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Product Market Fit Frameworks for Lean Product Development

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Summary: To succeed in today's dynamic and evolving markets, businesses need to continuously design products that meet the demands of the customer. While such demands can be difficult to fulfil, they offer businesses the opportunity to evolve their business models, deepen their skill-sets and knowledge, expand into new markets, and scale their operations. To stay viable amid accelerating change, businesses need product development frameworks that anchor the mental models for designing products that fit the market. However, evidence suggests that many start-up businesses lack such models. This completed research paper makes two important contributions to academia and practice. First, a conceptual framework that links the concepts of product viability, feasibility, and usability/desirability to lean product development is developed. Second, an evaluation framework that enables businesses to design products that fit their markets is proposed. The frameworks are grounded in design science literature and their utility has been evaluated through the industry engagements of the research team. The theoretical limitations of the lean concept are exposed and its implications for R&D practitioners and academic researchers are highlighted.

1. Introduction

Many companies, especially software start-up companies do not succeed (Mullins and Komisar 2009, Crowne 2002) because they waste too much time and money building the wrong product before realising too late what the right product should have been (Nobel 2013, Bosch, Olsson, Björk, and Lujngblad 2013). Indeed, over 98% of new product ideas fail (Mullins and Komisar 2009). Many companies lack a structured process for testing their business model (Blank and Dorf 2012) which leads to a variety of uncertainties, such as the allocation of scarce resources and finances to new products without first evaluating the potential markets (market needs, size, growth rate, etc.). To overcome such uncertainties, companies are increasingly shifting from the traditional product-centric development approach to a more agile process known as customer-centric development, which essentially requires an iterative process of 'building and evaluating' products (Blank and Dorf 2012). However, agile processes are principally solution-focused and provide an answer for 'how' to build products quickly, but they do not provide an answer for 'which' product to build (Bosch, Olsson, Björk, and Ljungblad 2013). This presents a number of non-technical challenges for a start-up company as the potential customers' needs may not be well understood and it may not be clear how solutions to address these needs should be developed (Eisenmann, Ries, and Dillard 2012). In response to these challenges, the Lean Start-up Methodology (LSM) has been embraced by many start-up companies as it offers an integrated approach to addressing some of the many uncertainties associated with start-ups (Harb, Noteboom, and Sarnikar 2015). LSM focuses on creating value for customers and eliminating waste during the development phase (Blank 2013).

LSM has gained prominence mainly owing to the seminal work of Ries (2011), who in turn has been heavily influenced by the Customer Development Model proposed by Blank (2005). This model places the customer front and central and provides a process for testing business model assumptions about markets, customers, channels, pricing, and so forth (Bosch, Olsson, Björk, and Ljngblad 2013). In order to test these assumptions, start-ups need to 'get out of the building' because in many instances what customers perceive as value is unknown to those in the company (Blank 2013). Using this approach start-ups translate their vision into falsifiable business model hypotheses which are tested using rapid cycles of hypothesis-driven, customer-centric, experiments using a series of 'minimum viable products' (MVPs). MVPs represent the smallest set of features and activities needed to rigorously validate a concept (Eisenmann, Ries, and Dillard 2012, Edison 2015). Negative test results may demand that the company 'pivots' by changing elements of its proposed business model and to proceed by testing the new assumptions upon which that model is based (Eisenmann, Ries, and Dillard 2012, Maurya 2012). Pivoting is a key principle of the LSM and has been identified by some as a common denominator among successful start-ups, which rarely end up doing what they initially envisaged (Ries 2011, Eisenmann, Ries, and Dillard 2012). Companies that follow a business-hypothesis-driven approach to evaluating entrepreneurial opportunity are called 'Lean Start-ups' (Eisenmann, Ries, and Dillard 2012).

LSM provides a platform to extract knowledge and creativity from consumers and stakeholders which may lead to value-creation and product quality improvement (Ries 2011). In addition to engagement with customers, there are many other positive drivers underpinning the popularity of the LSM: benefits of business-hypothesis-driven experimentation, validated learning, time to market, less waste of resources, and reduced risk (Blank, 2013, Eisenmann, 2012, Ries, 2013). Certainly, these benefits are needed given the challenges of early startups (Giardino, Bajwa, Wang, and Abrahamsson 2015, Giardino, Wang, and Abrahamsson 2014) and naturally make the LSM attractive to startups, considering the percentage of them that fail (Ries, 2013). However, claims regarding the effectiveness of LSM have largely been supported by anecdotal evidence rather than empirical, rigorous research.

