Design Driven Innovation – Minimum Viable Products and Energy Solutions in Rural Nepal

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Abstract: Design-driven innovation is claimed to have most impact when being carried out in early phases of the product- and service development process. Yet, designers struggle getting valuable contributions from users when developing an innovative product or service, or approaching alternative markets. This is partly due to the fact that user needs are difficult to validate before the product/service is launched. Minimum Viable Products (MVPs) address this problem. MVPs is a technique of the Lean Start-up concept, that helps design teams to establish a practice of connected leaning and development and it may lead to new opportunities for high-value user research. The MVPs process comprises proactive and customer-centric steps that utilize research for product and service innovation. MVPs are useful to test both vulnerable hypotheses on venture models, on the utility of a product before making efforts to improve its usability and desirability, and on promotion strategies. In the following article the value of the MVP concept for the product development process is analysed. We examine how MVPs can be integrated in the design process and sketch an example how the technique can be employed for accelerating the development of an off-grid energy solution in rural areas in Nepal. Conclusively, advantages and pitfalls of the MVPs for innovative product development are discussed. One value for the design team and the stakeholders is for example that with MVPs the product development does not end in a final delivery – the real learning starts when the product is launched. Further, MVPs emphasize the importance of testing different prototypes, which is an interesting onset for future research on collaborative knowledge generation and co-operative decision-making between stakeholders.

Keywords: Minimum Viable Products; Prototypes, Off-Grid Energy Solutions; Utility; Stakeholder collaboration

1. Introduction

How far users can contribute to the initial phase of a new technology is heftily debated in design research and some authors criticize the importance of user experience for developing a new technology solution altogether (Verganti, 2011, Norman 1998). The onset for this debate is the fact that even if the product may be well developed though iterations of user/customer research, prototyping, and usability testing etc. at launch, the risk remains that customers will not find it valuable enough buying and using it.

Realizing that the biggest risk for a start-up lies in uncertainties about the product/market fit, Ries introduces Lean Start-up as an approach that seeks to reduce this risk (Ries 2008). Ries defines a start-up as "a human institution designed to create new products and services under conditions of extreme uncertainty" (Ries 2011, 17). Conditions are uncertain because who the customer is and what the customer might find valuable is yet (heuristically) unknown. Thus Lean Start-up proposes learning as the essential unit of progress for start-ups. Any effort that does not contribute to learning about what provides value for customers is considered wasteful.

The Lean Start-up approach builds upon Blank's concept of Customer Development, where a start-up continuously is searching for a venture/business model that works instead of executing on a business plan (Blank, 2013). Customer Development originates from the realization that the greatest risk for a start-up lies "not in the development of the new product but in the development of customers and markets" (Blank, 2007, 5). Ries developed the methodology further and the Lean Start-up approach has grown popular lately. Lean Start-up introduces the technique of Minimum Viable Products (MVPs) iterations to accelerate learning about the product/market-fit. MVPs match well with the design methodology, since both develop solutions iteratively in close contact with users/customers[1] . However, for MVPs customer response is the *driving force* of iteration cycles instead of being just a part of them. This implies that launch to customers has to be included in iteration cycles.

This article is based on a document and literature review on energy solutions design, user feedback and MVPs methodology. Sources are reports, articles and web-sites and blog posts. After describing the MVPs technique and examining how MVPs influence the product development and design process in section two, we will sketch an example of possible MVP use in the design of an off-grid energy solution – the improved cooking stove (ICS) in section three. We suggest that MVPs can not only be used for introducing completely new solutions and approaching alternative

markets, but also to prevent long delays in designing optimized products for specific users. Conclusively, in section four, advantages and pitfalls of the MVPs for innovative product development are discussed and further research topics are indicated.

2. MVPs in the Design process

2.1 The Design Process

The standard design process can be drawn as a double-diamond model of divergence and convergence stages (Design council 2013) as illustrated in Figure 1 (Hunter 2014). These stages can be related to the iterative design steps of observation, ideation, prototyping, and testing as well (Norman, 2013).

