The Role of Early User Participation in Discovering Software – A Case Study from the Context of Smart Glasses

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Abstract. Smart glasses facilitate advanced user interaction and increase workplace efficiency through innovation. Yet, their capabilities rely on user-driven discovery of new software that harnesses its benefits. This study investigates user participation during the discovery of new software, leveraging this emergent technology. We investigate user participation during software product discovery, i.e. during early activities that precede classical development and design activities, through an in-depth longitudinal case study with two representative user organizations. The results suggest an evolutionary perspective toward the benefits of different types of user participation: 1) user as a source of information, 2) user as a co-creator, and 3) user as an innovator. Practitioners benefit from our lessons learned, validation and extension of software discovery toward the emergent technology, and recommendations to apply user-driven software discovery. We distill three lessons: evolving types of user participation, enhancing desirability through user participation, and carefully discovering software products for emergent technologies.

Keywords: Smart Glasses; Software Product; Software Discovery; Augmented Reality; User Participation

1 Introduction

When developing new software products, the literature presents different techniques, processes, and methods such as Scrum, XP or DSDM that help businesses to become more agile and increase development performance [1], [2]. While agile methods provide very little guidance related to early activities prior to programming [3], [4], scholars investigate the extension of these techniques with ideas from user participation practices such as user-centered design [5], [6]. Therefore, we need to better understand the role of user participation in these early activities, also called software product discovery [1]. Given the nature of innovation shifts from mechanical systems toward the software element of such products [7], the discovery of software products is an

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emergent research field [5]. The associated term of (software) product discovery describes the early activities that precede classical development and design activities. The term originates from the pharmaceutical domain where it is often associated with the discovery of new drugs (e.g. [8]). In other domains, such as new product development, the product discovery phase is described as ideation stage [9]. In innovation management, the terms "fuzzy front-end" and "front-end innovation" have been introduced (cf. [10]). Irrespective of the domain, the objective is to reduce uncertainty at inception of a product development and design project (e.g., [10]). Here, the phase involves users early in order to identify high level needs of the user base and assure the desirability of the solution [11].

The literature presents us with different types of user participation. From a development perspective, we can distinguish three types of user participation [2], [12], [13]. First, and often associated with a traditional waterfall methodology, the user is a source of information [12]. Second, the user can be engaged and co-create the software product with the product team [14], [15]. Third, the user can become an innovating force behind new trends by utilizing toolkits [12]. While some organizations may not decide to involve users at all, other may include them in design reviews or include a user representative as part of the product team [16–18]. However, little is known about the interrelations of different types of user participation.

Smart glasses are an emergent and disruptive technology that can have sustainable impact on society and businesses. The lightweight devices (such as Google Glass or Vuzix M300) are characterized by their high mobility and mobile internet connection [19]. Contrary to other disruptive technologies, such as social media and mobile technology, smart glasses gain faster adoption by businesses than consumers [20]. Businesses see the potential of smart glasses in the way it changes the interaction between the computer and its users [21]. For example, smart glasses used in service and business processes assist employees in conducting tasks through the augmentation of their reality [22], i.e. enriching an individual's reality with further information through digital technology. Particular innovation potential lies with the software and services offered for it [7]. Due to limited experiences with these new devices and the corresponding software, we need to understand the technology's induced changes and influence on users during the discovery of new software products in order to mitigate risks of change requests or unaccepted software products.

This study investigates user participation during the software discovery phase in the context of an emergent technology. Our research objectives are: i) to investigate user participation during software discovery, ii) to understand the interrelations of different types of user participation, and iii) to identify lessons learned from an application of software discovery in a smart glasses project. Consequently, we formulate the following research question: *How can development teams facilitate user participation during the software product discovery for smart glasses?*

Practitioners benefit from our identified activities, lessons learned, and their applicability to software discovery. These can be used as guidelines to instantiate the process of discovering software products for smart glasses [4]. Our theoretical contribution focuses on the investigation of user participation during early activities within software development [5]. First, we adapt existing approaches to discovery by focusing on the participation of users when identifying software products for an emergent technology [1]. Second, we investigate how different forms of user participation benefit the desirability of a product vision during product discovery [23]. Third, we identify the evolutionary nature amongst three types of user participation and suggest a preliminary process model [24].