As is often the case, novel and emergent methods (such as the LSM) are driven by practice led research, where experienced practitioners and consultants develop, advocate, and disseminate these methods. LSM has mainly been driven by practice-led research from Blank (2008) and has subsequently been popularised by Ries (2011). While there are merits to adopting practice-led research, little (if any) academic research effort has focused on the theoretical development of LSM and its underlying concepts. The adoption of LSM has, therefore, been centered on how practices are adhered to, rather than on any deep understanding of the value garnered from its use, adaptation, or abandonment. This is similar to other practice-led methods, such as agile, where 'being agile' is defined by how many practices (sprints, standups) are used, rather than by the actual value obtained from their use (Conboy, 2009).

LSM research is beginning to gain momentum, as evident from an increasing number of dedicated journal special issues, conferences, and workshops. Yet, the current body of lean start-up knowledge, while growing, remains limited. A review of that literature indicates that, start-up companies (and indeed more established companies) often lack the capability to efficiently and effectively progress their Minimum Viable Products (MVP) to a Product Marketing Fit (PMF[1]). In response to this gap in knowledge, this study utilises a design research approach to developing two artefacts – the first is a conceptual framework (the VFUD[2] Framework - From MVP to PMF) that links the concepts of product viability, feasibility, and usability/desirability to lean product development, the second is an evaluation framework (the VFUD Evaluation Framework) that enables companies to develop prototypes into products that fit their market. The frameworks enable start-ups, as well as more mature companies, to objectively design and evaluate their MVPs. Hence, the aim of this paper is to describe *frameworks that can support practitioners in designing and evaluating the viability, feasibility, and usability /desirability of their MVPs.* The resulting frameworks are grounded in the principles of design science research and resulting empirical data that was collected through the industry engagements of the research team.

The remainder of this paper is structured as follows. First, we outline the conceptual development of the 'VFUD Framework - From MVP to PMF'. Second, we describe the research approach that informed the design and evaluation of the two frameworks. Third, the VFUD Evaluation Framework artefact is presented and a complementary set of generic evaluation questions for MVPs is provided. Finally, the theoretical limitations of the lean concept are exposed and its implications for R&D practice and academia are discussed.

2. Conceptual Development of the VFUD Framework

A Product-Driven Process may be used for a market that is well known, where the customer needs may be predictable, and where the competition is understood (Blank 2007). The historical product development process is illustrated in Figure 1. A major limitation with the Product-Driven Process is that it does not answer two vital questions: *"Where is the customers' place here?"* and *"What expectations does the customer have?"*

[1] Product Marketing Fit (PMF) refers to the fit between a solution and the identified problem (Nobel 2013).

[2] Viability, Feasibility, and Usability and Desirability Framework - From MVP to PMF

Adopting this strategy creates uncertainty as a company focuses little attention on gathering prior insights into who their customers are or why their customers would buy the product or service. Focusing the first customer shipment on a 'Ready, Aim, Fire' strategy is, therefore, highly risky (Blank, 2007).

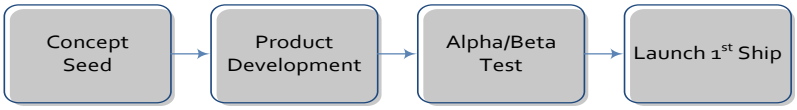

Figure 1: The product-driven process

In order to address market expectations, the product-driven model may be changed slightly to the classical Waterfall Process (see Figure 2). Challenges associated with the Waterfall model include the management of a large set of requirements, which usually may not be managed well and where there is misalignment with the customers emerging needs (Johnson 2002, Taylor 2000). Once the Waterfall Process starts, any fundamental changes necessary to meet customer needs may not occur (Blank and Dorf 2012), which can result in features being implemented even though they are not desired by the customer (Johnson 2002). This plan-based traditional waterfall method is more suited to a predictable, rationalised and engineering-based approach (Dybå and Dingsøyr 2008). In contrast, start-ups are generally exploratory in nature where there is a high degree of uncertainty around customers and even business models, as well as having limited resources (people, funding) and having to operate on very tight schedules (Bosch, Olsson, Björk, and Ljngblad 2013).

