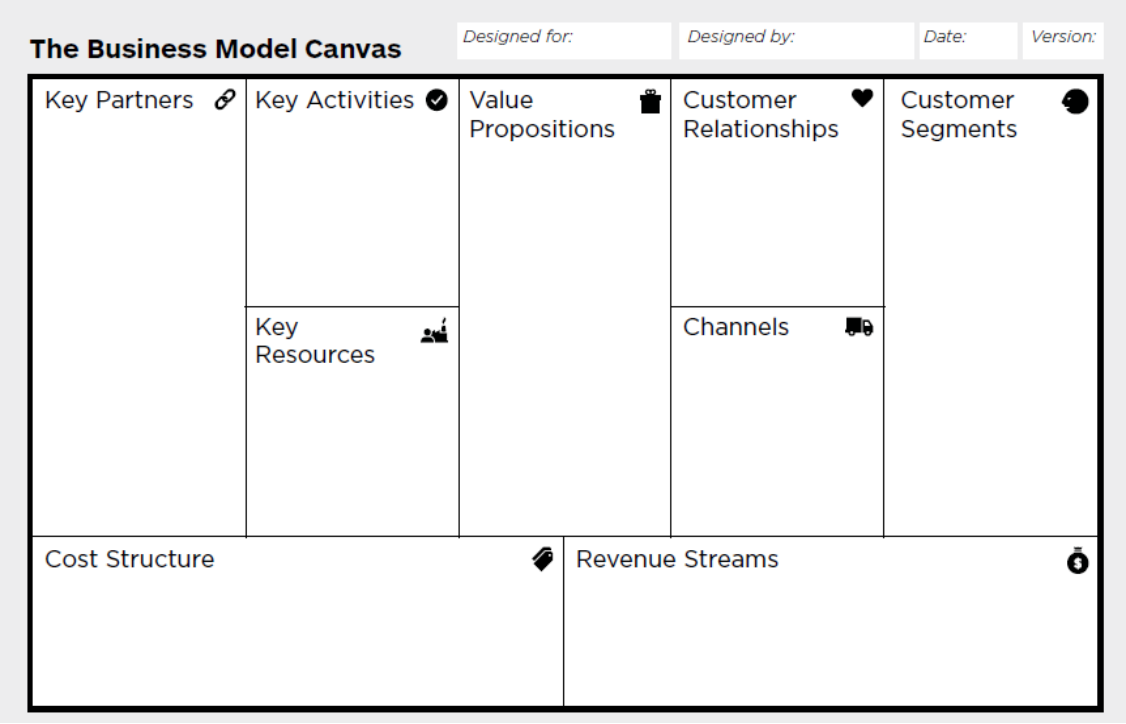


Figure 8: The Business Model Generation Canvas (image source: StrategyzerAG, 2018)

The different components of the model are highlighted below (Osterwalder & Pigneur, 2009):

Key partners – Are the stakeholders the entrepreneur depends on to the build the business.

Key activities – Summarises the core activities the business does.

Value propositions – Should outline the offer to the potential customers.

Customer relationships – Describes the relationship(s) required for each of the customer segments.

Customer segments – Outlines the type of customers the business intends to serve.

Key resources – This section should describe the resources to deploy.

Channels – Here the entrepreneur needs to articulate the mechanism to employ in order to reach customers.

Cost structure – Should answer the question 'What influences the costs of the business?'.

Revenue streams – This part addresses what customers are currently paying and what they are willing to pay.

Hulme (2011) suggests that using the BMC facilitates the learning process of a start-up. As entrepreneurs go through the model, it forces constant reflection on the business aspects and how they will fit together in a cohesive manner. The model gives a view of the whole business as well as its component parts. This is important as entrepreneurs may concentrate on certain parts of the business and neglect other equally important parts. The canvas includes aspects of Design Thinking - i.e. facilitates brainstorming - and promotes the development of customer-centric solutions (Hulme, 2011).

The BMC has been criticised for lacking particularity on the problem to be solved and its proposed solution. Although it includes a section on Value Proposition, which should naturally encapsulate the problem and solution, Maurya (2012) argues that lack of problem understanding significantly contributes to the building of wrong solutions by startups culminating in failure. Once the problem is well understood, then a startup is now well placed for defining a possible solution. Based on criticising the model, Maurya (2012) then proceeds to introduce a revised version of the BMC known as the Lean Canvas. This revised model places focus on other sections such as Unfair Advantage and Key Metrics. These two new sections substitute Key Resources and Customer Relationships as found in the BMC (Maurya, 2012). It should be noted that both models miss a particular focus of the competitive forces which are part of the business environment.

2.4.4 MVP Test Results and Entrepreneurial Biases

The LSM practitioner is supposed to learn from the iterative processes involving the use of MVP versions. However, maximising learning and reaching objective and factual conclusions is susceptible to failure due to false results and entrepreneurial biases that may affect judgement. Two sources of erroneous evaluation of customer feedback are false positive and false negative results, and biases the entrepreneur may have (Eisenmann, et al., 2013).

MVP Test Results

Eisenmann et al. (2013) point out that hypothesis tests using MVPs should be designed with the understanding that tests may either give false-positive or false-negative results. A false-positive result validates a hypothesis that is, in fact, invalid. When conducting tests on the demand for a new product, eliciting feedback from enthusiasts as test subjects can yield false-positive results. This a typical case of stated preferences not aligning to actual preferences (Eisenmann, et al., 2013).

According to Eisenmann et al. (2013), false-negative results disprove a hypothesis when in reality it actually holds. For instance, false-negative results for the demand of a new product are usually due to a badly designed MVP and hypothesis test. As a typical example, in providing a particular online product, test subjects may expect web pages to load fast. Sluggish performance in this area may deter customers from getting to the core of the MVP offering even if they would, in fact, perceive the new product to be appealing (Eisenmann, et al., 2013).

Entrepreneurial Biases

Entrepreneurs are subject to the well-known cognitive biases that impair clear judgments (Kahneman, 2011). These biases cannot be eliminated. It is critical to understand them and find measures to combat them (Eisenmann, et al., 2013). In Table 1 below common cognitive biases that may affect early-stage entrepreneurs are briefly described. Measures to reduce their impact are presented.

Table 1: Description of common entrepreneurial biases and how to reduce their impact (York & Danes, 2014)

Bias	Brief description	Measures to minimise impact
Optimism bias	Overstatement of the probability of a positive outcome and understatement of the likelihood of a negative outcome (Eisenmann, et al., 2013).	The entrepreneur can use falsifiable hypotheses which measure performance. Pre-mortems can also be employed by a team to realise possible threats and doubts (Kahneman, 2011). This assesses a hypothetical scenario in which the team has executed their plan exceptionally, but the venture still has failed to take off.
Planning fallacy	Is a form of optimism bias. It reveals a tendency to overestimate the benefits of a task and underestimate the effort, risk or costs involved (Eisenmann, et al., 2013).	Planning fallacy can be mitigated by (Lovallo & Kahneman, 2003): 1. Exercising awareness of the fallacy when making estimates. 2. Using a reference to comparable projects.
Confirmation bias	Describes the tendency to look for and remember information that confirms rather than invalidates one's beliefs. For example, by unwittingly sampling enthusiastic early adopters, an entrepreneur may return false-positive results (Eisenmann, et al., 2013).	Getting one team member to play the devil's advocate role can help bring a balanced practical view to the team (Eisenmann, et al., 2013).
Sunk cost	Incurred and irrecoverable expenses should not be considered in decision -making. If considered this may lead the entrepreneur to opt to continue with a failed project instead of	By early product launches and avoidance of unwarranted scaling, an entrepreneur's sunk costs are kept to a minimum and will be less likely to influence judgement (Eisenmann, et al., 2013).

Bias	Brief description	Measures to minimise impact
	discarding it. This presents a challenge to LSM practitioners during pivoting (Eisenmann, et al., 2013).	
Overconfidence bias	Unwarranted inflation of the importance of customer suggestions and/or the knowledge that one has (York & Danes, 2014).	Overconfidence bias can be mitigated by engaging mentors who give unbiased feedback (York & Danes, 2014)
Selection bias	Arises when an entrepreneurial team seeks feedback and information from sources which are likely to be confirmatory. This results in unrepresentative feedback from the target market (York & Danes, 2014).	Careful selection of samples and pairing up team members for customer interface sessions to constantly check on each other's assumptions (York & Danes, 2014).
Representativeness bias	The generalisation of feedback from a very small and non-random sample, which does not represent the target market (Eisenmann, et al., 2013).	Customer interface and feedback collection process can be made to be iterative and continuous. This assists in checking previous data and conclusions against new data (Eisenmann, et al., 2013).
Acquiescence bias	Arises when customers or respondents give answers they believe align well to what the entrepreneur is looking for or wants to hear (Eisenmann, et al., 2013).	Avoid "yes/no" questions by carefully wording the questions to elicit better feedback. Respondents should be asked questions that are not speculative. Rather, questions should be focused on the past and present behaviour (Eisenmann, et al., 2013).

2.5 Limitations of LSM

LSM as a hypothesis-driven approach is applicable in a range of scenarios even in established organisations with plenty of financial resources at their disposal (Ries, 2011; Eisenmann, et al., 2013). As some research work will show, there are some situations in which LSM cannot be adequately applied due to limitations. Several situations which may limit the methodology include but are not limited to (Eisenmann, et al., 2013):

- When the need to limit mistakes takes precedence in the development process.
- When customer demand will likely be high from the onset i.e. low uncertainty in demand.
- When product development cycles are long and therefore make early iterative product launches infeasible.

When mistakes must be minimal

In as much as LSM is centred on hypotheses and learning from mistakes (Ries, 2011), start-ups may operate in harsh environments in which mistakes may be detrimental. Product-specific limitations do arise in the form of inability to correct mistakes post-product launch when mistakes would render the product unusable by customers and when there is legal intolerance to mistakes (Eisenmann, et al., 2013).

As an example, Eisnenmann et al. (2013) express that interplanetary space equipment once launched there is no way to fix design mistakes in which case designers rely on contingency planning than on early iterative experimental launches in the case of LSM.

As another example, the development of new pharmaceuticals using clinical trials on human subjects requires strict protocols. This makes early launches of unpolished products impossible from a legal perspective (Eisenmann, et al., 2013).

When customer demand is high

When an entrepreneur is building a new product to solve for a very strong unmet demand, customer feedback becomes less relevant. In such a case, entrepreneurs can still use LSM to test different ideas of the product without having to launch early and often to gather data on customer demand as it is already validated (Eisenmann, et al., 2013).

When product development cycles are long

Long product development cycles are characteristic of big engineering projects in which case launching early and often becomes impossible. Moreover, if the product is innovative and requires engineering breakthrough, and demand certainty is low LSM becomes inapplicable. Customer reactions would only be measurable accurately once a breakthrough is made and a working prototype is developed (Eisenmann, et al., 2013). Gustasfsson & Qvillberg (2012) showed that long lead times and high cost projects render LSM inapplicable as iterative launches become infeasible.

In this case, other product development methodologies like the Waterfall Method may be more applicable.

2.6 Critical analysis of LSM

As noted by Dane and Yorke (2014), LSM coupled with tools such as Customer Development is gaining significant traction as one of the entrepreneurial approaches. Leading universities such as Stanford University and Massachusetts Institute of Technology have introduced this methodology in their entrepreneurship curriculum. In addition, LSM is being adopted in larger companies for intrapreneurship (Karlsson & Nordstrom, 2012), in diverse industries such as manufacturing (Blank, 2013), and healthcare (Silva, et al., 2013). Despite this traction, LSM is by no means flawless. There is a paucity of literature that

criticises the methodology. In this section, an attempt is made to collate enough evidence from literature to reveal the potential pitfalls and risks associated with LSM. This aims to foster an understanding of the methodology from opposite views.

Ladd (2016) studied 250 teams which participated in an American accelerator program and proved that LSM can be effective. However, Ladd (2016) asserts that while running market tests is beneficial to the entrepreneur, having a solid business strategy is more important in creating a successful startup. The research found out that teams that tested hypotheses about their business performed three times better than teams that neglected to test any hypothesis. The yardstick used to determine success was how teams performed in a pitch competition before industry experts at the end of the program. Ladd (2016) found out that there is no direct relationship between the number of hypotheses tests conducted and a startup's success. Teams that conducted interviews and more structured experiments with customers did not perform better than teams that only used one of the two approaches in the early business model design phases. Hence, Ladd (2016) concluded that more market feedback and validation is not contingent to the success of a startup. This is because more customer feedback may erode the confidence of the entrepreneur in the idea. Although feedback is necessary, beyond a certain threshold it yields diminishing returns to the start-up (Ladd, 2016).

Ladd (2016) points out the potential pitfall of LSM of yielding false-negative results. This results in invalidation and rejection of potentially viable ideas as LSM lacks structured rules for the entrepreneur to successfully validate the business idea, stop hypotheses testing and shift focus to scaling production (Ladd, 2016; Eisenmann, et al., 2013).

To solve this problem Ladd (2016) suggests a go/no-go decision threshold of 50% of the customer sample paying for the early MVP. If certain tests do not result in major alterations of the business model, then such aspects can be locked and treated as valid (Ladd, 2016).

The research found out that teams that focused on validating their assumptions on the triumvirate of customer segment, value proposition, and channel were poised for better performance –twice as much – than teams that neglected to focus on these three categories of the BMC (Ladd, 2016). Consistent with Ries (2011, p 271) - *"the Lean Startup is a framework, not a blueprint of steps to follow"-,* Ladd (2016) advises against the dogmatic application of LSM. Instead, LSM should be applied with reflection and consideration of constraints that are idiosyncratic to a business idea.

Anthony (2016) weighs into the LSM discussion and opposes extreme views from some LSM practitioners who argue that the only way to learn is through MVPs and market tests. This view suggests that research and objective thinking are of no value, which is not completely true. According to Anthony

(2016), any initial business strategy is partially wrong, but this does not rule out the thinking that went into the business model. The thinking will be partially right as well. Good innovations are a result of research which opens up the entrepreneur to formulating robust hypotheses that maximise the learning from the market tests. These views are in line with Felin, et al. (2019) who argue that LSM lacks robustness in the theory of value that the entrepreneur must bring into the market. Research on the market dynamics before tests can help the entrepreneur to avoid unnecessary tests. However, a balance is required to avoid over-engineering the business plan (Anthony, 2013).

LSM approach to hypothesis testing falls under the Bayesian approach to decision making. Bayesian decision making approach seeks to maximise the subjective expected utility out of an outcome among possible outcomes (Seidenfeld, 2001). In this case, the entrepreneur sets hypotheses, identifies data sources, gathers, and analyses data. Based on the data analysis, the hypotheses are either validated or invalidated setting a course of action as dictated by the evaluation. The goal is to make objective data-driven decisions, in which case the entrepreneur is aiming to deliver a product that is aligned well to the expectations of the customers. However, Bayesian decision making requires data in sufficient amounts which the entrepreneur may not be able to locate or data collection is simply infeasible (York & Danes, 2014).

York and Danes (2014) argue that the customer development process of the LSM is not rigorous enough as compared to scientific hypothesis testing which is solidly rooted in statistical approach. Formal hypothesis testing models follow a logical and systematic approach. Decision making, in this case, is based on hypotheses statements, testing of hypothesis, and verification of hypotheses based on data. Against this backdrop, York and Danes (2014) view the customer development process as based on informal and intuitive thinking lacking rigour. In the early stages, LSM relies on customer involvement, talking to experts and product users as means of validating hypotheses about the perceived problem. Informal hypothesis testing as applied in this case is therefore susceptible to biases which limit accuracy (York & Danes, 2014).

Yoo et al. (2017) developed a theoretical formalisation which investigates the effectiveness of LSM. Focus was placed on the effectiveness of MVPs in the LSM process. Despite the acceptance LSM is gaining in entrepreneurship and academic curriculums, there is lack of scientific evidence of the effectiveness of the methodology (Yoo, et al., 2017).

According to Yoo et al. (2017), this presents two concerns of importance. The first concern addresses the implementability of LSM to get maximum benefits out of it. Research has shown that practitioners find it challenging to elicit meaningful feedback through early MVPs (Hokkanen, et al., 2016). Consequently, the LSM practitioner will have difficulties in progressing from the MVP to the final product

that meets the needs of the customers (Dennehy, et al., 2016). LSM does not spell out guidelines that point to which MVP version should be developed. Generally, a minimum viable product has a connotation that the lower the quality of the MVP, the better it is in learning about the market. The second concern is that it remains unclear how LSM is applicable in different settings. According to Teece et al. (2016), LSM is largely applicable where customer feedback is rapidly available and learning is achievable, product development costs are low, and capital commitments are not reversible. For instance, LSM is less relevant in the aircraft and automotive industries due to the nature of the products (Teece, et al., 2016). When competition is closely monitoring an entrepreneur's innovation, LSM becomes less suitable (Mihm, et al., 2015; Yoo, et al., 2017). Yoo et al. (2017) argue that even in settings where LSM seems to be applicable it is not always the case that the entrepreneur will derive benefits from the methodology.

Yoo et al. (2017) managed to address the two concerns discussed above by means of a mathematical model based on the spatial differentiation model. This mathematical model treats customers as heterogeneous in horizontal preferences or tastes. To learn about the different customer tastes the entrepreneur uses a version of an MVP with a determined quality. Based on the MVP sales outcome, the entrepreneur decides in a Bayesian manner whether to fully develop the product or pivot (Yoo, et al., 2017).

Firstly, an analysis of the model reveals that the entrepreneur should decide on the choice of MVP and its quality and launch a product he/she believes is closest to the ideal product. The study also found out that LSM is less beneficial to an entrepreneur who has a strong prior belief about the product (Yoo, et al., 2017). In this case, the entrepreneur finds it undesirable to learn about the market. According to Yoo et al. (2017), an MVP of intermediate quality reveals the most information about what customers want. The vertical quality of the MVP maximises the learnings about customers and benefits to the entrepreneur. In general, a high quality MVP captures the entire market (i.e. the MVP sells), whether the MVP is the ideal product or not. The opposite is also true i.e. the MVP does not sell (Yoo, et al., 2017). This is contrary to the general belief that an MVP should be of low quality for facilitating learning about the market as pointed out earlier.

Secondly, the model shows that the product-market environment has a bearing on the benefits of applying LSM. Yoo et al. (2017) advance the thinking that in some cases the entrepreneur can optimally implement LSM (i.e. right choice of MVP and optimal quality) and benefit marginally. In other cases, a high-quality MVP needs to be deployed else the benefit of applying LSM will be non-existent (Yoo, et al., 2017). Additionally, Yoo et al. (2017) emphasise that LSM is not a general panacea for all product concept decisions entrepreneurs face. According to the study, LSM is not recommended when dealing

with low innovation products or where minimal differences exist between product designs, where its benefit will be minimal (Yoo, et al., 2017).

Another school of thought argues that not every startup should be a lean startup or implement pivots. Andreessen (2012) argues that start-ups with audacious goals (innovative, ground-breaking products) need to start audacious else they risk never putting the product into the market. By using Elon Musk's ventures as examples, Andreessen (2012) explains that for such projects an entrepreneur cannot implement them on a small scale. Against this background, startup investors are advised not to be hesitant to invest in such innovative ideas (Andreessen, 2012).

LSM can be interpreted wrongly to be condoning failure and misleading entrepreneurs into giving up early on ideas after failed MVPs. Andreessen (2012) warns against developing a "fetish for failure" and respects entrepreneurs who persevere until their business models work i.e. not every startup needs to constantly pivot. The other challenge Andresseen (2012) sees with LSM is that it may be used as an excuse. Entrepreneurs will tend to focus on the product only while neglecting sales and marketing functions (Andreessen, 2012).

Horowitz (2010) argues against LSM and rather advocates for the "fat startup". The argument hinges on two core priorities for any startup: 1. Creating the market for the product and 2. Not running out of financial resources. Horowitz treats running fat or lean as just strategies to win in both of the two priorities. Therefore, applying LSM or running fat are not ends in themselves. Horowitz (2010) warns that by making LSM an end, the entrepreneur risks not winning the market. This could be due to failure to fund the activities to achieve product-market fit or simply get out-manoeuvred by a competitor in the market. In certain cases, running fat is the right approach. The entrepreneur must employ the right strategy that results in achieving the two priorities and a high-growth company. According to Horowitz (2010), the opposite will be startup purgatory in which case a start-up does not run out of cash but also fails to achieve the right product-market fit. In this case, the business ends up as a small business (Horowitz, 2010).

2.7 Startup development and challenges faced

The value of business plans cannot be underplayed as it has some critical implications on startups. Chwolka and Raith (2012) researched on the impact of business planning on start-ups with a particular interest in opportunity evaluation before market entry to a rational (values planning) and nascent (does not value planning) entrepreneur. Findings suggest that business planning does not assure future performance and that planned start-ups do not necessarily outperform unplanned start-ups. The conclusion is that planning is evaluative, and the value of planning is contingent on the quality of planning and nature of the business venture or startup. Business planning affects the decision to enter

the market or not. Less than perfect planning cuts the number of startups that launch thus naturally reducing the number of start-ups that fail as some will not be launched based on information in the business plan (Chwolka & Raith, 2012).

As future performance is not guaranteed, once the decision to enter the market is reached it is critical to find the best way possible to overcome hurdles and minimise the risk of failure in the quest for a sustainable & scalable business model.

2.7.1 Hurdles to scalability

In the paper titled *"From Start-up to Scalable Enterprise"*, Picken (2017) highlights eight hurdles start-ups should clear on their road to scalability. Six of the hurdles draw attention and are briefly outlined below:

Setting direction and maintaining focus: The entrepreneur must understand the operating environment and establish clear goals and strategic priorities that lead the start-up to growth (Picken, 2017). The entrepreneur must address value creation and value capture. Value creation must address customer needs at a cost that customers are willing to pay for in relation to perceived value, while value capture must address the needs of the stakeholders in terms of sales and profits (Slack, 1999). The underlying business model must be validated detailing sales channels, distribution, product support, processes, and partnerships that make it work (Johnson, et al., 2008).

Positioning products/services in an expanded market: Understanding the requirements of the startup's initial customers (early adopters) is critical to market entry (Aulet, 2013). The dynamics of this relationship change as the startup expands geographically and moves into the mainstream market. The startup ought to reposition its product or service iteratively to satisfy the broader market (Picken, 2017; Moore, 2001).

Maintaining customer/market focus: As the start-up grows and functional silos are established, the informal instantaneous feedback between customer service and product development breaks down. Customer and quality issues may take longer to fix. This can be resolved by establishing customer-centric processes and focus from the top to the bottom of the organisation (Picken, 2017).

Managing risks and vulnerabilities: Startups are vulnerable to disruptions that include inherent risks such as technical risks (does the product work? Is it scalable?), competition and execution risks (does the start-up have skills and experience to achieve scalability) (Picken, 2017). Risk sources could be imposed by lack of experienced human resources, rapid growth or lack of infrastructure among others (Simons, 1999).

Building financial capability: It is critical for the entrepreneur to ensure efficient utilisation of the investment funds for the long haul. As start-ups operate under extreme uncertainty, significant investments should be limited until key milestones and validations are in place (Picken, 2017).

Building the team & the organisation: Building the team and the organisation that supports the startup into a full scale establishment remains one of the critical tasks for the entrepreneur (Picken, 2017). In addition, the task of leading the new venture lies on the founders leading the start-up to a typical shared leadership model in most cases where each member takes part in providing leadership to the startup (Bryant, 2004; Ensley, et al., 2006). Transitioning to a full establishment will require new structures and processes to ensure communication & decisions are not jeopardised, therefore, threatening the success of the transition (Picken, 2017).

It is against the backdrop of risks associated with start-ups that this research is based. This research will explore LSM implementation as digital entrepreneurs at InnoCentre search for scalability. Without scalability, revenues dwindle, and the start-up will eventually fail. The survival of a start-up is hinged on the ability to commercialise a new product (Girgenti et al, 2016), in the mainstream market. This task is, however, complex and the outcome is uncertain (Moogk, 2012).

2.8 Similar studies

Similar selected studies on LSM implementation are presented below highlighting possible challenges and key learnings in different contexts.

InCorp manufacturing startup case study

Gustafsson and Qvillberg (2012) researched the barriers of LSM in a manufacturing startup called InCorp. The company manufactures industrial machines and develops processes for a B2B market. The researchers compiled LSM principles into sets and implemented them in a manufacturing company in a case study. The research entailed keeping a diary of all the LSM activities, reflections, and observations throughout the process. Semi-structured interviews were used to collect a significant portion of the data internally from participants involved in LSM implementation. Telephonic interviews were conducted to collect feedback and customer needs. Most of the data were generated through diary keeping. Data were analysed by grouping experiences under themes structured according to main LSM principles.

The findings suggest that barriers related to four LSM principles could potentially hinder the smooth implementation of the methodology. The principle of rapid iteration could not be effectively implemented as customer feedback could not be retrieved fast enough from potential clients.

Pivoting proved difficult to implement as customer feedback showed that the product only offered minor performance improvements and did not solve a big enough problem to stimulate interest. LSM demands a solution that solves a big enough problem which results in a scalable business. As customers needed customised solutions, a single solution could not be found which would satisfy most customers.

The other challenge observed was that the company could not develop a minimum viable product fast and cheap enough due to the complexity of the product. A stripped-down version of the product was simply not feasible as it would affect its reliability and quality.

The research concluded that early customer consultations are critical. This aids in maximising learning instead of focusing on selling in the early stages of the LSM process. The research asserts that an MVP strategy may not work with some physical products associated with high costs and long lead times. Thus, LSM is influenced heavily by the nature of the product. In this case, identifying an early market product fit is recommended (Gustasfsson & Qvillberg, 2012).

Flopfile Software start-up case study

Warberg and Thorup (2015) deduced that there could be potential technical issues when implementing LSM in software engineering. LSM theory was analysed from a software development perspective. Although LSM has been hailed in the industry, critics say the methodology does not cohere with modern software practices.

The researchers introduced a software engineering startup, Flopfile, to LSM. The Danish startup was looking for ways to increase its likelihood of success in the market. All key events during the implementation process were recorded in a research journal in observation sessions. Informal questions were asked in the observation sessions to understand the reasons behind the initiatives the software engineers implemented. Semi-structured questions were used to get qualitative feedback from the employees to gather up any technical challenges they were facing in LSM implementation.

Data analysis entailed coding which grouped the data into predefined categories. The research concluded that when LSM is applied in software development startups two issues can possibly arise. These are (Warberg & Thorup, 2015) :

1. LSM is not aligned with proper software architecture and can lead to waste.
2. Application of LSM can hinder innovation in software development activities.

Out of these issues, the research concludes with key guidelines for LSM in software engineering summarised below:

Guideline 1 – Minimising waste in software development: Start-ups are unpredictable and often call for radical changes. In software engineering, this may lead to significant reworking or scraping of code. To reduce that unpredictability, Warberg and Thorup (2015) suggest that in order to cut down waste in line with LSM, decisions should be delayed until enough information about product requirements and software architecture has been gathered to reduce the impact of changes. Hence, a software startup should only build a functional MVP when it is justifiable to start expending resources and coding. Inexpensive mock-ups and basic wireframes are suggested as preliminary MVP tools to be used to collect empirical data from potential customers. The expected result is that once the functional MVP is coded, subsequent changes should result in less rework or scrap thus achieving leanness (Warberg & Thorup, 2015).

