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Process-Oriented Knowledge Management within the Product Change Systems of the Automotive Industry

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Abstract

The following paper extends the literature of process-oriented knowledge management. It describes the continuous increase of complexity within the product change management of the automotive industry (e.g. variety of products, globally positioned production sites, dynamic customer needs and regulations). This environment combined with less process-oriented systems requires an intense practice of experience-based knowledge that is not available to everyone at all times and thus leads to reduced project performance. Furthermore, it illustrates a new procedural understanding of knowledge activities and its application within a project at a German car manufacturer (Volkswagen AG). The application of this understanding in response to the challenges is accomplished by systems engineering. The result is an ergonomically created product change management system with decreasing need for experience-based knowledge, evolutional character, increased process quality and reduced processing times.

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Keywords: Process-oriented knowledge management; Knowledge activities; Product change management; Systems engineering; Business process modelling

1. Introduction

This paper contributes to the academic field of process-oriented knowledge management. It describes specific challenges within the product change management of the automotive industry, as well as how these can be taken by the practice of process-oriented knowledge management.

The initial introduction serves to describe the practical context and the academic relevance of this paper.

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1.1. The product change management as the application area

The automotive industry is faced to the challenges associated with a dynamic environment. Alternating customer preferences, new regulations and competitive activities initiate changes at the market placed product. The variety of models, served markets and globally distributed production sites result in a highly complex system. In addition, fast moving markets and decreasing product life cycles of built-in units (e.g. telecommunication, lighting technology) require decreasing reaction times. The following figure (Fig. 1) shows the increase of conducted change requests on market placed products within recent years at Volkswagen (brand Volkswagen AG).

