

Characteristics of Lead Users in the NPD Process

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Despite the promising ideas of lead users, the success rate of the open innovation process remains low if no proper personal characteristics are attached to the external contributor. The knowledge about the essential characteristic elements of lead users is crucial to select the right lead users in the early stage of the NPD.

open innovation

lead user

personal characteristics

new product development

co-creation

systematic review

1. Introduction

Open innovation supports corporate growth and profitability. Firms are increasingly opening their boundaries and applying various methods to identify user innovations ^[1] and tap users' product knowledge and experience ^{[2][3]}. Successfully innovating firms involve users ^{[4][5]}, customers ^[6] and patients ^[7] in the "fuzzy front end" of their new product development (NPD). Ref. ^[8] states that average users are not suitable for developing novel product attributes because they cannot accurately determine future market needs. Only leading-edge users with real-life usage experience can provide accurate information on the needs for product development. Quality information from lead users ^[9] and their systematic design freedom ^[10] results in better product development. von Hippel first defined the term lead user, then assigned two main attributes to identify them: "lead users face needs that will be general in a marketplace—but face them months or years before the bulk of that marketplace encounters them, and lead users are positioned to benefit significantly by obtaining a solution to those needs" ^[8] (p. 13). The high expected benefit and the superior trend position are also strong predictors for co-creation ^[11].

The lead-user method aims to identify and involve lead users to the NPD process as they are "at the leading edge of each identified trend in terms of related new products and process needs" and they "expect to obtain a relatively high 'net benefit' from solutions to those needs" ^[8] (p. 798). All later adoptions of the lead user method contain these two crucial attributes of lead users ^{[12][13][14][15]}. The adaption of the lead user method by ^[16] consists of the following four steps: 1. start of the lead user process, 2. identification of needs and market trends, 3. identification of the lead user, 4. concept design and the start of co-creation. According to scholars, it is challenging to determinate lead users in the fuzzy front end of the NPD process ^{[17][18][19]} even with the existence of multiple identification methods ^{[20][21][22]}.

While the lead-user method is suitable for the identification of lead users based on the two main attributes of 'ahead of market trend' and 'high expected benefit', it does not consider explicitly the personal characteristics elements of lead users, such as users' knowledge, motivation, skills, behavior, experience, betweenness centrality, attractiveness, etc. Studies emphasize that the lead users' personal characteristics are crucial for successful co-creation. According to [23], the contribution of individuals to the co-operation process varies strongly; therefore, the proper selection of lead users plays a critical role. This is in line with the findings of [24], which states that the characteristics of users differ significantly from the user type, typically involved in conventional research. Scholars emphasize the importance of selecting the right user profiles for the development process [25][26][27]. The authors [28] (p. 13) highlight the role of 'the human factor' and state that the synergy in innovation "can only be achieved if the right number of the right people are prepared to collaborate with each other" (ibid).

An increasing number of studies investigate lead users' personal characteristics. Ref. [24] underlines the importance of imagination capabilities, openness to new technologies, high level of expertise and technological competencies. According to [29], consumer knowledge, use experience, locus of control and innovativeness are important antecedents of lead userhood. Refs. [17][30] highlight the importance of "local" (tacit knowledge) information. Ref. [31] finds a positive impact on willingness, task motivation, creativity components, and relevant product knowledge. Ref. [32] states that individuals' creativity and personality play an important role in the determination of lead userhood. Ref. [33] finds that managers shall pay attention to the selection of the right users for idea generation of an innovation process. Ref. [34] emphasizes that improper customers may appear to offer benefits as experience sharing and improvement suggestions; however, their value is misleading due to the missing vital personal characteristics. Ref. [35] describes the case of failed innovation by ostensible users with a lack of essential characteristics.

Studies show that co-creation is an emerging phenomenon of contribution where customers are the central and essential part of the NPD process [36]. The participation of users has become crucial to realize successful innovation [37]. This kind of co-creation is different from the broader understanding of co-creation, which refers to co-creation experiences that includes the whole interaction between the customer and the firm, and it focuses on "creating an experience environment in which consumers can have active dialogue and co-construct personalized experience" [38] (p. 8). In the researchers case, co-creation is also different from customer involvement to allow for a single point of idea exchange [23]. Co-creation is when lead users actively participate in all phases of the NPD, including idea generation, concept formulation, product development and test, market diffusion and post-launch activities [39].

