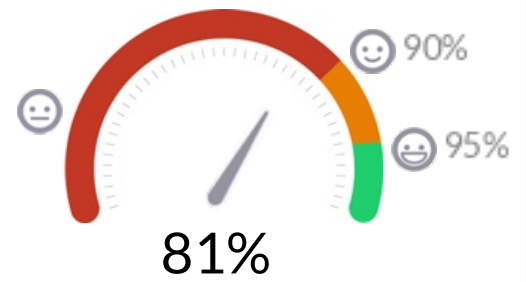


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Design Thinking:

Prototyping and Lead User

Business Studies: Design Driven Business Innovation

Table of Contents

Introduction

Brown (2008) suggests that design thinking will be perceived as a chaotic feeling by those who encounter it for the first time. In short, design thinking helps an individual to explore several ideas in a much faster way than when other methods are used (Brown, 2008). Brown (2008) emphasizes not stereotyping design thinkers and thereby identifies some of their characteristics. One of their main characteristics is based on collaborative attributes (Brown, 2008). According to this researcher, an increase in the complexity of experiences, services, and product development leads someone to shift from being a lone genius to being an interdisciplinary collaborator. Lead users who are capable of recognizing the needs of the general market in the early stage of an innovation process therefore seem to be attractive collaborative partners (von Hippel, 1986).

5 In other words, lead users are users of a product that currently experience needs still unknown to the public and who also benefit greatly if they obtain a solution to these needs. Because lead users innovate, they are considered to be one example of the creative consumers phenomenon, that is, those 'customers who adapt, modify, or transform a proprietary offering'

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Using the facts that design thinking has been increasingly recognized within the development of new products, and collaborative prototyping is seen as a search component within the ideation process (which involves both firm and user) as a starting point, this paper explores if specific users (namely lead users) can have a more significant influence in the prototyping phase. This is done by reviewing three main articles. In the first, Bogers and Horst (2013) propose a specific testing tool that evaluates collaborate prototyping with end users. In the second, Veryzer and Borja de Mozota (2005) introduce external integrity in order to show the importance of integrating external parties within a prototyping and ideation process. Finally, in the third Schreier and Prögl (2008) put forward an elaborate lead user approach that leads to a "userness" outcome.

The prototyping and lead user topics are briefly introduced in order to answer the following main question:

How can collaborative prototyping benefit from lead users?

The sub-topics considered in answering this question are as follows:

- Prototyping and its relevance to design thinking;
- Collaborative prototyping;
- The lead user concept and its origins; and
- Modern lead user characteristics.

The paper begins with an outline of the theoretical understanding of the benefits of prototyping and the lead user's characteristics, as these subjects play a crucial role in considering the main question.

2 The term product design presents definitional challenges, as it is used in practice in different ways, and even varies in usage regionally. For this article, product design is “conceiving and giving form to goods and services that address needs.” The activity of product design can be thought of as comprising several key decisions. Because the decisions of product design do not map cleanly to any one academic discipline, the subject has not garnered enough attention in any one field to develop fully its own academic identity. Scholarly research in product design has often been cultivated by the emergence of a methodological paradigm

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(Ulrich, 2011). Including prototyping in the early stages of NPD can lead to relevant development information being generated (Thomke, 1998). Moreover, prototyping is seen as a crucial component of the innovation process, given its importance vis-à-vis design practices (Mascitelli, 2000). This process can be influenced by intra-organizational boundaries that arise when involving different departments, such as research and development (R&D), management, and production (Atuahene-Gima & Wei, 2011). Nonetheless, Mascitelli (2000) emphasizes that prototyping is also considered a central element for improving NPD when it is included in an early stage of innovation and involves several stakeholders within the design team.

Collaborative prototyping

This paper considers in detail the importance of including different stakeholders within the process of prototyping. 4 The study, moreover, shows how, at various stages of the prototyping process, the actual prototype was used as a tool for communication or development, thus serving as a platform for the cross-fertilization of knowledge. In this way, collaborative prototyping leads to a better balance between functionality and usability; it translates usability problems into design changes, and it detects emerging usability problems through active engagement and experimentation.