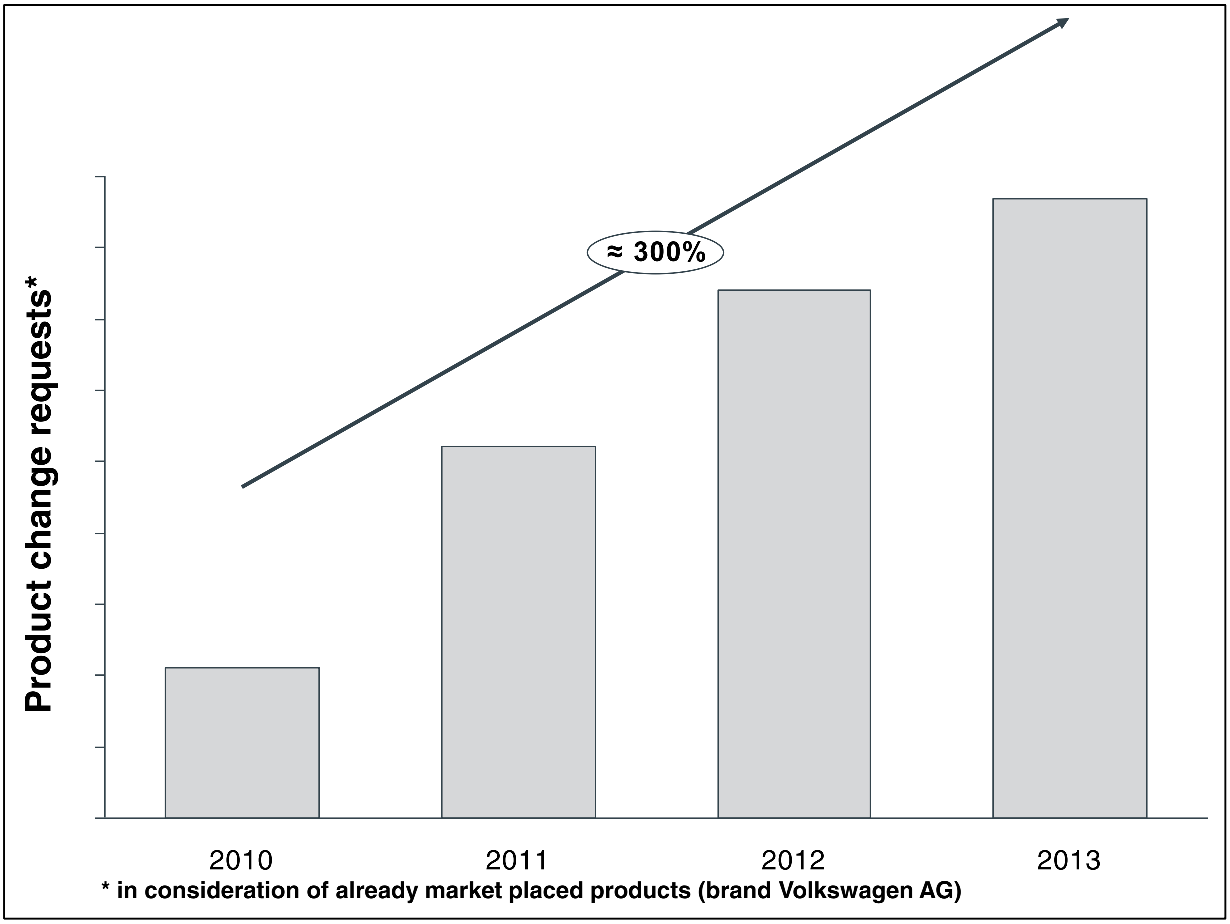

Fig. 1. Number of product change requests on market placed products.

New roles, organizational units and duties have evolved to resolve the emerging tasks within this environment of product change management. Thus, the realization of product changes has increasingly become a collaborative achievement with its organizational interfaces. The complexity described was a result of recent years. This complexity combined with less-process oriented systems requires the practice of experience-based knowledge. Thus, not only the product development process as mentioned in [1] but also the product change process requires an individual's experience-based knowledge. A deficit of this kind of knowledge affects the performance of product change projects. In particular, new hires and job reallocations lead to long periods of vocational adjustments and exacerbate this situation of diminishing project performance.

This paper is based upon a project applied within the product change management of Volkswagen AG. It illustrates a new method within the field of process-oriented knowledge management. The aims of this method are to improve the leverage of the organization's process knowledge, to increase quality and reduce processing time. Furthermore, its application establishes an adaptive system with a decreasing need of experienced-based knowledge.

1.2. Process-oriented knowledge management as a practical gateway

This part gives an overview of process-oriented knowledge management. Diverse existing methods are described without addressing applied tools in detail. It provides the insights in order to ensure a better understanding of the method elaborated within chapter 2.

While the fields of application of process-oriented knowledge management and the objectives of its conduction vary, the common purpose of the diverse methods is to create a linkage between processes and knowledge [2,3,4].