As the personal characteristics of lead users have a high impact on the success of the open innovation process, the clear understanding of the required personal characteristics' elements at different stages of the NDP is therefore crucial for managers to select the proper lead users for their NDP process. The relevance of the problem is judged by the evidence that managers aim to select the right lead users for their NPD depending on the level of lead user involvement in the NPD. In the case of high-level involvement, decision makers aim to reduce the gap of different professional backgrounds, different points of view between external contributors (lead users) and internal

employees (engineers, product owners, etc.). The knowledge about the lead user characteristics in different stages of the NPD is relevant for making the right decision during the selection process of lead users.

2.Characteristics of Lead Users in Different Stages of the NPD process

2.1. Idea Generation Stage

2.1.1. Knowledge and Experience

Refs. [24][30] emphasize the importance of the users' prior technical knowledge, experience and skills as these elements determine the type of idea and the solution the user will develop. Users utilize their own "local" (tacit) stock of need and solution knowledge to develop innovative ideas and products. This repertoire is in line with the statement of [40], which argues that the discovery of a certain innovation opportunity is driven by the user's prior education, knowledge and work experience. Ref. [24] highlights the importance of in-depth professional knowledge and 'need knowledge' of medical surgeons as a crucial basis for innovative idea generation and solutions that meet specific needs.

This type of knowledge gained through experience, experimentation, and extensive learning is tacit; therefore, it is "sticky", difficult and costly to transfer to manufacturers [17][24][32][41]. Consequently, this may explain the reason why users develop radically new ideas instead of manufacturing firms that are more focused on incremental improvements [24]. Ref. [42] compares internal and external lead users and found that employees who possess 'need knowledge' are able to take advantage of the direct access to the organisation knowledge to work out their solution and they are more creative than an employee who lacks 'need-knowledge'. The same author additionally states that creativity-enhancing knowledge schemas (e.g., solution knowledge) and creativity-hindering knowledge schemas provided by a company may contain knowledge that increases the resistance to change. The same study also highlights that internal user ideas are easier to realize, while external user's ideas have maximum novelty, user value, and market potential.

Multiple studies find a positive effect of use-experience and product-related knowledge on the innovation activities of the users [17][29][31][43][44][45]. Ref. [33] emphasizes that technically savvy users are more likely to generate technically feasible ideas, while technologically innovative customers tend to provide radical or new product ideas. According to [46], the technical innovativeness of customers increases the intention of firms to involve them in the early stages of the NPD process.

2.1.2. Motivation and Willingness

According to [23], a certain level of interest and task motivation is important in the idea generation phase to come up with new ideas, based on the evidence that creativity is driven by intrinsic motivation [47]. In contrast, Ref. [32] found that intrinsic and extrinsic motivation do not significantly describe the traits of lead users. In the consumer context, Ref. [31] examined the proportion of motivation-driven factors and found that 20% of the innovations are

“need-driven” and 80% are “excitement-driven”. The “need-driven” innovation is triggered by the perception of needs not yet fulfilled by the existing products on the market, while the “excitement-driven” innovators develop new ideas because of enjoyment, fun and pleasure, and less due to the desired outcome. This study also claims that community members are willing to share their innovative ideas with manufacturing firms free of charge. Ref. [43] expresses that willingness to collaborate and strategic alignment with brand identity are crucial characteristics of the users’ innovativeness.

In the industrial context, Ref. [44] found intrinsic motivation as the main characteristic of lead users. Ref. [48] states that in terms of radical innovations in the medical domain, manufacturers are reluctant to invest in NPD, considering the design instabilities that trigger the users’ entrepreneurial mindset to gain direct benefit from the tailored new technologies of their needs. The same authors emphasize that professional users experience difficulties in their daily work and they encounter the limits of conventional technologies, which motivate them to search for more workable solutions (motivation induced by problem). This strong intrinsic motivation supports creative activities [23][47] and enable innovations.

2.1.3. Creativity and Skills

Ref. [23] examines the impact of customer’s creativity components at different stages of the NPD process. They found that users in the idea generation phase need to possess creativity-relevant processes, including extraordinary domain-relevant skills and an appropriate motivation level, heuristics, and work style to create creative ideas, while domain-specific skills have no impact on ideas. This finding was explained by the intention of companies being more interested to find and figure out a problem because they usually have strong abilities to develop and produce new products.

The research conducted by Ref. [49] among children shows that “betweenness centrality” (i.e., the bridging link between different social groups in a network) and age have a significant effect on creativity. Children can create more and better ideas with increasing age and cognitive capacity. According to their study, the favorable network position of children stimulates individuals to utilize the information advantage and to become creative. This is consistent with the research conducted among young adults as lead users [50].