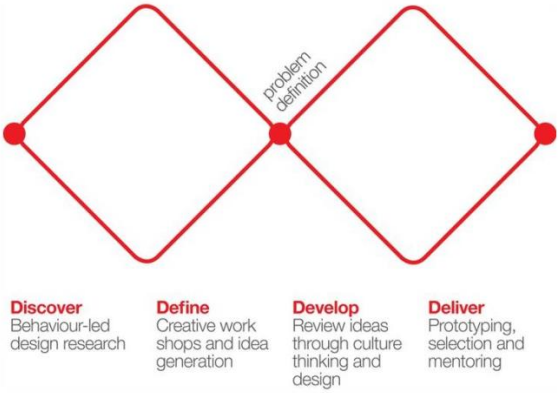

Figure 1: Double-Diamond, Diverge-Converge Model (Hunter 2014)

In the Discover stage (divergent) perspectives are kept wide in order to gain understanding and insights on user needs, opportunities and the context of the project. It states that a problem or opportunity exists and that a product or service development or iteration is necessary. In the Define stage (convergent) ideas are translated into problems to be solved and solutions are initiated and prototyped. Further, the design team has to comprehend the context of the problem in terms of cultural, economic and social issues, as well as to gain understanding of what is feasible within the capabilities of the organization providing a solution.

The goal of this stage is to "refine the scope of the project, and to home in on which solutions can have impact, which product or service pushes the business and design in the right direction" (Design Council 2013). The stage concludes with a design brief – a clear definition of the problem and a plan for how to address it.

In the Develop stage (divergent) different prototypes are iteratively refined and improved, which mitigates the risk of implementing a product with severe technical, utility or user experience errors. The conclusion of this stage is the specification for the product.

The Deliver stage is characterized by a final implementation of the solution and testing before launch. Many companies have routines for evaluating the success of the launched product or service, with the common aim to gain internal learning for future projects as well as to help gain buy in for other design projects (Design Council, 2013).

One disadvantage of the double-diamond model is that the design process is seen as seemingly linear which results in that no active strategy to iterate the solution once it is launched is proposed. If findings of the Discover and Define stage result in a product brief and iterations circulate around how well the solutions respond to this brief, the value of these iterations depends on how well the brief actually addresses market needs in the first place. Combined with the fact that designers struggle getting valuable contributions from consumers, when developing new solutions, one can argue that, related to the degree of innovation, a single run of the double diamond process may risk considerable failure at launch of new products and services, as illustrated in Figure 2.

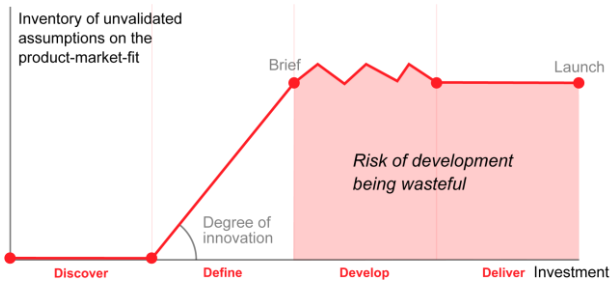

Figure 2: Roed's Analysis of accumulated Risk (2013)

In the Define stage assumptions increase related to the degree of innovation or alteration of the product, the value of the investments spent in the Develop and Deliver stage is based upon how well the assumptions in the brief *de facto* address customer/market needs.

If the degree of innovation and the uncertainty in the Define stage is high, iterations in the Develop stage become relatively irrelevant since the product might fail anyway. MVPs[2] applied in product design development might mitigate the risk of not answering to market needs at product launch.

2.2 Minimum Viable Products

Ries (2008) introduces the process of iterating with help of the Minimum Viable Products (MVPs) technique as part of the Lean Startup concept. An MVP is defined as "…version of a new product which allows a team to collect the maximum amount of validated

learning about customers with the least effort" (Ries, 2009). Validated learning is explained as "…the process of demonstrating empirically that a team has discovered valuable truths about a startup's present and future business prospects" (Ries, 2011, 46). The MVP process is concerned with learning about what provides value for which customers, and how product features correspond with these values (Laugero, 2012).

An MVP is a product made with the minimum set of features with the goal to start learning about the product – market fit. It is meant as a tool to test and reduce uncertainty about whether the envisioned product will have customers/users[3] or not. An MVP in itself does not necessarily imply a market launch, but the process aims at early market launch since many uncertainties lie in the hypotheses about how the product will be accepted after launch. MVPs are designed to accomplish the feedback loop of the Learn–Build–Measure–(Learn) cycle as quickly as possible (Figure 3). This iterativity resonates well with the design process however MVPs expand it by including a launch to customers in the iterations.

