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Knowledge Management as an important tool in participatory design

Xiaoli Chen¹, Ralph Riedel¹, Michael Bojko¹, Mandy Tawalbeh¹, and Egon Müller¹

¹ Chemnitz University of Technology, 09107 Chemnitz, Germany

{xiaoli.chen; ralph.riedel; michael.bojko; mandy.tawalbeh; egon.mueller}@mb.tu-chemnitz.de

Abstract. Innovation is a necessity for the survival in the dynamic and complex environment companies are currently in. Innovation is not only the result of a creative development process, but comes out also from the value adding process itself, and derives from the generation of knowledge, including the interaction and application of knowledge for market success. Therefore, the ability to collect all possible knowledge and trigger it for success is of great importance for being competitive. This is also the main focus of participatory design activities. In this work, with a special view on the importance of knowledge management, an approach using the analysis of relevant and available knowledge has been set up for the determination of suitable methods for participatory design activities. In detail, objectives of knowledge management are identified according to different requirements of the innovation lifecycle. Cognitive and technology gaps among participants are further analyzed to provide an in-depth view on the problem of participatory design. With the matching of problems with the potentials of possible participatory design methods, proper methods are further identified, which helps to realize objectives of knowledge management, in the end leading to the success of value adding.

Keywords: Knowledge management, participatory design, innovation lifecycle

1 Introduction

Ever increasing global competitive pressure, shrinking product lifecycles and fast changing technologies are driving companies towards innovation to remain in the competition [1]. Quite often, innovation is related to the occurrence of new products and technologies [2]. But currently, innovation is more and more seen as the process which results from various interactions among different participants. Especially, when it comes to new product development, innovation is particularly characterized by value adding, which derives from the generation of new knowledge and includes the interaction and application of knowledge for market success. It is the participation and interaction of all involved actors (e.g. designers, users, machine operators, suppliers/partners, logistic operators and customers), which finally leads to the success and competitiveness of companies. Therefore, participatory design for the full encour-

agement of all potential knowledge and its interaction is highlighted as one of the most focused issues of company management. A suitable knowledge management within the participatory design is an alternative shortcut contributing to the success of value adding.

When it comes to the aspects of knowledge management, it is not only the content of knowledge, but also the way in which different knowledge pieces interact with each other is crucial to the success of value adding. The manners of knowledge interaction is highly related to how the approach of participatory design is established. However, question arising here is: How to find out and establish appropriate approaches for the realization of efficient participatory design? And derived questions that should be clear are:

- What is an efficient participatory design?
- Which approaches are existing for carrying out participatory design?
- With a view to the objectives of knowledge management and also the real conditions of participants, how to identify a suitable approach for participatory design activities?

With all these in mind, the purpose of this work is to provide an approach, which helps to setup an efficient participatory design model. General work begins with the introduction of the relevant background. Further work goes on with a vast review on the theoretical basis. Related participatory design approaches are investigated based on the state of art. With a view to the importance of knowledge management, a general logic is composed as the rule for determining suitable participatory design methods. A detailed model is further established for interpretation. An empirical study is conducted for validation purposes. A conclusion of the work is composed in the end.

2 Definition and possible methods of participatory design

2.1 Participatory design and knowledge management

Participatory Design is “an emerging design practice” that involves different stakeholders within various co-design activities throughout the designing process [3]. Here, beside designers, stakeholders involve not only other discipline members from a development team (e.g. machine operators, project manager and general manager), but also external stakeholders within the supply chain (e.g. logistic operators, suppliers and partners). For better marketization, potential customers beyond the boundary of the company or industry would also be included during the design stages. Therefore, these stakeholders have usually “different backgrounds, experience, interests and roles within the project” [3]. For the full encouragement of participatory design activities, the consideration of the detailed contents of knowledge brought from the participants is of great importance. Moreover, the way how to trigger knowledge interactions dependent on the real situation is sometimes even more important and necessary. This brings special emphasis on the issues of knowledge management.

