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Maturity model for successful cost transformation in ETO companies

Johann Gregori¹ and Ralph Riedel¹[0000-0002-3704-8230]

¹ Chemnitz University of Technology, D-09107 Chemnitz, Germany
ralph.riedel@mb.tu-chemnitz.de

Abstract. Companies are more and more required nowadays to monitor and to improve their cost structure. Hereby, ETO enterprises experience particular difficulties, due to the high complexity and dynamics as well as less opportunities for standardization which are an intrinsic part of their products and processes. Therefore, a systematic and holistic approach for cost management is needed, considering hard factors as well as soft factors, like organizational and behavioral aspects. In this paper, we introduce a product cost maturity model, which integrates a multitude of success factors for cost transformation from different categories in an ETO environment. Hereby companies will be enabled to determine and evaluate their current state as well as a future state to derive a roadmap for necessary actions. The maturity model is based on a thorough literature research and on practical experiences in ETO companies. It is complemented with a systematic procedure for cost transformation projects. We describe the maturity model and its application as far as possible in detail, hereby also justifying every design decision we made.

Keywords: Cost transformation, maturity model, Engineer to Order.

1 Introduction

The importance of Engineer-to-Order (ETO) companies has been and is still increasing due to a higher demand for customized products [19]. The ETO industry is characterized by individualized products, low volumes, low standardization, high complexity, dynamism, long lead times and a project based approach for order processing [3, 6, 19].

Traditionally, the main competitive advantage of ETO industry has been to fulfill individual customer requirements and to master the resulting complexity and dynamism; costs resp. the price was not that important [6]. Since global competition has increased together with low-cost countries' ability to manage complexity and to produce ETO products at low costs, improving the cost efficiency of ETO processes has become vital for high-cost countries [3].

Due to their particularities, the conditions for cost reduction programs in ETO companies are not the best: it is difficult to standardize products, the heterogeneity of processes is rather high and learning curves are rather flat. Compared to serial production ETO companies usually have only one chance to design and to manufacture a

cost efficient product for a specific customer, which in turn has a considerable impact on their competitiveness already in the quotation phase and also later on when a reasonable price-cost-ratio is necessary. Therefore, thinking and acting in a cost-efficient manner affects all processes.

Following recent studies, the success rate of cost reduction initiatives is rather bad, i.e. only around fifty percent [14]. The challenge therefore is, to transform an ETO company to an entity, which is able to continuously review and decrease its costs. For such a transformation process a precise determination of the current position (where to start from) as well as the determination of a future state (where to strive for) and development path, which systematically leads from the current to the future state, are essential. Maturity models are a common approach to support this [18]. Following the argumentation above, a product cost maturity model (PCMM) is needed especially for ETO companies, which should not be focused on a single product's cost structure, but rather on the company's ability for (cost) transformation and resulting cost efficient processes.

In this article we describe the concept of a product cost maturity model and its application in ETO industry. The work is based on the design science research approach [16, 21] and includes the derivation of success factors from research as well as empirical insights from many cost reduction projects in industrial practice, namely from a big ETO company in south Germany, which produces equipment for the beverages industry. In the remainder of the article we briefly address some scientific basics of maturity models, explain then the development process for the PCMM as well as its results, and give some hints for the application of the model. At the end, we give some conclusions and an outlook on further work.

2 Maturity models in an ETO environment

Maturity models support the evaluation of the quality of a company's processes, often against some specific target state. The purpose of a maturity model is to identify gaps which can subsequently be closed by improvement measures [2, 21]. Famous maturity models are the capability maturity model (CMM) and its successor, the capability maturity model integrated (CMMI). Although CMMI has its origins and application in software industry, Alfnes [2] demonstrated its applicability in an ETO environment for materials management under engineering change situation. Another substantial argumentation, that practices of the CMMI can also be applied in ETO companies, can be found for instance in [24].

Maturity models usually consist of maturity levels, maturity dimensions and indicators, optionally weighted, and a maturity level - parameter-matrix [1]. Frameworks or procedures for designing maturity models are for instance provided by [4, 13]. The development process of maturity models should be closely intertwined with their later application process [21].

