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Complexity Assessment of Modular Product Families

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Abstract

Today's companies are confronting the threat of increased complexity through a modular product architecture. The implementation of a modular structure comes with high effort, yet during the application phase these expenditures are compensated by efficient complexity handling. However, the modular structure is not permanent. Decisions on new modules and module variants have to be made, while simultaneously ensuring commonalities within the product family. When preparing such decisions, an insufficient amount of support exists to calculate with reasonable effort the complexity costs. Therefore, a new approach to examine complexity costs has been derived and subsequently tested at Bosch Thermotechnik.

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Keywords: Modular Product Architecture; Complexity Costs; Complexity Management; Control-of-Variety; Decision-Making

1. Introduction

An increased complexity is a growing threat that companies are facing nowadays, caused by globalization effects, customer's request for individualization and shorter product life cycles [1]. Several strategies to control this resulting complexity exist. A solution to resolve this problem that has become more significant in the last decades is a modular product architecture (ModPA) [2]. This kind of product architecture offers a way to handle a company's internal complexity in a more efficient way [2].

Yet the implementation of a ModPA comes with high efforts and costs. Nevertheless, during the application phase these expenditures are compensated by more efficient handling of a company's internal complexity [4]. However, the ModPA is not permanent throughout its lifetime. Decisions on new modules and module variants have to be made, while simultaneously ensuring commonalities within the modular product family (ModPF) [5]. These new variants can influence a company's complexity managed by a ModPA in an advantageous or disadvantageous way [5]. Therefore, these effects on the internal complexity have to be evaluated.

The necessity for a decision support tool can be derived from literature and requests from industry. However, insufficient methods exist to assess the effects of complexity and to simply calculate the complexity costs of these new variants [4,5]. This results in impaired decisions based on a lack of transparency. The refinement of the ModPF is based on a poorly prepared proposal and consequently, the risk of a subsequent, undesirable increase in complexity is high. Therefore, a new approach to examine complexity costs of new modules and its variants has been derived to prepare well-grounded variant decisions of a ModPA and to ensure in a second step a well maintained ModPF.

This paper discusses the need for a methodical support to calculate complexity costs of new modules and module variants of a ModPA and illustrates a method to fulfill this demand. Initially, the characteristics of a ModPA are discussed and then, the prerequisite for a complexity assessment within the ModPF is derived in section 2. Afterwards, existing methods to calculate complexity costs are examined in section 3 and are assessed based on the requirements derived in the previous section. Based on the literature review a new concept to calculate complexity costs of new modules is introduced in section 4. Subsequently, the validation of this method at Bosch Thermotechnik GmbH (Bosch TT) is presented in section 5 and ultimately deliberated in section 6.

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2. Need for a complexity assessment within ModPFs

The challenge of a steadily increasing internal complexity is highly relevant for companies [1]. Cutting the external variety by consolidating an existing product range is seldom a sufficient way to face this threat [8]. The implementation of a ModPA allows a company to minimize the internal variety by simultaneously offering a broad external diversity [8].

The characteristics of the ModPA are one reason for the effective handling of the internal complexity. A ModPA is less complex than an integral product architecture due to de-coupled interfaces and less complex one-to-one mapping of the functional elements to the physical components [9]. The usage of commonalities is a further reason [3]. Modules are reused across different products [4]. The preconditions are; that modules must have defined interfaces in order to ensure compatibility [6]; and that modules capture all requirements of the products using it [4]. This implies that the sustainability of a ModPA is at risk, if the modular design rules are not considered in a module development [7].

The initial design of a modular product comes with a high effort since it requires more expertise and a higher degree of alignment to ensure that the modules cover all requirements of the products using it [4]. For the implementation phase a broad variety of methods exists [4]. The result is an initial modular construction kit that is derived from an existing product family and previously planned new products. The implementation phase of a ModPA is marked in Fig. 1 as uncritical because of existing support.

This higher initial development effort in the implementation phase is compensated throughout the lifetime of a ModPA. The re-use of modules is an imperative characteristic of ModPFs. This facilitates cost savings in inventory and logistics, economies of scale, a decrease in the development time of products and various further benefits [4]. However, the number of new products that can be created by the initial modular construction kit is limited. The market will ask for new functions and technologies not yet captured. Decisions on a refinement of the ModPF and thus on new modules have to be made. Adequate methodical support for such a refinement does not exist [5,7]. Bosch TT derived the need for such a support and the consequences of the missing support have been reflected, which are presented in Fig.1. Moreover, Bahns et al. identified, that one of the foremost challenges in modularity is long-time maintenance [10].

The assessment of complexity and its costs are a good way to support companies in refinement decisions of a ModPA. Bahns et al. determined that companies typically aim to quantify the complexity reduction of a ModPA in terms of

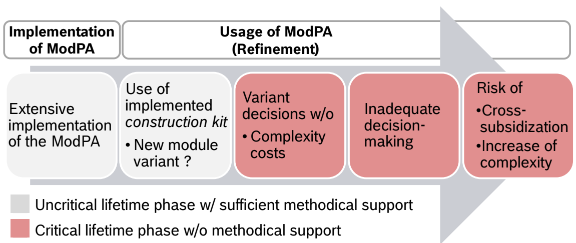

Fig. 1. challenges when refining a ModPA [7]

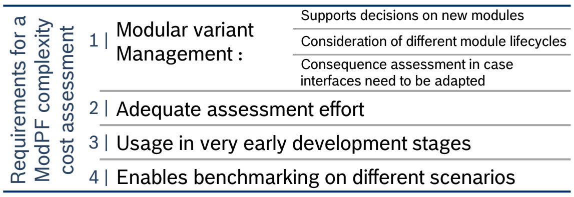

Fig. 2. ModPF complexity cost assessment requirements

costs [10]. Although the biggest complexity reduction step is made when implementing a ModPA, changes on the structure and on commonalities can both positively and negatively influence the internal complexity [5]. This implies that companies will not only need an evaluation of complexity to decide on an appropriate ModPA [3], but to refine an existing one.