2 Theoretical Background

2.1 Software Product Discovery

The product discovery process describes the generation of ideas that precedes the development of application functions, leading to a product vision or product discovery plan [5], [1] (Figure 1). The objective of such a vision or plan is to assure the product's feasibility (e.g. [25]), viability (e.g. [9], [26]) and desirability (e.g. [14]). Hence, specific product, user, and team related concerns need to be addressed in five distinct phases. *Initialization* suggests the need for a new development project to assure clearly defined boundaries, the availability of key resources, and key stakeholder commitment [5]. *Product vision building* provides a common understanding of planned software products amongst the development teams [27], [28]. *User engagement* describes integrating the user as early as possible into the discovery process [28], [29]. The participation of users assures gathering actual user goals and user needs and therefore, leads to a desirable solution [1], [28]. *Requirements specification* identifies software needs from their initial idea, to later refined requirements through user feedback [27], [29]. A product backlog will be filled with elements from this requirements specification, the product vision building, and the user engagement [1]. Following, the phase *development and design* of drafts and low-fidelity prototypes simplifies the communication of the vision and helps to gain further insights from users and stakeholders through additional iterations (cf. [29]).

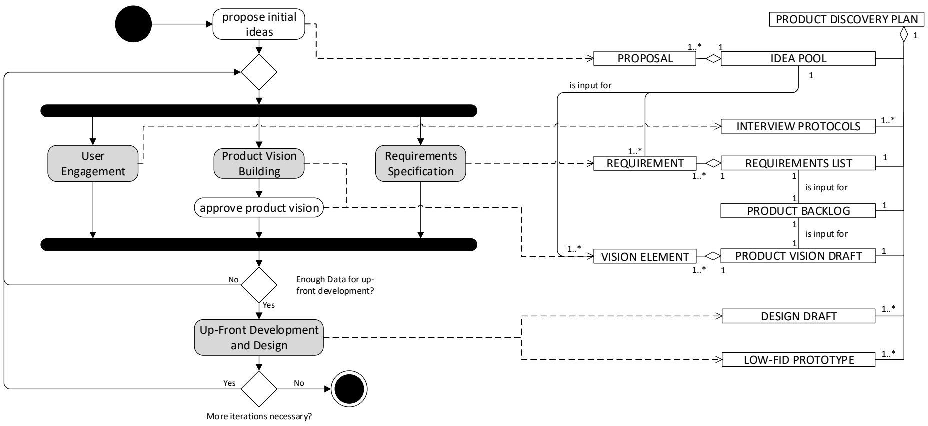

Figure 1. Software Product Discovery (simplified from Werder et al. [1])

2.2 User Participation

User participation has been an important factor in software development for decades [17]. Some of the benefits include quality enhancements, mitigation of unnecessary expenses, higher acceptance, increased use effectiveness, and enhanced development success (e.g. [2], [12]). While the literature presents differences between the concepts of user participation and a closely related concept of user involvement [30], recent studies suggest that scholars use these terms interchangeably most of the times [31], [32]. The positive effect between enabling participation of the user and system success has been empirically demonstrated [32–34]. Yet, system success has been measured in a variety of ways [31].

Prior studies suggest the multidimensionality of user participation [2], [15], [18]. One important dimension relates to the three different types of user participation [2], [12], [13]. First, the user can serve as a source of information. Designs are generated for the user. Second, the user can participate in the creation process as a co-creator. Hence, designs are generated with the user. Third, the user can be the innovating force behind new ideas, when designs are generated by the user. Despite the importance of user participation in software development, the role of user participation in early activities of the product development received little attention [5].

3 Research Method

Given the investigation of a contemporary phenomenon, the study adopts the case study research method [35]. The study presents a longitudinal single case with an embedded design in order to understand the changes in user participation during the discovery of software products for smart glasses. Given the quick adoption of smart glasses in businesses, the study focuses on the use of smart glasses to support employees in the logistics industry, e.g. through information provision or enabling user input during the execution of work-related tasks. The logistics industry is particularly interesting, as workers are confronted with many complex tasks established by manual labor, a field with high potential for technological support [36]. Following prior guidelines, the overall research design, the data collection and data analysis are presented in further depth [37]. Table 1 depicts the different activities and steps incorporating users in the instantiation and first iteration of the software discovery approach, including the duration in which the activities and phases took place. The activities are mapped to the main phases of product discovery (cf. [1], [10]). Since the early activities resulted in the design, development and evaluation of multiple prototypes, the varying timeframes of these iterations were documented in the table as range.

Table 1. Mapping of design technique to different discovery phases.