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Collaborative prototyping is assigned major importance here given that Bogers and Horst (2013) refer to the term in relation to the involvement of different stakeholders. Moreover, they

state that organizations shift the locus of innovation to users through collaborative prototyping. An interesting approach is also proposed by Buchenau and Fulton Suri (2000). These researchers suggest that not only design members and users but also clients utilize prototyping as an experience that leads to a first-hand appreciation of new product features through active dedication to prototyping (Buchenau & Fulton Suri, 2000).

Bogers and Horst (2013) tested three different cases of collaborative prototyping. These prototypes had three roles: *communication tool*, *sketching tool*, and *testing tool*. Since this paper is focused on understanding the lead user role in the prototyping process, only the *testing tool* is considered to be relevant.

Descriptives										
			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
							Lower Bound	Upper Bound		
Self-Concept THERAPY	Reality	6	32.65	15.71	6.41	16.16	49.13	13	49	
	Behavior	6	47.71	18.52	7.56	28.27	67.15	27	83	
	Psychoanalysis	6	42.70	26.44	10.79	14.96	70.45	14	79	
	Gestalt	6	55.68	16.84	6.87	38.01	73.35	32	80	
	Control	6	51.77	16.51	6.74	34.45	69.09	30	77	
	Total	30	46.10	19.60	3.58	38.78	53.42	13	83	

Testing tool. **7** In software engineering, graphical user interface testing is the process of testing a product's graphical user interface to ensure it meets its specifications. This is normally done through the use of a variety of test cases.

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The testing tool applied by Bogers and Horst (2013) concerns evaluating prototypes with end users. The goal of this tool is to identify emerging usability problems and undesired side effects when features have already been implemented (Bogers & Horst, 2013). According to the researchers, one of the challenges in this context is that user have a different productivity involvement.

In addition, Veryzer and Borja de Mozota (2005) propose that integrating a user-oriented design approach into the development of new products will positively affect idea generation. They underline the difficulties in focusing and orchestrating activities related to NPD. In terms of the user-oriented design, this paper considers Veryzer and Borja de Mozota's (2005) *external integrity* approach.

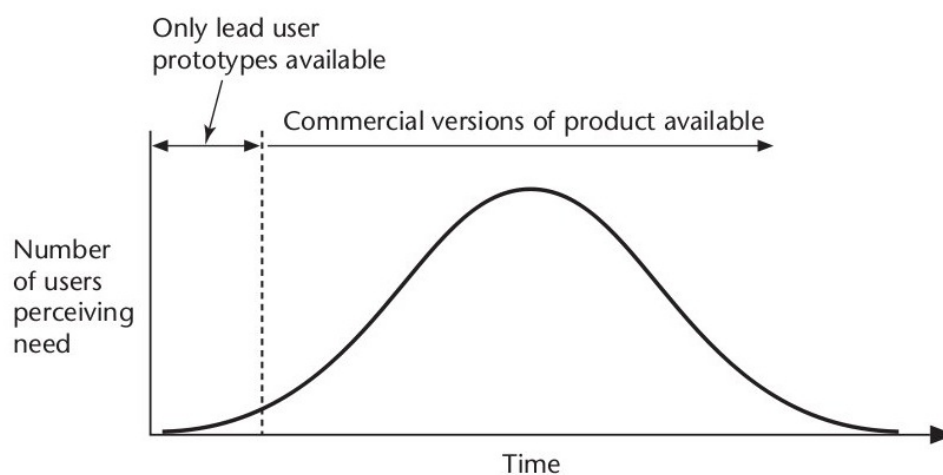
External integrity. External integrity in product development involves integrating external parties, which in turn enables the generation of new concepts to be managed by matching the product to the expected end-user (Veryzer & Borja de Mozota, 2005). Moreover, Maltz, Souder, and Kumar (2001) state that involving external parties can lead to a "collective creativity" due to the possible introduction of non-familiar or different perspectives than those that would stem from solely internal sources.

These observations lead to the purpose of this paper, which is to explore if lead user involvement could yield valuable insights in connection with identifying the stated usability problems and undesired side effects. The next section briefly introduces the characteristics of lead users (which differ from those of late innovation adopters).