In our development process we chose the design science research approach [16], which was specified for maturity models [21], as a general framework. In the rigor cycle we identified a suitable methodology for the PCMM design and we derived

categories, criteria, characteristics of success factors for cost transformation, in general as well as especially in an ETO environment. In the relevance cycle we considered the state of the art, especially insights from ETO practice. Hereby, the design-build and evaluation phases are passed-through several times, continuously improving the model. The design process itself followed the procedure proposed by [13].

3 Development of a product cost maturity model

The possible and selected design alternatives for the PCMM are shown in figure 1.

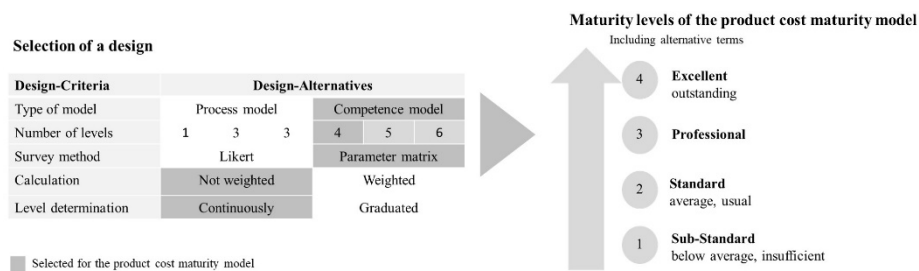


Fig. 1. Design approach for the PCMM

For our purpose we chose the approach of a competence model [12] instead of a process model [2], because we consider competencies of management and employees to have a decisive role for a successful transformation. The other design specifications are explained in the following sections.

3.1 Success factors and key areas

The *indicators* of the PCMM are defined by success factors [7] for cost transformation. (Critical) success factors are actions and processes that can be controlled by management to achieve an organization's goals [9]. The success factors are subsumed in key areas which form the *dimensions* of the PCMM.

Product cost reduction in combination with the necessary transformation is a complex field. Following our methodology explained in chapter 2, a thorough literature research focusing on cost management, cost reduction, cost transformation in conjunctions with success factors, change management, project management has led to an initial list of possible success factors which are grouped in five key areas (exemplarily [5, 8, 11, 17, 20, 22, 25, 26], categories from [23] and others); those are shown in fig. 2.

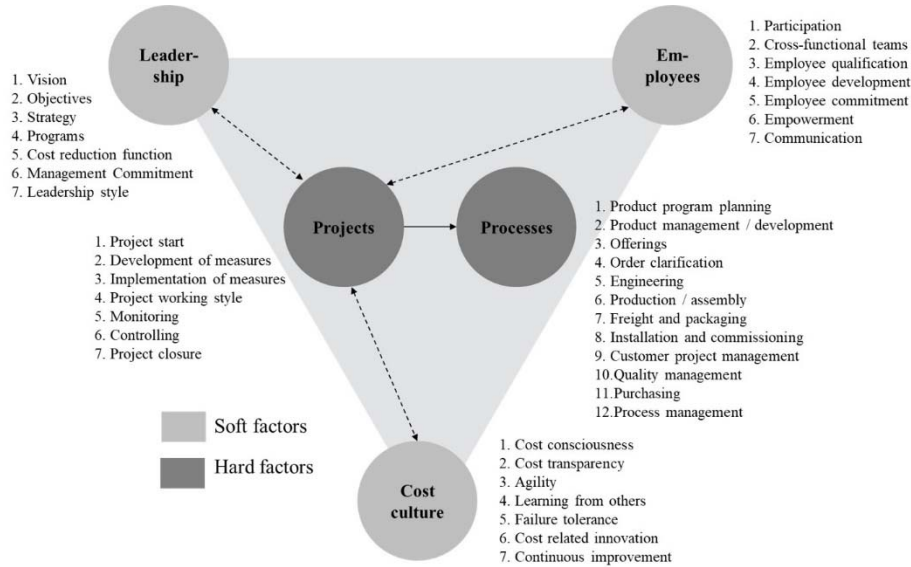


Fig. 2. key areas (categories, dimensions) and success factors (sub-categories, indicators)

“Hard factors” are ETO-specific processes, which all need to pursue the goal of cost-efficiency and cost-improvement, as well as projects, i.e. the transformation of the processes together with the whole company. The framework for both is provided by the involved people (employees), leadership and culture – the “soft factors”. It could be shown that behavioral and organizational factors have a substantial role in transformations endeavors [17]. In turn, those factors are – and need to be – affected by the transformation.