Knowledge management is a “planned, structured approach” to realize sharing, acquisition, refinement, distribution and application of knowledge as in the organizational asset [4]. With a view to the vast body of literature and practice, we see

knowledge management has been widely used in many fields, e.g. new product development [4], organizational learning, organizational innovation, project management [5], and so on. In this paper, while considering the relative advantages, knowledge management has been involved as an important tool in the development of efficient participatory design, which can help to access and structure the experience, knowledge and expertise of participants to create new competitiveness advantages, to enable better performance and in the end to increase value adding and customers' satisfaction [6]. And the establishment of an efficient participatory design requires not only the planning of knowledge pooled by participants, but also the structuring of knowledge for proper "collision", which leads to knowledge fusion and fission for creating new value [1].

2.2 Possible methods used for participatory design

The arrangement of an appropriate participatory design is, to some extent, a crucial determinant of innovation. Knowledge generation and value adding are all illusory scenarios if the knowledge from relative stakeholders could not be structured and formalized in a suitable way. Hence, studies of participatory design are highly emphasized both in theory and practice. Methods, such as LEGO® SERIOUS PLAY® [7], LEGO® MINDSTORMS®, scenario analysis, role plays, prototypes, Mind Mapping, morphological boxes, story-telling, persona, brain writing, diagrams and image schemes, contextual inquiry, ethnographic methods, participatory ergonomics [8], have come up during the past periods.

Numerous works can also be found dealing with the classification of participatory design methods [3, 9, 10]. Some focused on a basic understanding and tried to propose proliferation of theoretical foundation, e.g. in the works of Muller and Kuhn [9], more than 20 methods have been listed out, where two issues namely "position of activity in the development cycle or iteration" and "who participates with whom in what" have been concluded as the logics for the taxonomy. With the analysis of application cases in practice, others attempted to make a comparison among different participatory design methods, to help to list out the key features for the identification [10]. With the aim of combining theory and practice, works from Sander, Brandt and Binder [3] also tried to sort the situations of participatory design based on the purpose (for probing, priming, understanding or generating), group size and composition (individual or group) and manners of participatory design (face-to-face or on-line). Taken together, all these works contribute to the idea of the current work, yet two shortcomings can still be found: (1) the ignorance of knowledge management, though the compositions of knowledge and how the knowledge would be structured for collision are the core for the defining of an efficient participatory design; (2) the lack of a systematic approach, which can be used as a reference of application. Though a systematic method is of great importance for the decision support related to the participatory design activities, only partial theoretical and practical assets could be found separately. However, with a view to different objectives of knowledge management within various innovation stages, a bridge with an overall mindset to match the real conditions with the potential abilities of existing participatory design methods, is still a gap.

Therefore, a more “contemplative and nuanced approach” is required [4], so as to answer “how to get appropriate approaches for the realization of efficient participatory design?”

3 Establishment of the proposed approach

3.1 Framework of participatory design

Based on the aforementioned analysis, a general framework of participatory design has been composed as shown in Figure 1. As can be seen, three issues compose the initiate status of participatory design. Those are the *position in the innovation lifecycle*, the *team composition* and the *degree of prior knowledge* [8]. The general work of participatory design begins with the identification on the objectives of knowledge management. This is based on the analysis related to the *position in the innovation lifecycle*. Real conditions of knowledge, pooled by participants, are further analyzed with the consideration of the *team composition* and the *degree of prior knowledge*. *Cognitive gaps* and *technology gaps* among participants can also be identified according to the analysis of the real conditions. When taking into account both the objectives and real conditions, the logic of knowledge management plays the role of a bridge to match the existing gaps with the possible abilities of participatory design methods, which in the end leads to the identification of suitable methods.