The lead user concept and its origins

The purpose of tackling lead users in this paper stems from the observation in the literature that interest in involving lead users in NPD is growing (Franke, von Hippel, & Schreier, 2006). According to von Hippel (1986), who was one of the first to introduce the lead user concept, lead users are members of a specific user population who are likely to innovate due to their interest in solving their own product problems and who set trends based on needs that will be shared by several other users in the market. In summary, lead users have high expectations with regard to product benefits and are ahead of marketplace trends (Franke, von Hippel, & Schreier, 2006).

Von Hippel (1986) also refers to the challenge of identifying lead users who might be trendsetters in specific marketplaces. In addition, Christensen (1997) mentions that innovations arising from this specific group are mostly developed outside of a firm's boundaries. Examples include the development of the first mountain bike and the World Wide Web, both of which arose due to users staying at the forefront of market technology trends and having a desire to solve their own problems (Hiernerth & Lettl, 2011).



Modern lead user characteristics

In order to better understand how lead user stakeholders can be involved in collaborative prototyping, this paper introduces an article by Schreier and Prögl (2008) that suggested that

1 Lead users have been shown to be a highly promising source of innovation for generating radical new product ideas. According to lead user theory, these users are defined as being ahead of an important market trend and experiencing high benefits from innovating. There is strong empirical support that these users tend to come up with commercially attractive user innovations.

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To do so, the researchers conducted three studies to test sports-related hypotheses. In order to measure a lead user's userness, Schreier and Prögl (2008) developed hypotheses pertaining

to five concepts: (1) consumer knowledge; (2) use experience; (3) locus of control; (4) innovativeness; (5) adoption behavior.

Consumer knowledge. In their first hypothesis, Schreier and Prögl (2008) assume that the greater the consumer knowledge is with regard to a specific field, the greater lead usersness will be. Consumers with knowledge (who are better seen as experts) are described as having more insights in relation to a product's performance attributes, performance relationships, and components (Mitchell & Dacin, 1996).

Use experience. The second hypothesis states that the more experienced someone is in the usage of an underlying field, the stronger lead usersness will be (Schreier & Prögl, 2008). Even if use experience and consumer knowledge are similar in empirical and theoretical terms, differences can be found in the way that information is acquired (Park, Mothersbaugh, & Feick, 1994).

Locus of control. Schreier and Prögl (2008) state that lead usersness also depends on the locus of control. Rotter (1966) explains that users who have a high internal locus of control more strongly believe that outcomes are related to their own actions.

Innovativeness. **8 The more innovative a consumer's personality is, the greater the lead usersness**

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(Schreier & Prögl, 2008). Kirton (1976) describes innovative individuals as those who are not only willing to discover problems, but also to solve them.

Adoption behavior. The last hypothesis states that the extent of lead usersness relates positively to a willingness to adopt behavior that will lead to new solutions (Schreier & Prögl, 2008). According to Rogers' (2003) diffusion of innovation theory, individuals have different time stages concerning the adoption of an innovation. Compared to the majority of adopters, lead users are at the early stage of the diffusion of innovation (Rogers, 2003).

How can collaborative prototyping benefit from lead users?

The above sections provide insights into the meaning of the collaborative prototyping and lead user concepts. According to Veryzer and Borja de Mozota (2005), a user-oriented design focus can play a relevant role in achieving a company's strategic goals. Moreover, they conclude that depending on the firm's goal, design strategy must focus intensely on users' needs in order to achieve a product development that satisfies them (Veryzer & Borja de Mozota, 2005). To add value to the *external integrity* concept discussed by Veryzer and Borja de Mozota, Bogers and Horst (2013) propose a *testing tool* that confirms that implementing design changes within customers helps to identify and solve product problems very quickly.