Design technique / *Discovery Phase*	*Duration (Months)*	*Expert Interviews*	*WH-Observations*	*Cost-Benefit-Discussion*	*Idea Consolidation*	*Product Vision Formulation*	*Benefit Evaluation*	*Requirements Formulation*	*Mockup Design & Prototyping (per iteration)*	*Prototype Evaluation (per iteration)*
Duration (Months)		1	3	1	2	1	1	1	1-3	1-2
Initialization	4	X	X							
User Engagement	11		X	X	X	X	X	X		X
Product Vision Building	4					X	X			X
Requirements Specific	4						X	X		X
Development & Design	4							X	X	

3.1 Research Design

The study follows a longitudinal single case design in order to investigate user participation during the software discovery process. The research context is the logistics industry, where new software for smart glasses is needed to support employees. The discovery phase guides the development of a product vision. Two prospective user organizations that are interested in the software products idea take part in this study. While company ALPHA, a large German logistics handler providing global services, is specialized on contract logistics with a staff of over 12,000 and more than 3,1 billion € annual turnover, company BETA is a German organization mainly offering fashion transport and services with 2,500 employees and more than 250 million € annual turnover. ALPHA's aim of the project is to relieve employees ergonomically and protect them from mistakes in work security. Additionally, ALPHA wants to improve service quality and process time throughout the entire value chain. BETA's goal is to leverage emergent technology in order to create a more attractive and ergonomic workplace. Both seek to implement a software product usable on smart glasses in order to evaluate the innovativeness of the technology in logistics.

Throughout the study, various roles and stakeholders participated. The main activities included researchers from the field of information systems and logistics, domain experts from the two logistics case companies, and software development experts from a software provider focused on logistics solutions. The focus groups were moderated and documented by the participating researchers. Additionally, further domain experts from both case companies were included in an online questionnaire.

3.2 Data Collection

The data collection of this study uses different design techniques and hence, benefits from interaction research design practices [38]. Throughout the project duration, data from multiple sources of evidence was collected, i.e. *expert interviews*, *on-site* *observations through shadowing, focus group sessions, discussions, and an online survey*. An overview of the different design techniques used for data collection during product discovery, and their later use in the analysis is presented in Table 2. The numbers in brackets in the *Data Type* column represents the amount of occurrences (count) of the respective data type. The multiple sources of evidence allow us to triangulate results. Mostly, the literature review and ten discussions in the setting of focus groups lead to the definition of potential system components, collected as idea proposals and vision elements. The collection of data follows the guidelines set by Yin [35], i.e. using multiple sources of evidence, creating a case study database, and maintaining a chain of evidence.

Table 2. Overview of design techniques and their use in data analysis.

Design Techniques	*Data Type (Count)*	*Use in Analysis*
Expert interviews	Interviews with logistics IS experts (2)	- Gather initial ideas for the application of smart glasses in logistics. - Investigate user as an information source.
Focus groups / shadowing	Warehouse observations (4 *together with idea proposal discussions*)	- Examine and gain insights into the usage context.
	Idea proposal discussions (4 *together with warehouse observations*)	- Increase understanding of further potential idea proposals for smart glasses applications. - Investigate collaborative approaches through group discussion.
	Idea cost-benefit discussions (1)	- Construct and analyze cost-benefit based on ideas and product visions.
	Idea proposal consolidation (1)	- Corroborate understanding and consolidate analyzed idea proposals.
	Product vision formulation (1)	- Corroborate understanding and enrich idea proposals with further information and examples.
	Requirements formulation (3)	- Evaluation and formulation of the previously defined ideas and vision elements as requirements from both technical and functional perspectives.
Online questionnaire	Vision survey (1)	- Corroborate product vision benefits with other stakeholders. - Prioritize product vision elements and requirements.
Practical development and design	Design Mockups (3)	- Integrate and crosscheck understanding and findings using design artefacts. - Investigate participatory approaches to user participation.

Design Techniques	*Data Type (Count)*	*Use in Analysis*
	Low-fidelity prototypes (3)	- Integrate feedback and corroborate understanding of design. - Integrate and crosscheck interaction scenarios.
Prototype Evaluation	Focus group discussions (2) Survey (1)	- Review project instantiation through user feedback. - Gain information and feedback on the usage context and acceptability.

The following paragraphs provide a brief description of the applied design techniques embedded in the respective software discovery phases.