Guideline 2-Innovation as a development activity: Focusing on rapid development and iteration as the number one priority in startup phases can potentially be traded off with innovation. This is detrimental to a startup as opportunities of creating an extra competitive edge can be missed out. The rapidity of LSM and innovation should both be prioritised. Innovation should be treated as a development activity in the learning and idea phases of the LSM BML loop (Cohn, 2014). The startup team should create specific activities which drive innovation to be performed by the whole development team. Expectations are that innovative ideas and solutions can be created faster as the multiple team views are involved in the innovation activities. The team will be aligned better on all aspects of the development process thus understanding the product as a whole (Warberg & Thorup, 2015).

Experimentation in product development

A similar study was conducted in Finland with ten software companies at different life-cycle stages to understand experimentation, key challenges, and success factors for experimentation. It must be noted that the researchers, Lindgren & Munch (2016), looked at experimentation as a broad concept. Some of the work reviewed by the researchers are different experimentation approaches including some which borrow principles from LSM. For example, Fagerholm, et al. (2014) proposed a framework that hinges on the BML loop from LSM to come up with a continuous experimentation framework for value creation. It is within this context of several experimentation approaches which the subjects used to build their software products.

The qualitative study revealed that software companies following experimentation approaches face challenges in aspects such as product/iteration release speed, organisational culture, technical issues,

data availability and sharing, and data analysis among others (Lindgren & Munch, 2016). Not surprisingly, funding emerged as a challenge as well (Lindgren & Munch, 2016).

Lindgren & Munch (2016), identified technical tools and competence, organisational culture, customer knowledge, and product release cycle speed as CSFs for continuous experimentation in software development.

Although different experimentation approaches are being implemented, the practice has not filtered through sufficiently within the software industry according to Lindgren & Munch (2016). The research also points out that although data is collected, the processes are not systematic enough to collect objective learnings from the customers. Product usage data is reported to remain untapped to inform future product improvements (Lindgren & Munch, 2016).

LSM in large software companies

Edison et al. (2017) studied the implementation of LSM in large software companies to determine its impact on product innovation and to find enablers and inhibitors for startups within established companies. The adoption of LSM in large companies has been growing in the last few years but there is limited empirically grounded literature around its application in established organisations (Edison, et al., 2017).

This study found out that organisational structure and culture, technical knowledge, human resources, and the level of customer orientation the business affords, inhibit lean internal startups. The researchers argue that policies and guidelines within large organisations slow down startups in product development. Additionally, also teams can be caught up in competing priorities between satisfying current customers and working on future-long terms goals as represented by the purpose of the internal startup (Edison, et al., 2017).

On the other hand, leadership that supports strategic innovation, coaching and training, and human resources geared for internal collaboration were found to be enablers. Management should support internal startups by ensuring resources and budget are secured together with protection from strategic changes in the business (Edison, et al., 2017).

The research points out the need for similar studies in the form of comparative research between LSM in large and startup companies (Edison, et al., 2017).

2.9 Conclusion

Many researchers have studied LSM in different contexts but none has come close to researching on the methodology in the context of the CSFs of the methodology in digital innovation startups. Literature

is quite exhaustive on discussing why LSM is a game-changer in new product development. There is, however, a gap in studying the factors that actually make the methodology work well to develop new products or as a framework to develop digital innovation startups. This research attempts to fill this gap by looking into the key factors that are critical to the successful implementation of LSM in developing digital innovation startups. It is the setting of the research that dictates its uniqueness and contribution to the body of knowledge since it focuses on startups in the defined digital space. This is unlike related work which looks at LSM in the context of startups, scaling, and established businesses. The premise of this research is that there are critical success factors that are idiosyncratic to this particular setting which makes the research of particular interest to contribute to ongoing research around LSM.

The study conducted by Edison et al. (2017) also points out to future comparative research between business life cycle stage, established and startups. The goal of this research is to understand the implementation of LSM in digital innovation startups as an effort to get empirically grounded findings which can be juxtaposed with other research efforts in other contexts for similarities of CSFs or other related aspects.

3. RESEARCH METHODOLOGY

3.1 Introduction

The Research Methodology chapter discusses the design of the research approach and methods, spelling out the reasons for the implemented approach. Potential areas of weaknesses and measures to maintain the integrity of the study that were put in place are presented. The approach used for data collection and analysis is discussed to give the reader a clear understanding of how data were manipulated, and how findings were synthesised into insights.

3.2 Research design

The research was done entirely within the confines of InnoCentre. Due to the setting of the project and research question, a case study research method was followed. A case study is an empirical approach to investigating contemporary phenomenon in depth and within the real world context. In particular, the research employed a single case study with embedded multiple cases within it which allowed for a complete and in-depth study of the LSM implementation process by different startups from start to end including the classroom sessions where LSM was taught (Yin, 2014). A case study allows the researcher to develop a full understanding of the case as a general objective of the methodology (Punch, 2005). Verschuren (2003, p128) views the case study approach as a *"holistic rather than a reductionistic approach"*. Verschuren (2003) further points out that a case study is a research strategy that avoids tunnel vision and makes use of analytical comparisons between cases or sub-cases with the aim of describing and explaining complex real world phenomena. This view is consistent with what Yin (2014) highlights, that a case study takes place within real world settings.

These scholarly views demonstrate the key advantage of a case study method in doing research and why it may be a preferred method depending on research setting and research questions (Yin, 2014).

3.2.1 Tackling concerns about case study research

The case study method is a distinctive empirical enquiry to research, which some researchers disdain for different concerns (Yin, 2014). Below are two main concerns that critics of the case study method raise. Measures to deal with these concerns to keep the integrity of the research intact are presented.

Rigour

There is a presumed need for much tighter rigour when conducting a case study. Often, researchers do not follow systematic procedures in executing the research. Another threat is the use of equivocal evidence to influence research findings and conclusions (Yin, 2014).

To abate these potential risks great rigour was exercised, firstly, in designing the case study procedures by operationalising the steps into a coherent and systematic methodology, which is easily repeatable (Yin, 2014). Secondly, all research activities were conducted in strict adherence to the case study procedures designed for this research. In interpreting and presenting the results, great care was exercised in supplying unequivocal evidence as will be shown in the Results chapter to meet research objectives and fully answer the research question.

Generalising case study findings

According to Yin (2014), there are concerns about the generalisability of case study findings, particularly from single case studies. Other approaches like surveys use representative samples to deduce statistical generalisations about a population. On the contrary, a case study design seeks to make analytic generalisations that have broader application. Case study design aims to achieve a generalising analysis and not a particularising analysis (Yin, 2014). Stake (2005) weighs in on the case study design as a bound study whose outcomes are meant to be assertions. This implies that factual findings from the study can have broader and far-reaching implications outside the case study.

The objectives of this study are well-positioned to address this concern since the research focuses on developing analytic generalisations to obtain key learnings in the application of LSM in developing digital innovation start-ups.

3.2.2 Case study research design components

A case study research design typically consists of five components. These are (Yin, 2014):

- Research question.
- Propositions, if any – a proposition directs attention to a specific area that should be studied within the scope of the study.
- Unit(s) of analysis – defines the case and aspects to be studied.
- The logic which links data to propositions.
- Criteria for the interpretation of findings.

Table 2 below summarises the components of this study.

Table 2: Case study design components

Research design component	Description/Comments
Case study's question	What are the CSFs for successful implementation of the Lean Start-up Methodology in digital innovation start-ups?
Propositions	1. For LSM to be beneficial to the practitioner certain minimum requirements need to be met in the process for the methodology to be successfully implemented resulting in either a scalable business or successful invalidation of the business idea. 2. The depth of LSM is not properly understood locally with practitioners in the digital innovation space limiting practice to a small number of the concepts the methodology represents.
Unit(s) of analysis - the "case"	**Case:** InnoCentre **Sub-units of analysis:** Each start-up forms a sub-unit of analysis. Additional sub-units of analysis are derived from LSM facilitators and the content taught in class. All these sub-units of analysis form the data points that inform the evidence collection procedures and analysis.
Logic linking data to propositions	Data addressing each of the propositions is matched accordingly in the Discussion chapter. The same approach is implemented to address the research objectives.
Criteria for the interpretation of findings	Coding of qualitative data into themes using QDA Miner Lite software (thematic content analysis) will provide dominant themes i.e. CSFs. Findings are ranked based on the cumulative frequency of themes across the wide array of qualitative data collected.

3.2.3 Type of case study design

Yin (2014) recommends a case study approach to follow a formal design although it is possible to proceed without one. A formal design makes the case study stronger and easier to execute (Yin, 2014). The case study design follows one of the four types depicted in Figure 9 below.

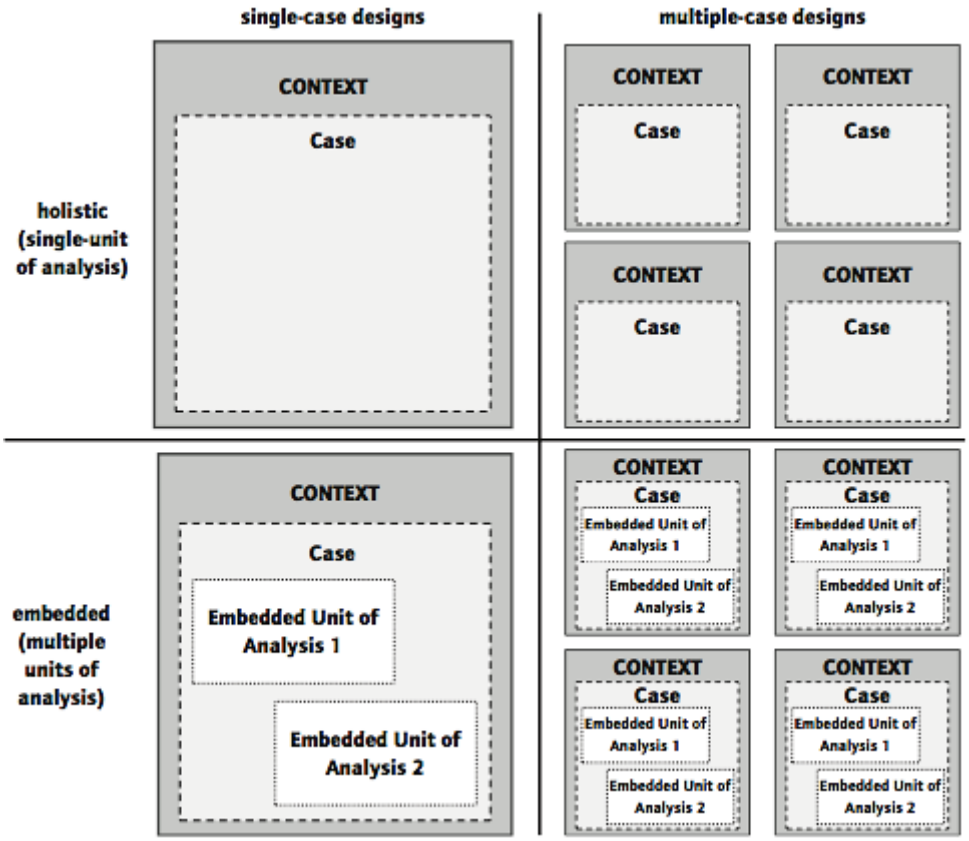


Figure 9: Types of case study design (Yin, 2014)

The study included several identified digital start-ups all falling under InnoCentre as the unit of analysis. Therefore, a single case study method was adopted. Each start-up or facilitator counted for a sub-unit of analysis. The design can be thought of as a *single case design with embedded units of analysis* represented by the bottom left quadrant in Figure 9. This research design facilitated an in-depth understanding and examination of the LSM implementation process to yield more robust analytic conclusions (Yin, 2014).

Case studies are prone to slippage in which case a research design no longer addresses the research question(s). Slippage is caused by a shift in the nature of the case study. The embedded case study design addresses slippage by having sub-units of analysis thus paving a way for an extensive empirical enquiry (Yin, 2014).

Yin (2014) warns against giving too much focus to the sub-units and failing to integrate them into the big case. The structure of the research design ensured that overcommitment to any of the sub-units is limited as all consenting sub-units were interviewed in a uniform manner. Almost the same questions, with variations where necessary, were used to get the interview discussions flowing. This ensured each sub-unit had equal representation in the data collection phase.

As highlighted before, the case study method does not seek to arrive at statistical generalisations but analytic generalisations. In as much as the case design is limited to InnoCentre digital start-ups and the LSM facilitators for 2018/19 program, this study will come up with analytic generalisations (key learnings) which apply to digital innovation start-ups and possibly beyond. Hence, the embedded single-case study design suffices as its context is wide and the array of evidence is quite extensive.

3.2.4 Quality of the design

A research design must be able to deliver logical statements when executed. The quality of a research design can be measured by several logical tests. The commonly used four tests are (Yin, 2014):

Construct validity

Deals with setting up the correct operational measures which the study will investigate. The potential pitfalls that the construct validity seeks to address are that a case study design may lack rigour in operational measures and may be susceptible to subjectivity in data collection methods (Flyvberg, 2006; Ruddin, 2006). Therefore, a case study design, which has correctly defined operational measures and lacks subjectivity, meets the test of construct validity. Yin (2014) proposes three measures to deal with construct validity issues. These are: the use of multiple sources of evidence, the establishment of a chain of evidence during data collection, and availing the study report for review by key informants (Yin, 2014).

Internal validity

Internal validity looks at the establishment of causal relationships where certain identified conditions are believed to result in certain conditions. This is the main concern for exploratory studies which seek to explain causal relationships. For instance, a researcher may wrongly articulate a relationship between only two factors, yet there is another third factor which affects the relationship which is unaccounted for. Descriptive and exploratory studies are not affected by this threat. According to Yin (2014), a case study research employs inferences for events that could not be directly observed. Based on collected evidence, a researcher will make an inference that a particular event is a product of some preceding occurrence. This raises questions on the validity and correctness of the inference thus affecting the internal validity of the case study research design (Yin, 2014).

External validity

Refers to the applicability of the research findings beyond the study. This particularly refers to analytic generalisation and statistical generalisation aspects of dealing with the study's findings (Yin, 2014) as discussed before.

Reliability

Reliability, according to Yin (2014), refers to the repeatability of the study's procedure over the same study by another researcher to produce the same findings and deduce the same conclusions. Yin (2014) places focus on repeating the same case following the same method and not necessarily the replication of the same results. Reliability in research method design is meant to reduce errors and biases in research. The use of a case study protocol to document the procedures and a case study database are recommended tools to operationalise the steps to meet the reliability mark (Yin, 2014).

Table 3 below summarises these tests and how this research was structured to satisfy the expected level of quality in line with established standards for case study research.

Table 3: Research design quality & measures to improve research quality (Yin, 2014)

Test	Summary of test details	Measures to meet the test
Construct validity	Deals with identifying the right operational measures for the aspects to be studied.	To maintain construct validity, the draft case study report was availed for review by key informants for accuracy. In this research, key informants are LSM facilitators and founding team members for each of the start-ups. Multiple sources of evidence are used i.e. observations, interviews with entrepreneurs and one-on-one in-depth interviews with the LSM facilitators.
Internal validity	Applies to explanatory and causal studies which seek to establish causal relationships whereby certain conditions supposedly lead to other conditions.	Use of logic models which show the relationships of data and events over time.
External validity	Focuses on establishing the generalisability of study findings beyond the scope of the immediate study. For case studies, this relates to analytic generalisation.	Use of related theory to explain findings and use of replication logic.

Test	Summary of test details	Measures to meet the test
Reliability	Refers to the repeatability of the case study procedures on the *same* case to produce similar findings and conclusions by a different researcher. The objective of reliability is to minimise errors and biases.	A case study protocol was developed and used to document the research execution process accurately as was done in the study. All research steps were operationalised in the case study protocol for ease of repeatability.

3.2.5 Case study protocol

According to Yin (2014), a case study protocol is a major approach that increases the reliability of a case study enquiry. It provides guidelines, procedures, and general rules on how the researcher will conduct data collection. Following a case study protocol is recommended under all circumstances more so for multiple case studies (Yin, 2014).

A case study protocol contains guidelines, procedures, and the instrument(s) for data collection (Yin, 2014).

A case study protocol is composed of four major sections: a case study overview, data collection procedures, data collection questions, and a topical guide for the case study (Yin, 2014). However, in this study, a topical guide was deemed not to be necessary given the size of the case study.

3.1.5.1 Data collection procedures

A case study approach requires the researcher to study phenomena in their real world context. It is critical to merge the events and data collection procedures as no control is assumed over the data collection environment (Yin, 2014).

The research involved the collection of sensitive data from human subjects and InnoCentre as an entity. As such there was a need to obtain informed consent from InnoCentre and every other prospective participant in the research. An ethics clearance certificate was obtained through the University's Ethics Committee (clearance number: H18/06/43).

Data collection took place in two distinct settings to enrich the array of evidence from which to draw conclusions from (Yin, 2014). These are: observation of content taught in the classroom environment, interviews with facilitators, and interviews with co-founders of the startups. Table 4 below summarises the key data collection activities for each of the data sets.

Prior to beginning data collection for the classroom session, each LSM facilitator read the participant information sheet which explains the purpose and scope of the study. Informed consent was then subsequently obtained if the participant agreed to the request for observations to be done, by signing a consent form. Samples of the information sheet and consent form are provided in Appendices B and C. This procedure was repeated for each of the classroom sessions observed even if the LSM facilitator had agreed to other previous sessions in the past. There was no need to obtain informed consent from the entrepreneurs, as observations were limited only to content and not the participation or engagements of the entrepreneurs.

Similarly, for one-on-one interviews conducted with the LSM facilitators, informed consent was obtained after a participant would have read and understood the information sheet. The consent form requested permission for an audio-recorded interview or alternatively permission for an interview where notes of important points were recorded in a notebook. Samples of the participant information sheet and consent forms for this category of participants is included in Appendices D and E.

For focus group interviews, all participants read the participant information sheet and the consent form before granting consent. The consent form requested the participants for an audio-recorded focus group interview. In the event that at least one participant did not consent to audio recording, a provision was in place to record notes in a notebook. See Appendices F and G for samples of the participant information sheet and consent forms.

Focus was placed on ensuring that participants find the conditions to participate favourable to boost response rates.

Table 4: Data collection activities and data sources

Data set	Key data collection activities	Comments
Observations	• Sitting in classroom sessions as LSM facilitators delivered training on different building blocks of LSM. • Taking notes.	Data collection entailed attending and observing LSM classroom sessions for entrepreneurs at InnoCentre. This activity was aimed at understanding the content and concepts that are taught prior to entrepreneurs going out to apply them in developing their business ideas. Other key observations were noted in a research journal throughout classroom data collection sessions (approach adapted from Warberg & Thorup, 2015). Observations were conducted between April 2018 and April 2019. The researcher attended 37 sessions following the schedule of the classroom sessions as advised by InnoCentre admin.

Data set	Key data collection activities	Comments
Interviews (one-on-one)	• One-on-one interviews with LSM facilitators. • Audio recording of interviews or taking down notes.	Only participants who consented to an audio-recorded interview were recorded. Otherwise, the feedback was written down.
Focus group interviews	• Discussing the LSM implementation process with each of the consenting start-ups. • Audio recording or taking down notes.	Only those participants who consented to an audio-recorded focus group interview were recorded. If at least one of the participants in the focus group did not consent to audio recording, a provision was provided to still continue with the interview and take notes.

3.1.5.2 Interview guidelines – for individual participants and focus groups

The research design followed established guidelines for conducting the interview component of data collection. A qualitative design should collect data, which models a very complex world scenario, from participants "on their own terms" (Brenner, 2006). As such, to maximise data collection the following interview principles were followed as adopted from Yin (2016).

Maintaining a modest amount of speaking

A decent conversation needs to be maintained although fewer words are to be used. The interview sessions are recommended to follow a normal conversation and be less interrogative (Merriam & Tisdell, 2016). Questions that yield "yes/no" answers were strictly avoided opting for extended monologues to get more insights and rich data. Judicious use of probes and follow-up questions was exercised to keep conversations going thereby maximising on insightful but less detailed responses (Yin, 2016).

Assuming a non-directive role and maintaining neutrality

The researcher should set interview boundaries while at the same time permitting the interviewee to follow their own sequences of thought. As a result, the researcher can gain access to the most important thoughts from the participant's experiences (Yin, 2016). In this research, the boundaries were set around digital innovation and the experiences of the participants in implementing LSM. This applied to LSM facilitators too who have experience in digital innovation entrepreneurship using LSM both at InnoCentre and elsewhere.

To maintain neutrality, every effort was made to ensure that voice tone, mannerism, and other interpersonal body language signals did not contain an approving or disapproving undertone to the responses of the interviewees. This was an attempt to ensure that no biases or preferences to responses

were cast on the interviewees (Yin, 2016). Nevertheless, the risk of biases and bringing in own viewpoints remains as qualitative research occurs in natural settings. It is critical to be aware of and avoid extreme biases that may reduce the data collected to a "negotiated text" (Fontana & Frey, 2000). Any biases that could potentially affect the data should be revealed and discussed in terms of how they affect the findings (Yin, 2016). These potential sources of bias will be discussed in Chapter 5.

Maintaining of rapport

This is quite interpersonal and requires the researcher to create an environment that makes it easy for the participant to share their experiences. Hateful words, private topics or anything that makes the participant uncomfortable and aggravated should be avoided (Yin, 2016). In the interviews, this guideline remained critical throughout to ensure that the interview sessions remained professional and yet allow getting to the core matters and insights as subtly as possible thereby enhancing data quality (Wilkerson, 2007).

Using an interview guide

This tool contains a limited subset of keywords which the interviewer puts down on a small piece of paper. Each keyword might represent a topic which is relevant to the research. Probes and words, which point to follow-up queries, can also be noted down (Yin, 2016). It is important to note that according to Yin (2016), an interview guide is not a questionnaire or set of questions to be administered to an interviewee. The interview guide can be beneficial to the researcher as a conversational guide to aid in producing an interview conversation within the required parameters and scope (Rubin & Rubin, 1995). However, an interview guide was used as well as a draft of guiding questions to improve the flow of the interviews into a conversation. As a result, many LSM concepts could be discussed in the interviews.

3.1.5.2.1 General remarks

Focus group data collection method hinges on the fact that a researcher gathers participants who can attest to the same real world experience or are presumed to share common views. As such when interviewing such a group the researcher is recommended to act as a moderator (Yin, 2016). As a moderator, Yin (2016) recommends the researcher to get all members to express their views with minimal direction as consistent with the interview guidelines pointed out earlier on.

Focus groups provide the capacity to interview several people all at the same time (Yin, 2016). For this reason, the data collection method for this study was designed with that obvious advantage in mind. Loss of depth from each of the participants is the downside of focus groups (Yin, 2016). However, the other potential benefit according to Yin (2016) is that participants may tend to open up more in a group setting than they would individually. As a result, extra insights are obtainable (Yin, 2016). For those

participants that appeared to be reserved and passive, brief individual interviews were requested to supplement the data. Dominant participants were politely but firmly managed without biasing the group discussion in line with guidelines from Yin (2016).

3.1.5.3 Specific guidelines for audio-recorded interviews

The research design included a provision for audiotaped interview sessions designed to collect as much data as possible for detailed analysis. Audiotaped data have significant benefits in improving the quality of the fieldwork from a primary evidence perspective (Yin, 2016). Although audiotaped raw data can produce humongous quantities of information during review and analysis, including this data collection method in research improves the richness of the research and the quality of the findings (Yin, 2016).

The following guidelines stipulated by Yin (2016) for audio-recorded interviews were observed in the study:

- Obtaining consent from participants to audio-record the interview.
- Ensuring the use of the audio recorder remained unobtrusive to the proceedings of the session. This avoids distractions when the device malfunctions during the interview session.
- Ensuring the device works properly before each recording session.
- Ensuring recordings remain anonymous and no identifying information is discussed in the recording sessions.
- Conducting the interviews where background noise is limited. This improves the quality of the audio data.

3.1.5.4 Guidelines for Observations

The only guideline that was of importance to the study was ensuring that the observations took place without being obtrusive to the classroom sessions i.e. non-participant observation. By acting as a non-participant observer, the researcher reduces bias on the data collection as a general guideline (Yin, 2016). As the observation entailed only the content taught and not how it is taught or received by entrepreneurs, concerns about bias are highly limited.

3.1.5.5 Storage of research data

All data collected were kept safe and confidentially. The following measures were put in place:

- Audiotaped data were transferred from the audio recorder into a password-protected computer as soon as possible after each of the interview sessions. Care was exercised to create access password that is difficult to determine and keep theme securely as confidential data (Princeton University, 2019). As soon as this operation was done, the audio file(s) would then be deleted

from the audio recorder. Files were also immediately backed up online onto OneDrive (Microsoft password-protected online storage) for protection against losing data.

- Observation notes were typed into Word Online, which is hosted on OneDrive through a password protected online account. Typing the notes online ensured that they are secured from being lost.
- Other notes taken by hand into a notebook during interview sessions were scanned into PDF documents and backed up online into the same data repository.
- Consent forms containing personal identifying information (PII) were stored securely in a locked cabinet during the course of the data collection (Princeton University, 2019).

3.1.5.6 Data collection questions and interview questions

The core of the case study is comprised of substantive questions that direct the study's line of inquiry. These questions do not form a research instrument but are designed as guidelines to the researcher. Protocol questions point the researcher to the data that needs to be collected and the rationale thereof. The main function of data collection questions is to keep the data collection on track. As such, each question should be linked to a potential source of evidence (Yin, 2014).

Table 5 below summarises some of the data collection questions that this study followed.