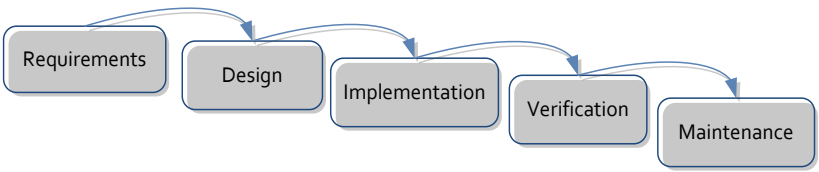

Figure 2: Product development waterfall process

The Agile Process is an incremental process that is used to facilitate an iterative interactive learning approach between an organisation and its customers to gather insights in order to develop a successful product (Johnson 2002). Feature-driven Development, Crystal, Scrum, Extreme Programming (XP), Dynamic Systems Development, and Lean Development belong to the agile family of methodologies which are used in software product development environments. The iterative 'design and review' nature of the Agile Process is illustrated in Figure 3 below, where results in the form of customer feedback are reviewed and used to inform decisions to make further changes to the product. After every iteration, the product (usually in the form of a prototype) is reviewed to determine whether it meets the needs and requirements of customers (Chang and Lu 2013). This process is repeated until a PMF is achieved and the product is ready for a market launch.

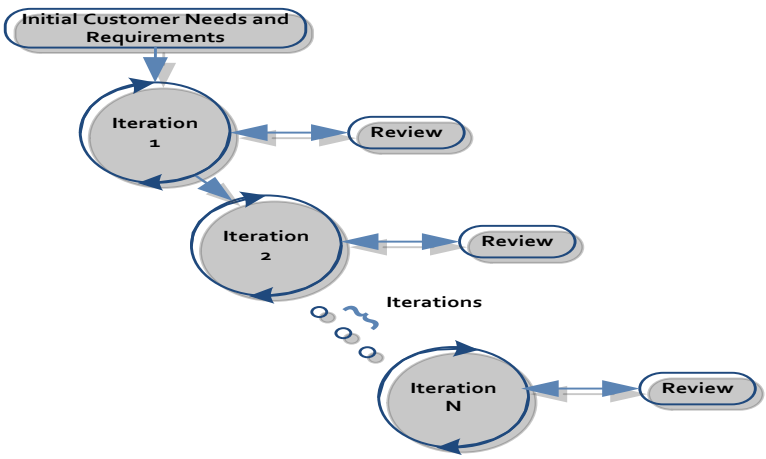

Figure 3: Iterations in the agile process

The advantages and disadvantages of being agile are well documented (Bahli and Zeid 2005, Cohen, Lindvall, and Costa 2004, Ilieva, Ivanov, and Stefanova 2004, Mannaro, Melis, and Marchesi 2004, Svensson and Höst 2005, Wils, Baelen, Holvoet, and De Vlaminck 2006, Petersen and Wohlin 2009). These are synthesised in Table 1 below.

Table 1: Advantages and disadvantages of being agile

Advantages	Disadvantages
Facilitates better communication and feedback due to small iterations and customer interaction.	Agile development does not scale well.
The benefit of communication helps to transfer knowledge between all parties.	Continuous testing requires much effort as creating an integrated test environment is difficult to deploy for different platforms and system dependencies.
Having the customer on-site to provide frequent feedback to developers and to update them with regular development progress.	Having customers on-site for the entire development process requires their commitment over a long time period and can be stressful for them.
From a work-environment perspective the agile concept is perceived as comfortable, respectful, trustful, and helps to preserve a quality of work life.	Testing is a bottleneck in agile projects as testing needs to be done frequently.

LSM belongs to the agile family of methodologies, which are (mainly) used in software product development environments. Such environments are characterised by extreme uncertainty as customer needs are not yet known and, therefore, the optimum solution remains unclear. LSM is most appropriate in these scenarios (Kodukula 2013). The principles of LSM include: eliminating waste, amplifying learning, deciding as late as possible, delivering as fast as possible, and seeing the whole picture (Cohen, Lindvall, and Costa 2004;Mannaro, Melis, and Marchesi 2004). LSM has gained popularity and is increasingly being adopted by start-ups and high-tech companies (Nobel 2013). To achieve the benefits of LSM, Blank and Dorf (2012, p. 544) advocate that companies need to adopt a Lean Launch Start-up Process (see Figure 4).

