

# Early Validation of User Needs in Concept Development; a Case Study in an Innovation-Oriented Consultancy

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**Abstract.** An innovation consultancy applies human-centered methods to explore user needs in the early phase of concept development. This paper compares methods applied by the consultancy with theory from the body of knowledge within Design Thinking and Systems Engineering. The basis for this research is observations and interviews for three specific cases for three different customers. This paper presents criteria and impacting factors on how effective the innovation consultancy performs early validation of user needs. A properly planned co-creation session with the customer is the core. Using a key driver graph we found the main impacting factors to be research on user needs, technology and market trends, techniques used for analyzing the problem and solution domain, selection of participants, and the competence of the facilitator. We conclude that in these three cases the methods are effective in communicating innovative ideas and concepts with the purpose of early validation of user needs.

**Keywords:** Human Centered Design · Systems Engineering · Early Validation · Design Thinking · User Needs · Innovation · Co-creation Sessions

## 1 Introduction

This paper presents a case study in an innovation-oriented consultancy for early validation of user needs in the concept phase. The innovation consultancy develops concepts, prototypes, and full-scale systems to customers within several domains. Early validation of user needs is essential to avoid costly design changes and to develop systems that fulfill their purpose for humans. Systems Engineering emphasizes the importance of identification of stakeholders, among them the users, and their needs to understand all perspectives related to the system of interest. These user needs must be identified

and clearly communicated. A challenge is that the softer human values may lose in a trade-off with the more specific technical requirements.

The following research question is the foundation of this research: *how effective does the innovation consultancy apply the methods for early validation of user needs in the concept phase?*

## **1.1 Research Methodology**

Case studies [1] form the basis for this research within an innovation consultancy providing innovation services to customers within different domains. This research focuses on three specific cases for three different customers. To determine what impacts the effectiveness of the early validation method used by the innovation consultancy, we firstly conduct a literature review on the state of the art of the various early validation methods. Through observations, interviews and discussions with technical engineers and designers, we investigate how the innovation consultancy performs early validation of user needs and why they are doing it this way.

## **2 State of the Art Early Validation of User Needs**

Early validation of user needs is a fundamental concept within Systems Engineering and Design Thinking. A major difference between the approaches is the applied industrial domain. Systems Engineering validates user needs by reviewing user requirements with customers and/or users [2]. Furthermore, the Systems Engineering approach applies ConOps [2] and/or OpsCon [3] to describe the operational concept of a system using scenarios. Traditionally, ConOps and OpsCon are highly textual-based methods originating from the defense industry. Several variants of the ConOps use less text and are less time consuming, such as agile ConOps [6] and illustrative ConOps [4]. Stakeholder analysis is applied for early validation in the Systems Engineering approach [5].

Storytelling and narratives [6] are early validation methods of user needs applied within Systems Architecting and agile forms of Systems Engineering, but also common in consumer-, IT-, and health care domain. These methods are used to understand the context of use. Conceptual modeling is another early validation method commonly applied within Systems Architecting [7]. This method provides an early validation of the most relevant quality attributes at customer/operational level.

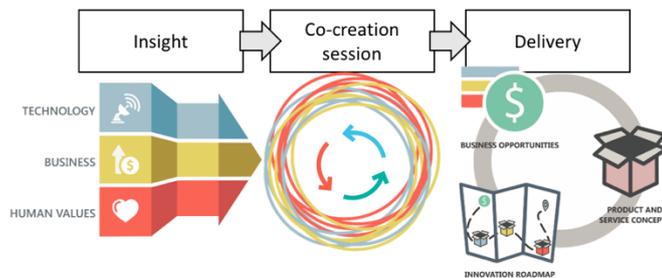
Rapid prototyping is typically used within Design Thinking [8], [9]. This provides quick and dirty validation of ideas using low-cost equipment in rapid iterations. Design Thinking is also advocating for releasing prototypes into the market in order to validate user needs at an early stage [10]. Virtual prototyping is another type of early validation method, based on a visual or software model of the system [11].