Table 5: Examples of data collection questions used in the study for entrepreneurs

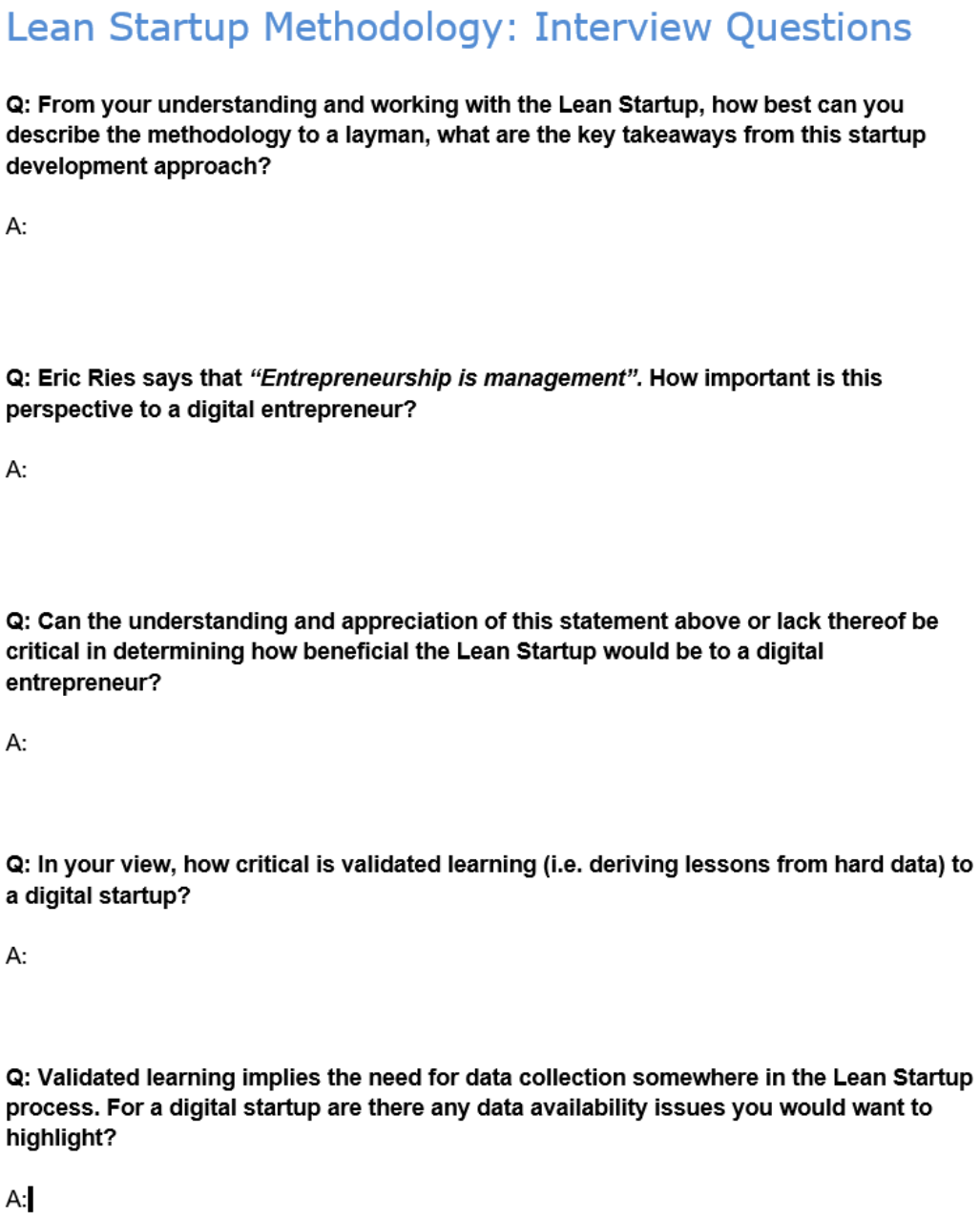
Data collection question	Potential source of evidence
Does the entrepreneur/group understand the unique value proposition they intend to offer customers and the whole business model?	• Directly observe the business canvas model classroom session(s) to determine the appreciation of the tool as a prerequisite for subsequent LSM steps. • Check for clarity on how the business is intended to work. • Check the level of understanding of how the business is perceived to solve a problem.
Did the entrepreneur/group manage to elicit reasonably sufficient feedback from early adopters?	• Analyse responses on customer feedback stage to check for quality and volume of feedback. • Cite evidence from responses pertaining to customer feedback which addresses product functionality, aesthetics, design improvement etc. that they wish

Data collection question	Potential source of evidence
	incorporated in the product. Evidence was extracted from interviews.
Does the entrepreneur/group succeed in incorporating customer recommendations into MVP design?	• Determine how much of early customer feedback goes into the MVP. • Determine any additional features the entrepreneur/group might add to increase product value and fit to customers.
Was there enough evidence to facilitate the decision to pivot or not?	• Interview the entrepreneurs (by group) for feedback on the process, data collected (customer feedback) and perception of customer feedback in terms of sufficiency. • Determine any key learnings from the pivots done.

Figure 10 below shows an example of the main questions which facilitated the discussions in the interview sessions together with keywords from the interview guide. This document was used for transcription as well to insert respondent answers under each question. Additional impromptu and follow up questions were asked to probe for more evidence. Appendix H has the full interview questions which the researcher used across interviews to guide the discussions.

To improve the flow of the interview from the start, warm-up and cool-off questions were asked (Lindgren & Munch, 2016). The interviews started off with an easy question on what the participants understand in basic terms about LSM as an example. To wrap-up, the interview participants were asked

if they had additional comments to make on the discussion. In most instances, participants gave more information that is important to the study.



Lean Startup Methodology: Interview Questions

Q: From your understanding and working with the Lean Startup, how best can you describe the methodology to a layman, what are the key takeaways from this startup development approach?

A:

Q: Eric Ries says that *"Entrepreneurship is management"*. How important is this perspective to a digital entrepreneur?

A:

Q: Can the understanding and appreciation of this statement above or lack thereof be critical in determining how beneficial the Lean Startup would be to a digital entrepreneur?

A:

Q: In your view, how critical is validated learning (i.e. deriving lessons from hard data) to a digital startup?

A:

Q: Validated learning implies the need for data collection somewhere in the Lean Startup process. For a digital startup are there any data availability issues you would want to highlight?

A:

Figure 10: Example of interview guideline questions used to probe for evidence

3.3 Data analysis procedures

The case study protocol detailed in the previous section resulted in the collection of a large qualitative data set in the form of research journal notes, interview notes and, audios of interviews. Audio data recorded from interviews were transcribed into QDA Miner Lite as and when it became available from the fieldwork for storage and thematic content analysis. QDA Miner Lite is a qualitative data analysis

tool which facilitates manipulation and analysis of qualitative data by coding it into themes (thematic content analysis) as was necessary for this research.

3.3.1 Thematic analysis

The thematic analysis approach implemented in this study follows a step by step process developed by Braun and Clarke (2006). Thematic analysis is a qualitative data analysis method that aims to identify, analyse, organise, describe, and report themes in a qualitative data set (Braun & Clarke, 2006).

Braun and Clarke (2006) argue that thematic analysis is a fundamental and foundational tool for analysing qualitative data although it is poorly understood and documented. This argument is hinged on the fact that thematic analysis provides the necessary skills for other forms of qualitative analysis. In this regard, many authors argue that thematic analysis is in itself a method for data analysis as opposed to a mere tool in qualitative analysis (Braun & Clarke, 2006; Nowell, et al., 2017).

According to Braun and Clarke (2006), a thematic analysis produces insightful findings if done rigorously to dissect the qualitative data. The steps to conducting a thematic analysis may vary. However, Braun and Clarke (2006) came up with a pragmatic process for conducting a particularly rigorous qualitative data analysis as there was no clarity prior to that as to how to do a trustworthy analysis (Nowell, et al., 2017).

Thematic analysis is a highly flexible and modifiable method to conduct a detailed analysis of qualitative data which can oftentimes be complex in nature (Braun & Clarke, 2006). King (2004) and Braun and Clarke (2006) argue that thematic analysis is strong methodologically as it facilitates easy comparison of perspectives provided by research participants, analyses similarities and differences, and extracts insightful but unanticipated insights from the data. By employing thematic analysis, the researcher is in a position to work with large data sets and summarise key insights (King, 2004).

Holloway and Todres (2003) point out that the flexibility associated with thematic analysis triggers the need for the researcher to be more vigilant regarding consistency and coherence in developing themes from the data. Hence, the Braun and Clarke framework was implemented in this study as it is rigorous and repeatable.

3.3.2 Braun and Clarke 6 Step Thematic Analysis Framework

Braun and Clarke (2006) proposed a six-step process for analysing qualitative data following the thematic analysis process. Figure 11 depicts this process.

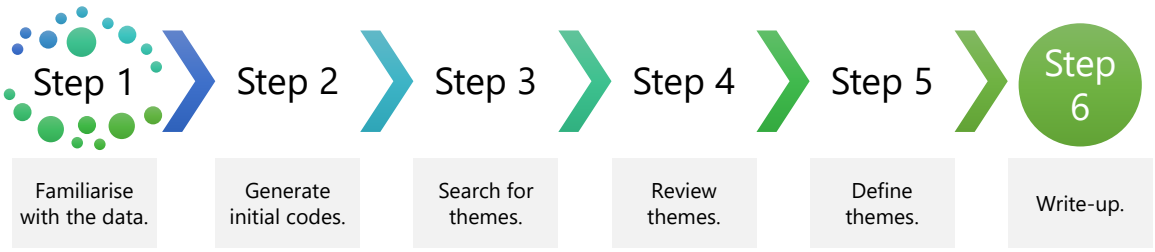


Figure 11: Braun and Clarke (2006) Six-Step Thematic Analysis Framework

Details of these steps are described in Appendix I.

3.3.3 Data analysis following the Braun and Clarke Framework

This section outlines the specific procedures which were implemented in handling and analysing the collected qualitative data. The approach follows the Braun and Clarke Framework outlined in the previous section.

Step 1 Familiarising with the data

Step 1 entailed data transcription, repetitive reading of the transcripts, and the development of initial ideas (Braun & Clarke, 2006). All audio-recorded data were moved from the audio device into a single secure repository in a password protected computer for transcription. Google Docs was used to do the verbatim transcriptions by listening to the audios and reading out the data to the Voice Typing tool in Google Docs as seen in Figure 12 below. Voice Typing automatically converts the audio data into text with a very high degree of accuracy.

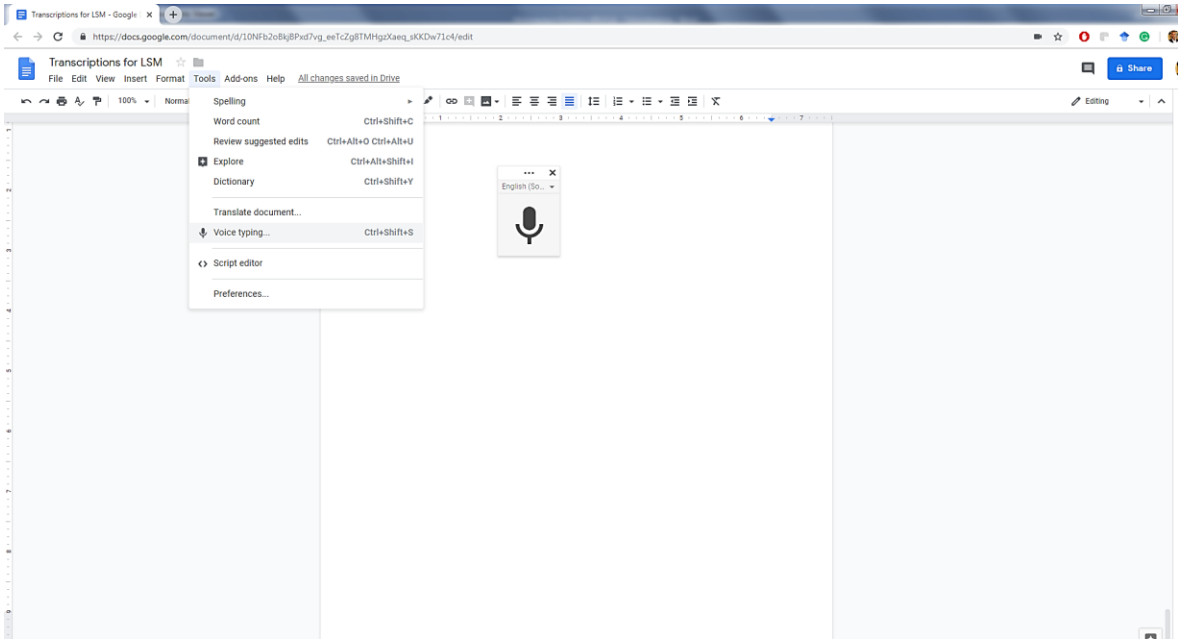


Figure 12: Voice Typing in Google Docs

This was done in a very quiet environment to improve the accuracy of the process. Automatic audio-to-text conversion using a voice typing tool significantly improves efficiency in transcription particularly when the research involves hours of audio data. While the data were read out, this facilitated familiarising with the data and getting an early understanding of what it is saying towards the research question and objectives. First-cut thoughts that stood out during the transcription process were noted down for later use as suggested by Braun and Clarke (2006).

In order to retain the original meaning of the responses, transcripts were punctuated accurately as understood from the audios and the flow of ideas from each of the respondents was closely followed. Poland (2002) warns that punctuation can significantly alter the meaning of a sentence. It is against this backdrop that transcripts were read through following the audios to punctuate the scripts correctly. Each transcript for each respondent or focus group was reviewed twice to improve transcript quality as well as get immersed in the data (Braun & Clarke, 2006).

While the process of transcription is tedious, every effort was made to do it diligently. The transcription phase was particularly important as it facilitated early stage analysis of the data in addition to improving understanding of what the respondents said (Braun & Clarke, 2006).

Step 2 Generating Initial Codes

After reading through the transcripts and noting down ideas of what the data seemed to tell, the combined transcript was imported into a qualitative data analysis software called QDA Miner Lite. This software package is a reduced version of QDA Miner - a much more complicated qualitative analysis

software. QDA Miner Lite contains all the necessary functionality to conduct thematic analysis hence it sufficed to use it. The tool is used for a wide range of tasks which include coding, annotating, and analysing qualitative data sets of any size including images (ProvalisResearch, 2019). Some useful features included in the software package are computer-aided coding tools, coding retrieval tools, statistical & data visualisation tools, and direct data import from external sources like documents (ProvalisResearch, 2019).

Using QDA Miner Lite the data were coded following the full transcript. As the codes were developed, QDA Miner Lite kept track of them such that when a similar code would appear again the pre-set code would be used. Figure 13 shows a screenshot of the coding process in QDA Miner Lite. An expanded audit trail example for this process is given in Appendix J. Due to the size of the data set, only ten examples are included to demonstrate this process.

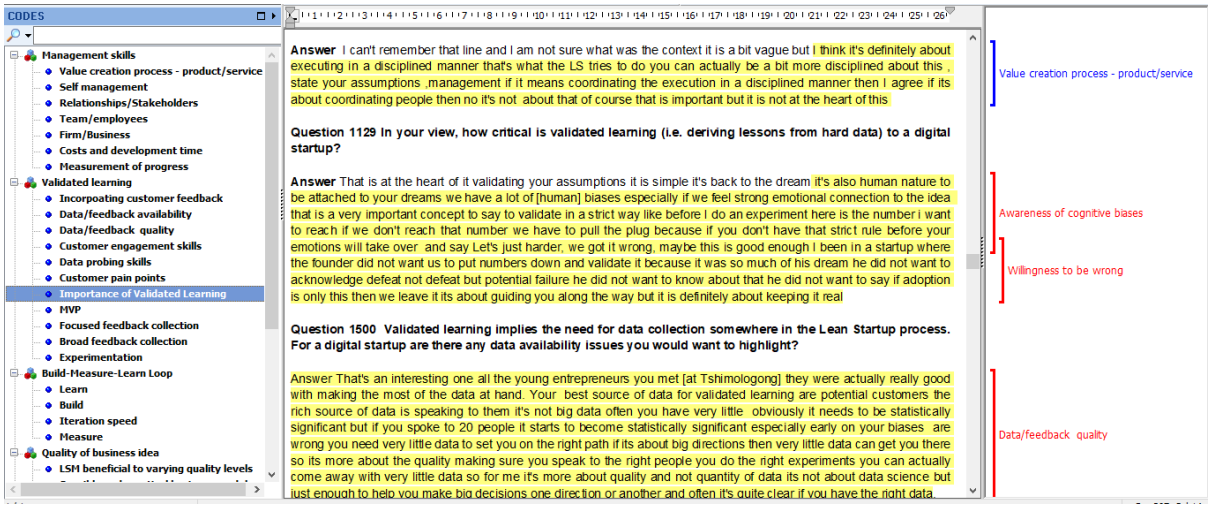


Figure 13: Data coding in QDA Miner Lite

The coding was based on an inductive approach i.e. themes are derived from the data. Inclination towards one of the two approaches, inductive or deductive, starts in the coding phase (Braun & Clarke, 2006). Therefore, it is important to disclose the nature of analysis when developing initial codes. The inductive approach being data-driven required the consideration of all the data collected in focus groups and interviews to pick up all the codes contained for a full and extensive analysis. This ensured that data were not fitted into a preconceived analytic framework.

The coding process was hinged on the following aspects as recommended by Braun and Clarke (2006):

- Coding for as many themes as possible with the expectation that some aspects may become interesting in later stages.

- Coding data extracts inclusively i.e. including some more text around the data extract to preserve context and meaning.
- Extracts of data were not limited to a single code as data may be coded many times as relevant to potentially fit into different themes.

Step 3 Searching for themes

All codes that were developed in the previous step across the array of data were collated into a long list. Step 3 is a step further in analysing the data which involved developing themes by sorting the codes into themes. Data extracts linked to the identified codes were also separately collated for use later in the analysis process. Step 3 is an analysis of the codes and putting together of related codes into a theme which combines them together (Braun & Clarke, 2006).

Using a visual tool helps in the analysis as recommended by Braun and Clarke (2006). A suitable mind mapping tool was used to organise the different codes into relevant themes. A first-cut analysis thematic map in Figure 14 was developed to depict the relationships between the codes and theme. This version was improved as more codes were discovered in the data to give a full thematic map.

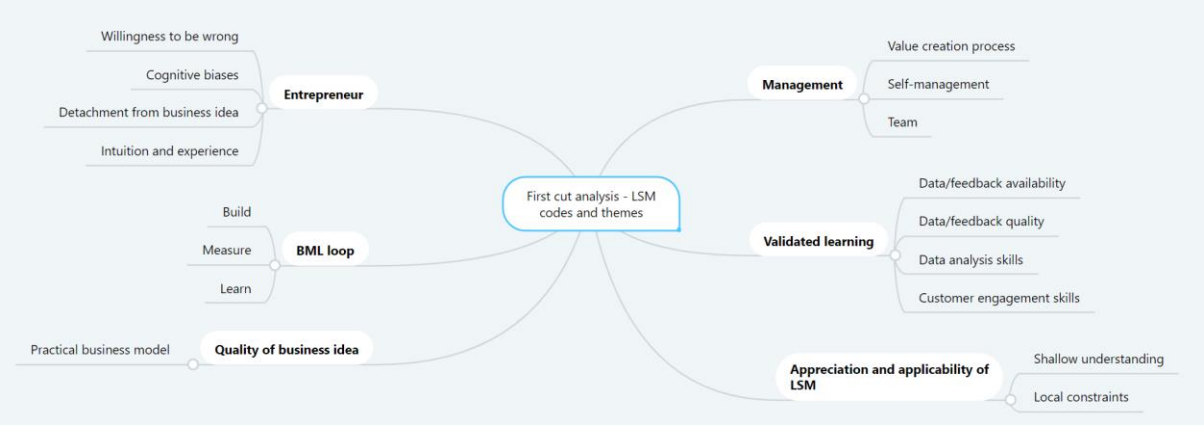


Figure 14: Early version of the thematic map to depict the codes and themes diagrammatically.

Some codes did not fit into the established themes and to avoid losing that data, a "miscellaneous theme" was used to keep those codes temporarily pending revision in an iterative loop. This phase ended with themes and suitable data extracts to which the codes emanate from as an output which informs the subsequent processes. These data extracts will be presented in the Results chapter as supporting evidence against each code.

Step 4 Reviewing the themes

In Step 4, all the generated themes underwent a refinement process aimed at establishing a perfect fit of the themes to the data and the codes. More codes were found in the data and the majority fitted well into the themes established in the early version thematic map. Some interim themes were condensed into existing themes as it emerged that though they appeared to be different to start with, they were in fact related, and there were not enough data to individually support them.

Following guidelines on Step 4, data within themes were checked for coherence by determining the "fitness" of each of the codes in each of the themes. Themes were refined to ensure that they are clear, distinct, and non-redundant by following a two-phase process (Braun & Clarke, 2006):

- Phase 1: All coded extracts were re-read to check relevance and coherence under each of the themes. Where candidate themes did not fit well, the themes themselves were reviewed or the data extracts. It is quite possible to misplace data extracts in a theme. After establishing a copacetic level of coherence in the themes a full candidate thematic map, building on the earlier version, was developed to visualise the relationships in the data.
- Phase 2: Although similar to Phase 1, here the entire data set was re-considered in relation to the established themes to check the validity and also to confirm the final thematic map developed in Phase 1. The candidate thematic map is required to represent the data as accurately as possible. Any additional codes deemed necessary were added until a satisfactory thematic map that accurately fits the data was developed.

Coding and reviewing themes could follow several iterations *ad infinitum*. The rule which was followed to establish a stopping point stipulates that as more refinements are done and the changes remain insignificant, it is time to stop (Braun & Clarke, 2006).

Step 5 Defining and naming themes

This step was informed by step 4 which resulted in a full thematic map of the data. All themes were further refined in preparation for analysis. The essence and importance of each of the themes were identified and the details of what each theme is about were laid out. Themes are required to be relevant avoiding complexity and lack of depth in the process (Braun & Clarke, 2006). To achieve this all the relevant data extracts were revisited before detailing the theme definition into a coherent account. Care was exercised in ensuring that the definitions of the themes were not a mere summary of the data extracts but an account of points of interest in the data and their relevance to the study. The detailed account of each theme needs to identify the story in the theme and also how it fits into the big picture story the data is telling as related to the research question. This ensured that the themes remained

distinct and that no overlap would occur amongst them (Braun & Clarke, 2006). Theme definitions are presented in the Results section, in Section 4.3.3 Table 9.

Initial theme names were revised to be concise and punchy to immediately give the meaning of each theme to the audience as recommended by Braun and Clarke (2006).

Step 6 Reporting the findings

Step 6 is presented in the Results and Discussion chapters. According to Braun and Clarke (2006), the account of the results should tell the story in the data in a convincing manner demonstrating the validity of the analysis. Data extracts were used as evidence to support the findings in the development of a rich, concise, and coherent account as presented in the Results and Discussion chapters (Braun & Clarke, 2006).

3.3.3.1 Making sense of the data

QDA Miner Lite tracks the frequency of appearance for each of the set codes. This tool provides afunctionality to depict data visually in the form of charts. From the frequency of each of the codes and themes, dominant themes can be derived based on cumulative frequency.

Data files were exported to MS Excel 2016 for further analysis in order to address the research question and objectives. Multiple graphs and tables are presented in the Results section following the analysis. A deliberate attempt was made to mine the data for additional and hidden insights resulting in multiple presentations of the data using descriptive statistics.

3.4 Conclusion

The research employed the case study design as the setting of the research was confined to InnoCentre and there was an opportunity to study a real world phenomenon in detail through the experiences of the participants. Data were collected through interviews. The validity of the study in the various forms discussed is maintained following the established recommendations by Yin (2014). The analysis of the qualitative data was conducted following the Braun and Clarke (2006) approach leveraging its recommended structure and logical flow. Descriptive statistics were employed to visualise the data to facilitate the process of synthesising the data into insights.

4. RESULTS

4.1 Introduction

This section presents the analysis of the data collected in two ways. Firstly, a summary of the results is presented as derived from the observations. Observation data were collected from classroom sit-ins over a period of 10 months (April 2018 to February 2019) from the beginning to the end of classroom lectures. Between March 2019 – April 2019 classroom lectures were focused on pitching training and no data were collected in these classes. Secondly, results from the thematic content analysis of the interview data are presented. Interview data were collected last towards the end of the mentorship and incubation programme. Thematic content analysis followed the Braune and Clarke (2006) framework as described in the previous chapter. The results presented in this chapter will be used as the basis for discussion in Chapter 5.

Table 6 below sums up the response rates from the two categories of participants in this study.

Table 6: Participant response rates based on maximum achievable response

Participant category	Max. respondents	Respondents who consented	Response rate
Facilitators/experts	9	5	56%
Startups	10	5	50%

Interview sessions were 45.22 minutes long on average across the two categories.

4.2 Results from class content observations

All topics that were taught in the classroom were put into clusters of related concepts as depicted in Figure 15 below.

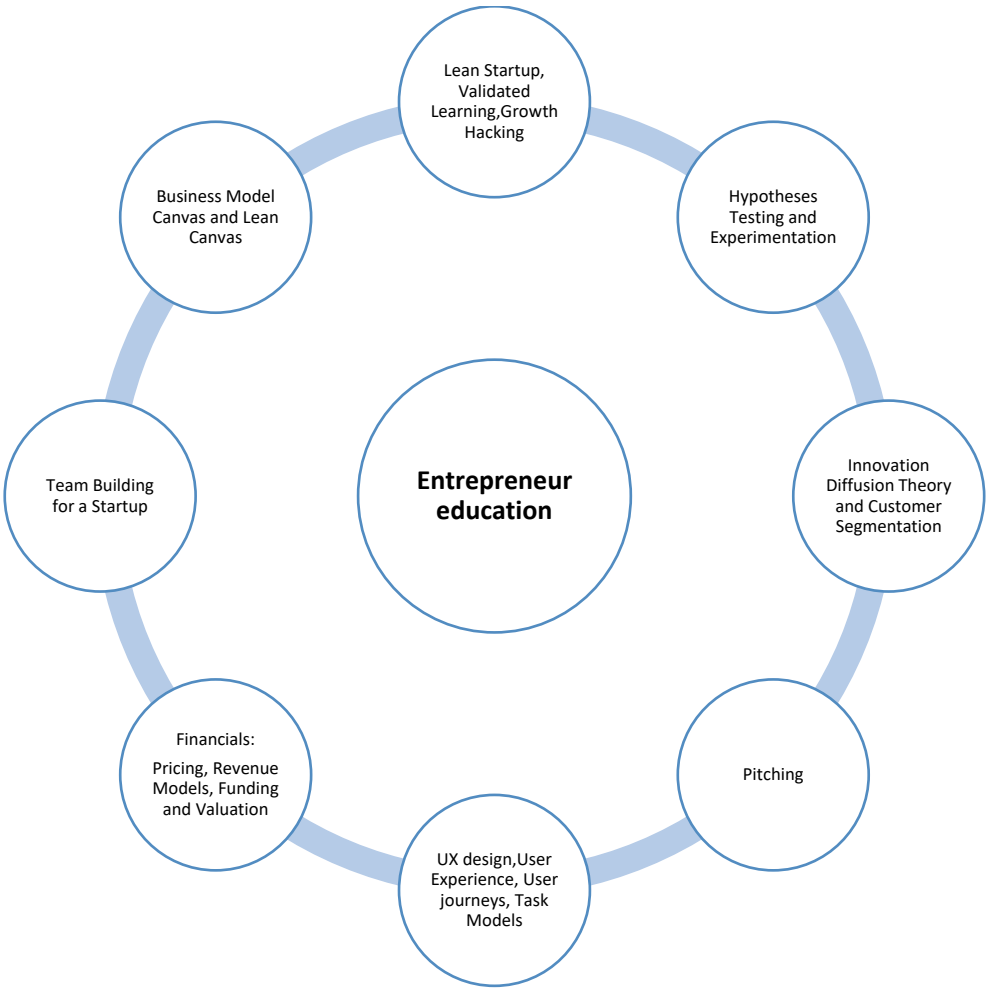


Figure 15: Class content clusters as taught from April 2018 to February 2019

Figure 15 above shows a classification of all the content taught in the master class sessions between April 2018 and February 2019 (10 months). Classes were held at least once a week in most of the months with minor interruptions due to holidays or other provisions in the entrepreneur education program. Factoring in all these disruptions the effective program time for this component works out to around 9 months considering also the December 2018 festive period.

The majority of the content, particularly from 2018, focused on various principles and topics with a strong connection to LSM in digital innovation. This ensured the entrepreneurs were equipped with almost all tools they needed on their journey from idea to product/service.

Towards the end of 2018, the masterclasses started to shift towards the other aspects of business such as Team Building, Financials, and Pitching. However, a constant presence of LSM principles was maintained in the classes, as it was the central product development approach taught at the institution. Classes were observed between April 2018 – Feb 2019 total 31.