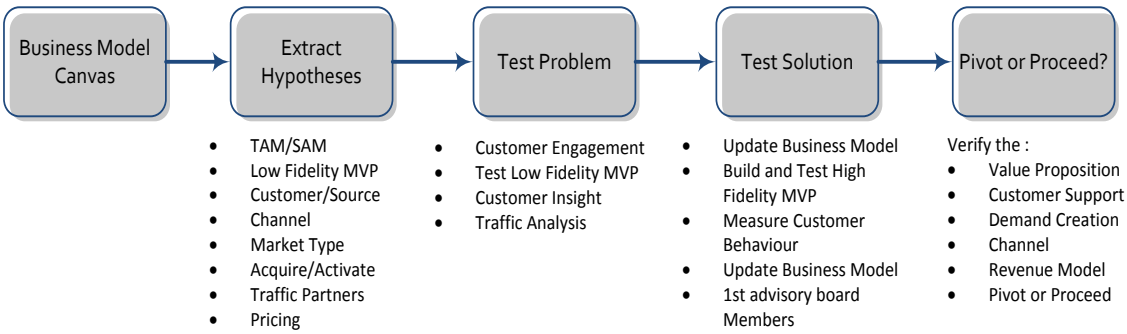

Figure 4: Step-by-step lean launch start-up process

It is proposed that a lean start-up ought to launch as quickly as possible with a 'minimum viable product' (MVP) which is the idea of the smallest product feature set necessary to go to market. The MVP allows the company to collect a large quantity of validated learning from the market about the customers while at same time devoting the least possible effort and cost (Ries 2011). In practice, lean start-up executives usually do not invest in scaling-up until they harvest substantial knowledge about how the solution fits the problem space and how it achieves the Product Marketing Fit (PMF). The Lean Start-up Process emphasises the need for companies to connect better with the people whom they serve (or intend to serve) in order to transform the customer's information into actionable ideas. This iterative collaboration between the company and customer enables the company to gather insights to increase the speed and effectiveness in moving the MVP towards PMF.

Based on this literature review as well as our academic and practitioner research, we have developed a framework to assist those adopting a lean start-up approach in moving iteratively from MVP to PMF – this is illustrated in Figure 5 below. There are three overlapping criteria in human-centred design that a new product concept must address in order to be a market success: viability, feasibility, and usability/desirability. The 'viability' space clarifies the answer to the question *"what is likely to become a sustainable business model?"* This includes the firm's strategic vision and its policies with regard to new product development and investigating its market segment. While the 'feasibility' space considers '*What is technically and organizationally feasible?"* and explores the technological foundations and requirements. Finally, the 'usability and desirability' space develops the necessary collaboration with the customer and stakeholders by asking "*What do people desire?"* and ultimately *"How do people decide on new products drawn out of innovative design prototypes?"* Essentially a business needs to start with the people whom they are designing for. Once a business has identified what would be desirable, it needs to consider potential solutions through the 'feasibility' and 'viability' spaces.