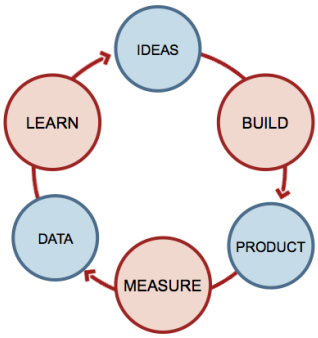

Figure 3: MVP Cycle, Ries 2008

Learn: This process starts with assumptions on how to create a sustainable venture model[4] for a product. Explorative research and consumer contact is crucial here. Early contact with customers does not seek definitive answers, but indicates what assumptions require the most urgent testing: "The first step in this process is to confirm that your leap of faith assumptions are based on reality, that the customer has a significant problem worth solving" (Ries, 2011, chapter 5, section 7). Hypotheses are established comprising for example who the customers/users will be, what they will find valuable, and how they will define quality. Further, hypotheses can address organizational, social and legal aspects. Iterating on this process can help building a feedback loop for the development team. The hypotheses are then prioritized by their amount of validated learning possibilities about the product/market fit. For a startup, the riskiest elements are the parts on which everything depends: leap of faith assumptions (i.e. weakly justified hypotheses) which are in the core of the venture model are to be tested first (Ries, 2011).The learning process provides ideas on how to design MVP prototypes.

Build: The MVPs are meant to prove or disprove hypotheses with the least amount of development effort. An MVP prototype is not necessarily a materialization of what a designer or a team believes to be the optimal product features and functions feasible at the time, or a product stripped of as many features as possible. It is rather a sample on a utility basis that functions as medium for communication on how to reduce uncertainties. In this phase the product is still incomplete, hypotheses are not validated, and the venture plan is not tested.

Measure: Hypotheses are tested by applying quantitative and qualitative methods such as empirical data collection or interviews (Ries, 2011, Løvlie et al., 2013). The hypotheses have to be formulated that results can give clear guidance for the next steps. The results should also reply to whether the hypotheses are relevant for the venture plan or not.

Continuous learning: The process of iterating on MVPs provides the basis for continuous learning about a product. The first hurdle is to get MVPs to the users. MVPs can target e.g. early adopters, i.e."… customers who feel the need for the product most acutely" (Ries, 2011, chapter 4, section 5) or competent users, who have a specific know-how related to the product. These user groups are typically more willing to spend time exploring a prototype, provide feedback and supplement with visions and requirements, and they are equally valuable for behavior studies and testing (Ries, 2011). Hence one strategy is to launch MVPs as pilot studies. It may take a considerable amount of effort to stage pilot studies; however, this activity in itself can contribute to valuable learning. Further, once a contact with these groups is established, the threshold for further participation is lower, which may lead to more time for gathering insights and less time to spend on project management and organization. Pilot studies may also lead to lasting connections with users over time. Overall, the MVPs imply a proactive relation to users by iterating on prototypes. Even if the first goal of MVPs is to validate hypotheses for a venture plan, its proactive user involvement approach might have effects for other domains of user research. Kolko and Tran (2013) mention e.g. increased empathy and the ability to continue insights beyond an initial research phase as advantages of ongoing partnering with stakeholders in the design process. These assumptions have to be tested in a pilot project. The following section is built on a hypothesis how an MVP approach can be

applied for an off-grid energy solution in rural areas in Nepal.

3. MVPs for renewable energy solutions

3.1 The context

About 60% of the households in Nepal do not have access to electricity. 64% of the households use firewood for cooking and most of it is collected from community- and government forests. The extensive dependence on forest in rural areas is not only causing deforestation and environmental degradation – it also has adverse effect for health- and living conditions of rural people, especially for women and children. Women do not only perform twice as much work for subsistence as men, and work up to sixteen hours a day, almost five hours of this time go for collecting wood (Gurung, 1999, Mahat, 2011). Saving time and resources and protecting health, the improved cooking stove (ICS) was introduced in Nepal in the early 1950s with the Indian Hyderabad model. The mud brick ICS got its standard version design in 1999 (Figure 4).