The redesign of an organization's knowledge processing is one such objective that is focused by the Model-based Knowledge Management [5]. Reference [5] provides an approach to cluster and allocate the entire knowledge of the company to its organizational entities. Furthermore, it extends the process modelling notation EPC (event-driven process chains) to adapt knowledge processing within the business processes. While [5] concentrates on the knowledge processing, [6] focus on the knowledge conversation of [7] by developing the KMDL (Knowledge Modeling and Description Language). With its notation, KMDL enables the modeling and analysis of business processes by emphasizing the knowledge conversion. GPO-WM[*] is a further method within the field of process-oriented knowledge management. It focuses on the elimination of weaknesses within the knowledge management system of an organization. By analyzing the processes regarding their demand and supply of knowledge, appropriate solutions from a toolbox can be selected and applied [8]. The optimization of knowledge flows as an objective is taken by PROMOTE[**]. PROMOTE identifies the methods of generating, searching and transferring knowledge within an organization. By implementing these knowledge activities into the business processes, the knowledge flows are aimed towards optimization [9,10].

As the following method creates a linkage between processes and knowledge, it can be assigned to process-oriented knowledge management. Nevertheless, it should be mentioned that the suggested method has certain differences from existing methods. For instance, it does not understand process-oriented knowledge management as an once-only project. Rather, it presents a scheme to ergonomically adjust a mature system to a one that enables a steady evolution with an organization's changing duties, environment and challenges.

2. The ergonomically creation of evolving product change management systems with process-oriented knowledge management

This section of the paper describes the method developed within a practical project at Volkswagen AG. The objectives are to accelerate the product change process, increase quality, reduce the need for experience-based knowledge in day-to-day business and ensure the smooth and fast vocational adjustment of new employees.

