IMPROVING IT-BASED USER ASSISTANCE FOR EARLY PRODUCT-COST OPTIMIZATION: EVALUATION OF A SOLUTION DESIGN

Extended Abstract

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In today's globalized market, product manufacturers are increasingly exposed to competitive pressure due to shortened product life cycles, increased product diversity, and rapidly changing customer requirements, among other phenomena. In response, manufacturers increasingly need to optimize their product costs at an early stage in order to maintain long-term economic viability. That need has become particularly important since up to 90% of total product costs are determined during product development, and thus before start of production (Mörtl and Schmied, 2015). Our collaborative research with the discrete manufacturing industry has revealed that, despite enormous competitive potential of product development to optimize product costs, existing information systems (IS) do not yet sufficiently support early product-cost optimization. The lack of support is due to not only a lack of functionality in existing IS (Schicker et al., 2008) but also the characteristics of product development, including information uncertainty (Vosough et al., 2017) and process emergence (Markus et al., 2002). To counteract that situation by designing a suitable solution to improve information technology (IT)-based user assistance for early cost optimization, we initiated a long-term research project following the methods of design science research (DSR; Peffers et al., 2007). In a problem-centered initiation with close collaboration with the discrete manufacturing industry (Walter and Leyh, 2017), we elaborated major challenges in designing a potential solution and evaluated its requirements (Walter et al., 2018). Considering the information system design theory (ISDT) for emergent knowledge processes (EKPs), we proposed a potential solution design involving extensive user assistance in early product-cost optimization that can support the management and implementation of a variety of optimization cases, such as optimization of material prices, investments in production machinery, or make-or-buy decisions. To ensure the flexibility needed to support such a variety of optimization cases, our solution design offers dedicated user assistance to cultivate specific optimization measures from their initial idea (Measure identification, Fig. 1) through their elaboration and evaluation to their final implementation, as described in Walter et al. (2018). The proposed approach was instantiated as a prototype in Walter (2019).

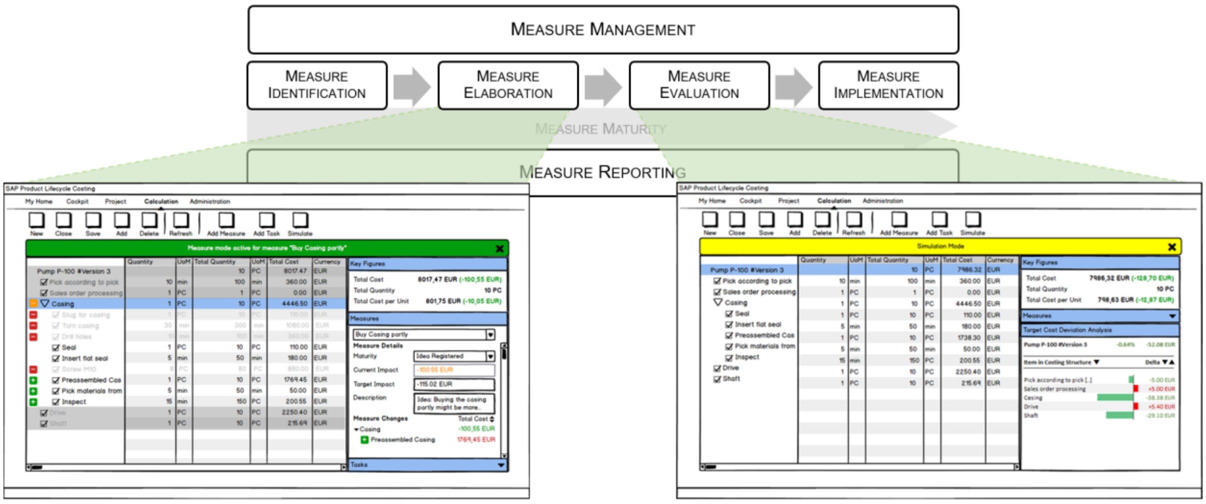

Figure 1. Approach to early product-cost optimization with prototype interface mockups

In that context, this paper resumes the evaluation of the instantiated prototype. Due to the singularity of EKPs, as underscored by Marin et al. (2016), and the consequent necessity for an in-depth evaluation of the solution design, we first developed a suitable strategy for such evaluation that combines artifact evaluation patterns recommend for DSR (Peffers et al., 2007; Venable et al., 2016; Sonnenberg and vom Brocke, 2012) with the specific needs of our research project respective to its domain. The resulting two-staged evaluation strategy aimed to assess whether and, if so, then to what extent our solution design can improve IT-based user assistance for early product-cost optimization and thereby overcome challenges with implementing the solution design as well as address requirements outlined in prior research (Walter et al., 2018).