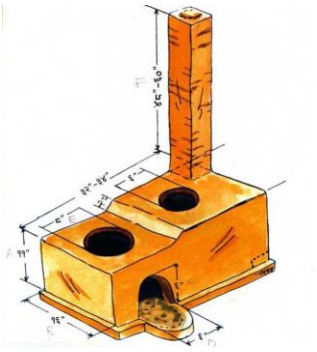

Figure 4: ICS standard version

From its initiation in 1999 to 2005 the National ICS Program has disseminated about 125 000 ICS, serving the same number of households in 33 mid-hill districts. The combined effort of national ICS Program and other organizations led to a dissemination of 200 000 ICS in the country by the end of June 2005. According to Vaz (2007/2008) the national ICS programme in Nepal was driven by Central Government policy, and funded primarily by the Danish International Development Agency (DANIDA). ICS construction in specific villages is conducted by local technicians ('promoters') operating as entrepreneurs. Non-governmental organizations (NGOs), community-based organizations (CBOs), local governments and other private groups are also involved, mainly in the training of local technicians.

3.2 The process

ICS comprise a simple technology however the understanding of simplicity between the designers and the end users did obviously not always overlap, which might be one reason that it took more than 30 years to develop a standard version. Another reason is perhaps that focusing only on an end product and its technology combined with conventional business plan was problematic. The first ICS products ran into difficulties in terms of user acceptance. ICS maintenance was difficult and the advantages of the new solution were not convincing to them. Promoters' demonstrations were often only focusing on why the new technology was better than the old one, which did not make prospective customers to spend money on it. Today a variety of ICS models for different geographic and cultural settings exist and overviews of use domains as well as advantages and disadvantages of different products are provided for those who can read. Further business plans have been improved in terms of entrepreneurship development and investment by establishing a business development fund (Practical Action 2013).

Applying the process of MVPs for ICS starts with a learning phase, where hypotheses on venture, product design and promotion/launch are developed. Hypotheses on venture may include questions such as: Where to buy ICS, who would/ should buy them, who would/ should sell them, under which conditions, and which conditions can encourage or hinder their use. If e.g. aiming at equal ICS distribution among village households, one could develop a social entrepreneurship model (Keitsch et. al 2013). This is based on the assumption that if ICS promoters are private entrepreneurs, who are merely profit oriented, 'rich' households are rather addressed than poor ones and rich villages before poor ones. Introducing the product to all residents should thus enclose social (and/or administrative) benefits for the promoters as well.

Relating to the product design one can assume that the ICS customer group would rather but a cheap product with functions they need, than an expensive elaborated one (Eyring et.al 2011). Thinking of launching, a promotion campaign could highlight the additional health and energy benefits of the ICS for a comparatively small price difference. Additionally, it could be more important to address the local knowledge and maintenance capability/support of/for potential users than to emphasize the technological features of the product.

In the building phase, a pilot project can be started designing and launching a prototype that has the utility of a conventional fireplace. Starting hypotheses for the product could be that users would accept a product that is smoke free, safe, and easy to maintain.

In the measuring and continuous learning phase the female cooks, as early adopters and/or competent end-users, would be included methodologically. Methods to

assess the hypotheses would be for example testing of ICS usability, user observation and protocol analysis, further the women would contribute with their knowledge and expertise to confirm or refute hypotheses above.

The continued learning phase comprises iterations of the prototype, based on new hypotheses developed with help of users' feedback e.g. variations of materials, functions, purposes etc. and would culminate in a new prototype launch that could be handed over to users for a longer period of time. Developing the new prototype also requires a profounder understanding of the context, including further fieldwork and collaboration with stakeholders. A level two 'cultural' prototype (Verganti 2009) could e.g. highlight additional product attributes that refer to aesthetic features and/or cultural and social practices and may stimulate a broader spectrum of users to provide feedback. The prototype two will also contribute to revise venture- and launch hypotheses.

3.3 Possible effects

The MVPs are first and foremost seen as a deliverance, which prevents that invalidated hypotheses pile up in first stage of the design process and are realized, such as using a costly ceramic insert in the ICS in 1982. [5] Employing MVPs the Develop and Deliver stage in the design process should thus be as short as possible (Figure 4). This may lead to less iteration in the Develop stage.

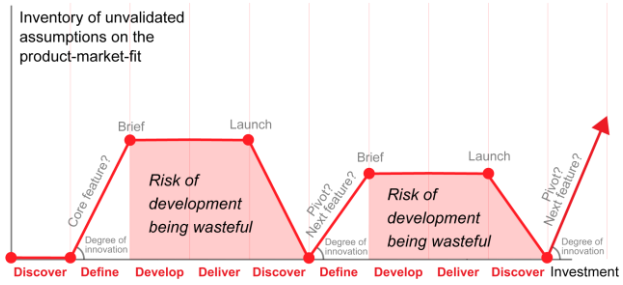

Figure 5: Roed's Analysis of accumulated risk launch

For ICS, it seems reasonable to ideate and prioritize MVPs on at least two levels.