The accomplishment of these objectives and the application of the entire undertaking should follow under the vision of creating an ergonomic and evolutionary product change management system. It copes with the objectives by delivering an ergonomic designed system by respecting the characteristics of the mature one. Furthermore, it induces experience-based knowledge a new denotation by leveraging it for the sake of an evolutional character.

[*] GPO-WM is the German abbreviation of business process-oriented knowledge management (Geschäftsprozessorientiertes Wissensmanagement).

[**] PROMOTE is the name of the EU-project and the product developed that applies process-oriented knowledge management.

2.1. Procedural understanding of knowledge activities

The elaborated system is based on knowledge management activities and their particular understanding in the context of process management. The preservation, distribution, leveling and use of knowledge are the incorporated activities. These activities introduced by [11] and [7] are used to set up a cycle that prevents the loss of knowledge and facilitates its utilization. This cycle with its distinct understanding is illustrated in Fig. 2.

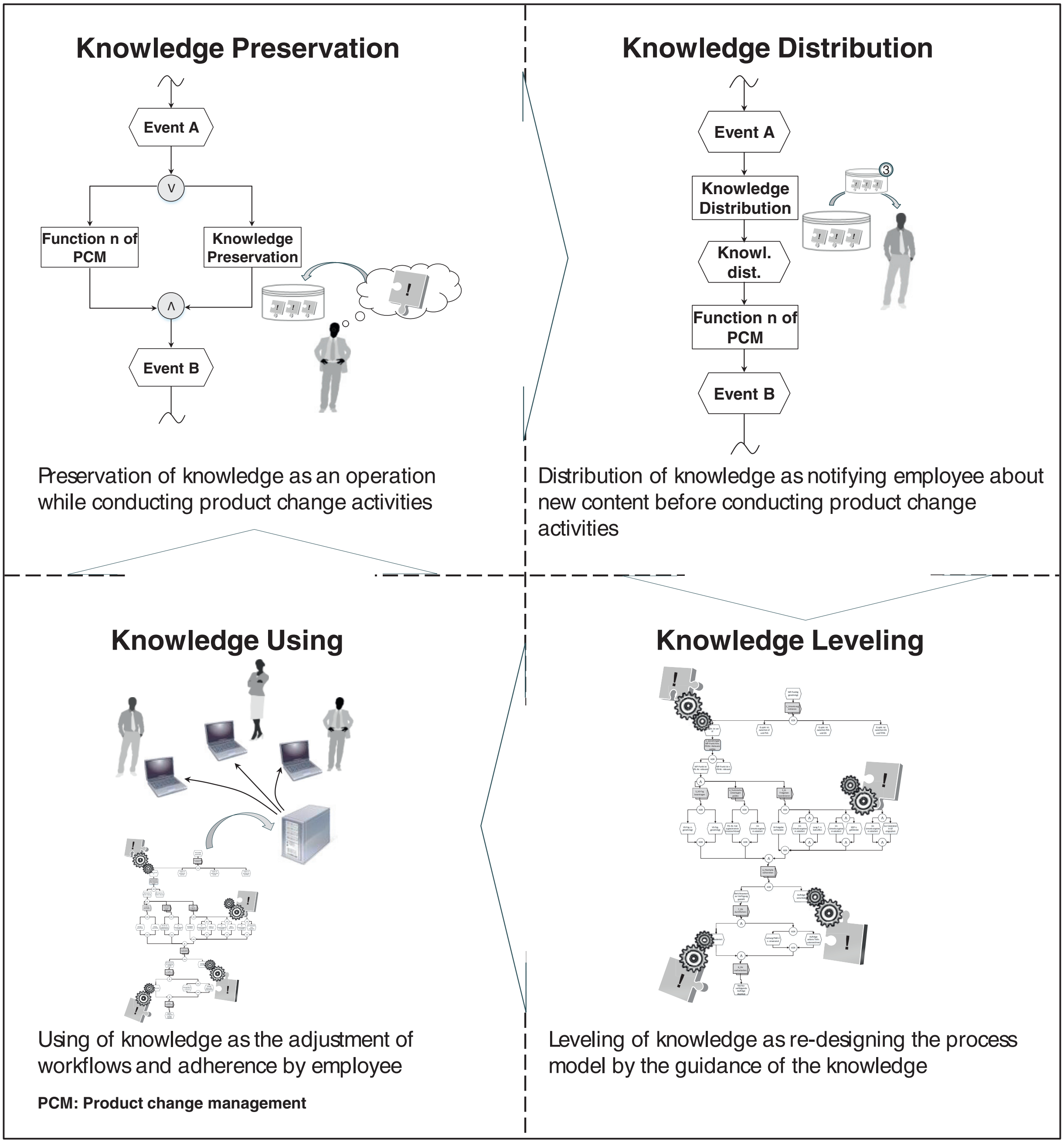

Fig. 2. Procedural understanding of knowledge activities.

The knowledge preservation and distribution are illustrated as the integration into the functional specification of the processes. In order to avoid loss of knowledge and ensure properness of the stored knowledge, the preservation is designed in parallel to the respective function of product change management. While the preservation is designed in parallel, the distribution of knowledge is arranged in serial. By preceding the knowledge distribution to the product change management function, the employee is also enabled to gain access to recently provided knowledge before starting his activities.

The understanding of knowledge leveling and usage ensure a sustainable adaption of an employee's knowledge into the process. The knowledge leveling is defined as the re-engineering of the respective parts of the process model by means of previously preserved and distributed knowledge. Therefore, knowledge leveling means to level knowledge into the processes. Subsequent to the leveling of knowledge, the translation of the process model as an adjustment of workflows is defined as knowledge usage.

This new understanding of the activities provides the basis to set up a system that transfers the individual knowledge of employee into the processes of the entire organization and get utilized by all participants.

2.2. A method of systems engineering to cope with the knowledge activities

While the preceding section presents the basic understanding of the knowledge activities, this part details how this understanding is being applied and implemented in an existing system at Volkswagen AG. The analysis of systems as well as the design and implementation of changes induces the application of systems engineering within the organization's architecture [12,13]. The developed approach at Volkswagen AG matches the activities of systems engineering to the layers of the organization's architecture and integrates the above understanding of the knowledge activities into the existing product change system. As the project is conducted at different layers of the architecture, different modeling languages have to be applied [13,14]. Fig. 3 depicts the allocation of modeling language to architectural layer.