Propose Initial Ideas. Initial ideas were identified by conducting expert interviews [39]. As part of the *initialization*, two experts were interviewed, a business system consultant and a business system analyst with experience in logistics. The interviews were each scheduled for two hours and were structured by previously developed guidelines. The interviews helped to understand logistics processes, the respective technical requirements to the technology of smart glasses, and practical development requirements in the domain of smart glasses. Additional usage scenarios were then collected by shadowing employees of both companies according to Myers [40]. Set up as a three-day-observation of workflows and activities relevant for the handling of cargo in goods receipt, storage picking and goods issue, results were documented as field notes and process models.

User Engagement. The *user engagement* phase was started through different focus groups. Eight focus groups were held according to established guidelines [41]. Employees of both companies, researchers with expertise in smart glasses technology and in logistics, and representatives of a software company were present at all focus group meetings. Each focus group was conducted moderated and extensively documented by a team member of the research team. A meeting protocol was sent to all participants, allowing them to make corrections and adjustments to the notes.

Product Vision Building. In order to build the respective *product vision* incorporating the different system components, a catalogue of 36 idea proposals was developed and enriched by descriptions and examples to generate common understanding. These particularized ideas formed vision elements, which were then evaluated using a personalized online survey. In addition to general demographic data and entry-fields for comments and notes, the questionnaire consisted of four questions for each vision (general usefulness, innovativeness, personal usefulness, adoption) using a 7-point Likert scale. 31 participants completed the survey (67% domain experts, 7% software developers, 26% researchers).

Requirements Specification. In order to *specify requirements*, the evaluation results were combined with an additional technical focus group meeting, discussing technical requirements of each vision element. Stemming from this inductive combination, a prioritization of the requirements was conducted in a backlog. Resulting from further focus group discussions with domain experts and software developers, functional and technical requirements were formulated, both for general applicability for smart glasses-based software, and for specific guidance of the respective vision element instantiation.

Up-Front Development and Design. Through the *implementation and design* of three different prototypes, the respective vision elements were instantiated iteratively. Three prototypes were implemented with two different goals aiming at supporting employees from logistics at their daily tasks through different sets of functions (documentation of damages or assembly errors, and process visualization for value-added services). The latter prototype was implemented in two iterations. The implemented systems were evaluated by applying different methods for each system. While the initial prototype was evaluated through a survey with students, the other two instantiations were presented and discussed with domain experts. The various qualitative remarks made by the participants as part of subsequent iterations of the phases *user engagement*, *product vision building,* and *requirements specification* were then included in the next iteration of development and design.

3.3 Data Analysis

The analysis was initiated by applying inductive class formation according to Mayring [42] for each data set, generating idea proposals for potential smart glasses application scenarios on the domain of logistics. Ideas were gathered investigating (a) functional support of a smart glasses application, (b) an implementation of technical requirements in logistics, or (c) a potential or already proven application scenario. Suitable ideas were identified in a subsequent analysis, whereas ideas could be assigned to an already defined idea (subsumption). In case no equivalent idea was previously proposed, a new element was formed inductively based on the specific content [40]. A fundamental challenge in the continuous formulation and aggregation of the idea proposals was the occurrence of partly diverging degrees of abstraction in the description through the different methods. Hence, category formation according to Mayring [42] was applied again, based on the results of the different methodological approaches, in order to subsume the idea proposals gradually. Thereafter, descriptions were derived (including actors, processes, and activities), examples for all scenarios were developed by domain experts of the two case companies, and product vision elements were generated. These artefacts were validated and consolidated in additional focus group meetings and formed the basis for the definition of technical requirements. The line of argumentation for the technical assessment of the requirements was inductively formed. The purpose of this coding step was to consolidate and derive the technical design and create architectural design proposals [42]. Pattern matching and explanation building was applied in order to analyze and synthesize our findings.

4 Findings from a Software Discovery Project

As we seek to investigate the role of user participation during the discovery of software products for smart glasses, the results are presented along the different types of user participation. First, we present findings supporting the participation of users as an information source. Second, we report findings with the user as a co-creator. Third, we present findings concerning the user as an innovator.

4.1 The User as Source of Information

Users were involved as a key source of information through the execution of interviews. This was the first design technique we applied during data collection at an early stage of software discovery. Following the recommendation of gathering idea proposals in software discovery, we identified first ideas, which were then further evaluated. We documented and collected all idea proposals in an idea catalogue. Hence, the idea generation reflects the initialization phase of software discovery, with the catalogue being equivalent to the idea pool. As a result of shadowing and observing users, they provided us with additional insights and information (e.g. at which process steps the user needs both hands). An idea proposal stemming from these activities was a system to support the picking process, by displaying information on which product to pick next, and provide confirmations via barcode scanning.