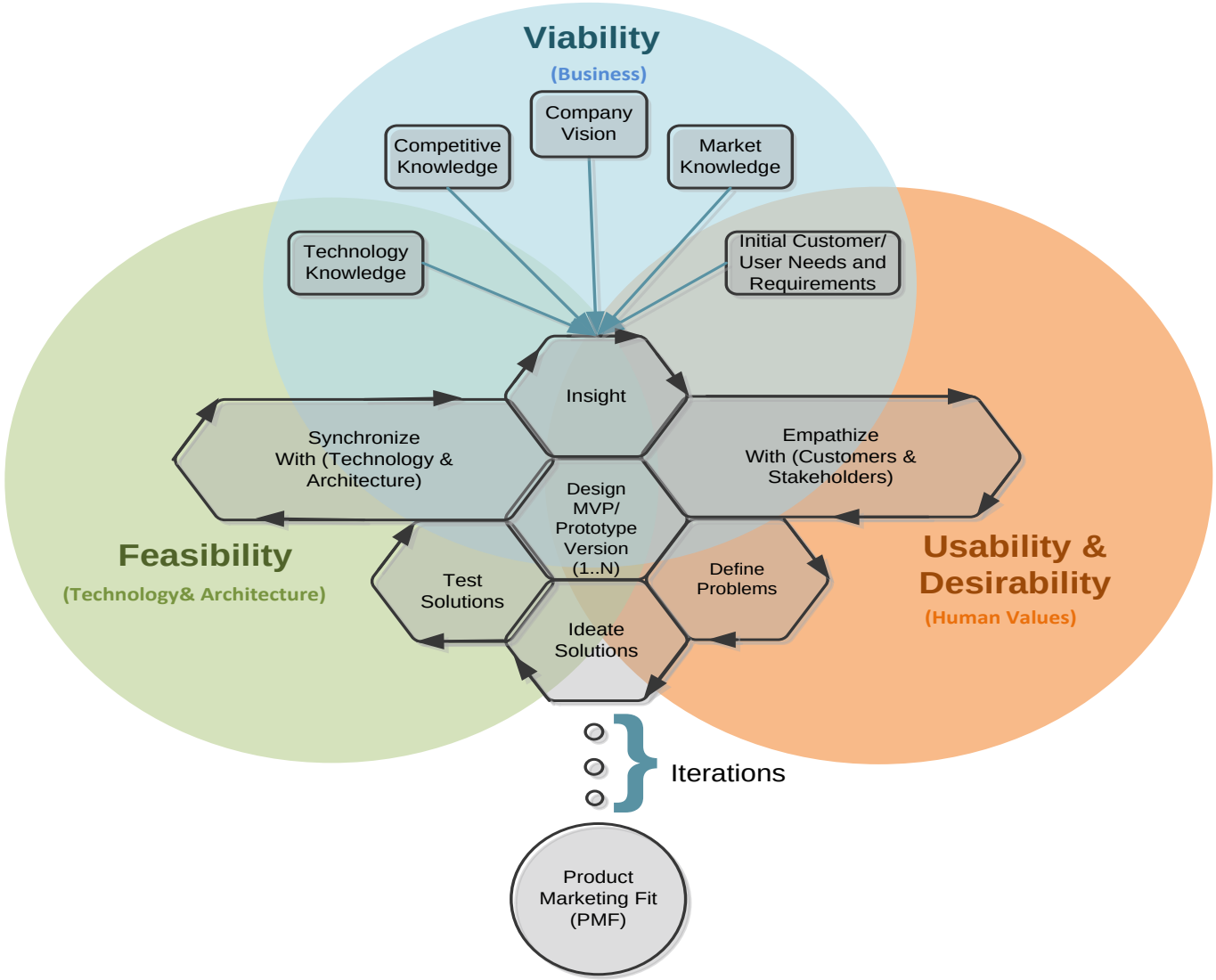

Figure 5: VFUD framework - From MVP to PMF

The solutions that emerge at the end of this process should be positioned at the intersection of these three criteria, which is referred to as the 'sweet spot'. It is here where optimum innovation occurs and is based on understanding the needs of the end-customer and creating products or services that fulfil their needs and desires and that generate sufficient value for the company.

3. Research Approach

The focus of this study is the design and evaluation using a design science research approach of the VFUD Framework and the VFUD Evaluation Framework. Design science research is a problem solving paradigm that seeks to *design and evaluate* innovative artifacts with the desire to use them to improve an environment (Hevner, March, Park, and Ram 2004, Simon 1996, Holmström, Ketokivi, and Hameri 2009, Gregor and Hevner 2013, Venable, Pries-Heje, and Baskerville 2012, Kuechler and Vaishnavi 2008). A key motivation of design science research is to 'build and evaluate' artifacts that when introduced improve the environment (Simon 1996). It is difficult to delineate the term evaluation due to its complexity and variety of application areas, (Cleven, Gubler, and Hüner 2009). Scriven (2007, p. 25) defines evaluation as a "process of determining the worth, merit, or significance of entities, and evaluations are the outcome of that process. Evaluation may be internal or external, or a mix of these; and it may be quantitative or qualitative, or a mix of these. It is strongly although not always sharply distinct from explanation". Accomplishing an evaluation tends to be difficult due to challenges such as objectivity, comparability and traceability of an evaluation (Cleven, Gubler, and Hüner 2009). The evaluation approach that was followed in the study is listed in Table 2.