Business modelling canvas [12], value proposition canvas [13] and the Lean Canvas [14] are techniques used for early validation in business theory among others based on a lean approach. Within the IT and enterprise sector, we find the workflow analysis used for early validation as it provides a systematic way of mapping the use of the system.

### 3 Early Validation Using Co-Creation Sessions

Based on the state of the art of early validation of user needs, we find existing methods that have proven applicable, and useful in several domains such as defense and aerospace. Based on the innovation consultancy's need for rapid validation in concept phase, we find the traditional early validation methods within Systems Engineering to be time consuming and comprehensive. The innovation consultancy has developed innovation services for early validation of user needs which are heavily inspired by more rapid approaches, such as Design Thinking [8], [9], Systems Architecting [6] and business theory [12], [13].

The innovation consultancy offers co-creation sessions to customers for early validation of user needs for technological product development. Their vision is building the brand of an innovation consultancy that provides product development based on human behavior. Fig. 1 shows the co-creation session with main input and output.



**Fig. 1.** Co-creation session with input and output

The insight phase on the left side is focusing on the three aspects of innovation; technology, business, and human values. This phase is an important input to the co-creation session, and typically includes stakeholder mapping and analysis, field visits, interviews, research on market trends and enabling technology. The duration of this phase is 1–2 weeks and the consultancy performs it in close communication with the customer.

The co-creation session with the customer is a direct interaction with several stakeholders from the customer and lasts for 1–3 days. The consultancy carefully plans the agenda of the session, choosing techniques from an internal library and adapting to the context and the participants. They select participants based on experience, role and if possible on personality. External stakeholders may participate if the consultancy expects added value from their participation. One or two people from the consultancy facilitate the co-creation session. The session may include other participants from the consultancy as well.

The delivery phase involves mapping and analyzing all collected data produced in the co-creation session. Typically, this phase has a duration of 1–3 weeks and the consultancy performs it. The outcome is refined concepts and a plan for further actions.

**Table 1.** Co-creation session case profiles

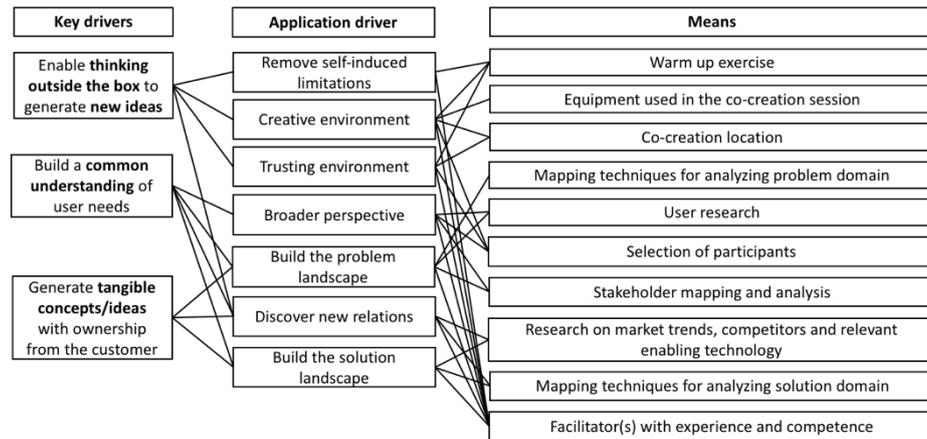
Case no.	Domain	Objective	Participants
1.	Cabin tourism	Innovative cabin resort	7 (customer), 2 (consultancy)
2.	Chemical plant	Increased loading efficiency	8 (customer), 5 (consultancy)
3.	Demolishing plant	Effective and efficient demolishing	18 (customer), 4 (consultancy)

We base our research upon three separate cases within three different domains. Table 1 describes the profiles of each of our cases.

#### 4 Criteria and Impact Factors of Co-Creation Sessions

By using a key driver graph, we derive the criteria for an effective method from the innovation consultancy’s perspective. The key drivers provide the objectives of applying the method, which makes them good candidates as criteria for evaluation. We discuss how these factors play a role in achieving the criteria.