In the industrial context and in the medical domain, Ref. [24] states that high problem pressure is the key source of creative activities. A divergent thinking style is the ability to “think outside of the box” and not being restricted by functional fixedness [32].

The close access to transdisciplinary know-how increases users’ creative capacity [24]. Ref. [29] found that innate innovativeness explains creative achievements, including individuals who break “patterns of accepted modes of thought and actions” [51] (p. 623), and similarly, they “tend to take control in unstructured situations” (ibid) and are resistant to former standards and possess a risk-taking manner. The study also states that locus of control (LOC) [52] is a personal characteristic and a key element of creativity [53]. Moreover, they found that lead users possessing high internal LOC are likely to deal with new usage situations. They leave the solid terrain of the ordinary, usually commit to a difficult risky task and put effort into mastering improvements in existing products.

2.1.4. Behavior and Attitude

Ref. [34] investigated ideators' online behavior and they found that their value lies in solution-oriented behavior and paying attention to other's ideas. The solution-oriented behavior is more related to suggesting improvements on existing goods than suggesting ideas. The ideators, who are curious and open to other ideators' ideas, are more likely to be successful. Lead users with early product adaption behavior are a valuable source of new ideas and additionally, they can successfully fuel the market diffusion process [54].

According to [55], empowered customers are more innovative through a co-creation IT tool, they feel trust and are willing to put effort into making a valuable contribution. Such a tool enables less-skilled customers and lower qualified users to participate in the virtual NPD task.

In the industrial context, Ref. [27] found that close customers and financially attractive customers yield a positive impact to the success of NPD, which relates to their market representation and reputation on the market. Additionally, they state that intensive customer interaction and close customers positively influence the product's success. In line with this statement, Ref. [24] underlines the importance of personal face-to-face interactions with users to develop and understand the user's complex and tacit information to be transferred. Ref. [27] found that personal interaction can increase the new product success during the early and late stages of the NPD, while the concept generation stages yield no impact. Appropriate skills for interaction need to be developed in radical innovation projects with respect to the users and firms. Ref. [46] claimed that in the collaboration process, firms require trustworthiness and credibility from customers otherwise they will ignore them.

2.2. Concept Generation Stage

Ref. [56] states that consumer innovativeness correlates positively with personality traits and processing abilities. Such customers, called "emergent nature customers", possess unique capabilities to envision or imagine how new product concepts might be developed. These unique personality traits and processing abilities support the product concept stage, enhance the ability to process information visually and verbally, and they are open to new experiences, reflection, thinking styles, a high level of creativity and optimism. In contrast, Ref. [57] found that lead users and also average users outperform the "emergent nature customers".

Ref. [58] states that technologically reflective customers demonstrate benefits in the concept generation and refinement phase. Technologically reflective customers can think about the impact of a product on its user's society in general.

Ref. [23] finds that domain-specific skills (e.g., factual knowledge of the domain, familiarity, and technical skill) and creativity relevant processes have a lower impact on the concept generation in comparison with the idea generation. The authors also highlighted that task motivation has no impact on the concept development or on the prototype development.

In the industrial context, only a few studies have been found that investigate users' characteristics in the concept development phase. Ref. [24] defines critical lead user characteristics including imagination capabilities, openness to technologies outside of the certain domain, and close access to an interdisciplinary approach. They all inspire creative thinking to develop state-of-the-art technologies. The availability of resources for research, e.g., time, human resources, and funds, are important individual and contextual factors in this stage of the NPD. Users without a supportive environment and available resources exhibited lower efficiency. Characteristics elements, such as problem-induced motivation, openness, and prior knowledge, play a crucial role at this stage of the new product development as well [24].

2.3. Prototype Development and Testing Stage

A limited number of studies have been found regarding the last stages of the NPD, i.e., prototype development, product development, and the testing stage.

In the consumer domain, Ref. [23] states that at this level of the NPD, the creativity-relevant processes and task motivation have no impact on the contribution of users, while domain-specific skills play an enhanced role in the users' interest in experiencing and testing new products. Ref. [59] states that the willingness to experiment is crucial at this stage, which is aligned with the ideas of Ref. [24] as well.

In the industrial context, Ref. [24] realized that the characteristics of tolerance for ambiguity are essential to deal with uncertainty between the final output and benefit of the product. The author emphasizes the importance of technological competencies, such as mechanics, electronics, and computer programming, in cases of radical innovations. In contrast with this finding, Ref. [27] concluded that there is a negative performance impact of technically attractive users related to their contribution to the development of mid-range (innovations between minor and radical changes) innovations. They argued that companies rely on their own technical expertise and they shall not expect additional skills from users.

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