3.2 Maturity levels

The maturity will be determined by a scoring procedure. There are two alternatives to choose from: statements, combined with a Likert-scale, or open questions and the assignment of answers to a parameter matrix. In the latter, the manifestations of the different maturity levels are described by objective, quantifiable or observable criteria [1]. As statements on a Likert scale do not provide instructions how to move from one level to another, we decided to define open questions and detailed descriptions of each maturity level. Based on this, indications are available how to develop from one level to the next one.

Typically, maturity models consist of three to six levels. The higher the number of levels, the more complex a differentiation will be. In order to limit this kind of complexity, parameter matrix based maturity models are usually limited to four or even three levels [15]. For our PCMM we defined four maturity levels, with designations in accordance with common management language: sub-standard, standard, professional, excellent.

For the scoring itself, a continuous or a staggered evaluation can be used [15]. With a continuous evaluation a total value is aggregated from all indicators and dimensions, independent from their particular maturity levels. In a staggered evaluation the maturity level of a dimension can only be as high as the lowest maturity level of its indicators. Likewise, the overall maturity level can only be as high as the lowest maturity level of its dimensions. For our PCMM, we chose the continuous evaluation method, because this provides a more transparent picture; the maturity levels of particular success factors should be the starting point for improvement. Furthermore, we did not include weights for indicators or dimensions in order to produce an unfiltered view.

In the PCMM the overall maturity level M is calculated as the arithmetic mean of the maturity levels d_i of its dimensions i . The maturity level d_i of a dimension i is calculated as the arithmetic mean of the maturity levels i_{ij} of its assigned indicators j . The maturity level of a particular indicator ij is calculated as the arithmetic mean of all evaluations of the assigned questions q_{ijk} in the parameter matrix.

3.3 Parameter matrix

The core element of the product cost maturity model is the evaluation tableau or parameter matrix. Its structure is illustrated with an example in fig. 3.

Vision	Sub-Standard	Standard	Professional	Excellent
To what extend orders are clarified before starting value adding activities?	No order clarification	Order clarification exists as a process, but orders are also processed without	Capacity and time is provided for clarification; sales people are enabled; orders are completely clarified	Key questions are formalized as checklists
To what extend a design freeze is consequently performed ?	No design freeze	Design freeze is discussed, but not performed consistently	Design freeze is part of contracts; open issues are clarified in time	Design freeze is used proactively to avoid change costs; vendor and customer intend to utilize the design freeze to reduce complexity
To what extend an optimum is achieved between customer benefit and low costs?	Copying of similar solutions without questioning	Utilization of proven technical concepts; usage of experiences with certain customers	Utilization of proven modules; intensive dialogue with contributing partners	No perfectionism; effort-benefit ratio is stressed

Fig. 3. parameter matrix for the success factor “order clarification”

For each success factor up to four open questions are formulated. The manifestations for the four maturity levels are described for each question. Hereby, the manifestations of lower levels are also valid for higher levels.

Usually only the optimal manifestation for a success factor can be derived from literature or from best practice. A gradation, which is necessary for the parameter matrix, needs to be defined based on practical experience. This input is gained from structured interviews with experts/ practitioners.

4 Application of the PCMM in transformation projects

The application of the product maturity model should happen in four steps, which follow an initiating phase, see figure 4.