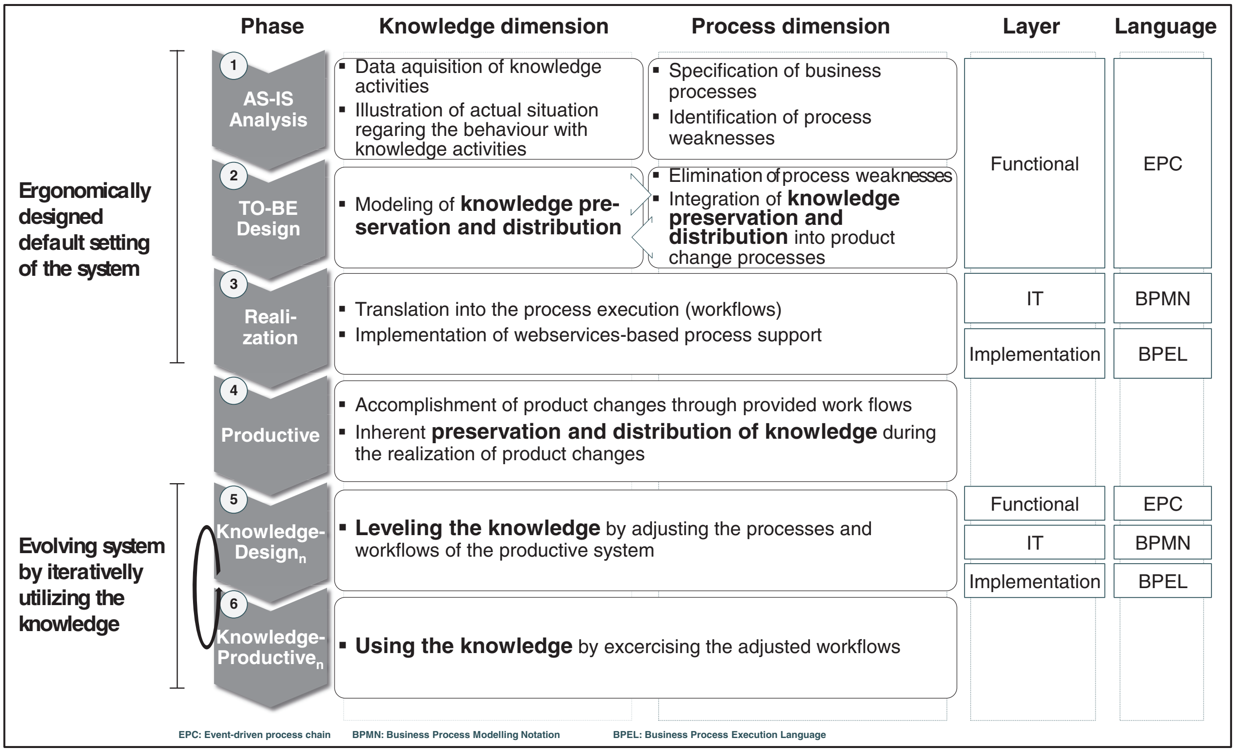

Fig. 3. 6-stage method for ergonomic and evolutional system creation.

Furthermore, it illustrates the entire approach that ergonomically converts an existing system to an evolutional system by utilizing the knowledge of employee. The AS-IS analysis ensures the comprehension of the existing system as the requirement to set up an ergonomically concept at a later stage. While the two dimensions of process-oriented knowledge management are considered separately, both the ascertainment of the processes and the knowledge activities require the employee's strong participation. In particular, the elaboration of weaknesses within both dimensions needs the employee's agreement and comprehension to successfully enter the subsequent stages.

The specifications of the AS-IS analysis are used in the TO-BE design. The procedural weaknesses are eliminated within the functional specification and the resulting processes are modeled with the notation of event-driven process chains (EPC). Due to EPC, an overall view on the organization's relevant functions, events and data can be provided and an implementation-oriented modeling can be accomplished [15,16]. The activities of knowledge preservation and distribution are also modeled with EPC and integrated into the product change processes. Thus, the unity between the dimensions process and knowledge is conducted within the functional specification. The TO-BE design arranges a concept that is eliminated by weaknesses (e.g. media and system discontinuity, redundant activities, absence of transparency). In addition, the above-described procedural understanding of knowledge preservation and distribution is applied during this stage.

The developed concept is consigned to the realization that responds on the IT and implementation layer of the organization's architecture. First, the functional specification of the process model is converted into the process execution, thus workflows are designed. This conversion is conducted by transforming the EPC into the business process modeling notation (BPMN). The implementation of the designed workflows is based on the business process execution language (BPEL). As the BPEL responds directly to BPMN, an translation from BPMN to BPEL can be accomplished [17,18,19].

The result of the first three stages is a webservice-based process support. The product changes can be permuted by the exercise of workflows. The run by workflows ensures the adherence of the process without experience-based knowledge. The employee is guided through the activities. Thus, diminishing project performance by vocational adjustments in the case of new hires or role changes can be counteracted. The integrated knowledge activities ensure knowledge preservation and distribution inherent to the product changes. Moreover, the AS-IS stage provides an overall understanding of the existing system with its people, organization and applications. As this understanding is leveraged within the TO-BE concept, an ergonomically designed system adjustment can be implemented and practiced by employees.

The following two stages embed the leveling and use of knowledge within the system. Whereas the previous stages set up a default status of the system, the upcoming stages have an iterative character. This character ensures the ability to repeatedly absorb developed knowledge for the benefit of adaptiveness. Within the knowledge design, previous preserved and distributed knowledge of the productive system is leveled. The leveling is conducted by transferring the impacts of the preserved knowledge into the technical specification by means of design changes of the EPC. Subsequent handover through the IT layer and implementation ensures the holistic knowledge leveling to the entire architecture.

Finally, the new knowledge can be used by the employee through the adherence of the workflows.

Since the first four stages set up an ergonomically designed and applied product change system that is also enabled to preserve and distribute knowledge, the final two stages foster its evolutionary character. This character is enabled by iteratively leveling the employee's knowledge into the processes and properly using it by the guidance of workflows.