All of these researchers emphasize the advantage of integrating users into the design process, which is referred to as prototyping in this paper. Schreier and Prögl (2008) add more value by considering the specific benefits of involving a lead user and the aforementioned

characteristics. ¹ In order to understand what type of users trigger attractive user innovation, von Hippel (1986) developed the 'lead user theory', according to which the 'nuggets' of user innovation should be concentrated in lead users. These are defined as being at the leading edge with respect to some dominant market trend (being ahead of trend) and at the same time as anticipating significant benefits from solving problems (expecting high benefits from innovating)

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They conducted three studies based on lead users in extreme sports, namely sailplaning, technical divers, and kite surfing (Schreier & Prüggl, 2008). The researchers' results may be summarized as follows:

First, while *consumer knowledge* and *locus of control* were tested in only one case, the findings indicate that both are positively related to lead userness (Schreier & Prüggl, 2008). Bogers and Horst (2013) confirm that involving experts in the prototyping process by referring to the trial-and-error learning cycle (Mascitelli, 2000) benefits in NPD. Moreover, collaborative prototyping also assists a firm by shifting knowledge to the user (Bogers & Horst, 2013).

Second, the lead userness characteristics of *use experience*, *innovativeness*, and *adoption behavior* are proven to be positively related to lead userness in two of Schreier and Prüggl's (2008) studies.

The *use experience* of a lead user in a certain field contributes in how users try to explain their own lead userness (Schreier & Prüggl, 2008). When combined with the findings of Buchenau and Fulton Suri (2000), these results indicate that the development of "experience prototyping" (which involves team members and users exchanging their insights during the prototyping process) can be further strengthened through collaborative prototyping.

Innovativeness plays a crucial role in lead userness considering Veryzer and Borja de Mozota (2005) statement. Therefore the designer's role can significantly be supported during the ideation of innovative products.

Finally, Schreier and Prüggl (2008) assert that a lead user's *adoption behavior* is also significantly related to userness. Moreover, their conclusions are based on their findings that consumers with higher lead userness are more likely and faster to adopt new products. Veryzer and Borja de Mozota (2005) even note that since innovation concerns change, diffusion innovation depends on the user's willingness to change. Collaborating with several experts leads participants to share their knowledge, which can also be directly implemented in the prototype phase of NPD.

Conclusions and limitations

This paper has shown that lead user characteristics are for the most part positively related to collaboration within prototyping. On the one hand, the findings of Bogers and Horst (2013), who

involved experts within the prototyping process, are in direct alignment with those of Schreier and Prögl (2008), who demonstrated the positive relation of consumer knowledge; this indicates that lead users should be involved. It is still noteworthy that the *testing tool* of Bogers and Horst (2013) yielded other interesting results. These two researchers found that not all users show equally productive involvement; as such the tool is useful for research, but it cannot be taken as a standard for future research.

On the other hand, the findings of Veryzer and Borja de Mozota (2005) can be translated into a high importance of lead users during the ideation process due to their positive relation to innovativeness. For the purpose of this paper, only the external integrity of Veryzer and Borja de Mozota (2005) has been considered. These researchers state that in order to achieve a high level of ideation, the right integration within internal integrity needs to be established. **6** Each of these is developed and presented in the form of a research proposition relating to the impact of user-oriented design on product development. The fundamental relationships articulated concerning UOD's impact on NPD form a conceptual framework for this approach to product design and development.

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This paper only focuses on integrating lead users based on their characteristics and the benefits they may offer within prototyping, not in terms of cultural integration (which might affect ideation and therefore needs further research).

Finally, the positive adoption behavior of lead users towards innovation (Schreier & Prögl, 2008) is a significant advantage when it comes to willingness to adopt changes during prototyping and the innovation phase. The greatest challenge remains to identify who lead users really are, in order that research may be conducted. All of the results that have been achieved to date are valid and reliable, but some ambiguity remains concerning the correct method to use for recognizing user who are ahead of trends.

Reflection

I initially chose this topic because I thought that lead users could make a positive contribution to the prototyping process. In general, lead users are always discussed in the context of early adopters in the innovation diffusion theory written by Rogers (2003). Nonetheless, I saw them as "single geniuses" who were solving their own needs but were never attached **3** to collaborative work.

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Found Text: *to collaborative work.*

3 Various attempts have been made to identify a single behavioral characteristic that distinguishes humans from all other animals. Many anthropologists think that readily observable

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This paper has shown me that great opportunities for involving lead users within the prototyping process and generating new products do exist. Moreover, from an entrepreneurial point of view, lead users involved in the prototyping phase spread the word and can already attract initial potential customers (both within their communities and beyond).

Finally, this research has also shown me that lead users are of a great value for external integration, contingent on pre-existing design teams being willing to accept external output.