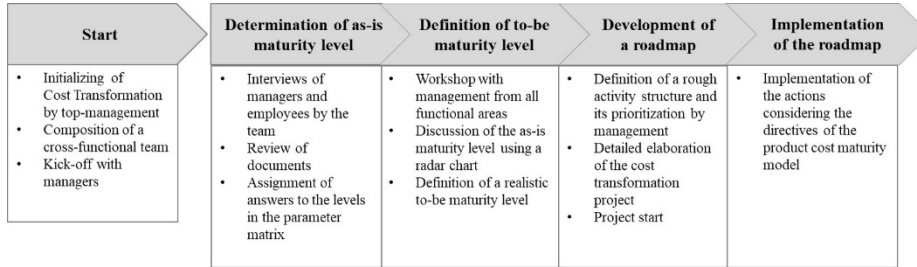


Fig. 4. application of the PCMM for transformation

The PCMM is suitable to be applied by an auditor or as a self-assessment tool [13]. For the auditor approach, often an external expert is engaged, who evaluates the maturity level and provides recommendations. Hereby, management and employees take a rather passive role. However, there is a risk, that the evaluation remains rather abstract, identification with the result is rather low and recommended measures are not implemented. A self-assessment can be done by one person or by a cross-functional team with and without the support of experts [15]. If a person does the assessment on its own, it might happen that the as-is analysis is biased. Studies show, that with a cross-functional team, different perspectives can be considered, and that after an intensive discussion the team reaches a consensus which in turn leads to a high level of commitment so that the process is kept going [10].

The as-is maturity level is determined with the help of a series of interviews. It is important to involve all affected persons. Hereby, diverse perspectives are generated, which form in the end a holistic view on the situation. For some questions it is also recommendable to consult existing artefacts, for instance documents, to verify the right answer.

A to-be maturity level (target state) shall be defined in a management workshop with managers from all functional areas. The as-is maturity level serves as a basis for discussion. The target state does not need to be necessarily the highest maturity level, but depends on the current state. Targets need to be challenging but also realistic and to be considered as achievable. So moving step-b-step from one level to the next might be an appropriate strategy. Also, not every success factor needs to be at the same level.

In order to manage the transition from the current to the target state, a roadmap is necessary, which should provide a rough structure, defined by management. This serves as the framework for a change project which should be detailed and consequently realized by executives and employees.

5 Conclusion and further work

In this paper, we argued that especially ETO companies face the challenge of cost reduction, but that the particularities of this type of business makes it even more difficult to succeed. Cost reduction needs to be considered from a strategic perspective as a continuous and anticipating activity [17]. Being cost-efficient and continuously striving for cost reduction is a capability, that a company needs to develop and to sustain. This, in turn, will be significantly supported by a systematic approach, involving different success factors, which should serve as an anchor for evaluating the actual state of a company and as a landmark for future development. In our research we used such success factors to compose a maturity model for product cost reduction (PCMM), following an established procedure [13].

The first version of the PCMM is currently based on an extensive literature review, which revealed a lot of success factors for cost reduction and cost transformation projects in ETO environments but also in industrial enterprises in general. Those factors are matched with the author's empirical experiences from a multitude of cost reduction projects in an ETO environment.

In a next iteration, following the design science approach, this first version is validated and adapted, based on experts' opinions gathered in structured interviews and workshops. Adaptations comprise the list of success factors which form the indicators of the PCMM and the description of their manifestation for different maturity levels in the parameter matrix. We only selected experts with a high level of experience in ETO industry. Experts will be invited to comment on the formulations and gradations as well as to add examples of best practices and also not so good practices.

The model and the systematic procedure it is embedded in will then be applied in case studies in the involved ETO company. The insights gained from this might lead to another improvement cycle.

References

1. Akkasoglu, G.: Methodik zur Konzeption und Anwendung anwendungsspezifischer Reifegradmodelle unter Berücksichtigung der Informationsunsicherheit. Aachen: Shaker (2014).
2. Alfnes, E.: Capability maturity model for engineering change management in ETO environment. Nääs I. (ed.): *Advances in Production Management Systems. Production Management Initiatives for a sustainable world. IFIP WG 5.7 International Conference, APMS 2016, Iguassu Falls, Proceedings* (2016).
3. Arica, E., Magerøy, K., Lall, M.: Barriers and Success Factors for Continuous Improvement Efforts in Complex ETO Firms. In: Moon, I., Lee, G.M., Park, J., Kiritsis, D. Cieminski, G.v. (eds.): *Advances in Production Management Systems. Production Management for Data-Driven, Intelligent, Collaborative, and Sustainable Manufacturing. IFIP WG 5.7 International Conference, APMS 2018, Seoul, Proceedings, Part I* (2018).
4. Becker, J., Knackstedt, R., Pöppelbuß, J.: Developing maturity models for IT management. *Bus. Inf. Syst. Eng.* 1 (3), 213–222 (2009).
5. Berk, J.: *Cost reduction and optimization for manufacturing and industrial companies*. Wiley (2010).