Level one prototyping aims at the short-term design of the utility of the functional object that is launched in a pilot study. Utility is the core of any user experience, and replies to questions such as: What should the product do? What is the product's reason of existence? Does the product do what users need? Researching utility for ICS implies e.g. looking for smoke reduction, safety, energy-saving and easy maintenance. Level one prototyping addresses early adopters and/or competent end-users and does not need to meet every possible user demand.

The other level of prototyping is for imagining and testing a long term vision and improving venture, launch and promotion. The visionary prototypes – which may correspond to what Verganti (2009) calls 'cultural prototypes'[6], do not necessarily address early adopters. These cultural prototypes can among others be used for visualization in workshops and stakeholder meetings and they have the character of boundary objects (Keitsch et al. 2013)[7] rather than being utility-testable products. The two level MVPs might be highly relevant for off-grid energy products in rural areas in Nepal, where the expectations- and knowledge gaps between different local and other stakeholders are deep and communication between designers, planners and end-users about goals and how to reach them rather challenging.

4. Discussion

This article has studied implications of applying the Lean Startup technique of Minimum Viable Products in the conjectural design process for an off-grid energy solution in rural Nepal. MVPs are useful to simplify ideas by displaying their core components, build and test those, and then iterate on the learning process. We argue that conventional design processes often lack these steps, which involves a considerable risk of failure when launching new, unfamiliar or alternative products and services. In terms of project organization and implementation, Minimum Viable Products divide development into smaller parts to validate the core implications before making development efforts on uncertain elements. This demands several loops early in the design process, but it may lead to less iteration in the late stages. In shortening the fail and retry phases of product and service launch, MVPs are an interesting technique for future research and development e.g. for developing alternative energy products.

The literature on MVPs shows a significant lack in discussing their use only for business purposes and it also is widely lacking considerations of the system dynamics (e.g. changes of social and cultural practices). Applying MVPs in design practice the first lack can partly be met by emphasizing and varying between level one and level two of prototyping in different design stages, depending on time and personnel resources. Further, the MVPs discussions are very lead-user oriented, and will thus not necessarily meet the demands of less-resourceful community members (the 'anti-users', Cooper, 1998). In a development project, product development is however not necessarily connected with a product's commercial success or failure but as well

with its availability, accessibility, affordability and accountability for the user.

In its current state and for the purpose of renewable energy solutions in rural Nepal, MVPs seem a reasonable tool to initiate pilot projects and commence valuable user contacts. One could also consider MVPs as appropriate technique for settings where alternatives (grid-supplied electricity) are (still) unavailable and new (alternative energy) markets appear (Eyring et al 2011). MVPs are then relevant not only for designing products and services but likewise for developing new venture and promotion models. However, more studies are needed to evaluate if MVPs should be methodologically integrated in e.g. Design for Development, which has the aim to provide long-term, socially and environmentally appropriate and practical solutions to the expressed needs of local communities.

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Notes

[1] 'Customer' and 'user' are used alike in this paper.

[2] This count also for services, however, the technique is not much tested in the service branch and we use Minimum Viable Products as terminus technicus.

[3] MVPs are not only interesting for the commercial market but also for organizations, who provide services and products. They can be user instead of customer focused and decoupled from economic benefit. A success factor for renewable energy solutions in Nepal can be for example that the product is accepted by the end-user.

[4] A 'business' model in a commercial sense.

[5] Besides increasing the price of the stove, the inserts often broke during long and complicated transportation in hill areas and were difficult to replace.

[6] Cultural prototypes interpret socio-cultural meanings in representative models. The prototype may also contribute to develop a radically new meaning and the end product often implies a deep change in socio-cultural practices such as the Wii game console, the Swatch watch, the 3Doodler, etc.

[7] Project teams often struggle to integrate different agendas and needs in a solution. Objects in the widest sense are a common topic of interest for them. The boundary object (BO) concept emphasizes that exploring objects in a team may facilitate communication. BOs are for example prototypes, models, standardized forms etc. The advantage of BOs as communication facilitators is their ability to represent specific constraints of one area of expertise (e.g. engineering or architecture), while their use allows developing and maintaining coherence across intersecting areas.