4.2 The User as Co-Creator

Thereafter, warehouse tours helped to gain more detailed insights and impressions of the needs and processes of different warehouse settings. After two tours at each customer company, followed by in-depth discussions with various stakeholders, most of the previously gathered ideas were validated. Furthermore, new ideas were identified and discussed. The results from our initial user participation activities (i.e., the expert interviews, shadowing, and initial focus groups), formed the first version of our idea pool. Since the focus groups included stakeholders and potential users, the tours and discussions engaged the users as part of the software discovery process.

Throughout the participatory discussion and idea pool evaluation, various ideas were regarded as either too ambiguously defined, or too similar to other ideas. To promote a common understanding across both companies, each company was asked to enrich each element with a detailed description and possible scenarios. This helped us to identify differences between both case companies. As a result, when larger differences were identified, we divided an idea into separate elements (e.g., displaying warnings and safety instructions was separated to a process-based and an object-based warning system idea). Thereafter, we could unify many elements that covered the same area, yet were initially associated with two different idea proposals (e.g., the ideas of identifying objects through QR- and barcodes or RFID were unified to a general object identification). Through this consolidation, the final idea pool was reached for further investigation. The underlying warehouse tours and the focus group discussions were planned in the first iteration and served as main basis for all subsequent steps. Detailed evaluation of the resulting ideas and vision elements was conducted toward the middle and end of the discovery phase. From this type of user participation, more elaborate ideas and vision elements could be derived, such as the documentation of damages by usage of the smart glasses' camera and the transfer of this documentary evidence to damage management. These elements form the product backlog that guided the development, and were later instantiated as a prototype.

4.3 The User as Innovative Force behind Trends

With a well-described and communicated set of system components, a prioritization according to their practical benefit was needed. Hence, an online questionnaire was developed to provide a second evaluation. For both companies, the survey led to a prioritized list of the previously unsorted backlog items. Through this survey, users provided their input and evaluated each component. They were given the means to engage and prioritize backlog items according to the stakeholders' needs. This enabled the user to actively shape the software discovery process, as backlog elements that were deemed as unimportant or not useful for the customer and user could be neglected. This increased the influence of the user, in particular in the area of emergent technologies. The survey counts toward requirements specification, as specific requirements or concerns of different stakeholders and users were highlighted.

Mock-ups as well as prototypes were then designed, developed and evaluated in order to showcase the application of smart glasses in a specific use case (process guidance). Benefitting from early user and stakeholder participation, we were able to document cases in which idea proposals, their detailed formulation as vision elements and development and design artifacts were created by stakeholders or users. For example, the idea to support the process of assembling, equipping and examining promotional displays for groceries was actively developed and matured by a stakeholder and participant of the warehouse tours, and was then chosen as first content for the process guidance prototype. This prototype was then instantiated in two iterations. During both iterations, a close collaboration with the users existed, leading to two maturity stages. The development was conducted toward the end of a product discovery iteration.

5 Toward the Process Model for User Participation

We developed a preliminary process model that seeks to clarify the interrelations of different types of user participation (Figure 2). Through the previously described activities, users and stakeholders were actively involved in the discovery process. Our results suggest that early participation of users and stakeholders is exceedingly important in emergent technologies, as desirability is essential for an intention to use a new system.

The process model starts with the intention to develop a new product idea, serve a new user need, or utilize a new technology. Hence, the development and design team has to learn more about the users' tasks and work context. In this scenario, the users typically act as a source of information for the development team. Building on this knowledge, the users can be invited to co-create, for example through co-creation workshops. Through co-creation design techniques, the users becomes more familiar with essentials of the software development and design processes. Once familiar with different techniques and an understanding of their individual strengths and weaknesses, the users may further contribute. They are now equipped with essential process skills and corresponding tools, which are typically readily available online for easy and quick sketches and prototypes. Building on these skills, the users can develop their own design suggestions and share those with the development and design team. Also, new feature ideas can be integrated into existing screenshots by the users, simplifying the communication between the users and the development team. Therefore, the users can drive further innovation by developing their own ideas. We suggest that the evolution of different user participation types is the result of a knowledge creation process [43], where knowledge about the application domain and knowledge about the technology need to be combined [44]. Through structuring this approach as a sequential and incremental process model with iterations between the subsequent stages (i.e. having one stage of user participation leading to a more mature, more integrated stage including changes to the user's tasks, goals and the environment), we provide an ex-post suggestion on how a software discovery project can be conducted. While the definition of a chronological order of the stages is only one possibility of a respective process model, it provided us with an easy to use and successful guideline throughout the investigated project.