Between March 2019 and early April 2019, the classes focused more on preparing the entrepreneurs for the final day of pitching their business ideas to officials from a government department focusing on innovation in startups. A total of 6 classes were observed during this period.

For the classroom data collection point, the focus was on understanding the topics taught. It is, however, noteworthy to highlight observations regarding the assimilation of the taught concepts in real startup business operations. The observations and discussions between the facilitators and the entrepreneurs from the classroom set up showed that teams were able to immediately implement the principles into their businesses. The gap of on average 5-7 days between classes allowed for the entrepreneurs to go away and practise the classroom lessons. This gap was spread out throughout the duration of the program. The assumption is that all entrepreneurs were thoroughly equipped with the right knowledge and tools to use LSM.

4.3 Results from Interviews

Analysis of the data was extended to the characteristics of the startups which participated. Profiles of participants are also presented. The results are presented in Table 7 and Table 8. This kind of analysis and organising of data was important for the study to uncover hidden insights.

Analysis of the interview-generated data resulted in 6 themes. Each of these themes addresses a specific objective of the research and ultimately seeks to answer the research question. A summary of the results is presented in Table 9 below followed by a presentation of supporting quotes from the participants for each of the codes.

4.3.1 Participant profiles

Table 7 summarises the profiles of the participants. Dimensions such as education level, work experience, current employment form, and a rating of LSM knowledge were important in constructing the profiles.

Table 7: Profiles of participants in terms of education, work experience, and LSM knowledge ratings

Participant name	Formal Education	Experience	Employment form	Rating of LSM knowledge	Previous exposure to LSM	Comments
P1	PhD Entrepreneurship	Lecturer and business owner	Employed	High	Y	P1 coaches entrepreneurs of SME's in LSM.
P2	MSc Entrepreneurship	Business owner consulting for startups	Self-employed	High	Y	Has own academy for LSM coaching.
P3	BSc,PrEng, CertEng	Lecturer and business executive	Employed	High	Y	Previously a CTO. Co-founded an innovative startup.
P4	B. Com, MBA	CEO, Corporate executive.	Employed	High	Y	Leads a design consulting company.
P5	B.Eng (Computer)	Insurance industry, startup	Self-employed	High	Y	Helps companies to develop software.
P6	B. Admin	Startup founder and CEO, programming	Self-employed	Medium	Y	Participant read Eric Ries' book beforehand.
P7	B. Com	Startup, programming	Self-employed	Low	N	Joined the team later in the LSM program.
P8	Matric	Startup founder and CEO, programming	Self-employed	Medium	N	Self-taught programming skills.
P9	Matric	Startup, programming	Self-employed	Medium	N	Self-taught programming skills.
P10	Matric	Own startup as founder and CEO	Self-employed	Medium	N	No hard skills which are pertinent to startup.
P11	Matric	Startup as co-founder	Self-employed	Medium	N	No hard skills which are pertinent to startup.
P12	Matric	Own startup as founder and CEO	Self-employed	Low	N	No hard skills which are pertinent to startup.
P13	Matric	Startup as co-founder	Self-employed	Low	N	No hard skills which are pertinent to startup.
P14	Matric	Own startup as founder and CEO, programming	Self-employed	Low	N	Self-taught programming
P15	Matric	Startup as co-founder	Self-employed	Low	N	No hard skills which are pertinent to startup.
P16	Matric	Startup as co-founder	Self-employed	Low	N	No hard skills which are pertinent to startup.

Table 7 shows that a total of sixteen participants took part in the study. Just over 31% of the participants were LSM facilitators at the incubation facility. The rest of the participants were entrepreneurs. In terms of previous exposure to LSM prior to the mentorship programme, only one participant of the eleven entrepreneurs had exposure to LSM. This participant reported having read the LSM book by Eric Ries that introduced the methodology. About 38% of the participants are rated to have Low LSM knowledge. The remainder, 62% of the participants, were rated to have Medium to High LSM knowledge. The composition of the participants indicates diversity in terms of work experience, education, and employment status. Amongst the entrepreneurs, the Matric qualification dominates as the highest qualification obtained at 56% of the participants. The facilitators are highly skilled people all having obtained tertiary education qualifications. Additionally, 80% of the facilitators have postgraduate qualifications.

4.3.2 Startup profiles

Table 8: Startup profiles showing key features of each of the startups

Startup name	Size of team	Participant names	% contribution to themes	Product domain	Product orientation	Innovation novelty	MVP?
1	4	P6, P7	13%	Mobile application for private security.	B2C - * SaaS model	Medium	Y
2	2	P8, P9	14%	Fintech software application.	B2C, B2B - SaaS model	High	Y
3	2	P10, P11	8%	Education software.	B2B - SaaS model	Medium	Y
4	2	P12, P13	5%	USSD product for mobile banking.	B2C	Low	N
5	3	P14, P15, P16	8%	Crime detection software application.	B2B - SaaS model	High	Y

*SaaS – Software-as-a-Service

Table 8 summarises the key details about each of the startups. By the end of the incubation and mentorship programme, four of the five startups that participated had managed to build MVPs to demonstrate how each of the ideas was envisaged to work. One startup did not have a product to show as of April 2019. Most of the startups - 80% - oriented their products to a Software-as-a-Service (SaaS) model.

The level of novelty for each business idea was derived from the following criteria:

- Perceived difficulty to build the product application.
- Perceived impact on solving social problems.
- Perceived applicability in the South African context.

4.3.3 Thematic analysis results

Table 9 below summarises the themes and codes derived from the thematic data analysis conducted. Each code has all participants who contributed to it attached for reference purposes. Figure 16 is a summary of the results table shown in the form of a thematic map. Green lines on the thematic map represent a relationship between elements in the map. Each code is explored in detail in Sections 4.3.4 to 4.3.9. Selected quotes are provided to show where the codes were deduced from.

Table 9: Results table showing theme description, codes, frequencies and source of each code

Theme	Description of theme	Objective	Codes	Frequency (n=159)	No. of interviews code appeared out of 10 interviews	Participants who gave input
Management (M)	The Management theme as an idea captures ideas that speak of managing aspects which respondents articulated as important for a Lean Startup business. These are aspects as represented by the codes are areas respondents think should be managed for successful LSM implementation.	Objective 1	Value creation process	5	5	P3, P4, P5, P8
			Self-management	4	3	P1, P8, P10
			Relationships and Stakeholders	7	3	P3, P6, P7, P8
			Team	4	4	P1, P2, P10, P16
			Business	3	3	P1, P3, P14
			Costs and development time	1	1	P6
			Measurement of progress	1	1	P6
Validated Learning (VL)	Validated Learning implies the use of data to derive lessons that inform the decisions the entrepreneur makes about the product or service (Ries, 2011). This theme captures all elements as they appeared in the data that enable, refer to or are associated with Validated Learning.	Objective 1	Data/feedback availability	10	7	P1, P3, P4, P6, P11, P13, P14
			Data/feedback quality	3	2	P1, P5
			Customer engagement skills	5	3	P1, P2, P4,
			Data probing skills	5	4	P1, P3, P4, P11
			Customer pain points	2	2	P1, P16
			MVP	2	2	P7, P9
			Focused feedback collection	5	4	P3, P5, P6, P15
			Broad feedback collection	4	3	P2, P4, P9
			Experimentation	9	5	P3, P4, P5, P6, P16

Theme	Description of theme	Objective	Codes	Frequency (n=159)	No. of interviews code appeared out of 10 interviews	Participants who gave input
	Examples of the codes that form this theme include data availability, data quality, customer engagement skills, and data probing skills.					
BML loop (BML)	The Build-Measure-Learn loop theme refers to ideas on building an MVP, measuring it in the market, and learning from the data collected. Any text along these lines was coded as such.	Objective 1	Build	1	1	P4
			Measure	2	2	P3, P6
			Learn	10	7	P1, P2, P5, P7, P8, P10, P13
			Iteration speed	3	2	P2, P3, P4
Accounting Innovation (INN ACC)	-	Objective 1	-	0	0	-
Entrepreneur Traits (ENT)	The Entrepreneur Traits theme is about all aspects that relate to the entrepreneur, which the data points out as pertinent to the research question. That is, entrepreneur traits have a bearing	Objective 1	Willingness to be wrong	7	5	P1, P2, P5, P6, P9
			Intuition and experience	2	1	P1
			Detachment from business idea	4	3	P1, P11, P2
			Pivoting and adaptability	12	10	P1, P2, P3, P4, P5, P6, P7, P8, P10, P11, P13, P15
			Cognitive biases.	5	4	P2, P3, P4, P5
			Outcome orientation	2	1	P2

Theme	Description of theme	Objective	Codes	Frequency (n=159)	No. of interviews code appeared out of 10 interviews	Participants who gave input
	on the successful implementation and extraction of maximum value out of the LSM for successes or failures.					
Quality of business idea (QBI)	The theme concerns ideas that point out the significance of the quality of the business idea and LSM success.	Objective 1	LSM beneficial to varying quality levels	6	6	P1, P3, P8, P9, P10, P12
			Sensible and practical business model	7	6	P1, P2, P4, P5, P6
Appreciation and Applicability of LSM (APP)	This theme captures ideas around how well appreciated LSM is in the local digital innovation space. The theme also filters out all ideas in the data around the applicability of the LSM in various business models and ideas in digital innovation.	Objectives 2 and 3	Not popular	8	7	P1, P3, P5, P6, P8, P9, P11, P14
			Shallow understanding	6	5	P2, P3, P4, P12,13
			Local constraints	3	2	P8, P9, P14
			Practical methodology	3	2	P6, P8, P9
			Applicability across ideas	8	7	P3, P4, P5, P6, P8, P9, P11, P15, P16

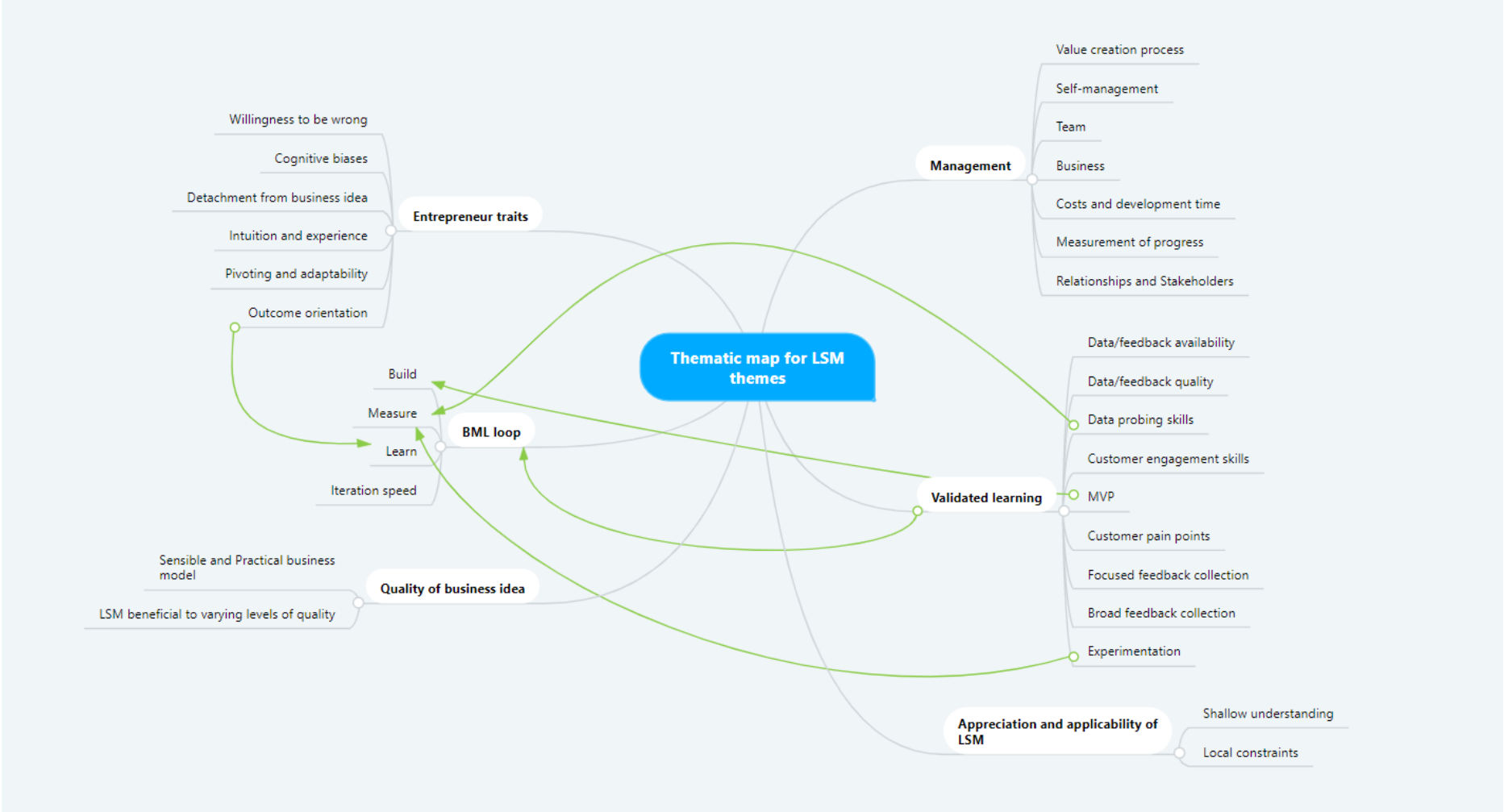


Figure 16: Full thematic map depicting all codes from the data analysis.

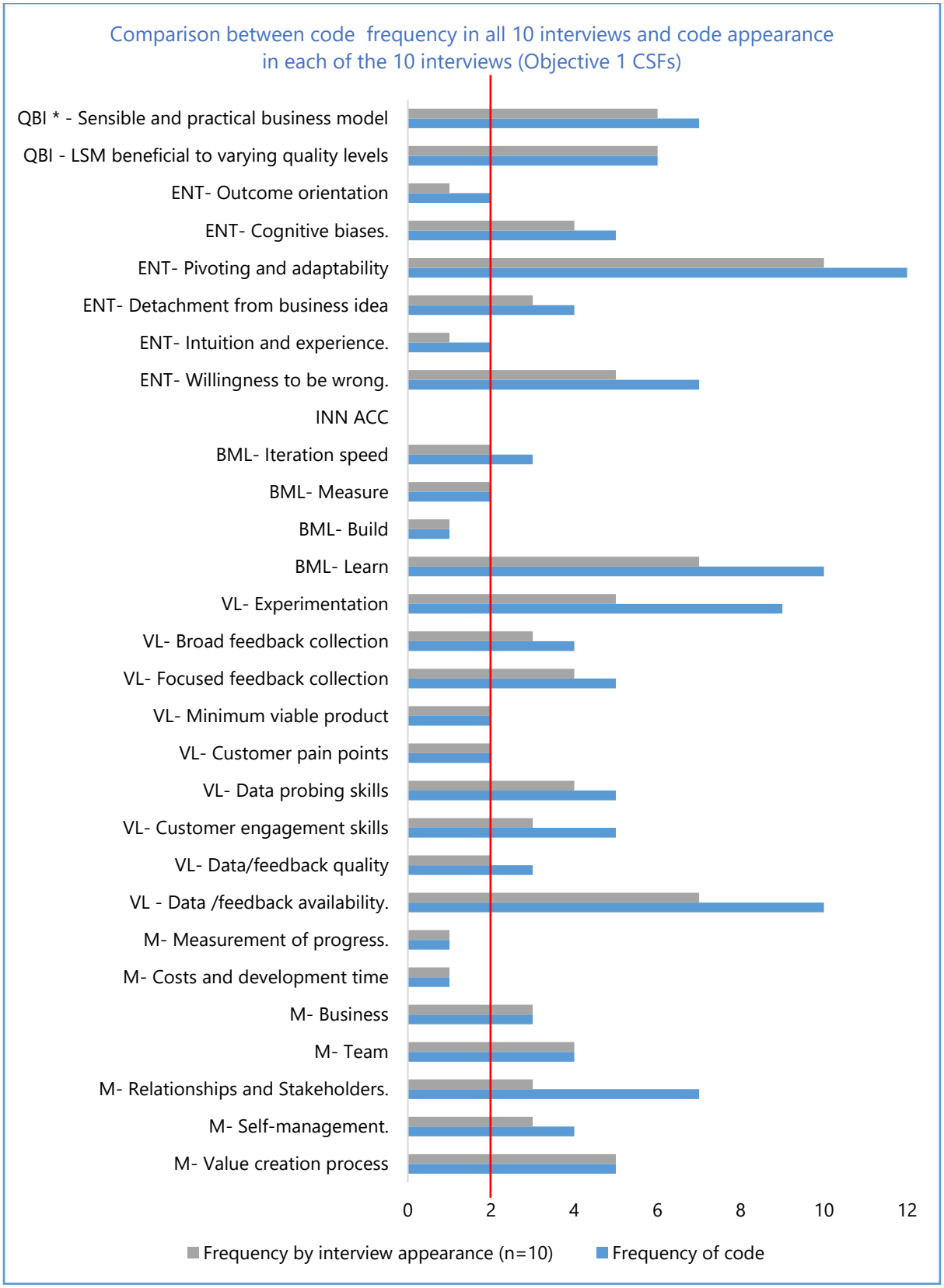


Figure 17: Graph showing a comparison between cumulative code frequency and frequency in each of the 10 interviews for Objectives 1 and 2 (the red line shows the cut-off point at a frequency of 2).

*Key:

ENT	Entrepreneur traits
BML	Build-Measure-Learn loop
VL	Validated learning
M	Management
INN ACC	Innovation Accounting
QBI	Quality of business idea
APP	Appreciation and applicability of LSM

Figure 17 compares the cumulative frequency of each code and the number of times it appeared uniquely in each of the 10 interviews. For example, a code can have a frequency of 10 appearances only in 1 interview, whereas a code can also have a frequency of 10 appearances as it will be appearing in each of the 10 separate interviews. To establish an understanding of the distribution of the codes, Figure 17 measures how widespread the codes are across the 10 interviews.

Dominant codes by frequency as depicted in the graph are Sensible and Practical Business Model, Pivoting and Adaptability, Willingness To Be Wrong, Learn, Experimentation, Data availability, and Relationships & Stakeholders. Each of these codes has a frequency of 6 or greater. Code frequencies by interview appearance follow a similar trend.

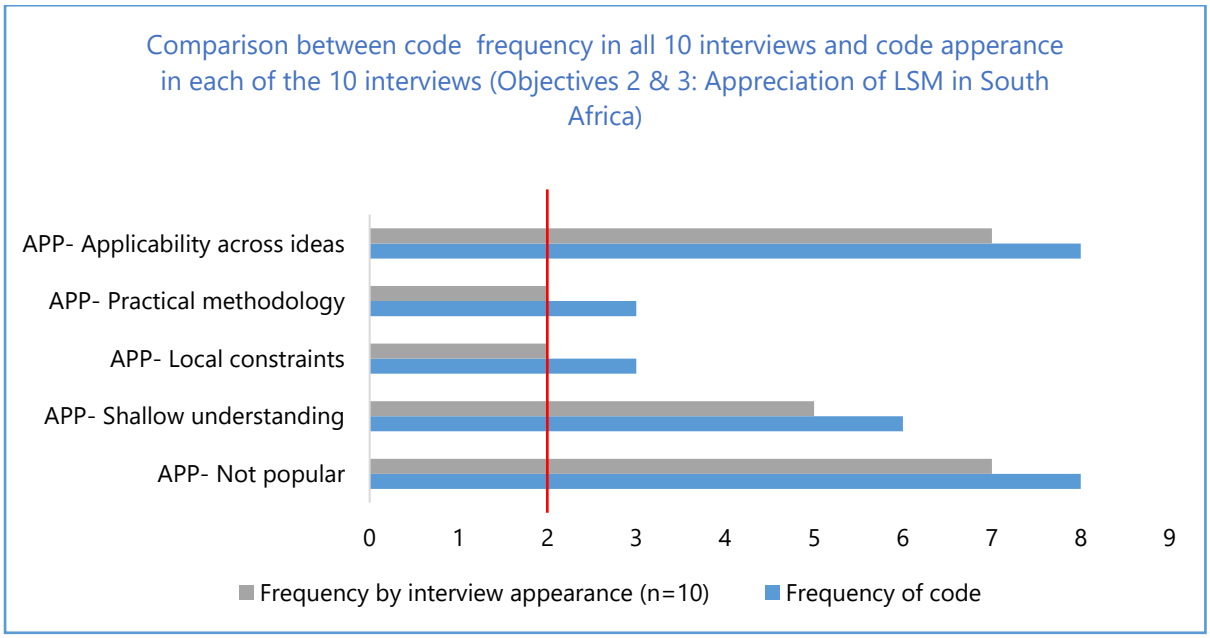


Figure 18: Graph showing a comparison between code frequency and frequency in each of the 10 interviews for Objective 3(the red line shows the cut-off point at a frequency of 2).

Figure 18 shows that Applicability Across Ideas, Shallow Understanding, and Not Popular are the dominant codes by both code frequency and frequency by interview appearance. Practical Methodology and Local Constraints codes only appeared 3 times each throughout the data.

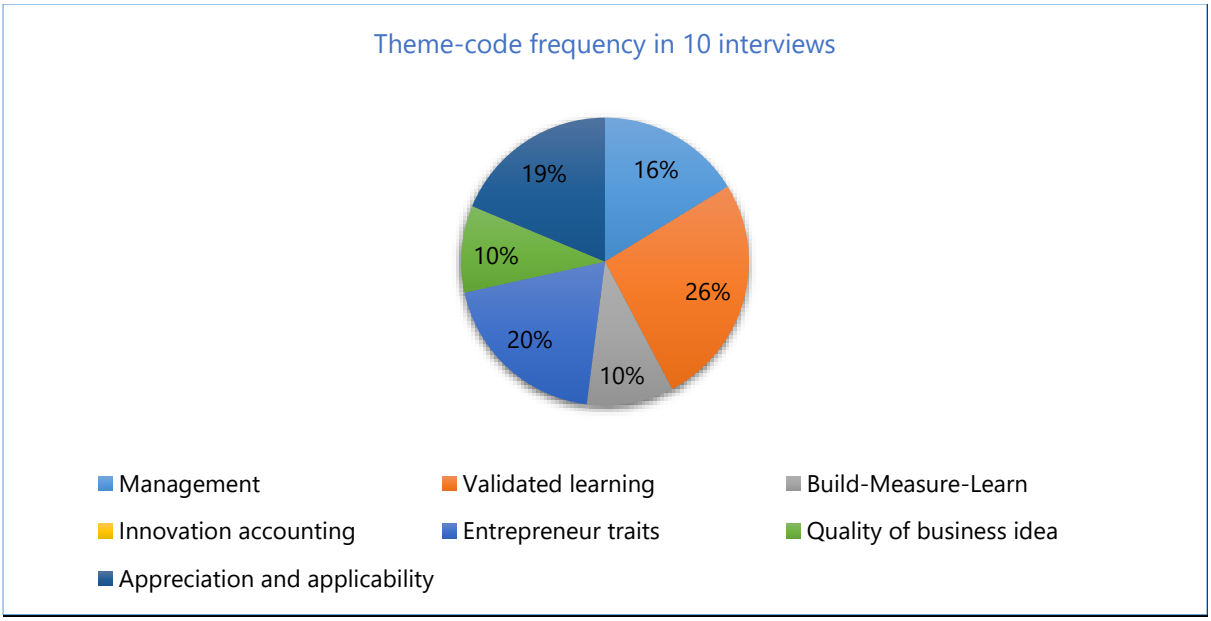


Figure 19: Contribution of each theme as deduced from the frequency in each of the 10 interviews.

Participants expressed extensive views on Validated Learning, Entrepreneur Traits and, Management themes as depicted in Figure 19. Validated Learning contributes 26% of the codes by unique appearance. Also, participants were quite vocal about the Appreciation and Applicability of LSM with 19% of the codes attached to this theme. Build-Measure-Learn and Quality of Business Idea themes are the least contributors sitting at 10% contribution each.

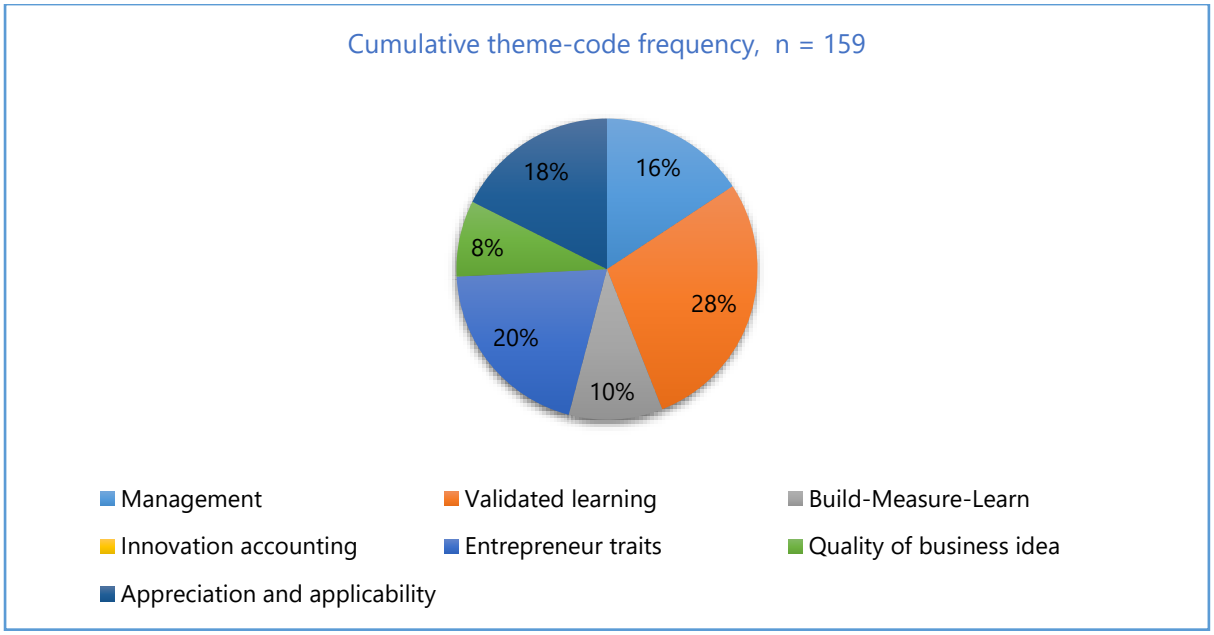


Figure 20: Contribution of each theme by cumulative frequency

The frequency of all themes combined totalled 159 appearances. The biggest contributor is the Validated Learning theme with 28% contribution. Entrepreneur Traits, Appreciation and Applicability, and Management each contribute 20%, 18%, and 16% respectively. Quality of Business Idea theme contributes 8% of code frequency. The least contributor is the Innovation Accounting theme at 0%.