3. Conclusion

Complex environments combined with less-process oriented systems require experience-based knowledge. As the availability of this knowledge to everyone at all times is not ensured, project performance decreases. In particular, in the case of new hires or job reallocations processing times and quality of projects are being affected.

The above-presented concept illustrates an adjustment of existing systems to cope with the challenges described. The aims are to accelerate proceedings, increase quality and ensure adaptiveness in complex environments. Moreover, it creates a system that reduces the need for experience-based knowledge and decreases vocational adjustments of new employees.

Accelerated proceedings and higher quality are due to eliminating process weaknesses. The reduced need for experience-based knowledge and fast vocational adjustments are due to transparent processes and the adherence of workflows. The first four stages of the suggested concept are dedicated to these aims. Furthermore, these stages prepare the fundaments of adaptiveness by integrating the knowledge preservation and distribution into the system. Through a high degree of participation, these stages establish the ergonomic character of the system adjustment. A holistic approach by considering the employee's behavior and work patterns, the organization's structure and application landscape ensure additional acceptance in early stages.

In additional to these, adaptiveness is the matter of the iterative stages – knowledge design and knowledge productive. Afore preserved and distributed knowledge get leveled to the processes and get used by the adherence of provided workflows. The knowledge gets utilized by leveling the insights from the EPC through BPMN to the BPEL within the stage of knowledge design. The provision of workflows ensures subsequent knowledge use within the stage of knowledge productive. Thus, this cycle ensures an evolutional system that keeps pace with environmental changes and new challenges by leveraging previously preserved and distributed knowledge.

The result is an ergonomically designed product change management system with reduced need for experience-based knowledge, fast vocational adjustments, high quality and reduced processing times. Moreover, its evolving character ensures adaptiveness to its changing environment.

This paper describes a sustainable way to transfer employees' knowledge into organizational structures. The sustainability mentioned can be realized under the terms of the iterative character of knowledge design and knowledge productive.

In addition to this, the described method involves different layers of the organization's architecture. On closer examination, the understanding of knowledge activities follows the same manner. For this reason, system adjustments are not restricted to design documents or change activities; rather, the system becomes live through the interlock of the different layers. Essentially to this interlock are the applied modeling languages, which ensure an efficient run through the layers. As the AS-IS stage is also conducted by describing the processes by the modelling language EPC, the method ensures an implementation-oriented specification and analysis.

Crucial insights of the paper are the application of the knowledge activities by means of the described understanding. The integration of knowledge preservation and distribution ensures the leveling and use of knowledge in latter stages. The functional specification with EPC depends on the AS-IS analysis. This paper does not address the specification in detail. The leverage of the preserved knowledge in an iterative matter depends on the delivery of the preserved knowledge from the productive system into the stage of knowledge design. Here, it is transferred into changes of the functional specification and translated through the IT layer to adjustments within the implementation. Thus, the knowledge preservation has to be designed in a manner whereby the delivery to the iterative stages and its leverage can be accomplished in an efficient way.

Prospective plans will involve concretizing the process model of knowledge preservation and distribution with EPC. This specification has to be conducted in a manner to achieve unity between the product change activities and knowledge activities. Subsequently, the concept should be realized and an evaluation of its effectiveness has to be conducted.

Furthermore, the loop on iteration is also not addressed. It strongly depends on the quantity of the workflow cycle, as well as the insights and amount of preserved knowledge.

As the described method is applied at the change management system of Volkswagen AG, mentioned issues and plans will be addressed in later publications that correspond with the progress of the practical project.

References

[1] G. Dragoi, S. M. Rosu, M. Guran, C. E. Cotet, L. Rosu, A knowledge management methodological view to improve virtual product development , in: B. Katalinic (Eds.): DAAAM International Scientific Book, DAAAM International, Wien, 2007, Chapter 19.

[2] U. Remus, Prozeßorientiertes Wissensmanagement. Konzepte und Modellierung, Process-oriented knowledge management. Concepts and Modeling, Dissertation, Universität Regensburg, Wirtschaftswissenschaftliche Fakultät, Regensburg, 2002.

[3] J. Jung, I. Choi, M. Song, An integration architecture for knowledge management systems and business process management systems, in: Computers in Industry, 58 (1), 2007, pp. 21–34, Online available: http://www.sciencedirect.com/science/article/pii/S0166361506000479.