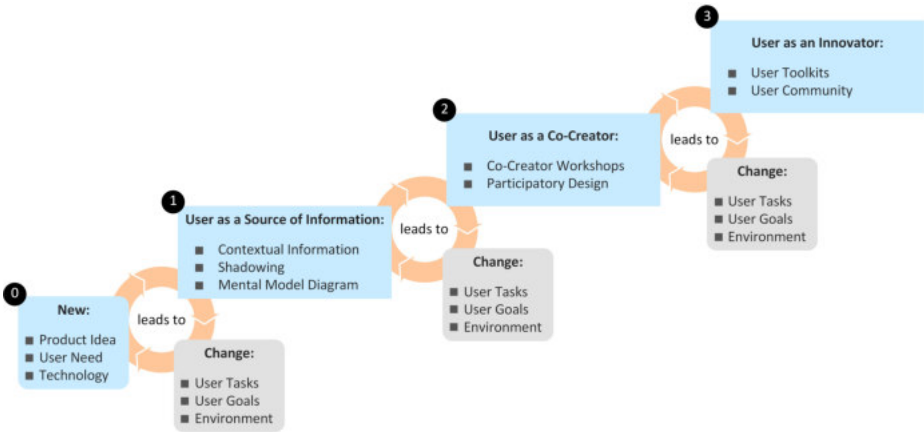

Figure 2. Preliminary process model for the evolution of user participation types

While other researchers, such as Damodaran [2] or Markus and Mao [15], stress the importance of user participation and present detailed role descriptions and research propositions, they do not specify any order or evolution of different types of user participation. As our model focuses on the creation of completely new software in the domain of emergent technology, this temporal link serves as a basis for a holistic approach to user participation. The users are thoroughly guided toward more autonomous roles. We observed that without a chronological order or procedural guidelines, users are quickly overwhelmed by the sheer number of design techniques and design dimensions available and lose track of key objectives, leading to scope creep with ideas and functionality that is out of the scope of the system under development.

6 Lessons Learned

We answer our research question with three lessons learned we identified through the course of the case study. Adhering to and considering these three aspects, practitioners can facilitate user participation when discovering new software.

Consider Evolving Types of User Participation. During the study, multiple iterations of software discovery have been conducted. Through the different iterations, different types of user participation have been observed [13], [16]. The data collection started with interviews, which provided a better understanding of the users' tasks and their environment. Within these interviews, the user served as an information source. Thereafter, on-site observations and focus group discussions were the main source of information. Hence, the user's role evolved, as they were not only the source of information, but also participated in the creation and shaping of designs and prototypes. Lastly, users were engaged as they were given the opportunity to actively influence the design of the software, by generating their own design suggestions. Practitioners should keep these different phases in mind when integrating users to gain the desired information or result.

Enhance Desirability through User Participation. We were able to identify early user and stakeholder participation to be essential for a successful discovery of smart glasses software. The early participation helped to shed light on some concerns and other issues raised by the users and stakeholders. Consequently, these issues and concerns could be addressed from the beginning. Involving users early in the process provides assurance and reduces uncertainty for all people involved [17]. For example, many of the idea proposals resulted from the focus group discussions. Several ideas were related to a tension field (e.g., data privacy). Hence, users had to be reassured that the project aimed at improving processes and ergonomics in their favor without jeopardizing their data privacy. Thus, rushed introductions of technological advancements can have negative effects, whereas comprehensive up-front communication and preparation help to avoid such pitfalls. In the case of emergent technologies, uncertainty or unawareness frequently have to be managed. As different stakeholders, such as users or customers, were not able to imagine the specific use of smart glasses in their work context, hands-on demonstrations were provided in order to specify the technological capabilities of smart glasses within their work environment. Through this course of action in conjunction with the innovative characteristics of smart glasses, different desirable prototypical implementations have been developed. This became apparent as new participants could be regularly included into the focus groups.

Thoroughly Discover Software Products for Emergent Technologies. Through the interaction with users and other stakeholders, prior concerns with the technology became apparent. We wanted to put an emphasis on discovery activities using prototypes and mockups. These artefact-centered means of communication helped to reduce uncertainty by specifying design ideas and concepts. While prior research suggests steps and activities for the discovery of products (e.g. [1], [10]), the case context suggests specific nuances for the application with smart glasses. Given that smart glasses are still an emergent technology, little application examples exist. The role of very early participation of users in order to understand the tasks, goals and work context are important in contrast to application domains with a variety of mature software alternatives fulfilling the same or a similar purpose. Hence, while in an established application domain given instances may swiftly consider co-creation workshops or user participation with a focus on innovative ideas, in our case, technology provider and technology user have to become familiar with each other's domains, as users from all stakeholders issued not being familiar with the technology.