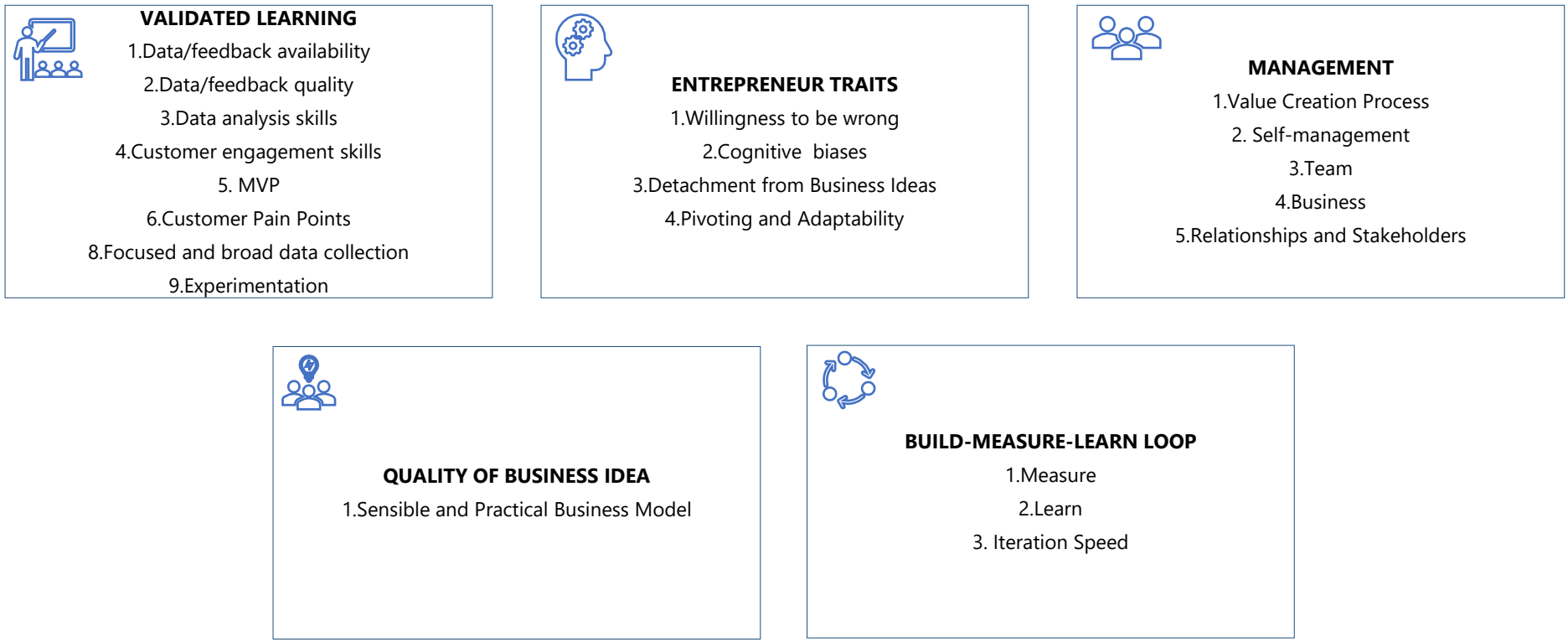


Figure 21: A model of CSFs for LSM in digital innovation space

Figure 21 was derived from Figure 16 by now only including those codes that appeared in at least two (2) different interviews. In this case, the raw frequency of each of the codes was not considered. As a result, Innovation Accounting themes are not included in Figure 21. Appreciation and Applicability theme does not feed into the CSFs model and is excluded from Figure 21 as it responds to a separate sub-objective.

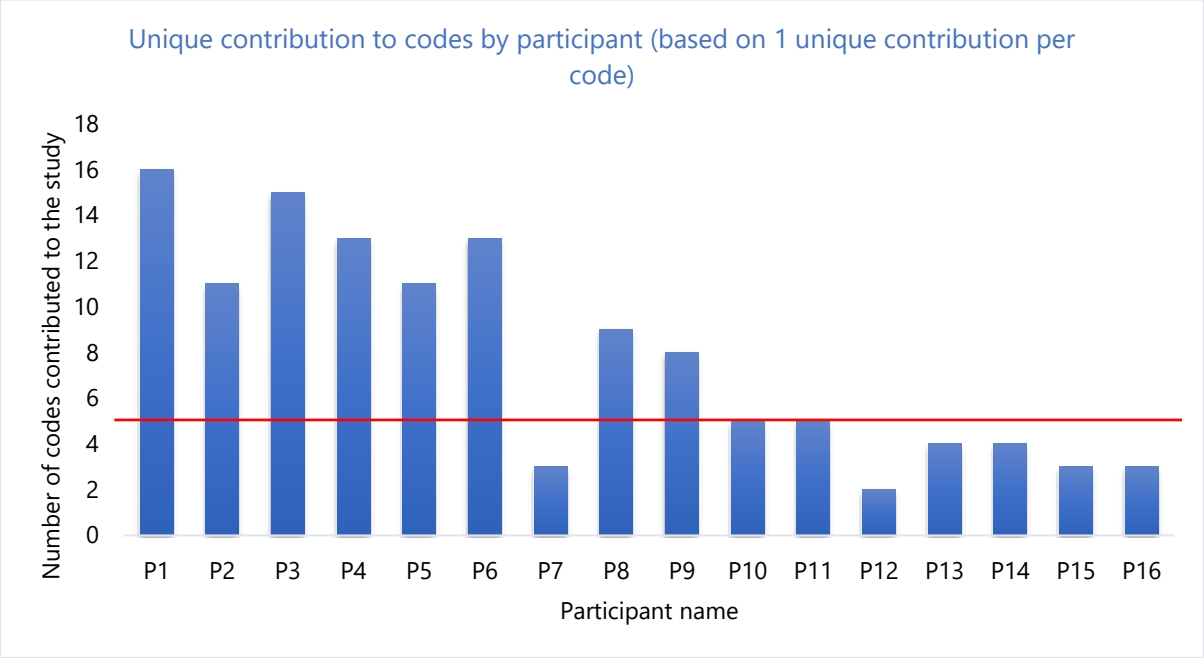


Figure 22: Unique code contributions by each participant (the red line shows the cut-off point at a minimum contribution of 5).

Figure 22 above is a summary of the unique code contribution by each participant. The graph shows a red baseline of 5 codes, any contribution above the red baseline can be deemed as satisfactory. P1 contributed the most codes with a total contribution of 16 codes. From participants P2 – P6 there is a consistent strong contribution of at least 10 codes for each of these participants. P8 and P9 contributed more than 5 codes. Participants P7 and P10 – P16 each contributed 5 codes and less. P12 recorded the lowest contribution at 2 codes.

4.3.4 Management theme

Participants expressed thoughts around the pertinence of Management for LSM practitioners in the digital innovation space. Concepts expressed are more inclined to resource management among other aspects. Below are each of the codes under this theme.Each code is supported with quotes from the data.

4.3.4.1 Value Creation Process

An expert in new product development views the process of LSM as a value creation process for new products or services, which the entrepreneur is managing when viewed from another perspective. New products or services may mean creating something new, which does not have benchmarks or references thus making managing the value creation process a difficult task for the digital entrepreneur. The expert (P4) says:

"I think entrepreneurship is management because you are managing an early stage value creation process. If you think about what the definition of management is: deliberate set of actions to be able to get a particular outcome. The only difference with an entrepreneur is you are managing the creation. What you are managing may not exist. So, you are managing the process of creating. Which is where it becomes tricky. Managing something that exists, you already have a tactical understanding of the variables, you can touch it you can feel it. You have reference points. With entrepreneurship, you have no reference points, but you still have to create the value. You are managing value creation from scratch. If you are innovating and creating new or you are managing value creation into new spaces, if you innovating or evolving stuff, you are still managing a value creation process." - P4_2019

4.3.4.2 Self-management

Four out of five of the digital entrepreneur teams having worked from ideas to MVP to a full-fledged product point out self-management as a key component in the LSM journey. The most important aspect that stands out is managing time. One respondent said, *"You have to manage time"* - P13_2019. Elsewhere, a respondent speaks of entrepreneurship as lacking someone senior to guide your day-to-day activities or tasks. The participant points out that:

"Of course, management is crucial because first of all, you need to manage yourself because if you do not manage yourself everything else crumbles. If you do not manage your own time, your own habits the business will crumble as well……. You have to manage yourself because you have no boss." - P12_2019

Here, we see that the Self-Management aspect as viewed by digital entrepreneurs extends to managing one's habits and routines that are critical to the business.

4.3.4.3 Relationships and Stakeholders

Relationships and Stakeholders should be managed to support the LSM implementation as will be seen here. Difficulties may arise when other stakeholders within the startup hinder the implementation of a pivot, as an example, which the technical founding team may be considering to be a critical step. One participant said the following:

"When I had different stakeholders trying to convince them what the market is telling you sometimes it's a tough thing. Because they have their inertia and their beliefs and trying to show them the process and validating hypotheses can be tough. It is almost a requirement to be able to bring your stakeholders along with you on the [LSM] journey. Otherwise, you end up losing the market opportunity because you cannot bring your stakeholders along and you end up struggling internally. It is therefore important to have like-minded people around you who partner with you, who have a stake in it. Not that all your partners are

thinking waterfall, but rather, are willing to iterate and go through the process and actually buy-in into these methodologies." - P3_2019

Some entrepreneurs believe in the importance of building and managing relationships in development, testing or any other relationship that can be beneficial to the startup. In this case, the relationships they built were necessary to facilitate the MVP and run iterations. One participant said the following:

"The relationship management of it as well, we are in the safety sector we work a lot with security companies - private security companies. You kind of have to be there to build those relationships yourself. If you do not, no one else will do it for you. So, relationship management including those developers as well, you need to form some good relationships, a mutual understanding of what needs to be achieved."- P6_2019

4.3.4.4 Team

Some entrepreneurs emphasised the importance of managing the founding team to deliver the required value proposition. One founding team member says, *"If you have a team, you have to manage those people as well because some people cannot manage themselves to be aligned and produce results. For me what stands out is the management of people that you work with"* - P6 2019. In this statement, we also see how an aligned team is likely to deliver results as the startup takes on the LSM journey.

The ability to put together the right team seems to stand out as an important element for a digital innovation startup. A participant who has extensive experience in teaching LSM argues that a wrong team will not transform into an excellent team because the startup follows LSM.

"Can you hire and build a team? It is not like I have a rubbish team and LSM is going to fix it, no. We have seen with many corporates we have worked with, that it is like meaningless, because the calibre of the team is just low, no methodology is going to help them execute well if they cannot make good product decisions." - P2_2019

4.3.4.5 Business

Management is pointed out as it pertains to the admin and leadership aspects of the business. Views from a seasoned digital entrepreneur highlight that depending on where the business is some form of management is required. This ensures that the entrepreneur avoids the collapse of the operation of value creation. Thus, this calls for some management process to be put in place as the guiding framework when going through the processes of LSM. Below is an extract which supports this code:

"You need to put that energy into a management framework. I think it really depends on where you are in the life cycle how much of a management framework is required. But I think there is certainly a lot of management throughout the course of the entrepreneurial life cycle."- P3_2019

In another instance, a participant emphasises that the management of the business is *"very important for administration and leadership"*. - P5_2019

4.3.4.6 Costs and development time

After completing an outsourced software development process, one of the respondents speaks about the importance of managing development time and associated costs. This implies that for the startup to go through its product iterations they had to carefully manage scarce resources at their disposal. The participant said the following:

"……especially for startups costs is a big issue, building a prototype, you look at costs. Some people will say to you its ZAR500K for two apps and a back-end. For a startup, you do not have that kind of money. What can I raise and how can I manage to bring the product to life? Because at the end of the day without managing everything else you cannot waste time and try to build something for which you do not have the resources. You manage [development] time by getting people who understand where you are coming from cost-wise in building that MVP. So, yes, the management part is very important". - P7_2019

4.3.4.7 Measurement of progress

As tracking of progress is a concept in the LSM, it was not surprising to come across it in the interviews. A participant said the following about measuring progress through the cycles in the startup:

"Managing entrepreneurship will show you if you are making progress, if you do not understand that concept then you will be stagnant, and you won't be able to maximise on the methodology." - P16_2019

This evidence demonstrates how LSM practitioners can use measurements to gauge their relative performance and growth.

4.3.5 Validated learning theme

Concepts around Validated Learning proliferated throughout the data analysis phase. Each of the codes under this theme is supported below with quotes retrieved from the data.

4.3.5.1 Data availability

The issue of data availability is a challenge to digital entrepreneurs citing that to create your own data set is often a difficult endeavour. However, it is not impossible to create a usable data set that can start to address the fundamental assumptions about the product offering. Three instances below point out the difficulties. One participant articulated the following points:

"It is really difficult to find ready-made data set which you can just go and tap into. However, it is not impossible; it is just a little bit more hard work. So, you have to able to describe your customer, you have to able to describe your product. With those two data sets, which you create, you can create a data set around your customer, and you can create a data set around the information of your product. …. Why I am saying that is that you can easily find a small dataset 10 to 20 people, you must at least be able to find a small group of people that fit your target audience and that becomes your data set. So, on the one hand, I agree I think ready-made data sets are difficult to come by. Maybe expensive. Maybe not the right data for you …… I think that does not mean it is impossible it just makes it a little bit harder. Unless if you create a dataset, you cannot have validated learning." - P4_2019

In line with the above evidence, an experienced mentor and entrepreneur in the digital space agrees to the above citing that *"data is not readily and willingly available to the entrepreneur*". - P10_2019

The other concern raised is that *"you may not be able to access the people whom you need to ask questions"*. - P3_2019

This suggests that data from which to learn from may require significant effort to gather up for use in the LSM process.

4.3.5.2 Data quality

Should the data be available to learn from, the issue of its quality becomes relevant. Most importantly, it is the data quality that is more important than the quantity. A participant says:

"Your best source of data for validated learning is potential customers. The rich source of data is speaking to them. It is not big data often you have very little. Obviously, it needs to be statistically significant but if you spoke to 20 people it starts to become statistically significant. Especially early on, your biases are wrong you need very little data to set you on the right path. If it is about big directions, then very little data can get you there. So, it is more about the quality, making sure you speak to the right people, you do the right experiments. You can actually come away with very little data… so for me, it's more about quality and not quantity of data. It is not about data science but just enough to help you make big decisions, one direction or another, and often it is quite clear if you have the right data." -P5_2019

4.3.5.3 Customer engagement skills

Three participants emphasised the need for entrepreneurs to be skilled in engaging with prospective customers. One participant had the following to say regarding this aspect:

"So, you need the skill [of properly engaging the prospective customers] as well, you need to ask the right questions and be able to first set up a scene or make people think in a certain way so that they can give you an honest opinion about the product. But that skill is not something that every entrepreneur has." - P13_2019

In a different interview, the same idea surfaced up. The following was said:

"The other generic advice is that there is definitely a bit of an art and science to interviewing customers in the sale process. So, I would really suggest that they get comfortable with some of these ideas - how to ask good questions, how to basically sell to customers, and learn from customers without being biased." - P2_2019

4.3.5.4 Data probing skills

This code is about the entrepreneur's skill to make sense of the data obtained from engaging with customers. In particular, the analytical skills that enable an entrepreneur to read what the data is saying and make decisions from it.

From one of the interviews, we have the following thoughts coming up:

"I think that one of the hard things is getting a sufficient sample size of data by going to the market and being able to gather enough information. But once the data is there certainly analysing the data requires something special. Some insight to see that even though the data is telling the story maybe there is another unwritten story that is a bit mysterious for us. My point being that if you are trying to measure A or B you end up measuring B there could be something in C that you should be able to spot. C may be some latent variable. Something hidden. I think some of the best things happen by accident in the world but that is when C is stumbled upon. Almost by accident. My belief is that C could also be a challenge to see. But to spot this hidden thing C requires something more than just looking at the data." - P3_2019

4.3.5.5 Focused feedback collection

Concerning feedback collection, we see participants advocating for objective and targeted collection of feedback. This code contrasts with going to the market without specific objectives to fulfil. An experienced software programmer and business owner said:

"It is about being very specific it is not everything that is important. What are the big risks, what are the big assumptions and focus on those. The other things are distractions. It is the 80-20 principle. There is something that if that answer is not right then that is a showstopper. You focus on that. The minor details come later. That is when you fine-tune your product and then you go to finer details. But in the early

stages, it is the big questions, big assumptions and big risks. Then if you pass that then it gets more granular." - P5_2019

4.3.5.6 Broad feedback collection

Three participants suggested that digital entrepreneurs should approach feedback collection with a broad approach. This is more important in the early phases according to this argument. The following was said to support this argument:

"I think that is probably a mistake I made initially, and I would say there is a balance between just doing it, trying something and see what happens versus a feeling that you have to have the exact right methodology. I think that in the early phase it is much more by feel and qualitative stuff and just trying stuff and getting a sense of whether it worked. Obviously, as your market size grows, and you are dealing with much bigger numbers then it is just bringing in some statistics and doing comparisons." - P4_2019

4.3.5.7 Experimentation

Participants weighed in on the importance of experimentation to digital startups. One participant emphasised the need to regard the product or service as an experiment in the early phases of the business. The following evidence supports this argument:

"The whole idea about the Lean Startup is you see your product ambition as an experiment. I think it is very important. I think the lesson is seeing the whole thing as an experiment. If you do not, then you close yourself to learning or you might spend everything you have and learn when it is too late. In fact, it is important to do it as cheaply as possible." - P5_2019

In another interview, a participant spoke about Experimentation citing the following thoughts:

"Experimenting refines everything in the business not just the app [product/service]. Experimenting is quite crucial in your digital business you cannot just rely on building. You need to experiment constantly. In terms also of experimenting for startups we have room for mistakes through experimentation. We are not corporates where there are structures, with us there are no such structures it is just a matter of, we experiment, we get feedback, we build or we refine ....." - P12_2019

4.3.6 Build-Measure-Learn Loop theme

The Build-Measure-Learn loop theme is about ideas from the data that reference the importance of this core idea in LSM. Participants expressed opinions on each of the components of the loop central to validated learning. The theme is made up of four codes, Build, Measure, Learn, and Iteration Speed. Each of these codes are supported below with at least one quote that best represents the code.

4.3.6.1 Build

An expert in design consulting argued the following on the importance of the Build stage in the BML loop:

"Build. If you have not built what are you measuring and what are you learning from? If you have a PowerPoint presentation that talks about designing a pen it's great but until you build the pen there is nothing to learn from, there is nothing to measure. Build is the key, that is the starting point and hence why the quickest route to success for the LSM is to have the ability to show people things regularly. Show them, learn, change, understand. So, the Build piece is the most important without doubt." - P4_2019

4.3.6.2 Measure

The importance of the other aspects of the BML loop is deemed to be overemphasised. Evidence from the data suggests that some LSM practitioners view Measure as a critical aspect of the loop as expressed below:

"Building is often overemphasised, and we neglect the measure. What we need to do is amplify measurements to create leaner things, simpler solutions that we can go and test out in the market and get feedback to plough in and learn. Because then we build the right things, we have more appropriate energy [effort] usage and more appropriate resource usage etc. If we amplify what to measure that should naturally amplify the learnings. I believe that learning is built into build and measure. But measuring can probably teach you a lot more than build can in a smaller space of time. Build can consume a lot of your energy. So, I would say measure is the one that should be most amplified." - P3_2019

4.3.6.3 Learn

In the following textual evidence, a participant expresses the importance of learning to a digital startup:

"A lot of time goes into Build. But I think the interesting one is learning, and adjusting, and pivoting."- P1_2019

"Learn is the really important one there is no point in iterating for the sake of iterating you have to be really getting real insights that will result in a better product. Sometimes people go around the loop for the sake of going around the loop and the result is not a better product. Obviously, you have to be very careful that if you are doing this thing to improve the product that you have to be the kind of the calibre of person who has domain knowledge and the product development knowledge to actually result in version 1 being better than version 2." - P2_2019

4.3.6.4 Iteration speed

Apart from talking about the BML loop, a critical point on the speed at which a startup completes the cycle was raised:

"I think what is important is the speed at which you get around that loop. In some of the corporates that we worked with what would happen is they would take on the BML loop, but they were using old school management techniques. The speed at which they could build something and learn from it was like in months, so it just became completely irrelevant. The big idea around the BML loop is how quickly are you getting around that loop." - P2_2019

4.3.7 Entrepreneur traits theme

4.3.7.1 Willingness to be wrong

This code comes from the expressions below. Participants believe that an entrepreneur who is in the process of implementing LSM should appreciate being disproved of their product convictions. Two participants said the following:

"I have been in a startup where the founder did not want us to put numbers down and validate it because it was so much of his dream he did not want to acknowledge defeat. Not defeat but potential failure. He did not want to know about that. He did not want to say if adoption is only this then we leave it. It is about guiding yourself along the way but it is definitely about keeping it real." - P5_2019

"I think if you come at it with good knowledge and principles and being open to being wrong then it should be easy. I think what happens where I have seen it not work is where some entrepreneurs you introduce them to the principles, they have been committed to an idea for 2 years. They have put a lot of money into it and then a lot of the cognitive biases kick in and they have too much to lose by realising the idea is wrong. I think you also do have some issues with some entrepreneurs who really develop some attachment to a bad idea. For them they got this vision, no one or data is going to stop them and then they end up wasting months or years of their life." - P4_2019

4.3.7.2 Intuition and experience

From the following quote we pick up more on the soft side of LSM – intuition and experience. A participant articulated the following:

"Entrepreneurship is that a lot of things are luck, your intuition, your trial-and-error kind of method. So, there are certain things that you cannot give definite answers to say do it now or do it later it is a combination. That is why sometimes when entrepreneurs come and ask me things, I say I do not know, you are the one who has been doing all this. You are the one who has been running this business what does your intuition tell you?" - P1_ 2019

4.3.7.3 Detachment from business idea

In relation to Willingness to Be Wrong is the idea that LSM entrepreneurs should give up attachment to the ideas they will be attempting to get through to the market. The following thoughts on the subject came from two separate interviews:

"The driving force behind the entrepreneur is his conviction to make it [the solution] work. He has to be motivated by that. The thing that eradicates the drive that the entrepreneur has is rejection, it is tiring, and you realise that the idea that you initially had is taken aback by the feedback of what the market says. So, you have to be strong in understanding that I am in it to learn more than I am in it for anything else. And if you are in it to learn you do not really get disappointed you continuously look forward. That's why a lot of drop out of entrepreneurship but if you fall in love with the problem you will have the drive to solve it, fall in love with learning and the problem." - P4_2019

"I think you also do have some issues with some entrepreneurs who really develop some attachment to a bad idea. For them they got this vision, no one or data is going to stop them and then they end up wasting months or years of their life." - P3_2019

4.3.7.4 Pivoting and adaptability

The code Pivoting and Adaptability was derived from the following pieces of evidence found in separate interviews:

"Especially, in this model where the word pivot comes along a lot, you constantly need to pivot. From even where we started initially to now, we had to pivot a lot on certain things." - P15_2019

"So digital startups need to adapt and change like how water fits the shape of the container you put it in. Never hold on to what you started with, that can change any day. Having to adapt and move if you are in a tech space is important." - P4_2019

"Great emphasis to be placed on this aspect [pivoting] due to the learning curve and experience that stems from the evolved processes of pivoting." - P10_2019

4.3.7.5 Cognitive biases

The idea of entrepreneurial cognitive biases was picked up in four instances in the data. The quote below best demonstrates this code:

"Are you aware of cognitive dissonance or cognitive bias? What happens is our natural tendency to be believe what we believe and find data to reinforce that belief, until it is too late and there is a catastrophic failure. So, we have to be aware of that tendency of ourselves of not wanting to recognise what is being

told to us. We have to reject that in ourselves and fight against that cognitive dissonance. Otherwise, we end up reinforcing the things that we want to shed. So, all of this energy is wasted if we try to go down the path of validating our models and validating our hypotheses. But then we fail to change based on the information that we receive. If we are too attached to our ideas and we fail to iterate and change we are ultimately doomed to be like someone who has not gone through any of those processes and therefore it invalidates the entire effort. You might as well save your energy and just go with your assumption in the beginning." - P3_2019

4.3.7.6 Outcome orientation

The Outcome Orientation code is a product of the following thoughts from one of the participants:

"So, I think it does not really matter, the methodology can be valid [valuable] across domains the mistake that people make is focusing much on the methodology and not enough on the outcome. So, what they will do is like they are interested in following the methodology filling out templates and not "ask are we solving a problem?" Are we building a business? What I have seen happen sometimes is the methodology becomes forefront and in some cases, it can actually get in the way of building a successful business. It is not the holy grail that will turn you from a B grade entrepreneur into an A grade entrepreneur." - P2_2019

4.3.8 Quality of Business Idea theme

4.3.8.1 Practical and Sensible Business Idea

The data shows that it may be necessary for an entrepreneur to have a sound and practical business model. An experienced expert has the following to say:

"When you come up with an idea it needs to be scalable, so it has to have quality it has to impact people's lives. It [LSM] can work literally on any idea. It is just a matter of doing your research around the idea learning around the idea, market research around the idea and going back to refine the idea. I agree on scalability. We want to build companies which are scalable. A form of technology that can be used literally anywhere in the world. Not everyone is after that, some people just want a small internet cafe [however] they can still use the methodology." - P4_2019

4.3.8.2 LSM beneficial to varying quality levels

In line with the previous code evidence quote, it emerged that LSM can be applied to any idea. The quality or innovativeness of the idea does not limit the methodology. This code is derived from the following quote:

"There is no relationship, through the Lean Startup you will see if you will survive or not. I believe it is structured in such a way that when you get to a certain stage you will know if your business will succeed

or will not succeed. So, there's no relationship between those two. The Lean Startup will validate your business idea or invalidate it." - P4_2019

4.3.9 Appreciation and Applicability of LSM theme

4.3.9.1 Not popular

From eight instances in the data, it became clear that participants perceive LSM to be not popular in South Africa. The following three quotes support this observation:

"In South Africa it [LSM] is not well known. South Africans are still stuck up on the business plan. Even if you go to other incubators, they will still tell you about market research. They are taking more time instead of doing a prototype, keep the ball rolling, and with the Lean Startup you make progress."- P9_2019

"Not a widespread business methodology due to the insufficient focus on tech start-up development and support."- P14_2019

"The Lean Startup is known in tech business the other people have no clue about it, it is the old conventional way. So, for a business in construction, they have to have a business plan. I do not think the Lean Startup is well known out there." - P1_2019

4.3.9.2 Shallow understanding

Participants raised a case to the effect that LSM is not properly understood in South Africa. They had the following to say on the subject:

"I think it is understood at surface level. I think it is understood that it is a new way of approaching problems, brings you value you sooner, it is different from the old. But I don't know how many startups have actually implemented it and used it. So, I think it is understood at a theoretical level, but I don't know if it has been understood at an application level, but what it actually means I think there might be a gap there from my experience." - P4_2019

"We have now been engaging with corporates for a while. Commonly, what we found is that there is a veneer thin understanding of how to do it. So, people were familiar with the buzz words, but they practically did not know how to do a decent problem interview. They did not know how to descope a product and get it into the market quicker." - P2_2019

4.3.9.3 Local constraints

There is evidence which suggests that the local environment is not supportive of new ways of building startups. In different interviews we come across the following evidence:

"Not a widespread business methodology due to the insufficient focus on tech start-up development and support." - P14_2019

"I think maybe like in America, like Silicon Valley, you can see how they approach business versus how we approach business. They are quite aggressive in getting the MVP quickly or prototype, getting seed funding, all of those things. It takes documentation and less of customer interviews. I think that side they keep up with this thing they apply it more, it actually does work." – P11_2019

4.3.9.4 Practical methodology

Three participants hailed LSM as a practical and efficient business development approach. Two quotes presented below support this code:

"I also believe it is more practical because it gets you to do more outside the business than on the product. It gets you to understand what the product is, what the product is all about, are you doing the right product instead of you doing the product. I believe it is more practical in that way. It is also easy when you are taught because you get to do follow-ups like your problem interviews. I believe it is more practical and just to add, you do not need a product at first. Just applying the lean canvas, it will give you the product." P4_2019

"Although there are times, I find applying it a bit challenging but when it comes to all its features and how is designed, I think it is the easiest to go to the market quickly with a prototype. I think its delivery system is quite efficient." - P12_2019

4.3.9.5 Applicability across ideas

In this code, participants explored the applicability of LSM across different ideas operating in different markets or sectors. Customising LSM to suit the application environment and digital businesses as the common beneficiaries of LSM emerge as key ideas from the following textual evidence:

"I think the principles apply you would have to be clear around what it is that you are building, solving for or creating. It has been applied in software and technology quite easily because if we have conversation now we go back to our desks we code we come back an hour and half later, we have something different but in the chemical process it is very different. This implies customising it to suit the industry, speed between industries, say unstable gases, may be different as compared to the technology space, when you are building a rocket a quick turnaround time could be a year because of the engineering processes involved. When you are building an app a quick turnaround is an hour, prototyping of key variables could be a way to do it in industries with long lead times." P4_2019

"Digital startups tend to get the most benefit out of this… First of all, you have a great deal of scale, the businesses are extremely scalable out there in the market and therefore your addressable market is massive, often. You can easily get feedback. The beauty of it is that because software rapid prototyping is so achievable and so democratised, and you can get access to the skills and deploy something in hours from a machine to test in the market. Never before have we had that opportunity. So, the barrier for us to be able to participate in that market is very low, everyone can build a digital startup, you get the skills….. they are online, all you need is a computer and access to [an] internet connection." P3_2019

4.4 Conclusion

The results presented sum up the observations from the classroom sessions to understand what the entrepreneurs were taught in their training. Profiles of the participants and the individual were also presented to give the reader the full context of the research environment. The use of descriptive statistics allowed for the visualisation of the data where possible giving us the multiple tables and graphs presented. Extracts from the qualitative data support the source of the codes. The research objectives were easily located in the data. It turned out that all research objectives got attached to at least some result.