Table 2: Evaluation approach adopted in the research

Question	***Description of Criterion***	***Reference***	***Criterion adopted in Study***
What?	This relates to the *object* of the evaluation, which may be a *construct*, *model*, *method*, and/or *instantiation*. Each of these may be evaluated in one of two modes – evaluation of the *artefact-as-such* or *artefact-in-use*, where the former involves evaluating the artefact without any involvement from real users, while the latter involves evaluating how real users interact with the artefact.	Cronholm and Goldkuhl (2003)	The *objects* of the evaluation are two models: 1) the VFUD Framework - From MVP to PMF and 2) the VFUD Evaluation Framework. Both models were evaluated as *artefacts-in-use.*
How?	This relates to the *means* of evaluation, which may be *goal-based*, *goal-free*, or *criteria-based*. Goal-based evaluation means that the quality of the artefact is compared to predefined organisational goals. Criteria-based evaluation means that artefact is compared to predefined general criteria that are not specific to an organisational context. Goal-free evaluation means that the artefact is determined in an inductive and situational way as no predefined goals exist. Each of these can be further subdivided into qualitative and quantitative evaluations.	(Cronholm and Goldkuhl 2003, Cleven, Gubler, and Hüner 2009)	The study adopted a goal-free evaluation approach using predominantly qualitative evaluations through the use of focus groups, face-to-face interviews and online user studies.
Who?	This relates to the *performer* of the evaluation, which may be either an *internal* party (who is also involved in the construction of the artefact) or alternatively an *external* party (who is not involved directly in its construction).	(Cleven, Gubler, and Hüner 2009)	The research team primarily acted as the internal party for the construction of the artefact. External party evaluation occurred through industry engagement.
When?	This relates to the *timing* of the evaluation, which may be selected from *ex ante*, *ex post*, or *both*. Ex ante evaluation is when the proposed artefact is evaluated before it is implemented, whereas ex post evaluation is when the artefact is evaluated after it is implemented.	(Pries-Heje, Baskerville, and Venable 2008)	*Ex ante* evaluations were conducted between August and November 2013 and *ex post* evaluations occurred between Nov 2013 and Mar 2014.
Where?	This relates to the *locus* of the evaluation, which may be either *naturalistic* or *artificial*. Naturalistic evaluation takes place in realistic settings, whereas artificial evaluation takes place in contrived settings. Naturalistic evaluation is '*the real proof of the pudding'* as it involves real users using real solutions to solve real problems.	(Venable 2006)	A blend of artificial and naturalistic evaluations was conducted throughout the study. Artificial evaluations were necessary for the online user studies and naturalistic evaluations of the artefacts were conducted at the workplace of participating employees.

The evaluation activities (i.e. user studies, focus groups) were executed in order to capture meaningful insights from industry partners and to build these insights back into the frameworks. User studies are an essential tool for the success of virtually any design endeavour and may include methods such as surveys, usability tests, rapid prototyping, cognitive walkthroughs, quantitative ratings, and performance measures (Kittur, Chi, and Suh 2008). While focus groups are used for exploratory and confirmatory research methods because the nature of the data generated is different to that of other research methods, and it is useful when researchers want to build a holistic understanding of a topic or a problem situation based on the participants' own comments and experiences (Bhattacherjee 2012). Focus groups are also useful because the interactions between participants allow for the emergence of ideas or opinions that are not usually uncovered in individual face-to-face interviews which in turn produces a rich body of data (Stewart, Rook, and Shamdasani 2007, Wilkinson 2004, Peffers and Tuunanen 2005).

4. The VFUD Evaluation Framework Artefact

Informed by academic literature and empirical data gathered from the evaluations, the research team developed the VFUD Evaluation Framework that is depicted in Figure 6.