7 Conclusion

The paper investigates the discovery of software products for smart glasses. Key phases and activities for software discovery applied in a case study in the logistics context. As a result, the use of different user participation techniques, depending on the products maturity is suggested. While initially, the user is often seen as a source of information for the developers to understand the task goals and work environment. Subsequently, the user can be engaged as a co-creator. With the use of toolkits, the user can also drive innovative processes by developing own design alternatives and ideas for new product features. While we investigated different sources of information over a longer period of time in order to develop a preliminary process model, the study does not investigate cause-and-effect relations. Hence, future research may investigate the use of different user participation types toward the performance of the discovered product.

References

1. Werder, K., Zobel, B., Maedche, A.: PDISC – Towards a Method for Software Product DISCovery. In: Maglyas, A. and Lamprecht, A.-L. (eds.) International Conference on Software Business. pp. 47–62. Springer International Publishing, Cham, CH (2016)
2. Damodaran, L.: User involvement in the systems design process - a practical guide for users. Behav. Inf. Technol. 15, 363–377 (1996)
3. Heikkilä, V.T., Paasivaara, M., Rautiainen, K., Lassenius, C., Toivola, T., Järvinen, J.: Operational release planning in large-scale scrum with multiple stakeholders - A longitudinal case study at F-secure corporation. Inf. Softw. Technol. 57, 116–140 (2015)
4. Kuusinen, K.: Improving UX Work in Scrum Development: A Three Year Follow-Up Study in a Company. In: 5th IFIP WG 13.2 International Conference, HCSE 2014. pp. 259–266. Springer Berlin Heidelberg, Paderborn, DE (2014)
5. Brhel, M., Meth, H., Maedche, A., Werder, K.: Exploring principles of user-centered agile software development: A literature review. Inf. Softw. Technol. 61, 163–181 (2015)
6. Salah, D., Paige, R.F., Cairns, P.: A Systematic Literature Review for Agile Development Processes and User Centred Design Integration. Proc. 18th Int. Conf. Eval. Assess. Softw. Eng. (EASE '14), London, United Kingdom, 13-14 May, 2014. 5:1--5:10 (2014)
7. Bosch, J.: Speed, Data, and Ecosystems: The Future of Software Engineering. IEEE Softw. 33, 82–88 (2016)
8. Nwaka, S., Hudson, A.: Innovative lead discovery strategies for tropical diseases. Nat. Rev. Drug Discov. 5, 941–955 (2006)
9. Cooper, R.G.: Winning at New Products: Creating Value Through Innovation. Basic Books, New York, NY, USA (2011)