5. DISCUSSION AND RESULTS ANALYSIS

5.1 Introduction

This chapter discusses the results to address the research question, research objectives, and propositions set out for this study. The results of the thematic analysis are presented in the previous section and this section will refer to these results linking them to the presented literature review and the existing body of knowledge related to LSM as a subject. Consequently, results will be placed in the context of the purpose and motivation of the study.

For ease of reference, the research question and propositions are repeated below:

Research question: What are the CSFs for successful implementation of the Lean Start-up Methodology in digital innovation start-ups?

Propositions:

1. For LSM to be beneficial to the practitioner certain minimum requirements need to be met in the process for the methodology to be successfully implemented resulting in either a scalable business or successful invalidation of the business idea.
2. The depth of LSM is not properly understood locally with practitioners limiting practice to a small number of the concepts the methodology represents.

5.2 Participant and program characteristics

5.2.1 Program structure

The entrepreneurs were given the required skills necessary to implement LSM in developing their business ideas and search for a scalable business model. Figure 15 in section 4.2 depicts the eight (8) clusters of the content taught in classroom sessions. A good number of sessions were dedicated to learning about LSM and its overarching principles. Subsequent to that, facilitators spent time on training the entrepreneurs on Validated Learning and Growth Hacking. Hypothesis Testing and Experimentation classes were also a crucial part taking a considerable amount of time. In addition, the BMC and Lean Canvas tools were covered in detail.

Of these eight content clusters, five (i.e. 63%) namely LSM and Validated Learning, Hypothesis Testing & Experimentation, Innovation Diffusion Theory, BMC & Lean Canvas, and UX Design & User Journeys,

were directly related to LSM theory and its concepts. This format of content arguably is holistic giving the entrepreneur a solid base and understanding of LSM. As the business ideas were all of digital nature, it is expected that entrepreneurs derived value from the concepts of UX and User Experience Design components found in this cluster. These concepts are applicable in designing experiments around the usability of the product. The content was linked extensively to Hypothesis Testing and Experimentation equipping the teams with the required skills to effectively implement LSM.

Additionally, entrepreneurs were taught how to build startup teams, pitching, and financial aspects of business. This content seems to digress from LSM at first glance. However, one can argue that the skills the entrepreneurs acquired helped them to build better business models. For instance, Pricing and Revenue Models content equips entrepreneurs with a deep understanding of the Cost Structure and Revenue Streams building blocks of the BMC. This in turn can inform experimentation around revenue models enabling the teams to optimise that component of the business.

The Team Building component is important to help the teams build competent teams. These teams can in turn ensure LSM aspects are implemented to test hypotheses about the business in a disciplined and methodical manner.

Finally, the program structure was well-designed and helped all the teams on their LSM journey given that it was holistic in its nature.

5.2.2 Participant and Startup participant profiles

Table 7 in section 4.3.1 summarises the profiles of all the 16 participants and Table 8 in section 4.3.2 is a summary of the five startups to give the reader the full context of the study. Facilitators, i.e. P1 to P5, are highly educated and experienced in entrepreneurship. All facilitators own and run businesses, and are knowledgeable in LSM having practically used its principles in business development and new product development. As a result, startup teams were mentored from a deep practical perspective during the incubation process.

Four of the five startups managed to build an MVP as can be seen in Table 8 in section 4.3.2. Novelty levels for these four were either High or Medium ratings. The respective teams contributed between 8-14% of the themes found in the data. One team, Startup 4, did not manage to build a functional MVP by the end of the program. This is despite the fact that the novelty of the product was low and was also rated to be easy to implement relative to the other products which had medium or high novelty ideas that were rated harder to implement.

From the data in Table 8, it follows that the most knowledgeable teams on LSM managed to build an MVP to physically test their product in the market. The least knowledgeable team did not manage to

build an MVP despite the product being easier to implement relative to the other products. Theme contribution attributed to Startup 4 is 5%, the lowest of all five startups. Based on this fact, one can argue that Startup 4 found LSM difficult on their part as they seemed to lack in understanding the methodology. At the least, the researcher expected Startup 4 to have managed to put together a first generation MVP as their idea remained largely the same from the start factoring in any pivots along the way.

Based on this data set, there is a noticeable strong connection between knowledge in LSM and the ability to successfully use the methodology to run at least the first iteration of the MVP. It must be noted that the data sample is relatively small, however, the correlation is noticeably strong. A bigger data set would be required to validate this observation pointing out to an area of further research.

5.3 Discussion in relation to research objectives

To address research objectives, the analysis takes its departure from Table 9 in section 4.3.3 were all themes and codes are summarised. Table 9 feeds into a full thematic map shown in Figure 16 in section 4.3.3. The figure shows connections between the themes and codes to represent the relatedness of the ideas obtained from the data. The relatedness between Validated Learning and BML loop stands out as these two augment each other extensively. For instance, Experimentation is closely linked to Measure as each experiment must collect data from which entrepreneurs can learn from. We do not see links between other themes as they were deemed to be distinct in nature in representing separate ideas.

5.3.1 Objective 1: LSM CSFs

Figure 17 in section 4.3.3 summarises the frequencies – cumulative and unique – for each of the codes to look for the relative theme strength. Although the graph depicts multiple codes, interest is on those codes that both achieved a cumulative frequency and unique frequency of at least 2. Following this logic, a model of CSFs, Figure 21 section 4.3.3, was deduced which only depicts themes with relative strength of 2 or more. The CSFs model consists of:

- Management
- Validated Learning
- Entrepreneur Traits
- BML loop
- Quality of Business Idea

These building blocks of the model will be fully explored in relation to literature in the following sections.

5.3.1.1 Management

The results of this study support the position that for entrepreneurs to succeed following LSM, different aspects of Management should come into play. The study came up with multiple facets of the entrepreneurship process which should be managed to facilitate successful and beneficial implementation of LSM.

Ideas around thinking about LSM process as a Value Creation Process which the entrepreneur is managing emerged quite strongly. This is congruent with the nature of LSM which is built to create value that customers will want to pay for (Ries, 2011). It follows that the strength of an entrepreneur as a "manager" of that process becomes important in the LSM journey. The challenge the entrepreneur faces is the absence of a benchmark to measure the new product against. Thinking about new product development in LSM as a value creation process helps the entrepreneur to navigate the complexities of building a product which does not have a framework of reference. The new product value will be realised in various forms of value. Key to the startup is the value of the product or service. Slack (1999) defines this value as the worth of the product or service in the eyes of the customer as a function of usefulness in meeting a customer need, perceived importance in meeting the need, and cost. It follows that if a startup can satisfy the three areas, it would have iterated towards scalability which delivers intended value to other stakeholders such as investors. Value to investors would be the potential of the product or service to bring in sales and profits (Slack, 1999). This study finds out that managing the Value Creation Process in LSM implementation should be key in the startup as supported by Picken (2017).

Under this CSF, we also see Self-Management as crucial for LSM, particularly in startups. This is more around the entrepreneur keeping themselves disciplined in the process of the methodology. Keeping on track with the process and applying its concepts with discipline and following through is certainly critical in the implementation of LSM. Without this discipline, the impact of LSM in the search process will be nullified. Underpinning LSM is the notion that a startup needs to follow a systematic and disciplined approach to find scalability. It follows that the startup team will thus need to maintain the required discipline in following the process to ascertain if there is progress and validated learning (Ries, 2011).

The study reveals the importance of the LSM practitioner in managing Relationships and Stakeholders who are invested in the business idea. LSM is by nature unconventional and requires the buy-in of all stakeholders involved as a preference of the old methodologies is still prevalent. It is therefore clear that if the stakeholders are not sold to LSM the startup will struggle to implement the methodology and may face significant interference in the process. The successful implementation of the methodology

will be hampered as a result. Entrepreneurs must manage relationships with stakeholders to smoothen the LSM implementation process and derive maximum benefit from the methodology.

In support of this finding Ries (2011) highlights that startups face risk if the stakeholders lack confidence in the methodology in building the business. A typical case would be lack of traction after investment is laid down based on a promise to deliver a ground-breaking product or service. To the stakeholder success is delivery. However, along the LSM journey, the startup may fail on delivery but come out with validated lessons (Ries, 2011). Therefore, to avoid misalignment, the entrepreneur must bring the stakeholders along in the LSM journey as this study also attests.

The need to manage the startup team is also a critical component of the Management CSF. Managing the team is about ensuring buy-in from every team member on board to deliver on the various implementation stages of the LSM. Managing the team ensures that all members are held accountable to the delivery of their inputs to LSM implementation. The leadership model determines where the responsibility to keep the team aligned rests on. In the case of a startup, there are two leadership models to apply – vertical and shared leadership models. The vertical leadership model places the responsibility to lead on a single individual. On the other hand, the shared leadership model shares the task of leadership on each of the team members (Ensley, et al., 2006). In this study, the entrepreneurial teams were observed to largely follow the shared leadership model to deliver on LSM milestones in the implementation process. Shared leadership seems to fit startups where the team members are at equal levels of contribution to the startup often resulting in a non-centralised model of leadership and accountability in the team.

The presence of the shared leadership model in each of the participating startups supports the evidence from the data that managing and leading the team is a contributing element to the Management CSF for LSM in startups. This assertion is in line with Bryant (2004) who points out that in startups the founding team must lead the charge of creating the new venture. Bryant (2004) points to the absence of standard operating procedures or structures to reference when building a startup as the reason why the founding team must lead.

Apart from managing the above to support LSM, the entrepreneur will need to manage the administrative business aspects as deduced from the Business element of the Management CSF. This is to align activities and priorities to support the implementation of LSM. The entrepreneur operates within a firm and the management of the firm is important to keep the startup going in validating its business model or the search. It is important to note that the energy that needs to go into the startup phase is not comparable to the scaling phase where a lot more of management is required. The scaling phase is associated with setting up formal management structures to manage business activities according to

Blank & Dorf (2012). However, a management framework of the business in the startup phase has been shown in this study to be critical in the LSM implementation journey.

Overarching all these codes building the Management theme is the argument by Ries (2011) that the entrepreneurship process is a form of management. In this context, one will be managing a startup or an early value creation process as this study supports.

5.3.1.2 Validated Learning

According to the study, Validated Learning is a key component of the process of implementing LSM. Validated Learning is a core concept of LSM which is completed by the BML loop and it is not surprising for this study to find out that practitioners assert its importance as it emerged as a strong theme in this study. This means that LSM entrepreneurs must ensure that they are capable of running initiatives that ensure that validated learning is taking place in the startup. The theme of Validated Learning emerges strongly in the data with nine codes attached to it which will be explored in detail as they are pertinent to the process of application. This finding aligns with Ries' (2011) argument that the primary objective of a startup is to master the process of building a sustainable and validated business model. Blank and Dorf (2012) assert the same point arguing that the number one priority of a startup is to validate its business model and this rests largely on how well the startup is going through product iterations and experiments that result in validated learning. It follows that a sustainable business model found through validated learning should serve the needs of customers and create shareholder value as decisions are based on facts and data.

It is important to note that while LSM does not guarantee success, a startup which is rooted in validated learning should achieve less and less of false-positives and false-negatives. As a result, whatever data and decision the startup pivots upon is true and valid. This ensures that the startup does not miss opportunities or pursue fake opportunities that will lead to a dead-end and a waste of scarce resources.

Participants honed in on Validated Learning spelling out why it is critical for a new business operating mostly with assumptions. Accordingly, validating the assumptions and learnings bolsters the confidence of the startup operating under conditions of uncertainty as this study finds out. The confidence built up by validated learning ensures that the startup maximises on LSM and gives the startup evidence to either pivot or persevere. Below the building blocks Validated Learning as a CSF are explored.

5.3.1.2.1 Data availability

Underpinning Validated Learning as a CSF are related ideas which this study reveals are important in LSM implementation. Critical to Validated Learning is Data Availability as a driver of the process. According to this study, data is not readily available to the entrepreneur and must be generated in one

form or the other. Often entrepreneurs struggle to decide on meaningful measurements making the process overly complicated. Knowing what to measure to make the data available is sometimes not clear to entrepreneurs. In addition, the data collection process can be hampered greatly when the entrepreneur cannot have access to the right people on whom to base research or data collection on or cannot derive a statistically significant data set. The right instruments to collect data need to be in place, which are easy to come up with using digital platforms.

LSM being a Bayesian decision making approach based on data, it would require data in sufficient amounts to allow the entrepreneur to arrive at solid conclusions (York & Danes, 2014). For this reason, the LSM practitioner must ensure that there is a reasonable amount of data to base decisions on.

5.3.1.2.2 Data quality

Closely linked to Data Availability is Data Quality. The quality of what the entrepreneur collects or measures determines the quality of the learnings from the data. Hence, it is important for the right quality of data to be collected and to avoid vanity metrics like *number of customers* which do not mean much in the big scheme of things for digital innovations. For digital startups, useful metrics could be *new activated users* (i.e use the product consistently), *cost of acquiring a new customer, and cash burn rate* (Blank & Dorf, 2012). According to Ries (2011), these are some of the examples of actionable metrics which the startup can use to objectively measure the business and validate milestones. Actionable metrics give the entrepreneur a picture of cause and effect (Ries, 2011) making them more useful in digital innovation startups. This gives the startup a clear picture of how to tune the engine of growth and what to focus on for maximum impact. Hence, data quality in terms of what is being measured is a critical component of the LSM process as this study attests.

5.3.1.2.3 Data analysis skills

LSM entails working with data which the entrepreneurs collect in the process of validating the business idea. The startup must be able to package the data into an intelligible format which is easy to understand and learn from. It is therefore important and critical to LSM that the entrepreneur be able to manipulate and read the data to validate or invalidate ideas as the study reveals. Reading into the data in the entrepreneurial space may imply going beyond the surface level of data and see the less obvious. Some opportunities which can go on to become lucrative business lines may be hidden in the data. It would then take good data analytical skills to uncover the story behind the numbers and charts. It is important to emphasise that the entrepreneur will also need to understand the relationships between certain variables in the business model and how they affect the big picture of the business.

5.3.1.2.4 Customer engagement skills

The study alerts us to the need for startups to engage well with prospective customers from the onset. For startups, the focus is more on engaging the early adopters and prospective customers to buy into the idea and court them for their goodwill to act as sources of data for the validation process. Customer Engagement Skills can be extended to inform the strategy the startup will need to use to get the engaged participation of customers from early on. This is critical as the startup will need data sources or a readily available sample size for product tests given the reliance of LSM on data and customer feedback.

As the startup seeks external engagement and participation in the new product development it is recommended to clearly communicate the vision to early customers. This way the startup is better placed to extract adequate objective feedback and avoid the obvious pitfall of early/prospective customers false-positive feedback.

5.3.1.2.5 MVP

LSM uses the MVP as an enabler for the different processes the entrepreneur needs to execute following the methodology. Data collection, communicating the idea to prospective customers, testing out features among other uses all require the use of an MVP in their different types as found in literature. Due to its pertinence in the LSM processes, it emerged as a critical enabling element to the Validated Learning CSF.

Duc and Abrahamsson (2016) studied the role of the MVP in early stage software startups and came up with dimensions of use in the product development process. The software startups implemented different types of MVPs from landing pages to piecemeal MVPs. The researchers deduced 3 primary themes which describe the typical uses of MVPs in product development. Startups use the MVP as a design artefact, as a boundary spanning artefact, and as a reusable artefact. As a design artefact, the MVP aids the process of visualising the design idea, is a tool for creativity, and acts as a tool to clarify mismatches on user expectations. The MVP as a boundary spanning artefact is used to bridge gaps between the business mind *vs* technical, startup team *vs* end user, and startup team *vs* investors. As a reusable artefact, the MVP is used for documentation of technical progress, as a growth hacking and bootstrapping tool (Duc & Abrahamsson, 2016).

The entrepreneurs who participated in this research used their MVPs primarily to collect data and as a proof of concept to investors. The other uses Duc and Abrahamsson (2016) highlighted are naturally embedded in the operations and processes of a startup with an MVP rolled out. Evidently, the MVP is a critical element of LSM, and this study asserts the importance thereof as Duc and Abrahamsson (2016) highlight.

5.3.1.2.6 Customer pain points

While LSM focuses on addressing customer pain points it does not negate the importance of the entrepreneur's knowledge of what these maybe. For LSM to yield the benefits intended from the methodology, the entrepreneur must give priority to understanding the pain points prospective customers need to be addressed. It is only when the pain points are validated through early customer engagements and prioritised that an MVP can be subsequently and iteratively turned into a product that addresses the same. Understanding Customer Pain Points and prioritising them is akin to the Empathise phase in Design Thinking.

It is important to note that in the case of digital startups customer pain points may also be in the software solution the startup is bringing to the market. The design of the product should aim to reduce friction as this negatively impacts customer or user satisfaction. These pain points that are internal to the product are not touch-point specific. However, the entrepreneur should have a means of tapping into such problems using data and analytics to address them. Understanding these pain points may help unlock opportunities in designing seamless customer experience (Caprara, et al., 2017).

While pain points maybe need-based it is important to think about product-specific pain points. In this study the thrust was on need-based pain points which the startup should aim to address first as this is important to the LSM cycle.

5.3.1.2.7 Focused and broad data collection

The study finds out about the importance of data for LSM as discussed in the literature review. The other elements of the Validated Learning that have been discussed here earlier are Data Availability and Data Quality. How a startup approaches data collection is also important giving rise to the Focused and Broad Data Collection elements. Data are a key enabler of LSM as Ries (2011) has shown around Validated Learning. This study points out the same.

While data are definitely needed the question is what approach needs to be implemented when gathering data. This study proposes gathering data broadly particularly in the early phases of the startup before building an MVP. By so doing, the entrepreneur can quickly scan for feedback from prospective customers on many levels of the problem to be solved to create a bird's eye view of the issues. The startup can use this data to inform the design of the first iteration of the MVP.

The second approach to data collection is focused and should seek to address specific objectives in understanding the product and the customers. Focused feedback collection is closely linked to Validated Learning and hypotheses testing. The LSM practitioner must therefore be able to design tests and identify relevant data sources or collection points in the various iterations.

By having the right data on hand startups are better placed to learn from it, plough back the learnings into the product and, build a product customers will pay for and use. When the startup focuses on data to deliver customer value it means that the risk of focusing largely on the solution is mitigated (Bosch, et al., 2013).

5.3.1.2.8 Experimentation

The study also shows the significance of Experimentation in the process of LSM implementation. This finding aligns with the building blocks of the methodology one of which is rigorous experimentation as shown in the LSM conceptual framework (see Figure 4) (Ries, 2011).

Of importance is not the mere identification of Experimentation as a CSF but the implications in the wider context of LSM and the objectives it seeks to achieve. The main one being validated business ideas stand a chance to succeed in the market. Critically, it is the mastering of the art of executing rigorous experiments that is important in this case.

Research shows that startups that take a rigorous experimental approach to idea validation achieve more valid frequent pivots to a different idea and perform better than startups with no rigorous experimental approach. This follows a study of 116 startups over a period of about a year in which both the control and treatment groups were taught gauging idea feasibility based on feedback. The treatment group was further taught to approach experimentation with rigorous scientific framework while the control group followed intuitive approaches (Gambardella, et al., 2018). This research augments the finding of this study that Experimentation is an enabling element for Validated Learning as a CSF for LSM as it has been shown in other research work to improve success and predict higher revenues (Mollick, 2019).

5.3.1.3 Entrepreneur Traits

The Entrepreneur Traits CSF is made up of four building blocks namely: Willingness to Be Wrong; Cognitive Biases; Detachment from Business Idea; Pivoting and Adaptability.

The common theme which ties these building blocks is that the entrepreneur can be a determining factor to the success of the methodology. LSM builds on the fact that the business idea to be validated is potentially 'wrong' in the eyes of the market in which case it will be rejected based on data. In this case, the entrepreneur should pay attention to the data and use it to decide a new course for the startup.

However, because of the cognitive entrepreneurial biases Eisenmann et al. (2013) touch on, the entrepreneur may not be ready to act in accordance with the data. This highlights that Willingness to Be Wrong or openness to contradicting information against the idea the entrepreneur may be attached to becomes critical in the process. Attachment to a business idea is not encouraged for LSM. Yoo et al.

(2017) argue that LSM is of least benefit to an entrepreneur with a strong belief in the idea to be validated. This implies that the entrepreneur should not approach the validation process with predetermined prefered outcomes to ensure that the process remains data-driven and objective.

Closing linked to the other three building blocks is Pivoting and Adaptability. This study advances the point that flexibility in opinion to change course should data suggests so is critical to LSM. The process of pivoting must happen as soon as the plan for a new direction is set to run the next experiment. This will ensure that validated learnings are quickly assimilated into the new product in a tight feedback loop.

Although entrepreneurial cognitive biases cannot be completely mitigated, all efforts must be made to reduce their impact following a framework of the measures discussed in Table 1. This will ensure that objectivity remains part of the LSM implementation towards the validation of business ideas.

5.3.1.4 Quality of Business Idea

The Quality of Business Idea CSF is made up one building block termed Sensible and Practical Business Idea.

The data shows that LSM is applicable to almost any idea. However, the preference of the methodology is for coming up with an idea that is "*scalable, so it has to have quality, it has to impact people's lives*" P4_2019. This statement from the research data points to the practicality of the business idea and the potential to be of value to society. In most cases, quality and valuable ideas carry with them great novelty which allows them to be impactful. Novelty may mean great uncertainty around the idea although it may be practical and sensible from principle. It is in this case where the benefits of LSM are most pronounced where an idea faces great uncertainty in the market that validating each facet of the business becomes important. Ideas which do not sound practical and sensible from principle are pointless to validate. In this study, close to 40 startups were enlisted at the incubation centre. By the end of the program, only about 10 startups were still in existence and in a position to have applied LSM to refine the idea. The study observes that the huge dropout rate has to do largely with the quality of the ideas which may be so impractical that validating them with experimentation is close to impossible. From the observations made, it is believed that this would lead to frustration and subsequent disintegration of the startup team as no progress towards a first MVP can be made in a reasonable time. This demonstrates the importance of novel practical and sensible ideas which one can breakdown and validate successfully with LSM.

For practical ideas of low novelty or which face no uncertainty in the market LSM can still be applied. However, the entrepreneur does not benefit much from LSM as all of the business' facets in terms of the BMC will be validated already. LSM is most beneficial where there is uncertainty and the

entrepreneur is looking for scalability. This finding is aligned to what Yoo et. al (2017) find that LSM is not beneficial to ideas of low innovation.

5.3.1.5 BML loop

Not surprisingly, the data shows the importance of the Build-Measure-Learn loop. This loop is central to LSM as Ries (2011) articulates Validated Learning is driven by it. The BML loop CSF is built of three elements found in the data namely: Measure; Learn; Iteration Speed.

It is important to note that although the BML loop CSF is derived from the data, the Build code is not included. Build existed as an element in the early CSF model. However, it lacked the minimum required frequency to be included in the final model.

The data proves that it is important in LSM to do the right measurements as the product is run through iterations. We have understood that entrepreneurs do not always know what it is they should measure about their product or service. If any data are to be collected the startup will need to be strong on measuring. What is more important is to measure the right metrics to avoid the trap of vanity metrics.

Measurements inform what the entrepreneur will learn from the data. The study finds out about the importance of the Learn aspect in LSM. As the purpose of the startup is to find a scalable business model according to Blank & Dorf (2012), learning as much about the product and validating these lessons is key.

In addition to the Measure and Learn codes, the data showed that it is important not to focus entirely on these two elements. According to this study, what is more important is the Iteration Speed element i.e. the rate of going through the BML loop. One of the key aims of LSM is to facilitate faster and frequent product releases to the market to elicit feedback at a fast pace (Ries, 2011), to which this finding attests.

5.3.2 Objective 2: LSM Applicability

Objective 2 of the study seeks to understand the perceived applicability of LSM to different digital innovation business ideas. The ideas may be operating in different sectors. This study comes up with a common and agreed position which says that LSM is very much applicable in the digital and technology space. More so in software products. This position is explained by the relatively short lead times associated with iterating from one version of the product to the next. These short lead times are facilitated by the fact that to iterate from A to B takes making software changes whereas in specialised physical products iterations could involve complex engineering processes with long lead times. As a result of the relative ease of implementation in the digital innovation space, entrepreneurs in this space tend to benefit more from LSM.

According to this study, there is no evidence which suggests that the perceived applicability of LSM is different across business ideas in the digital innovation space. Different business ideas were taken through LSM cycle from SaaS to consumer software products designed for completely different markets, but the available data do not suggest that LSM is less applicable to other business ideas. It must be noted that it is possible that though mostly applicable to digital innovation products as a general principle, some digital innovation products may be harder to build and take through the LSM cycle. The democratisation of the digital innovation space in terms of the relative availability of cheap outsourced coding skills is handy to startups if the core skills are not available internally. This should further promote digital innovation products.

5.3.3 Objective 3: Appreciation and understanding of LSM

LSM is relatively new and is still gaining traction in South Africa. This study revealed some inhibiting factors which may be specific to developing economies with South Africa serving as an example. The approach around getting investor buy-in when sourcing funding still follows the traditional method of business plans and principles of the waterfall method to new product development. As a result, local investors are not keen to fund startups readily unless the business idea has already accumulated traction as this study has found.