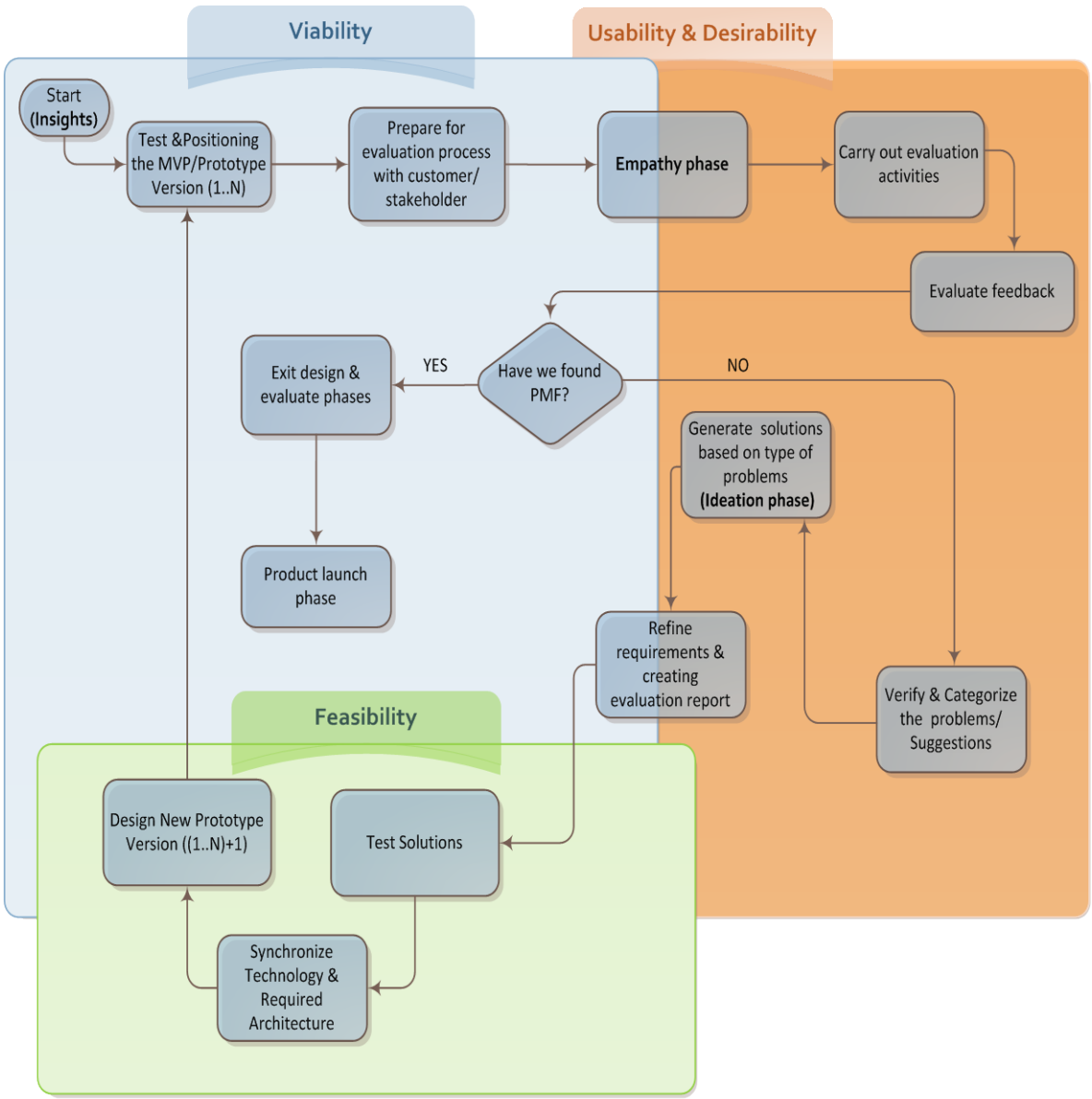

Figure 6: VFUD Evaluation Framework

The VFUD Evaluation Framework advocates a process that commences with the insights that are the primary motivation for creating a new product and form the basis for developing the initial MVP. Following this, the company commences the empathy phase by engaging with existing customers or potential ones using techniques such as focus groups and field observations of people using the MVP in its intended environment (e.g. workplace, home).

Feedback is collected, collated, and evaluated to establish if the company has found a product-market fit. If a PMF is found then evaluation is complete and a product launch is planned. In most instances though, the empathy phase reveals various problems that were not envisaged by the design team during the ideation phase. The MVP is subsequently refined by adding new features to the product, removing features not desired, or modifying features that were problematic for users. This results in a new version of the MVP and a second iteration of the evaluation process is required. If no PMF is found, the design team further modified the MVP. This iterative evaluation process is repeated until the MVP moves closer to the PMF. Once the PMF is found, the next phase is to prepare for a product launch phase. To manage this evaluation process, Blank and Dorf (2012) advocate that a company should maintain a Product Positioning Statement Template. The statement identifies the product name, product version, target user, category, key benefits, and the key differentiations with similar products currently on the market by other competitors.

Through further industry engagement the research team derived a set of generic evaluation questions (see Table 3) that enable practitioners to comprehensively test the concepts of viability, feasibility, and usability/desirability of a MVP. While Table 3 is not an exhaustive list of evaluation questions, it does provide a good starting point for companies to ask the right evaluation questions which in turn help to keep the evaluation process on course.

Table 3: Generic evaluation questions

Viability Lens (Business)	o Is there a well-defined market with potential customers for this prototype? o Does the prototype have a better performance and features in comparison with the similar competitors' products? o What would be the probable barriers to customers adopting the prototype? o If the prototype addresses the target market, what would be its market share comparison with the competitors' similar product? o Does the company embrace the necessary standards which the market addresses for this kind of prototype? o How much financing would be necessary to spend on this prototype to grow sufficiently to address the target market? o What is the company's customer retention strategy for the prototype? o What are the company's patent policies that relates to the prototype? o Who are the key players in relevance to this type of prototypes?
Feasibility Lens (Technology & Architecture)	o Do you usually do similar activities as paper-based or on-line? o What other technologies or platforms would you use for these activities? o What other features are related to this prototype? o Do customers trust the product? If not, why not? o What features and performance are provided by the closest competitors? o Are the technologies/architectures expensive at the business-side for the development phase? o Are the technologies/architectures expensive at the customer side for the deployment phase?
Usability & Desirability Lens (Human Values)	o What is your first impression of the prototype? o How much better or worse is this prototype than what you have used previously? o What businesses do you recommend that deployment of this product would be essential? o Having tested the prototype, what do you think are its strengths and weaknesses? o Have you used with a different prototype with the same functionality? o What do you least like and most like about the interface design? o What do you think about user layout customisation? (i.e. selecting necessary fields, positioning reporting columns and diagrams) o What level of proficiency is required to use this prototype? o How much training might be required?