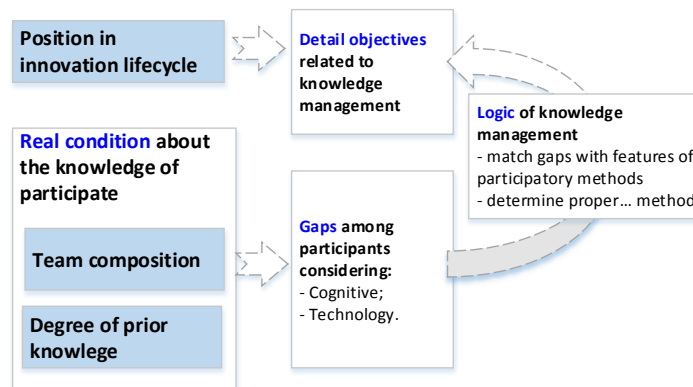


Fig. 1. General approach for the establishment of participatory design

3.2 Detailed view of the approach

Based on the composition of the general framework, the proposed approach has been detailed as shown in Fig. 2. It can be seen, that the approach could be divided in three stages: 1) obtain detailed objectives of knowledge management; 2) analyze the real conditions of the knowledge pool to find gaps among participants; 3) match to determine a proper participatory design method, to realize the objectives of knowledge management.

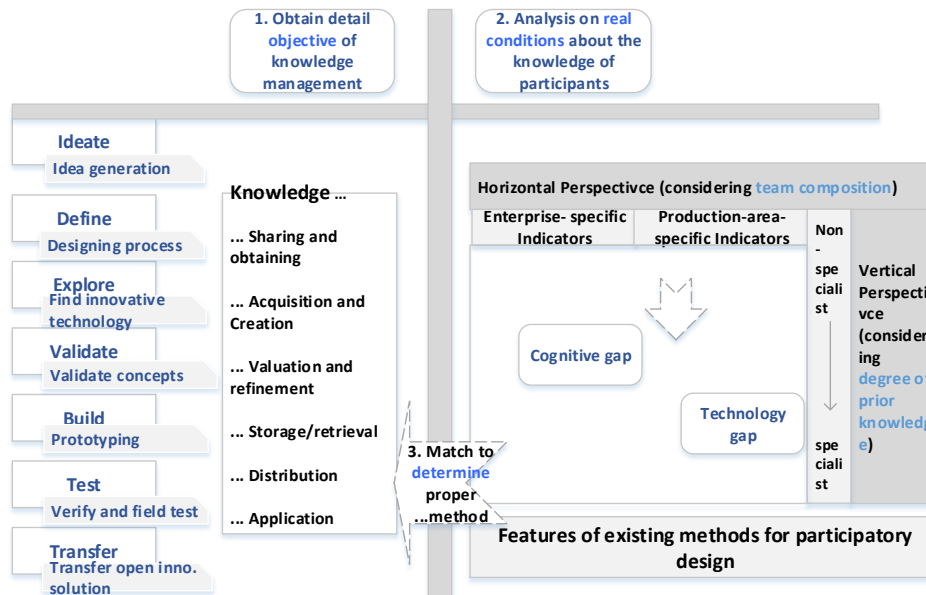


Fig. 2. Detail interpretation of the approach

1) Obtain detailed objectives of knowledge management

Knowledge management is a “set of activities, initiatives and strategies” [11], which enables effective and efficient usage of knowledge and helps to create new value. Within different stages of the innovation lifecycle, the target of knowledge management varies differently, e.g. the idea generation stage requires more knowledge sharing and obtaining; the validation stage needs more valuation and refinement of knowledge. Based on the works of Plessis [4] and also Grant and Dumay [12], activities and detailed objectives of knowledge management have been gathered as: *knowledge sharing and obtaining; acquisition and creation; valuation and refinement; storage and retrieval; distribution and also application*. Here, *knowledge sharing and obtaining* mainly refers to the engagement and participation of all stakeholders, communication to share ideas, which triggers the obtaining of information and interactions for new ideas. The *acquisition and creation of knowledge* is a more in-depth stage, which relates to reconstructing and synthesizing of knowledge and also the organization of knowledge for getting general concepts [12]. The *Valuation and refinement* is mainly connected with the set-up of metrics for evaluation and attempts to refine the knowledge accordingly; the *storage and retrieval* includes the codifying and documenting of knowledge for storage. The *distribution* is more the spreading of information in hope to get better effects for the existing knowledge pool [11]. The *application* refers to the usage of knowledge to realize value.