6. Birkie, S.E., Trucco, P.: Understanding dynamism and complexity factors in engineer-to-order and their influence on lean implementation strategy. *Prod. Planning & Control* 27 (5), 345–359 (2016).
7. Boynton, A., Zmud, R.: An assessment of critical success factors. *Sloan Mngmt. Rev.* 25 (4), 17-27 (1984).
8. Bragg, S.M.: *Cost reduction analysis. Tools and strategies.* Wiley (2010).
9. Brotherton, B., Shaw, J.: Towards an identification and classification of critical success factors in UK hotels. *Int. J. of Hospitality Mngmt.* 15 (2), 113-35 (1996).
10. Chiesa, V.P., Voss, C.: Development of a technical innovation audit. *J. of Product Innovation Mngmt.* 13 (2) (1996).
11. Couto, V., Plansky, J., Caglar, D.: *Fit for growth: A guide to strategic cost cutting, restructuring, and renewal.* Wiley (2017).
12. Crawford, K.: The Project Management Maturity Model. *Information Systems Mngmt.* 23 (4), 50-58 (2006).
13. de Bruin, T., Rosemann, M., Freeze, R., & Kulkami, U.: Understanding the main phases of developing a maturity assessment model. *Australasian Association for Information Systems: 16th Australasian Conference on Information Systems, Sydney* (2005).
14. Deloitte: *Thriving in uncertainty. Deloitte's fourth biennial cost survey: Cost improvement practices and trends in the Fortune 1000.* (2016).
15. Fraser, P., Moultrie, J., Gregory, M.: The Use of Maturity Models/Grids as a Tool in Assessing Product Development Capability. In: *Proceedings of the IEEE International Engineering Management Conference*, vol. 1, pp. 244 - 249, Cambridge UK (2002).
16. Hevner, A.R.: A Three Cycle View of Design Science Research. In: *Scandinavian Journal of Information Systems*, vol. 19 (2), 87-92 (2007).
17. Himme, A.: Critical success factors of strategic cost reduction. *J Manag Control* 23 (3), 183–210 (2012).
18. Jording, T.: *Entwicklung und Konzeption eines Reifegradmodells des Supply Chain Managements: Der Supply Chain Management Maturity Cube (SCMMC).* In: *Logistik und Supply Chain Management* 18, University of Bamberg Press (2018).
19. Kjersem K., Giskeødegård M.F.: Changing Markets: Implications for the Planning Process in ETO Companies. In: Ameri F., Stecke K., von Cieminski G., Kiritsis D. (eds): *Advances in Production Management Systems. Production Management for the Factory of the Future. APMS 2019. IFIP Advances in Information and Communication Technology*, vol 566. Springer, Cham (2019).
20. Kotter, J.: Accelerate! *Havard Business Review*, Nov. 2012.
21. Mettler, T.: Maturity assessment models: a design science research approach. *Int. J. Society Systems Science* 3 (1/2), 81-98 (2011).
22. Schein, E.H., Schein, P.: *Organisational culture and leadership* (5th edition). Wiley (2017).
23. Sharma C.: *Business Process Transformation. The Process Tangram Framework.* Springer, New Delhi (2015).
24. Veldman, J., Klingenberg, W.: Applicability of the capability maturity model for engineer-to-order firms. *Intern. J of Technology Mngmt* 29 (7), 539-545 (2009).
25. Westerveld, E.: The Project Excellence Model®: linking success criteria and critical success factors. *Int. J of Project Mngmt.* 21 (6), 411-418 (2003).
26. Zhang, S., Bartol, K.: Linking Empowering Leadership and Employee Creativity: The Influence of Psychological Empowerment, Intrinsic Motivation, and Creative Process Engagement. *Academy of Management Journal* 53 (1) (2010).