The other observation from the available research data is that the methodology is not only less popular but also not understood in depth. It was observed that there are knowledgeable practitioners and professionals in the software engineering field, however, outside of that, the methodology remains new.

Upcoming entrepreneurs understand LSM as a method that hinges mostly on "getting out of the building" to talk to customers as was understood during the yearlong study. It is clear that LSM includes much more interconnected concepts and should not be reduced to talking to customers as the big idea. The methodology consists of multiple concepts and stages which the LSM practitioner must diligently go through. Concepts like Validated Learning, Hypotheses Design, and Innovation Accounting are key and central to LSM and from a practical perspective, the data did not report much. There is a risk of not fully capitalising on the tools and processes in the methodology which is designed to make the process of developing startups more predictable towards achieving scalable businesses. For instance, Ries (2011) introduces Innovation Accounting as a powerful tool for entrepreneurs to determine if the startup is really making growth. It may be argued that every startup must be fixated on this since growth and ultimately scalability is what every startup searches for in the early phases. The data shows no awareness of this critical tool of LSM which suggests that in implementation possibly none of the startups were leveraging this tool.

Linked to the argument above, it was generally observed that the study did not get much ideas from entrepreneurs who had not read the book "*The Lean Start-up: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*" written by Eric Ries. On the other hand, participants who had gone through the book understood that LSM is a holistic approach and therefore they could contribute more during the discussions in a meaningful way. Figure 22 demonstrates this argument where 50% of the participants did not contribute more than 5 codes. Those who did contribute more than 5 codes reported to have read the book during or before the incubation program. It is critical that entrepreneurs who take on LSM as their approach be thoroughly informed and educated on what the methodology offers rather than shallowly thinking of it as limited to "getting out of the building" methodology.

5.3.4 Objective 4: Recommendations to LSM digital incubators

There are a couple of recommendations that can be derived from this study for digital incubators. Considering low-cost high-impact initiatives, focusing on the following can yield great impact on entrepreneurs and the incubation program namely: providing Ries' LSM book; hypotheses design; data analytics; increased mentorship & grounding in entrepreneurial biases; opening up more funding opportunities, and pre-qualification of ideas prior to admission.

The evidence from this study shows that entrepreneurs who read the LSM book by Eric Ries tended to know more about the methodology and articulated meaningful insights during the interviews. Also, the general impression is that entrepreneurs tended to reduce LSM to one main idea – "*getting out of the building*". Although most of the codes are on Validated Learning (see Figure 19 section 4.3.3), the majority of the contribution came from experienced facilitators who seemed to appreciate the importance of this concept in LSM. To improve in these two areas, it is proposed that startups which implement LSM are encouraged to go through "The *Lean Start-up: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*" and use it to guide implementation as an additional resource to classroom sessions. This way the entrepreneur will be fully grounded in the concepts and practices of LSM and maximise on the methodology. This should give the entrepreneur a solid footing in validating the business and possibly develop it to scaling.

Additionally, it is recommended to ground the entrepreneurs more in hypotheses design, data collection, and data analytics. These elements form key skills in LSM, and a gap was noted during the research as the entrepreneurs seemed not to have a rigorous grip on the three areas. It was noted that entrepreneurs may not know what to validate or what to measure or how to design experiments to execute. Without these core elements, LSM cannot be successfully leveraged as it is a scientific and data-driven approach (Ries, 2011).

It is also important for incubators to ensure LSM mentors maintain a tight feedback loop between themselves and the mentees. Feedback should be digested and where necessary ploughed back into the product. The progression of the product given the availability of feedback should be incremental and iterations should be executed quickly in the market. Sometimes that accountability may be difficult to maintain on the entrepreneurs who have a sense of entitlement to the business idea and direction they intend to take. In this case, it is recommended to ground entrepreneurs in the entrepreneurial biases that may affect LSM implementation as entrepreneurs may fail to pivot when data suggests so, falling victim to the Sunk Cost Fallacy described by Eisenmann et al. (2013) as an example.

It is also proposed to keep the startups exposed to wider funders and potential investors as the institution can leverage its relationships with the business community. One may realise that startups may go through incubation and struggle after the program ends due to lack of funding to bring commercially viable ideas to fruition and scale.

While LSM seeks to validate ideas, it is recommended to go through a phase of idea selection before the entrepreneurs are on-boarded. A high level commercial viability check is recommended when selecting the startups to ensure only solid entrepreneurs and potentially groundbreaking ideas are filtered through to LSM mentorship. Some business ideas simply do not take off because they do not address a real need in the market. The startup team may lack the courage to terminate the idea early and pivot to a completely different idea and end up arbitrarily going through the mentorship cycle. It was observed early in the program that some of the ideas that were on the table were not technically and commercially strong from a high level assessment. The teams subsequently disengaged from the program for other reasons not related to LSM. The main reason being weak founding teams with no grit to pursue their business ideas even with the provision of incubation facilities. Idea selection should be a strategic approach of any digital incubator to ensure mentees succeed, scale, and create employment.

5.4 Propositions

5.4.1 Proposition 1

For LSM to be beneficial to the practitioner certain minimum requirements need to be met in the process for the methodology to be successfully implemented resulting in either a scalable business or successful invalidation of the business idea.

Proposition 1 is related to the research question and the first objective which formed the basis of the study. The proposition is fully addressed as this research deduced a model of the CSFs for the successful implementation of the methodology in digital innovation space. These CSFs are the minimum

requirements the entrepreneur needs to be aware of to maximise on LSM and to make sure they are thoroughly embedded in the day to day activities through the LSM implementation cycle.

Figure 21 in the Results section depicts a model of the CSFs according to this study.

It is important to note these factors may also be critical in applying LSM in other settings apart from digital innovation space. For instance, CSFs such as Validated Learning and Entrepreneur Traits are not specific to digital innovation advancing the argument that other innovation spaces should require the same as they are central to LSM.

5.4.2 Proposition 2

The depth of LSM is not properly understood with practitioners limiting practice to a small number of the concepts the methodology represents.

Data suggests that LSM practitioners are limiting the ideas associated with the methodology to a few concepts. As already been highlighted the major takeaway entrepreneurs take way from LSM is "getting out of the building". Although there was much to say on Validated Learning, it was observed that entrepreneurs lack depth and cannot therefore fully maximise on this important aspect of LSM. Validated Learning is core in that Hypothesis Testing and Experimentation aspects feed into Validated Learning and those areas are weak as well. This research advances the argument that LSM is a much wider methodology whose concepts need to be all implemented in full where applicable to realise the envisaged advantages the methodology has to offer.

However, this is not an assertion that LSM is a perfect methodology with no pitfalls. It is acknowledged that it is a holistic methodology for practical purposes which must be implemented as such in an attempt to find a scalable business model. This claim is made on the backdrop that LSM has its weaknesses which may disadvantage the entrepreneur in certain instances. However, for businesses in digital innovation they stand to benefit more from the methodology due to its excellent fit in this space.

5.5 Conclusion

The study addresses each of the set out objectives by providing empirical evidence. Additionally, the findings relate to literature on the subject in the broader view of entrepreneurship and new product development within startups and even established organisations. It is interesting to note that some of the critical success factors derived from this study are in fact applicable widely to new product development in other spaces. For example, Validated Learning is certainly key and must be central in the process of LSM implementation.

The presented model of critical success factors highlights the important areas entrepreneurs need to ensure are in place as they apply LSM. This raises awareness of the other factors that need to be enforced or simply acknowledged to ensure entrepreneurs derive maximum benefit from the methodology. LSM in its own is not beneficial unless if it is applied with a rigorous intent while at the same time reducing the impact of the human element involved which brings in biases.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

6.1.1 Significance of the study

This study sets out to identify the CSFs of the Lean Startup Methodology in digital innovation space. Based on the qualitative analysis of the data, CSFs were derived. According to this study, it can be concluded that the CSFs model and enablers of LSM are in 5 themes: Validated Learning, Entrepreneur Traits, Experimentation, Quality of Business Idea, and Management.

The study also notes several enabling elements which fall under the 5 themes. Validated Learning was shown to be important to digital entrepreneurs given that the multitude of the enabling elements link to it as a CSF. Entrepreneur Traits is a rather interesting theme. It attaches the entrepreneur to the implementation highlighting that certain entrepreneur traits may lead to benefiting less from the methodology. This is closely associated with how biases highlighted by Eisenmann, et al., (2013) are inherent in the entrepreneurship process. For a startup to reap the most from LSM, these biases need to be kept in check to leave the scientific methodology to guide in objective decision making.

By examining LSM implementation in different business ideas in digital innovation, this study has shown that LSM is equally applicable to different ideas. To explain this, it is understood that the democratisation of digital skills and product nature being software/app, make it is easy for entrepreneurs in digital innovation to quickly build product iterations and test in the market. The change between version A and B could simply be a few lines of code. However, other products may be slow to develop and run iterations due to regulations if we consider the case of fintech startups. In other products where lead times are long, for instance in high tech engineering, running quick iterations may not be achievable thus limiting the applicability of LSM. As a result of short lead times in digital innovation space, digital entrepreneurs stand to benefit more from the methodology due to the ease of implementation in this space.

As LSM is relatively new, there was interest from the onset of the study to understand its appreciation in South Africa as an emerging economy. It was deduced that LSM is not yet a prevalent methodology of new product development in the wider local context. It is understood that LSM is still to be widely known. However, some companies in software development are familiar with the methodology and

apply it in software development activities. Practitioners of LSM are, however, limiting the concepts to apply in product development. The methodology is primarily thought of as a "get out of the building" approach to the extent that some ideas of LSM seem to receive little to no attention. This study advances the argument that LSM is made up of multiple concepts which should be put together in implementation to maximise the methodology for the benefits it can offer. To that effect, there is no point in the data where any of the participants talks about Innovation Accounting. By looking at how this concept is important in LSM one would have expected to come across insights that point to it. This shows that depth is still lacking in implementation.

The study also investigated ways of improving digital innovation incubation where LSM is used as the new product or startup development approach. Emphasis was placed on low-cost high impact initiatives which could result in maximised value from the observed incubation program. Without changing much of the observed program, the study points to the need to do more around hypotheses design and data analytics. More so, from the perspective of ensuring the entrepreneurs are more grounded in these critical areas of LSM. The need to raise awareness about entrepreneurial biases is noted as data showed that the entrepreneur as an entity is a CSF to LSM implementation. The belief is that the more these biases are exposed and measures to deal with are learnt, the more the negative influence of biases can be contained. Due to the observed lack of depth in what LSM fully encompasses, it is recommended that entrepreneurs be exposed to the literature on the subject for a full perspective of the tools available. Lastly, there is a need to open up more funding opportunities to the entrepreneurs to ensure that validated ground-breaking ideas can reach scalability which often demands more resources. Solid ideas should live to see maximum potential and the death of valid ideas after incubation should be watched with intent.

6.1.2 Research question and Objectives

The study addresses the research question adequately by providing the CSFs of LSM in digital innovation.

Objective 1 which ties into the research question was addressed. The relevant findings culminate in a CSFs model in digital innovation which is presented in the Results chapter.

Objective 2 is adequately addressed given the evidence and arguments presented on the applicability of LSM in different business ideas.

Objective 3 is sufficiently addressed. Adequate evidence is presented which tells us the level of appreciation and applicability of LSM in South African digital innovation startups.

Objective 4 is successfully achieved. Observations from the study are synthesised into recommendations and tangible actions that can help digital incubation programs become more successful.

All set out objectives were achieved as demonstrated above. By addressing these objectives, the researcher managed to confirm Propositions 1 and 2 which were set out before the study. Indeed, the study found CSFs for LSM in digital innovation and data confirmed the limited understanding of the full scale of LSM tools.

6.2 Limitations of the results

The delimitations to the study discussed earlier in Chapter 1 are important to note considering the shortcomings of the results. The study followed a qualitative approach with participants of varying levels of expertise in LSM. All participants were assumed to have sufficient knowledge of LSM to be able to give insightful responses. This posed a potential weakness in the quality of the responses. To mitigate this risk, the researcher ensured that complicated questions were simplified wherever the respondents seemed to be not clear of the questions.

It was noted that although the respondents could be familiar with the content or meaning of an LSM principle in some cases they were not clear of its high level name. A good example is Validated Learning which seemed to be a vague term in both groups and the researcher had to often break down the concept before the respondents could say their views thus ensuring responses were aligned to the question. Amongst the entrepreneurs, only one participant read the LSM book by Eric Ries. The rest of the entrepreneurs became acquainted with LSM through the classroom sessions. This explains why certain terms were vague from a theoretical perspective. To bridge this gap, the researcher broke down the questions into relatable concepts to facilitate a recollection of the concepts as would have been encountered by the participants in the implementation of LSM.

The researcher acknowledges that the study only focused on five experts and five startups. The setup of the research setting limited the sample space as the study was designed to study participants within the incubation facility in a case study format. However, the participation of startups resulted in a sample space of 16 participants. As a result, the researcher was able to obtain data from a wider spectrum of participants with different experiences and views on LSM.

The duration of the study was attuned to the incubation program duration. This means that the study focused on data obtained within this period. A proxy for success and determinant of how well the startups fared with LSM was an MVP product at the end of the incubation. What the entrepreneurs achieved after the end is not material to the study. The researcher is aware that the LSM process can

take longer than 12 months for startups to find a scalable product and business model. However, the study was limited as such for practicality purposes and to accommodate time constraints.

6.3 Recommendations for Future Study

The following related areas of study are recommended for further study:

- Investigating the critical success factors of LSM over a much larger sample of digital innovation startups and bigger sample of experienced practitioners of the methodology.
- Investigating the critical success factors and applicability of LSM in manufacturing startups to determine opportunities and challenges of the methodology in the context of South Africa.
- Investigating the critical success factors and the applicability of LSM in developing cost effective government programs with maximum impact and value to all stakeholders.

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8. APPENDICES

8.1 Appendix A

Business Idea: What for whom and how?

Product / Service Idea: Key functionality of the product / service.

Key Partners

Who are our Key Partners?
Who are our Key Suppliers?
Which key resources are we acquiring from partners?
Which key activities do partners perform?
Motivation for partnership:
Optimization and economy
Reduction of risk and uncertainty
Acquisition of particular resources and activities

Key Activities

What Key Activities does our value proposition require?
Our Distribution Channels?
Customer Relationships?
Revenue Streams?
Categories:
Production
Problem solving
Platform/Network

Key Resources

What Key Resources do our Value Propositions require? Our Distribution Channels? Customer Relationships?
Revenue Streams?

Value Propositions

What value do we deliver to the customer?
Which one of our customer problems are we helping to solve?
What business products and services are we offering to each Customer Segment?
Which customer needs are we satisfying?
Who are our competitors and how are we different?
Price?

Characteristics:
Newness
Performance
Customization
"Getting the job done"
Design
Brand/Status
Price
Cost reduction
Accessibility
Convenience/utility

Customer Relationships

What type of relationship / resources do each of our Customer Segments expect us to establish and maintain with them?
Which ones we have established?
How are they integrated with the rest of our business model?
How costly they are?
Examples:
Personal assistance
Dedicated personal assistance
Self-service
Automated services
Communities
Co-creation

Channels

Through which channels do our customer segments want to be reached?
How are we reaching them now?
How are our channels integrated?
Which ones work best?
Which ones are most cost-efficient?
How are we integrating them with customer routines?

Customer Segments

For whom are we creating the value?
How many potential paying customers?
Who are our most important paying customers?
How big a market share could you capture in what time frame?

Mass Market
Niche Market
Segmented
Diversified
Multi-sided Platform

User Segments

For whom are we creating the value?
Who are our most important end users?
How many potential users?
How many potential users by November?
Mass Market
Niche Market
Segmented
Diversified
Multi-sided Platform

Cost Structure

What are the most important costs inherent to our business?
Which key resources are most expensive?
Which key activities are most expensive?

Revenue Streams

For what value are our customer really willing to pay? How much?
For what do they currently pay?
How are they currently paying?
How would they prefer to pay?
How much does each revenue stream contribute to overall revenues?

Figure 23:Business canvas model (BMC) showing the multi-facets of the business

8.2 Appendix B



Participant Information Sheet - Observation

Good day,

My name is George Mukwawaya and I am a Masters student in Industrial Engineering at Wits University in Johannesburg. As part of my studies I have to undertake a research project, and I am investigating **critical success factors for Lean Start-up Methodology (LSM) in developing digital innovation start-ups.**

As part of this project I would like to attend the Tuesday LSM classroom sessions as an observer. This activity will involve sitting in the sessions as you teach the Lean Start-up Methodology. This observation session is not directed to you as the facilitator/lecturer or the entrepreneurs but rather aims to understand the development of entrepreneurs from an LSM content perspective i.e. what knowledge is required to implement the methodology. With your permission, I would also like to take notes during the classroom sessions. If you do not consent to this request, please note that there are no consequences of any kind.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time without any consequences of any kind. The observations will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the observations I note in the sessions will be held securely in a password protected laptop and not disclosed to anyone else.

If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email hrec-medical.researchoffice@wits.ac.za/ Shaun.Schoeman@wits.ac.za . If you have any queries with the HREC details kindly reach me on 582314@students.wits.ac.za / 073 125 6142 or Dr. Bruno Emwanu on Bruno.Emwanu@wits.ac.za / 011 717 7343 (Supervisor).

Yours sincerely,

George F. Mukwawaya.

Figure 24: Participant information sheet for observations

8.3 Appendix C

Consent Form for Observation

Title of project: A case study on the critical success factors in implementing the Lean Start-up Methodology in developing digital innovation start-ups.

Name of researcher: George Mukwawaya (582314)

I .....agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

- I understand that even if I agree to participate now, I can withdraw my consent to have my lectures/classes observed by the researcher at any time without any consequences of any kind.
- I agree that the researcher may attend my lectures/classes till such a time as the classes are no longer on my schedule or I have withdrawn my consent.
- I agree that my participation will remain anonymous.
- I understand that all information I may provide for this study will be treated confidentially.
- I understand that I will not benefit directly from participating in this research.
- I agree that the information I may provide indirectly or otherwise may be used anonymously by other researchers following this study.

Signature of participant:..... Date:.....

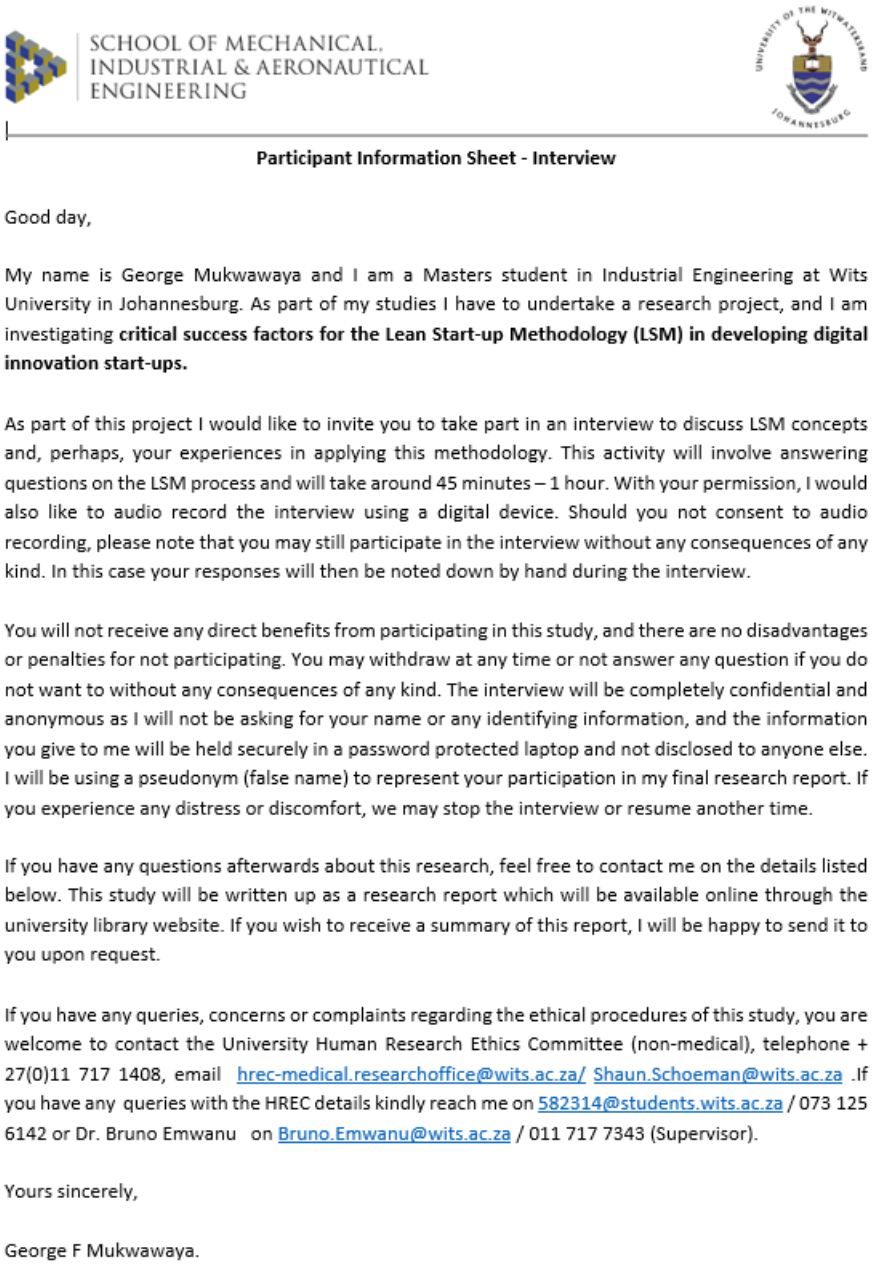
Signature of researcher:

I believe the participant is giving informed consent to participate in this study.

Signature of researcher:..... Date.....

Figure 25: Consent form for observations

8.4 Appendix D



SCHOOL OF MECHANICAL, INDUSTRIAL & AERONAUTICAL ENGINEERING

Participant Information Sheet - Interview

Good day,

My name is George Mukwawaya and I am a Masters student in Industrial Engineering at Wits University in Johannesburg. As part of my studies I have to undertake a research project, and I am investigating **critical success factors for the Lean Start-up Methodology (LSM) in developing digital innovation start-ups.**

As part of this project I would like to invite you to take part in an interview to discuss LSM concepts and, perhaps, your experiences in applying this methodology. This activity will involve answering questions on the LSM process and will take around 45 minutes – 1 hour. With your permission, I would also like to audio record the interview using a digital device. Should you not consent to audio recording, please note that you may still participate in the interview without any consequences of any kind. In this case your responses will then be noted down by hand during the interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to without any consequences of any kind. The interview will be completely confidential and anonymous as I will not be asking for your name or any identifying information, and the information you give to me will be held securely in a password protected laptop and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation in my final research report. If you experience any distress or discomfort, we may stop the interview or resume another time.

If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email hrec-medical.researchoffice@wits.ac.za/ Shaun.Schoeman@wits.ac.za .If you have any queries with the HREC details kindly reach me on 582314@students.wits.ac.za / 073 125 6142 or Dr. Bruno Emwanu on Bruno.Emwanu@wits.ac.za / 011 717 7343 (Supervisor).

Yours sincerely,

George F Mukwawaya.

Figure 26: Participant information sheet for interviews

8.5 Appendix E

Consent Form for Interview

Title of project: A case study on the critical success factors in implementing the Lean Start-up Methodology in developing digital innovation start-ups.

Name of researcher: George Mukwawaya (582314)

I .....agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

- I understand that even if I agree to participate now in the interview, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I agree that my participation will remain anonymous.
- I understand that all information I provide for this study in the interview will be treated confidentially.
- I agree that the researcher may use anonymous quotes in his research report.
- I understand that I will not benefit directly from participating in this research.
- I agree that the information I provide may be used anonymously by other researchers following this study.

Signature of participant:..... Date:.....

- I understand that the focus group interview may be audio recorded or alternatively responses may be noted down by hand.
- I grant the researcher permission to collect my responses by selecting one of the following methods:

  Audio recording ☐ Taking notes ☐
- I understand that even if I agree to an audio recorded interview or one in which the researcher takes notes of my responses now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

Signature of participant:.....

Figure 27: Consent for one-on-one interviews

8.6 Appendix F



Participant Information Sheet - Interview

Good day,

My name is George Mukwawaya and I am a Masters student in Industrial Engineering at Wits University in Johannesburg. As part of my studies I have to undertake a research project, and I am investigating **critical success factors for Lean Start-up Methodology (LSM) in developing digital innovation start-ups.**

As part of this project I would like to invite you to take part in a focus group interview together with your team to discuss how you implemented LSM from start to end. This activity will involve answering questions on the LSM process and will take around 45 minutes – 1 hour. With your permission, I would also like to audio record the interview using a digital device. Should you not consent to audio recording, please note that you may still participate in the interview without any consequences of any kind. In this case your responses and your team's will then be noted down by hand in the focus group interview.

You will not receive any direct benefits from participating in this study, and there are no disadvantages or penalties for not participating. You may withdraw at any time or not answer any question if you do not want to without any consequences of any kind. The interview will be completely confidential and anonymous to anyone outside the focus group as I will not be asking for your name or any identifying information, and the information you give to me will be held securely in a password protected laptop and not disclosed to anyone else. I will be using a pseudonym (false name) to represent your participation, in my final research report. If you experience any distress or discomfort, we may stop the interview or resume another time.

If you have any questions afterwards about this research, feel free to contact me on the details listed below. This study will be written up as a research report which will be available online through the university library website. If you wish to receive a summary of this report, I will be happy to send it to you upon request.

If you have any queries, concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (non-medical), telephone + 27(0)11 717 1408, email hrec-medical.researchoffice@wits.ac.za/ Shaun.Schoeman@wits.ac.za .If you have any queries with the HREC details kindly reach me on 582314@students.wits.ac.za / 073 125 6142 or Dr. Bruno Emwanu on Bruno.Emwanu@wits.ac.za / 011 717 7343 (Supervisor).

Yours sincerely,

George F Mukwawaya

Figure 28: Participant information sheet for focus group interviews

8.7 Appendix G

Consent Form for Focus Group Interview

Title of project: A case study on the critical success factors in implementing the Lean Start-up Methodology in developing digital innovation start-ups.

Name of researcher: George Mukwawaya (582314)

I .....agree to participate in this research project. The research has been explained to me and I understand what my participation will involve.

- I understand that even if I agree to participate now in the focus group interview, I can withdraw at any time or refuse to answer any question without any consequences of any kind.
- I agree that my participation will remain anonymous.
- I understand that all information I provide for this study in the interview will be treated confidentially.
- I agree that the researcher may use anonymous quotes in his research report.
- I understand that I will not benefit directly from participating in this research.
- I agree that the information I provide may be used anonymously by other researchers following this study.

Signature of participant:..... Date:.....

- I understand that the focus group interview may be audio recorded or alternatively responses may be noted down by hand.
- I grant the researcher permission to collect my responses by selecting one of the following methods:

  Audio recording ☐ Taking notes ☐
- I understand that even if I agree to an audio recorded interview or one in which the researcher takes notes of my responses now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

Signature of participant:.....

Figure 29: Consent form for focus group interview

8.8 Appendix H

Interview questions

Q: From your understanding and working with the Lean Startup, how best can you describe the methodology to a layman, what are the key takeaways from this startup development approach?

Q: Eric Ries says that *"Entrepreneurship is management"*. How important is this perspective to a digital entrepreneur?