2) Analyze the real conditions of the knowledge pool

According to Tawalbeh et al. [8], the real conditions about the knowledge pooled by the participants could be analyzed from both a horizontal and also a vertical perspective (see Fig.2). Here, the horizontal perspective focusses on considering the team composition, where *enterprise-specific* or *production-area-specific indicators* would be used for the analysis. In detail, *enterprise-specific issues* include knowledge on cognitions, mindsets, norms, values, hierarchy, business process and other special characteristics of the company [1]; and the *production-area-specific items* are more focused on the technical know-how. Indicators, such as education background, previous work done in certain areas, or simply working with similar technologies or in the same type of industry would be used for interpretation. Beside the horizontal perspective, a vertical one, focusing on conditions regarding the degree of prior knowledge would also be taken into account. Different levels of the knowledge base of each participant can also be assessed accordingly. As a result, a knowledge distance, namely cognitive and technology gaps could be identified based on the above knowledge portfolio and their relative levels. Methods with multi-dimensional scaling analysis proposed for instance by Stuart [13] and Baum et al. [14] are suggested as the references for further work here.

3) Match to determine a proper participatory design method

With the consideration of the objectives of knowledge management, and based on the knowledge gaps among participants, detailed requirements can further be gathered for the determination of a participatory design method. Detailed characteristics listed out for the identification and classification of participatory design methods from [3, 7, 8, 9] would be involved for the interpretation of each method's features. With the matching of requirements with potential features and abilities of participatory design methods, the target method (the most suitable one) could be identified as a result. This general idea is displayed in Fig. 3.

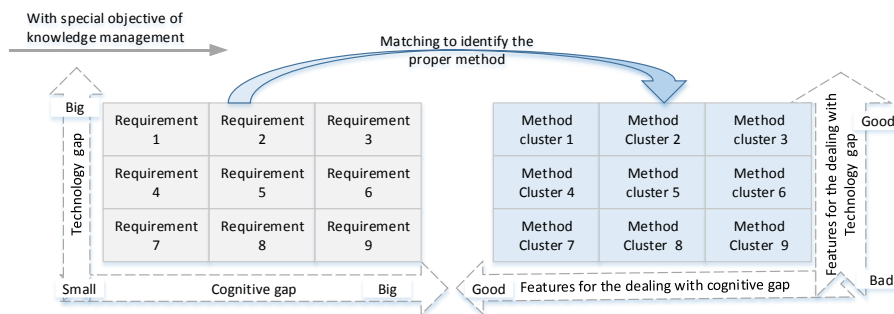


Fig. 3. Matching for the identification of a proper method

4 Empirical study

The German initiative “Mittelstand 4.0-Agentur Prozesse” is a platform focused on the digitalization of resource and process management [7]. The main target of this initiative is to support the qualification of information multipliers, who are enabled to help small and medium-sized enterprises and also handicraft companies [8]. Here, the major activities of knowledge management are related to the distribution and transfer of digitalization knowledge. The participants have different backgrounds, experience and interests. As most participants come from different industries, a big gap exist both on cognitive and technology aspects. Therefore, as shown in Fig.3, the requirements on the participatory design method are identified as “requirement 3”. To deal with this special condition, a method, which embodies the ability to deal with the big gap (on cognitive and technology related knowledge), should be considered for facilitating participatory design.