The key drivers shown on the left-hand side in Fig. 2 derive from observations and interviews of facilitators and participants of the three separate cases within the innovation consultancy. The key drivers represent the criteria of effectiveness for the early validation of user needs. To realize the key drivers (criteria) the innovation consultancy applies several application processes using the means shown on the right-hand side in Fig. 2.



**Fig. 2.** Key driver graph of the co-creation session

*Enable thinking outside the box to generate new ideas* is a key driver. The innovation consultancy applies several means to realize this key driver, such as a *warm up exercise* that contribute to the application drivers *remove self-induced limitations* and provide a *creative and trusting environment*.

The *selection of participants* for the co-creation session is a mean to a *creative and trusting environment*, as well as a *broad perspective* to realize the key drivers *enable thinking outside the box* and *build a common understanding of user needs*.

The means shown on the right-hand side in Fig. 2 are representative of the impact factors on the effectiveness of the early validation method. An important part of co-creation sessions is *playful (warm up) exercises* aiming to prime the participants with some subconscious information and set the mood to achieve the session's goals. Examples of these exercises include describing one's superpowers as a superhero, explaining why one has gotten an imaginary gift from another or a physical activity that require negotiating a team strategy to win a competition. These types of tasks function as an exercise to *remove self-induced limitations*, open for *creativity* and create a *trust* between the participants.

The *equipment and the room(s)* used in the co-creation session need to support more practical issues like a large wall for mapping activities, sticky notes in diverse colors, drawing ink instead of common pens to minimize use of word on sticky notes (be specific and easier to read for all), rapid prototype equipment like tape, carton, and paint.

The *location of the co-creation session* is also important to remove the participants from their everyday controlled working environment. This creates space for wonder, curiosity, and play.

*Building the problem landscape* takes place in the first phase of the co-creation session and *building the solution landscapes* takes part in the later phase. The innovation consultancy has experience with various techniques for this purpose, such as user research based on interaction and interviews with users in their operational context (part of insight phase prior to co-creation session), canvas for eliciting user needs, mapping current and better view of the situation on a timeline, and canvas for understanding pains and gains. When the focus is turning more towards the solution landscape, the innovation consultancy applies techniques for ideation, evaluation, and selection of ideas. These techniques include categorization of ideas based on effort, tangible value (revenue) intangible value (brand awareness or customer loyalty), selecting ideas by voting with stickers etc.

Another impact factor of the co-creation session is the *selection of participants*. To provide a trusting and creative environment, as well as a broad perspective, the facilitator has to consider the group dynamic needs based on personality, experience, and competence carefully.

Doing business on providing innovation services like the co-creation session, also require *facilitators with competence and experience* to guide, inspire and lead the participants through the session.

## **5 Discussion and Conclusion**

This paper explores criteria for an effective early validation of user needs from an innovation consultancy perspective. Three specific cases in three different domains are the basis for this study.

As part of the insight phase for the co-creation session, the innovation consultancy performs user research by interviewing and interacting with users in their operational

context. This is well aligned with the empathize phase in Design Thinking [8] and stakeholder analysis in Systems Engineering [5]. The insight phase also includes research on enabling technology, market trends and competitors, as we find in business model theory [12]. During the co-creation session, the innovation consultancy performs exercises for removing self-induced limitations and makes use of different techniques to analyzing the problem and solution domain, such as considering pains and gains. These methods are familiar in both Design Thinking [8], [9], Systems Architecting [7] and business theory [13]. Playful (warm up) exercises are however more common in Design Thinking than in Systems Architecting.

By using a key driver graph, we derived criteria and impact factors of the effectiveness of the early validation method applied by the innovation consultancy. The derived criteria are: *think outside the box to generate new ideas*, *build common understanding of user needs*, and *generate tangible concepts with ownership from the customer*. The main impact factors are: *research on user needs, technology and market trends*, techniques used for *analyzing the problem and solution domain*, *selection of participants*, and the *competence of the facilitator*. We conclude that in these three cases the methods are effective in communicating innovative ideas and concepts with the purpose of early validation of user needs.

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