Q: Can the understanding and appreciation of this statement above or lack thereof be critical in determining how beneficial the Lean Startup would be to a digital entrepreneur?

Q: In your view, how critical is validated learning (i.e. deriving lessons from hard data) to a digital startup?

Q: Validated learning implies the need for data collection somewhere in the Lean Startup process. For a digital startup are there any data availability issues you would want to highlight?

Q: Are there any challenges associated with learning from data for a digital entrepreneur should it be available?

Q: Any comments on how digital startups should approach learning about their customers i.e. should they try to learn everything or specific areas about the customers? Kindly substantiate your response.

Q: How important is experimenting to a digital startup? How easy is it to design experiments to run?

Q: In experimenting with the product/service in the market, what guidelines would you emphasise for digital entrepreneurs practicing the Lean Startup?

Q: In the Build-Measure-Learn loop (which facilitates validated learning) which of these stages do you view as most important and why?

Q: In your view, how important is pivoting for a digital startup and why?

Q: How well understood is the Lean Startup methodology by entrepreneurs in the digital space in South Africa?

Q: Considering digital solutions under your mentorship at Innocentre or otherwise, how applicable is the Lean Startup to different business ideas? Any limitations which stand out?

8.9 Appendix I

Braun and Clarke Framework

Step 1 Familiarise with the data

Step 1 of the thematic analysis process entails reading through the textual data at least once before coding can commence. The identification of possible patterns and themes happens as the researcher gets even more acquainted with all the aspects of the data in terms of breadth and depth (Braun & Clarke, 2006). This step requires the researcher to actively search for patterns in the data, often requiring repeated reading (Nowell, et al., 2017).

Step 2 Generating initial codes

Step 2 commences after the researcher has engaged extensively with data in the familiarisation step where interesting ideas in the data have been identified (Braun & Clarke, 2006). Initial codes are generated from the data by constantly revisiting it to arrive at meaningful and useful codes (Nowell, et al., 2017). Coding facilitates reflection and interaction with the data, and the researcher is able to simplify the data and focus on critical points – developing structured ideas from unstructured data (Nowell, et al., 2017; Savage, 2000; Morse & Richards, 2002). Step 2 involves identifying relevant sections from the data and attaching suitable labels as they relate to themes in the data (King, 2004). Braun and Clarke (2006) recommend that coding be done in a systematic manner by working through the data, paying attention to every aspect of it and identifying relevant aspects that will subsequently form the guidelines of themes throughout the data. Codes can be broken into sublevels yielding hierarchical coding. This way, the researcher can analyse the data broadly at a higher order code and details are provided by the lower order codes. The caveat is that too many levels of codes tend to be counterproductive in the analysis process (King, 2004).

Step 3 Search for themes

After coding all the data, the next step is to collate all the codes into relevant themes (Braun & Clarke, 2006). A theme should bring meaning and identity to repetitive ideas in their various forms as dictated by the experiences of the participants. Thus, a theme captures and condenses all the related experiences into a meaningful insight (DeSantis & Ugarriza, 2000). Braun and Clarke(2006) point out that a theme is relevant to the study if it captures important aspects of the codes in relation to the study's question. Theme development can follow inductive or deductive approaches. In applying the inductive approach, the researcher derives themes from the data. This ensures that analytic preconceived ideas do not influence the analysis. The inductive approach is data-driven. On the other hand, deductive theme development fits codes into theory and research conducted prior. The downside of deductive analysis

is the tendency to drift away from the richness contained in the overall data despite the fact that certain aspects can be locked in for a detailed analysis (Braun & Clarke, 2006). According to Braun and Clarke (2006), researchers can use a number of tools to organise the themes. These tools include tables, code manuals or mind maps as examples.

Step 4 Reviewing themes

The next step after coming up with themes is to review and refine them by going back to coded data extracts to determine coherence in building a pattern. Each theme is reviewed as a whole to determine its accuracy capturing what the data means (Braun & Clarke, 2006). The researcher should at this stage address all shortfalls either in codes or themes and make changes to improve the rigour of the analysis process. New relevant codes may be inserted and irrelevant or substantially overlapping codes may be deleted (King, 2004). The same process applies to themes which lack enough evidence from the data which may be collapsed into other themes while other themes may need to split into separate themes. Themes are required to be specific and discrete at the same time be broad enough to ensure that all relevant ideas from text segments are represented (Braun & Clarke, 2006).As themes become more clear and distinctive, the researcher should be in a position to understand how the themes fit together and the story that they articulate about the raw data (Braun & Clarke, 2006).

Step 5 Defining and naming themes

The fifth step entails determining the key and interesting aspects from the data that each of the themes captures. Once identified, a detailed analysis of what each theme is really telling about the data should be put together by the researcher (Braun & Clarke, 2006). At this stage, Braun and Clarke (2006), point out that the researcher can start to make analytic considerations about how each theme addresses the research questions. King (2004) suggests that themes should only be finalised once all pertinent pieces of text are considered and included. Furthermore, a prerequisite to the finalisation of themes is going through the data and themes at least twice (King, 2004). At the end Step 5, the researcher is expected to have developed clear definitions of the themes – what they represent and what they do not. If this level of clarity has not been reached more scrutiny and refinement are necessary (Braun & Clarke, 2006).

Step 6 Write-up

Writing-up the findings is the last step after clear themes have been established. The account of the findings should follow a logical, coherent and non-repetitive manner to yield an interesting account of what the data is revealing (Braun & Clarke, 2006). In addition to this, Thorne (2000) suggests that the processes used to arrive at the findings should also be logical and clearly communicated as this matters to improve the credibility of the findings to critical readers (Thorne, 2000). Direct quotes and extracts of

raw data may be included in reporting the findings in an effort to go beyond a mere description of the data to telling the complex story embedded within it (King, 2004; Braun & Clarke, 2006). The researcher will build a meritorious argument by interlinking literature with themes and research findings to confirm the findings, challenge existing literature or add to it (Braun & Clarke, 2006; Tuckett, 2005).

8.10 Appendix J

Example of Audit Trail of Data Analysis in QDA Miner Lite

The exhibits below show how the coding process and themes were found and organised in QDA Miner Lite. Below we see the interview text (data) in the centre from which codes were derived. On the far left the codes are organised into themes.

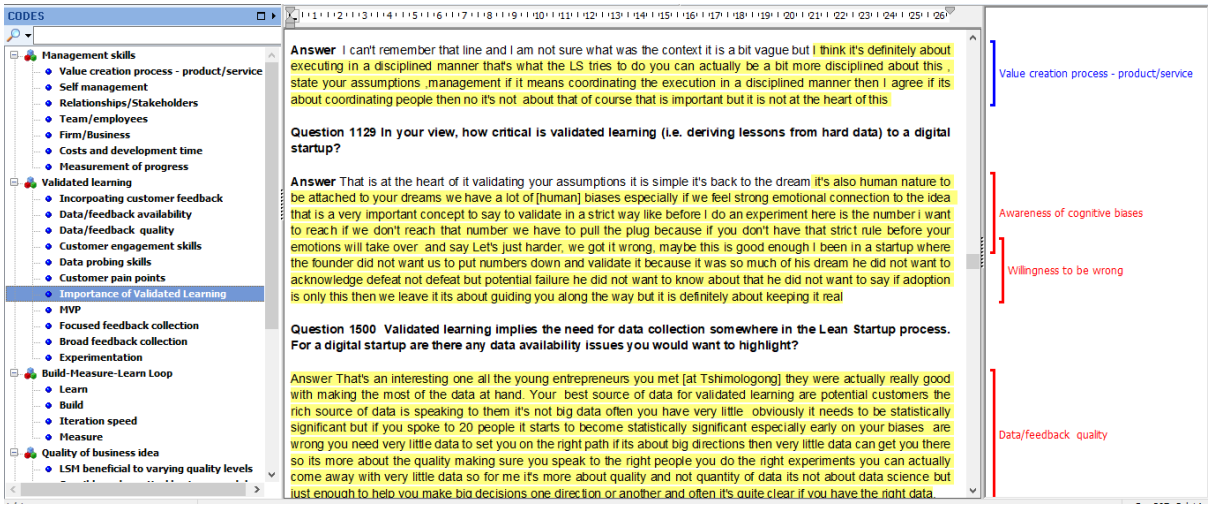


Figure 30: Thematic data analysis audit trail example 1

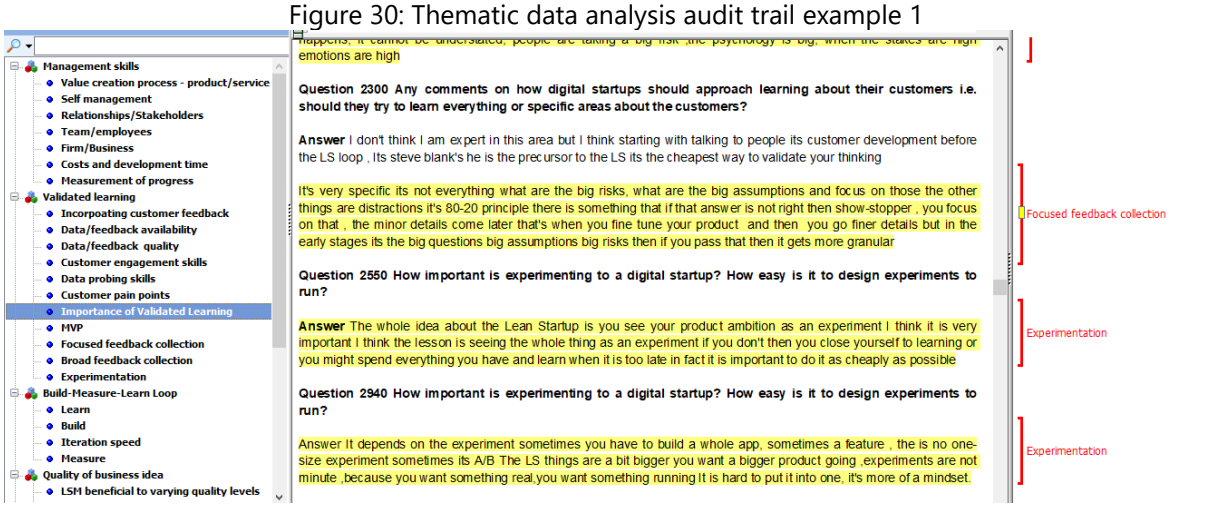


Figure 31: Thematic data analysis audit trail example 2

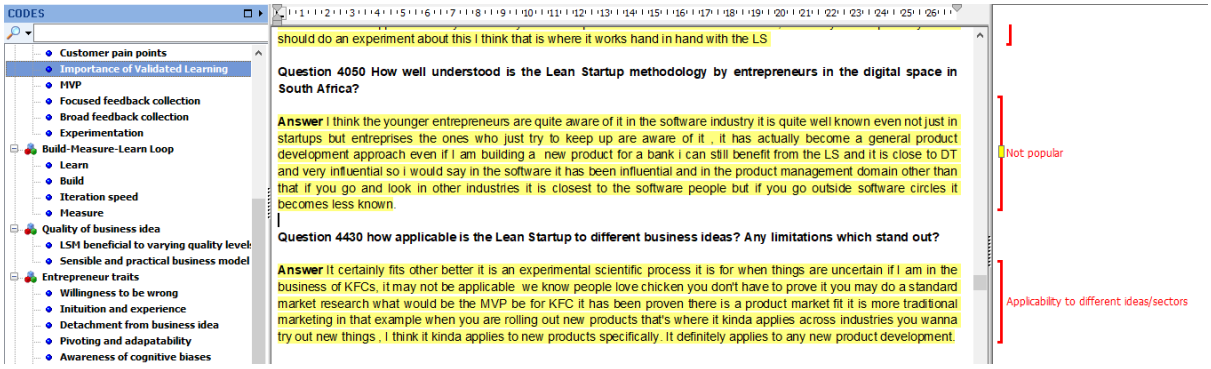


Figure 32: Thematic data analysis audit trail example 3

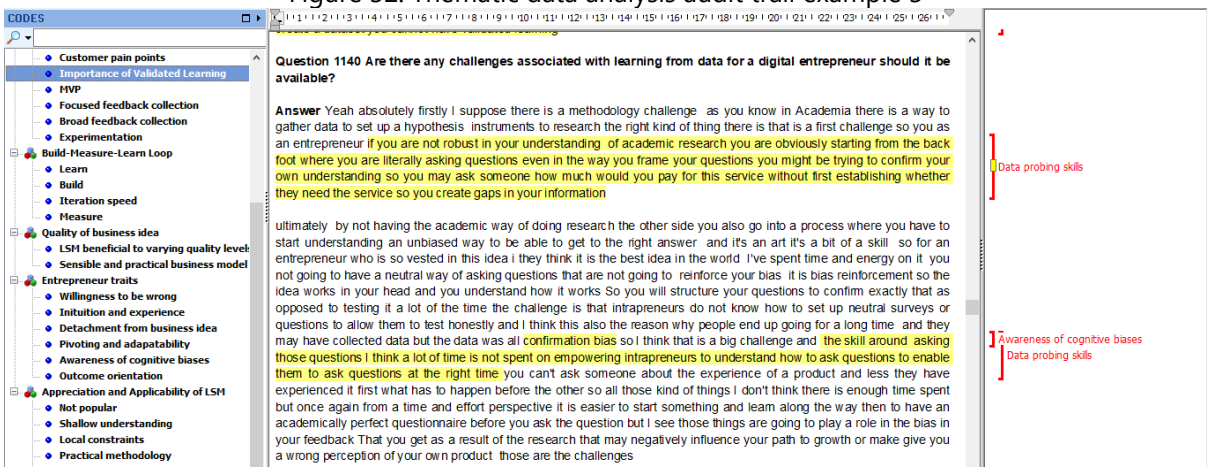


Figure 33: Thematic data analysis audit trail example 4

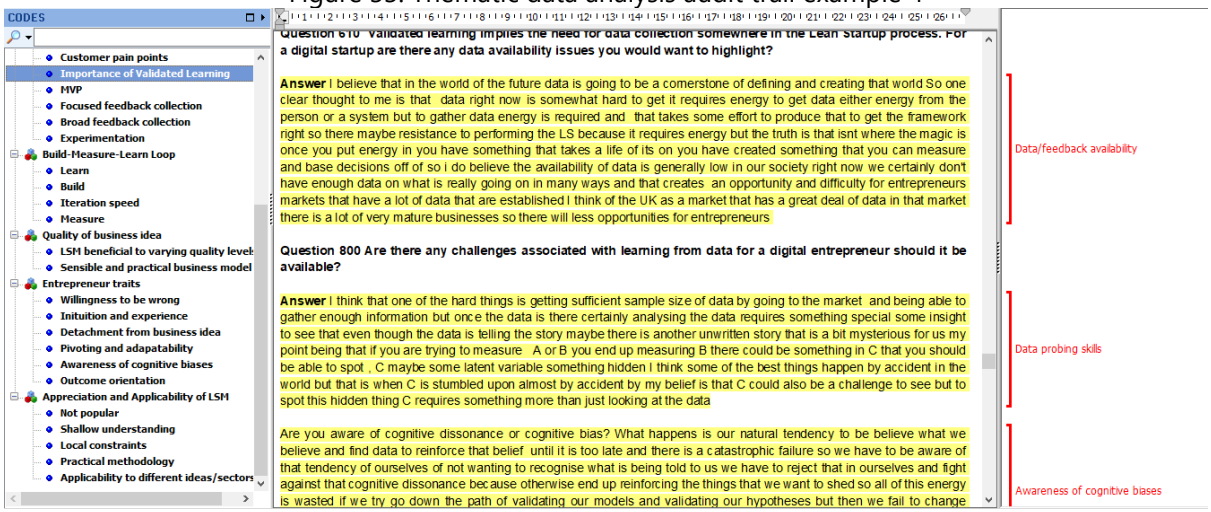


Figure 34: Thematic data analysis audit trail example 5

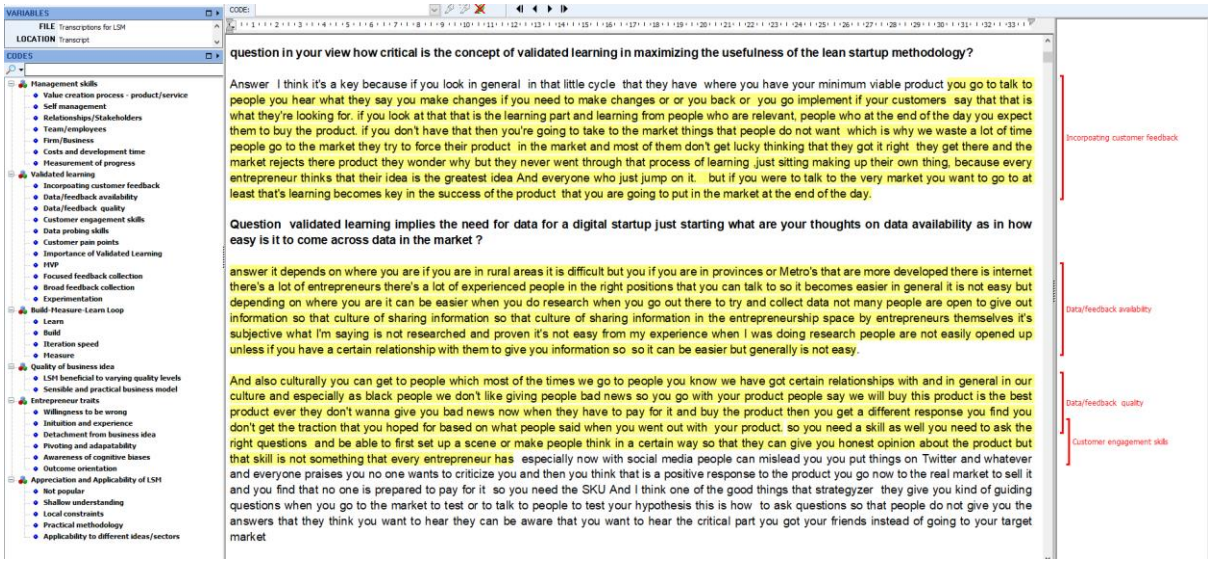


Figure 35: Thematic data analysis audit trail example 6

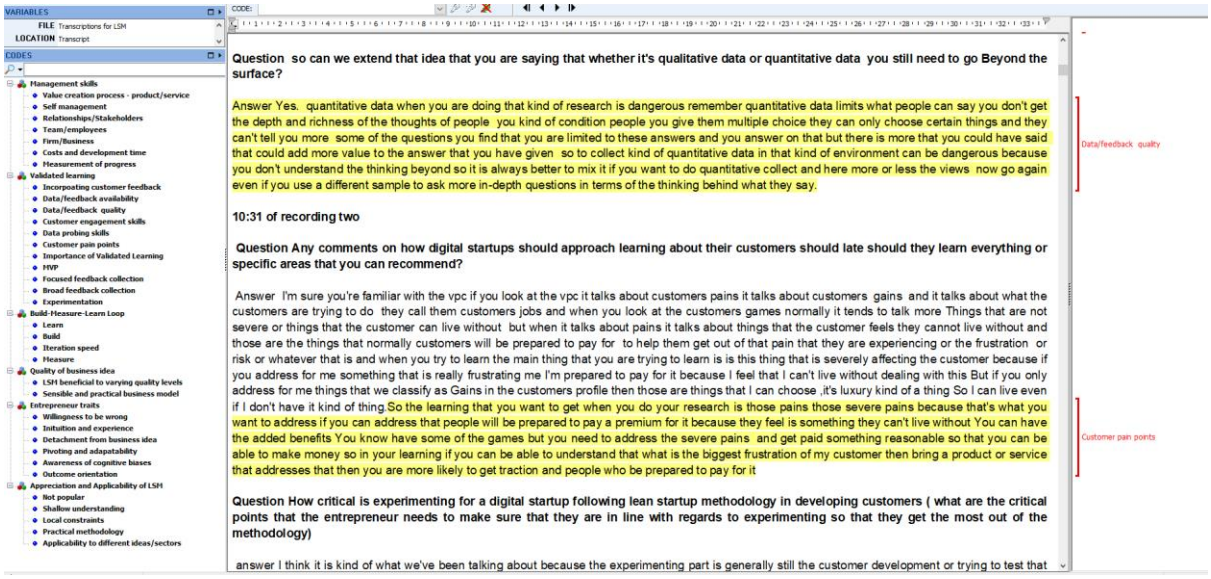


Figure 36: Thematic data analysis audit trail example 7

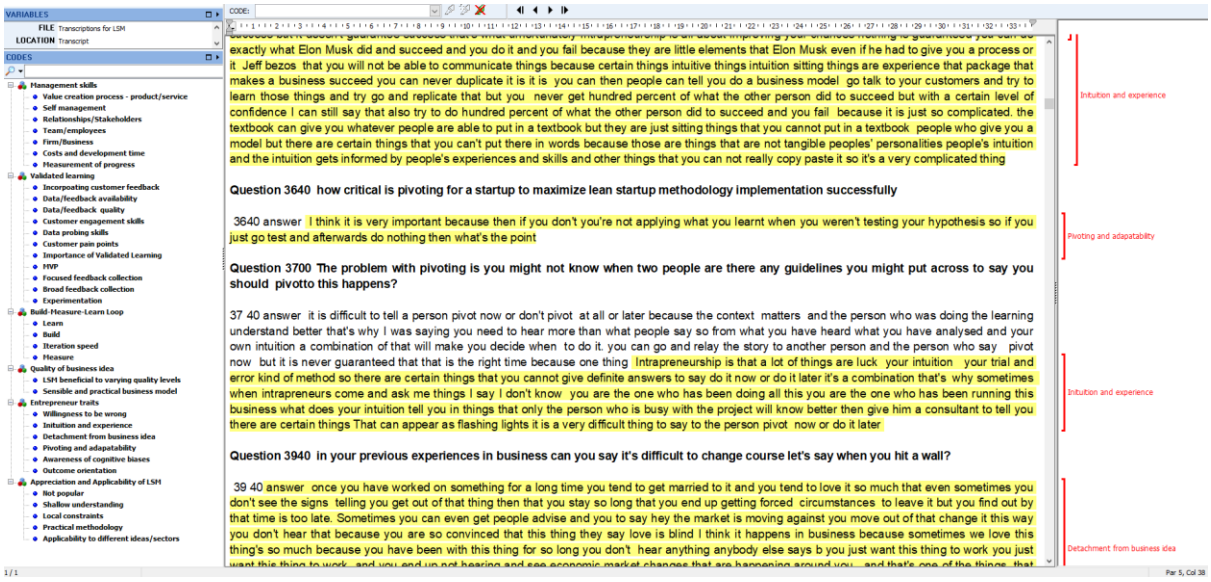


Figure 37:Thematic data analysis audit trail example 8

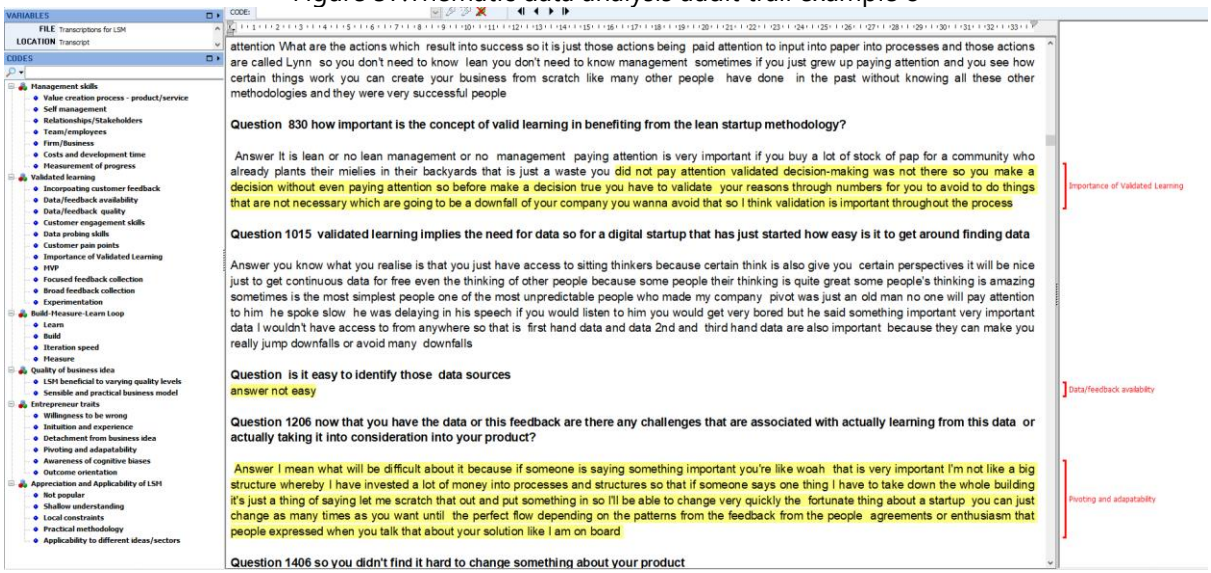


Figure 38: Thematic data analysis audit trail example 9

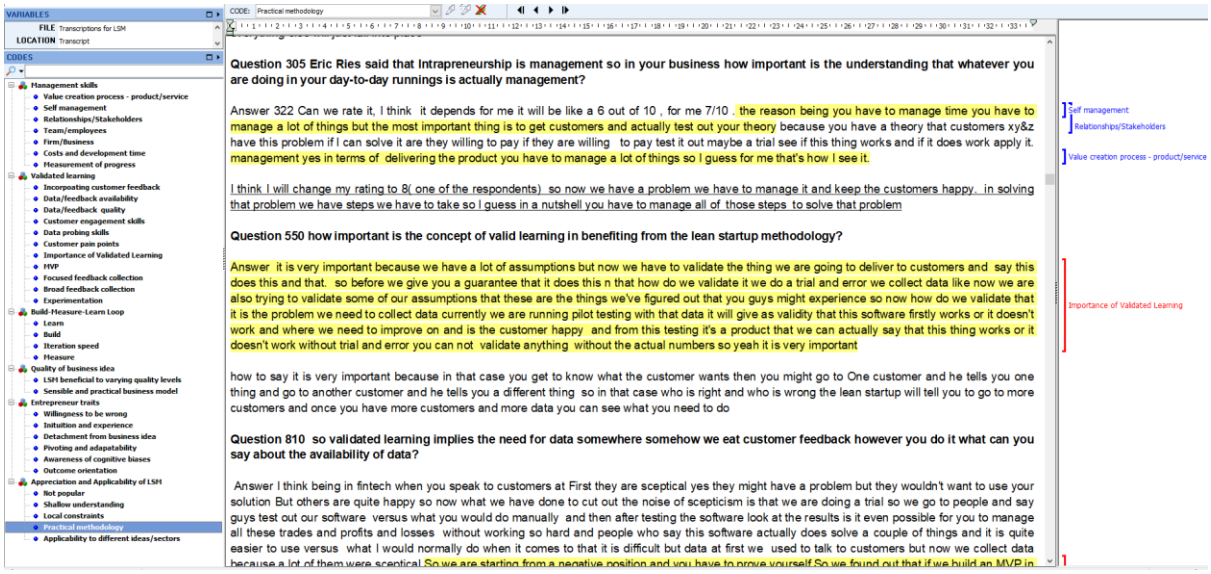


Figure 39: Thematic data analysis audit trail example 10