With these requirements in mind, a vast search through all possible methods has been conducted. In the end, LEGO® SERIOUS PLAY® has been identified as the proposed method. LEGO® SERIOUS PLAY® is “an innovative hands-on and minds-on method based on metaphorical thinking to improve the understanding of processes” [8]. In this case, a fictive company has been modelled as the objective of the investigation. Each of the participants has been pointed to a special role within this objective company. Via the establishment of the fictive company, problems with the gaps considering the special company and industry could be solved. As all participants were introduced to the same objective company, they were moved to the same knowledge level for a common understanding. With the introduction of the theory and warming up with Lego, all participants could feel free to design their view of the future versions of the objective company in the year 2020. Moreover, with the learning-by-playing approach, concrete actions for realization could be worked out suitably when considering the scenario of their working area within this fictive company and also with the consideration of external influences of the system’s environment. A joint model representing the common understanding of the digitalization has also been concluded. Taken together, with the logic of knowledge management, LEGO® SERIOUS PLAY® has been confirmed as an appropriate method within this project. Here, the problems with the cognitive and technology gap have been solved smoothly and the knowledge of the different participants has been fully shared and triggered under a common understanding. Therefore, the approach proposed as in this paper could be seen as to be validated to some extent.

5 Conclusion and Outlook

With a view to the importance of knowledge management, a new approach has been set up using knowledge analysis as a basis for the determination of participatory design methods. This helps to answer the question: How to identify appropriate approaches for efficient participatory design? With help of knowledge management, the participatory-design approach has been established in a general system. This helps to

fill the gap between real conditions and existing participatory design methods. Moreover, with the detailed interpretation of three application stages, this approach also helps to build a bridge between theory and practice. Based on an empirical study, the proposed approach was validated. Considering that the research work is still in progress, the established approach has only been applied to one case. More empirical studies with quantitative analysis have been planned to be carried out in the following work. When it is well confirmed, the proposed framework could be used as a reference model for practice within different industries.

References

1. Chen, X. L.: Technological Innovation Capability Evaluation and Decision Support for companies in innovation alliance. Doctoral Thesis, Chemnitz University of Technology, Germany (2014).
 2. Schulz, K.P., Riedel, R.: Innovation through Process Simulations and Business Games- Considering the Social Aspects of Innovating in Networks. In: International Conference on Advances in Production Management Systems: Innovation in Networks, Helsinki University of Technology, Finland (2008).
 3. Sanders, E. B., Brandt, E., and Binder, T.: A framework for organizing the tools and techniques of participatory design. In: PDC '10 Proceedings of the 11th Biennial Participatory Design Conference, pp. 195-198. Sydney Australia (2010).
 4. Plessis M. D.: The role of knowledge management in innovation. *Journal of Knowledge Management* 11(4), 20-29 (2007).
 5. Liao, S. H.: Knowledge management technologies and applications-literature review from 1995-2002. *Expert systems with Application* 25, 155-164 (2003).
 6. Gloet, M. and Terziovski, M.: Exploring the relationship between knowledge management practices and innovation performance. *Journal of Manufacturing Technology Management* 15 (5), 402-9 (2004).
 7. Schneider, H.: Mittelstand 4.0 - Agentur Prozesse. Retr. on 20.02.2017; <http://www.prozesse-mittelstand.digital/>
 8. Tawalbeh, M., Riedel, R., Horler, S., and Mueller, E.: Case studies of participatory design comparison of methodologies in factory planning. In: IFIP International Conference on Advances in Production Management Systems, pp.159-167. Springer (Heidelberg), Hamburg Germany (2017).
 9. Muller, M. J., Kuhn, S.: Participatory design. In: *Commun. ACM* 36 (6), 24 -28 (1993).
 10. Berthet, E.T., Barnaud, C., Girard, N., Labatut, J.: How to foster agroecological innovations? A comparison of participatory design methods. *Journal of environment planning and management* 59 (2), 280-301 (2016).
 11. Donate, M. J., Pablo, J. D.: The role of knowledge-oriented leadership in knowledge management practices and innovation. *Journal of business research* 68, 360-370 (2015).
 12. Grant, K., Dumay, J.: *Leading Issues in Knowledge Management*. 2nd edn. Published by Academic Publishing International, Japan (2011).
 13. Stuart, T. E.: Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry. *Strategic management journal* 21 (8), 791-811 (2000).
- Baum, J.A., Cowan, R., Jonard, N.: Network-independent partner selection and the evolution of innovation network. *Management science* 56 (11), 2094-2110 (2010).