Evaluation criterion	**Ø**	**σ**
The scenario of the prototype test was realistic.	4.2	0.6
The prototype is useful for supporting product costing.	4.3	0.7
The prototype enhances productivity in product costing.	4.0	0.8
The prototype enhances transparency in product costing.	4.1	0.8
The approach enhances the quality of product costing.	4.0	0.8
The approach is able to cover optimization use cases in my organization very well.	3.4	1.2

Table 1. Extract of the results of the evaluation of the instantiated prototype from the second step of evaluation on a 5-point scale (1 = strongly disagree*, 5 =* strongly agree*).*

Overall, the results of the evaluation (Table 1) revealed the significant potential of the proposed solution design for broad industrial application. The developed approach can increase the productivity, transparency, and quality of early cost-optimization processes for the evaluated scenario of application. Major reasons for the positive results of the evaluation are attributable to the underlying ISDT and its design principles for EKPs (Markus et al., 2002). Nevertheless, since our research domain does not perfectly align with all EKP characteristics, the ISDT's design principles were mapped to design-related features of the instantiated prototype and discussed in terms of their adequacy for and relevance to the results in the respective research domain. For example, the prototype's design features that link relationships of optimization measures to different types of entities within the prototype (e.g., personal responsibilities, products, maturity phases, and tasks), a specific component supporting the parallel elaboration of conflicting optimization measures, and the loosely coupled collaboration management to assist in evolving knowledge structures over a measure's maturity can be expected to benefit productivity, transparency, and quality.

Particularly remarkable among the positive results of our evaluation was that potential users of a future IS implementation have evaluated the prototype for different organizational contexts in discrete manufacturing. Such collaborative diversity facilitated valuable feedback due to the speak-aloud evaluation procedure addressing further improvements to the solution (e.g., to support additional optimization cases). The next step is thus to incorporate the collected feedback and pursue the chosen evaluation path "Human Risk & Effectiveness" (Venable et al., 2016), and ultimately perform a naturalistic evaluation (Sonnenberg and vom Brocke, 2012) that can rigorously underpin broad effectiveness of the solution design to improve the status quo toward IS support for early product-cost optimization.

References

Markus, M. L., Majchrzak, A., and L. Gasser (2002). "A design theory for systems that support emergent knowledge processes." *MIS quarterly*, 179–212.

Marin, M. A., Hauder, M., and F. Matthes (2016). "Case management: An evaluation of existing approaches for knowledge-intensive processes." In: *Business Process Management Workshops: BPM 2015, 13th International Workshops*. Ed. by M. Reichert and H. A. Reijers. Cham: Springer International Publishing, pp. 5–16.

Mörtl, M. and C. Schmied (2015). "Design for cost - a review of methods, tools and research directions." *Journal of the Indian Institute of Science* 95 (4), 379–404.

Peffers, K., Tuunanen, T., Rothenberger, M. A., and S. Chatterjee (2007). "A design science research methodology for information systems research." *Journal of management information systems* 24 (3), 45–77.

Schicker, G., Mader, F., and F. Bodendorf (2008). *Product Lifecycle Cost Management (PLCM): Status quo, Trends und Entwicklungsperspektiven im PLCM – eine empirische Studie*. Arbeitspapier Wirtschaftsinformatik II, 02/2008. Universität Erlangen-Nürnberg.

Sonnenberg, C., and J. vom Brocke (2012). "Evaluation patterns for design science research artefacts." In: *Proceedings of the European Design Science Symposium (EDSS) 2011*. Ed. by M. Helfert and B. Donnellan. Dublin: Springer, pp. 71–83.

Venable, J., Pries-Heje, J., and R. Baskerville (2016). "FEDS: a framework for evaluation in design science research." *European Journal of Information Systems* 25 (1), 77–89.

Vosough, Z., Kammer, D., Keck, M., and R. Groh (2017). "Visualizing uncertainty in flow diagrams: A case study in product posting." In: *Proceedings of the 10th International Symposium on Visual Information Communication and Interaction*. Bangkok, Thailand, pp. 1–8.

Walter, M. and C. Leyh (2017). "Knocking on industry's door: product cost optimization in the early stages requires better software support." In: *Proceedings of the IEEE 19th Conference on Business Informatics (CBI 2017)*. Thessaloniki, Greece, pp. 330–338.

Walter, M., Leyh, C. and S. Strahringer (2018). "Toward early product cost optimization: Requirements for an integrated measure management approach." In: *Proceedings of the Multikonferenz Wirtschaftsinformatik 2018 (MKWI 2018)*. Ed. by P. Drews, B. Funk, P. Niemeyer, and L. Xie. Lüneburg: Leuphana University Lüneburg, pp. 2057–2068.

Walter, M. (2019): Approach to IS Solution Design and Instantiation for Practice-Oriented Research – A Design Science Research Perspective. In: *AITM 2018/ISM 2018, LNBIP 346.* Ed. by E. Ziemba. Cham: Springer, pp. 194–213.