10. Stevens, E.: Fuzzy front-end learning strategies: Exploration of a high-tech company. Technovation. 34, 431–440 (2014)
11. Cagan, M.: Product Discovery, http://www.svpg.com/product-discovery
12. Kaulio, M. a.: Customer, consumer and user involvement in product development: A framework and a review of selected methods. Total Qual. Manag. 9, 141–149 (1998)
13. Werder, K.: Team agility and team performance - The moderating effect of user involvement. 24th Eur. Conf. Inf. Syst. ECIS 2016. (2016)
14. Simonsen, J., Robertson, T.: Routledge International Handbook of Participatory Design. Routledge, New York, NY (2013)
15. Markus, M.L., Mao, J.-Y.: Participation in Development and Implementation - Updating an Old, Tired Concept for Today's IS. J. Assoc. Inf. Syst. 5, 514–544 (2004)
16. Cui, A.S., Wu, F.: Utilizing customer knowledge in innovation: antecedents and impact of customer involvement on new product performance. J. Acad. Mark. Sci. (2015)
17. Bano, M., Zowghi, D.: A systematic review on the relationship between user involvement and system success. Inf. Softw. Technol. (2014)
18. Liu, X., Werder, K., Maedche, A., Mädche, A.: A Taxonomy of Digital Service Design Techniques. In: 2016 International Conference on Information Systems, ICIS 2016. pp. 1–12. AISeL, Dublin, IE (2016)
19. Matthies, D.J.C., Haescher, M., Alm, R., Urban, B.: Properties Of A Peripheral Head-Mounted Display (PHMD) Peripheral Head-Mounted Display (PHMD). 1–6 (2015)
20. Frick, W.: Google's Strategy vs. Glass's Potential.
21. McKinsey Digital: Industry 4.0 - How to navigate digitization of the manufacturing sector. (2015)
22. Niemöller, C., Metzger, D., Fellmann, M., Özcan, D., Thomas, O.: Shaping the Future of Mobile Service Support Systems - Ex-Ante Evaluation of Smart Glasses in Technical Customer Service Processes. In: Mayr, H.C. and Pinzger, M. (eds.) Informatik von Menschen für Menschen (Informatik 2016). pp. 753–767. LNI 259, Klagenfurt, Österreich (2016)
23. Lewis, J.R.: Usability: Lessons Learned … and Yet to Be Learned. Int. J. Hum. Comput. Interact. 30, 663–684 (2014)
24. Ralph, P.: Toward Methodological Guidelines for Process Theories and Taxonomies in Software Engineering. IEEE Trans. Softw. Eng. (2018)
25. Pavlou, P. a., El Sawy, O. a.: From IT Leveraging Competence to Competitive Advantage in Turbulent Environments: The Case of New Product Development. Inf. Syst. Res. 17, 198–227 (2006)
26. Mintzberg, H.: Patterns in strategy formation. Manage. Sci. 24, 934–948 (1978)
27. Kajko-Mattsson, M., Nyfjord, J.: A model of agile evolution and maintenance process. Proc. 42nd Annu. Hawaii Int. Conf. Syst. Sci. HICSS. 1–10 (2009)
28. Sy, D.: Adapting Usability Investigations for Agile User-Centered Design. J. Usability Stud. 2, 112–132 (2007)
29. Salah, D., Paige, R., Cairns, P.: A Practitioner Perspective on Integrating Agile and User Centred Design. Proc. 28th Int. BCS Hum. Comput. Interact. Conf. HCI 2014 - Sand, Sea Sky - Holiday HCI. 100–109 (2014)
30. Barki, H., Hartwick, J.: Rethinking the concept of user involvement. MIS Q. 13, 53–63 (1989)
31. Harris, M., Weistroffer, H.: A New Look at the Relationship between User Involvement in Systems Development and System Success. Commun. Assoc. Inf. Syst. 24, 739–756 (2009)
32. Lin, W.T., Shao, B.B.M.: The relationship between user participation and system success: a simultaneous contingency approach. Inf. Manag. 37, 283–295 (2000).

33. McKeen, J., Guimaraes, T., Wetherbe, J.: The relationship between user participation and user satisfaction: an investigation of four contingency factors. MIS Q. 18, 427–451 (1994)
34. Tait, P., Vessey, I.: The effect of user involvement on system success: a contingency approach. MIS Q. 12, 91–108 (1988)
35. Yin, R.K.: Case Study Research: Design and Methods. Sage, Thousand Oaks (2009)
36. Reif, R., Günthner, W.A., Schwerdtfeger, B., Klinker, G.: Pick-by-Vision Comes on Age: Evaluation of an Augmented Reality Supported Picking System in a Real Storage Environment. In: Proceedings of the 6th International Conference on Computer Graphics, Virtual Reality, Visualisation and Interaction in Africa. pp. 23–31. , New York, NY, USA (2009)
37. Dubé, L., Paré, G.: Rigor in information systems positivist case research: current practices, trends, and recommendations. MIS Q. 27, 597–635 (2003)
38. Zimmerman, J., Forlizzi, J., Evenson, S.: Research through design as a method for interaction design research in HCI. In: Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '07. p. 493. ACM Press, New York, New York, USA (2007)
39. Bogner, A., Menz, W.: The Theory-Generating Expert Interview: Epistemological Interest, Forms of Knowledge, Interaction BT - Interviewing Experts. Presented at the (2009)
40. Myers, M.: Qualitative Research in Business & Management. Sage Publications Ltd., London (2009)
41. Bohnsack, R.: Group discussion and focus groups. A companion to Qual. Res. 210–221 (2004)
42. Mayring, P.: Qualitative Content Analysis: Theoretical Foundations, Basic Procedures and Software Solution. (2014)
43. Joshi, A.W., Sharma, S.: Customer Knowledge Development: Antecedents and Impact on New Product Performance. J. Mark. 68, 47–59 (2004)
44. von Hippel, E., Katz, R.: Shifting Innovation to Users via Toolkits. Manage. Sci. 48, 821–833 (2002)