This set of evaluation questions balances discussions related to the three lenses (viability, feasibility, and usability/desirability) which in turn enable companies to objectively evaluate their MVP. Objectivity is important as it ensures that designers and design teams do not have a 'rose tinted' view of their MVPs, which may be technologically feasible but lack the viability and/or the usability/desirability to be successful.

The implications of this study for R&D practitioners and academic researchers are discussed in the next and final section.

5. Implications for R&D Practitioners and Academic Researchers

LSM has been receiving increasing attention from R&D practitioners and academic researchers, yet there is a notable absence of frameworks to assist companies with achieving PMF. Our ongoing industry collaborations have demonstrated the criticality of developing frameworks for assisting companies in understanding how to go about LSM and how to design and evaluate MVPs to ensure PMF. In line with the research in Conboy (2009), we found that when it comes to LSM there is limitation in the knowledge of practitioners and academics, such as:

1. *Lack of clarity:* There is a general consensus in principle regarding what constitutes key lean concepts such as MVP and PMF. However, assumptions regarding the specific definitions, interpretations, use and evaluations are often unclear in many studies using lean as a theoretical lens which make critical appraisal, evidence-based evaluation and comparison across studies extremely difficult.
2. *Lack of cumulative tradition:* A good concept or theory should cumulatively build on existing research (Dubin 1978) and behind any good concept or theory there should be a strong underlying logic and rationale. Whetten (1989) refers to this as "theoretical glue" that should bind all the factors together. Theories are more likely to be cumulative "if new attempts at theorising clearly identify the prior theory that relates to the problem area… and then build on as much relevant prior work as possible" (Gregor and Jones 2007 p. 20). Yet, there has been very little academic research that has examined lean start-up using more mature and substantive theories, frameworks and other lenses that have been tested over time. Rooted in manufacturing, the lean concept has been robustly applied in manufacturing since WW1 and yet, in lean start-up, we observe a myopic and limited use of the broad lean frameworks available and little if any consideration of other concepts (agility, flow, and innovation) that influence the success of lean.
3. *Limited applicability:* As the range of applications of a concept is a key criterion for judging its quality (Dubin, 1976, 1978; Metcalfe, 2004; Weick, 1989), lean start-up and its underlying components should be applicable in a wide variety of contexts. Adherence based measure of lean start-up inhibit the ability to apply it in domains other than that originally intended. Research, such as this study is now attempting to apply LSM in other environments such as large organisations, regulated environments, and indeed in organisations that are experiencing the challenges typically associated with a lean start-up company. Undoubtedly this will become a more prevalent issue as this trend continues.

It could be argued that these limitations are not that important since "there is nothing as practical as a good theory" (Lewin, 1951). However, we know from existing research the concerns raised above resonate with the issue of fragmented adhocracy (Conboy, 2009, Banville and Landry, 1989, Fitzgerald and Adam, 2000, Hirschheim Klein, and Lyytinen, 1996) an issue that could overshadow the Lean Start-up Movement.

We, therefore, utilised a design research approach to develop two artefacts – the first a conceptual framework (the VFUD Framework - From MVP to PMF) that links the concepts of product viability, feasibility, and usability/desirability to lean product development and the second an evaluation framework (the VFUD Evaluation Framework) that enables businesses to develop prototypes into products that fit their market. The evaluation of the frameworks provided some evidence that they assist start-ups, as well as more mature companies, to objectively design and evaluate their MVPs. In real terms our frameworks have assisted companies in introducing new products through an iterative process of 'designing and evaluating' their MVPs using a robust set of evaluation hypotheses. In addition (and perhaps more importantly) we have observed how the frameworks have strengthened their mental models of how to go about introducing new products. We expect that this impact will be long term as the frameworks have shaped their design practices and design philosophies. However, a longitudinal analysis of these changes would be required before we can comment on the long-term impacts of the changes.

Finally, while this study makes a contribution to addressing these issues, significant contributions from the wider research community is required for the theoretical advancement of the lean concept and for examining its applicability to new domains.

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