[4] R. Woitsch, W. Utz, V. Hrgovcic. Integration von Prozess- und Wissensmanagement, Integration of process and knowledge management, in: F. Bayer, H. Kühn (Eds.): Prozessmanagement für Experten. Impulse für aktuelle und wiederkehrende Themen. Process management for experts. Impulse for current and recurring topics. Springer. Berlin, Heidelberg, 2013, pp. 355–372.
[5] T. Allweyer, Wissensmanagement mit ARIS-Modellen, Knowledge management with ARIS, in: A.-W. Scheer (Eds.): ARIS - vom Geschäftsprozess zum Anwendungssystem, 4. Edition, Springer, Berlin [et al.], 2002, pp. 162–168.
[6] N. Gronau, J. Fröming. Eine semiformale Beschreibungssprache zur Modellierung von Wissenskonversionen, A semiformal description language for modeling knowledge conversion, in: Wirtschaftsinformatik (48), 2006, pp. 349–360.
[7] I. Nonaka, H. Takeuchi, The knowledge-creating company. How Japanese companies create the dynamics of innovation, Oxford University Press, New York, 1995.
[8] P. Heisig, Integration von Wissensmanagement in Geschäftsprozesse, Integration of knowledge management into business processes, Reports of PTZ (Produktionstechnischen Zentrum Berlin), Berlin, 2005.
[9] D. Karagiannis, Wissensmanagement: Einige Konzepte & Technologien, Knowledge management: Concepts and Technologies, in: Informationswirtschaft: Ein Sektor mit Zukunft, 2003, pp. 191–206.
[10] R. Woitsch, D. Karagiannis, Process oriented knowledge management. A service based approach, in: Journal of Universal Computer Science (4), 2005, pp. 565–588.
[11] G. Probst, S. Raub, K. Romhardt, Wissen managen, Managing knowledge, Springer Fachmedien. Online available http://gbv.eblib.com/patron/FullRecord.aspx?p=750783, Wiesbaden, 2010.
[12] A.-W. Scheer, Architektur integrierter Informationssysteme. Grundlagen der Unternehmensmodellierung, Architecture of integrated information systems. Basics of corporate modeling, Springer, Berlin, New York, 1991.
[13] H. Krallmann, A. Bobrik, O. Levina, Systemanalyse im Unternehmen. Prozessorientierte Methoden der Wirtschaftsinformatik, Systems engineering in companies. Process-oriented method of business informatics, 6. Edition, Oldenbourg, München [et al.], 2013.
[14] D. Draheim, V. Geist, C. Natschläger, Integrated framework for seamless modeling of business and technical aspects in process-oriented enterprise applications, in: International Journal of Software Engineering and Knowledge Engineering, 22 (05), 2012, pp. 645–674.
[15] G. Keller, M. Nüttgens, A.-W. Scheer, Semantische Prozessmodellierung auf der Grundlage "Ereignisgesteuerter Prozessketten (EPK)", Semantic process modeling based on ‘event-driven process chains (EPC)‘, in: A.-W. Scheer (Eds.), Veröffentlichungen der Instituts für Wirtschaftsinformatik (89), Universität des Saarlandes, Institut für Wirtschaftsinformatik (IWi), Saarbrücken, 1992.
[16] A.-W. Scheer, O. Thomas, O. Adam. Process modeling using event-driven process chains, in: M. Dumas, W. van der Aalst, A. Ter Hofstede (Eds.): Process-aware information systems. Bridging people and software through process technology. Wiley-Interscience, Hoboken, New Jersey, 2005, pp. 119–146.
[17] S. Mazanek, M. Hanus, Constructing a bidirectional transformation between BPMN and BPEL with a functional logic programming language, in: Journal of Visual Languages & Computing, 22 (1), 2011, pp. 66–89.
[18] C. V. Geambasu, BPMN vs. UML Activity Diagram for Business Process Modeling, in: Accounting & Management Information Systems, 11 (4), 2012, pp. 637–651.
[19] M. Chinosi, A. Trombetta, BPMN: An introduction to the standard, in: Computer Standards & Interfaces, 34 (1), 2012, pp. 124–134.