The missing complexity assessment of new modules leads to inadequate decisions, as these are made based on incomplete information. A lack of transparency will be prevailing in the company, due to the unknown complexity effect of new modules. A failure of the ModPA might be the result. Decisions on variants without consideration of complexity costs could result in a cross-subsidization [17], thereby causing a recovery of the reduced complexity.

At Bosch TT there is increased necessity for methodical support to evaluate the complexity costs on variant decisions of a ModPA, which is the subject of this paper. The premises for this support are summarized in Fig. 2. Such a method needs to ensure that all requirements of a modular variant management framework are taken into consideration [7]. The framework helps to prepare decisions on new modules and module variants. The principle goal is the assessment of the initial and recurring complexity costs of possible new modules and module variants. For the recurring complexity costs the various module lifecycles must be taken into account. Additionally, this framework predicts the consequences in case inter-modular interfaces need to be modified. These prerequisites are summarized under the first requirement in Fig. 2.

Supplementary fundamentals on a complexity costs assessment have been defined at Bosch TT. Initially, the effort to calculate complexity costs should be proportionate to the benefits created by that assessment. Moreover, the calculation method has to be applied in the very early design stages, when the possibility to influence product costs is highest [11] and overhead costs are lowest. Finally, the complexity costs assessment must be comprehensive enough to ensure that different scenarios can be compared. Based on these criteria existing complexity costs methods have been evaluated in section 3.

3. State of the art

The topic of complexity and its costs is discussed in several scientific works. Since the definition of the term complexity differs highly in various papers [1] a brief definition is necessary. Derived from Lindemann et al. [2,12], complexity is defined as an attribute of a system. Complexity implies various aspects, such as the number of components and variants in a system, as well as the dependencies of the components in a system. Both internal and external influences can result in complexity, yet only the internal factors can be affected [2]. Complexity costs are the monetary evaluation of complexity and arise from a company's internal variety [13].

Miscellaneous methods on complexity and variant management exist. These can be divided into methods based either on costs or based on other aspects (Fig. 3).

First, methods focusing on other aspects are examined. Avak has designed a method to decide on new modules [14]. This method reviews whether the concepts for new modules are compatible with the interfaces and product structure and subsequently, evaluates and improves these concepts. Based on that, a decision on new variants can be made [14]. Junge developed a modular balanced scorecard, which assesses an existing and/or future ModPF, while taking into consideration its contribution to the company's strategies and the aims of the ModPA [15]. Both methods are specifically tailored to a ModPA, yet do not deliberate complexity costs aspects. Furthermore, Junge evaluated whole, existing ModPA concepts, which are not solely single variant decisions.

Second, methods evaluating complexity costs have been examined. These can be divided into concepts evaluating overall product architecture concepts and methods assessing single variant decisions. The cost prognosis concept by Ripperda and Krause evaluates various ModPA concepts by comparing the complexity costs differences of several possible structures [3]. This tool evaluates complexity costs of ModPF concepts and not single variants.

Several further methods exist that calculate complexity costs of new variants. Most of which are dependent on an activity based costing approach. The activity based costing method by Cooper and Kaplan assigns activities and processes to variants by a cost unit rate per cost driver [16]. Adapting this concept, Bohne calculates complexity costs by inspecting the different processes and resources [20]. Different variant scenarios can be benchmarked based on their contribution to a company's complexity. This method is not suitable for industrial usage due to its high effort [18]. Furthermore, Schuh enhanced the activity based costing concept by determining sub- instead of primary-processes and subsequently calculates resources per sub-process [17]. The calculation of the complexity costs of new variants using this method similarly comes with high effort.

For the above mentioned methods, detailed design information is necessary, which often does not exist in the early development stages. Park and Simpson have developed an activity based costing approach to support the early development phases [19]. Estimated production and non-production costs are linked to components to support designers with complexity costs information [21]. To reduce the prevailing evaluation efforts Bayer has refined the activity based costing method by combining the different complexity drivers by a factor analysis and calculating the resulting cost unit rates [18]. Based on that, complexity costs of new or expiring products and complex assembly variants are partly pre-evaluated and can be used as input for future calculations [18]. Most of the above mentioned methods still come with high effort and are not particularly suitable for ModPAs.

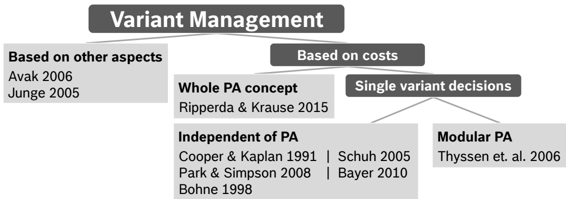

Fig. 3. literature review on complexity costs

Thyssen et al. used an activity based costing approach to support decisions on product modularity [22]. Although this method calculates complexity costs for variant decisions of a ModPA, the tool is impractical to evaluate complexity costs for refinement decisions of a ModPA. The method compares the benefits of one common module to several unique ones. Complexity costs of new modules are not a focus.

In section 2, the requirements of a complexity assessment for variant decisions of ModPFs has been discussed. Such a complexity assessment should support decisions on new modules and its variants, and consequently, should consider the different module lifecycles. A monetary assessment of the consequences in case interfaces have to be modified needs to be provided. Additionally, reasonable calculation effort, the usage in the early development stages and the possibility to benchmark different scenarios should be ensured.

None of the above mentioned methods fulfills these requirements. Either they assess overall product structure concepts without considering single variant decisions or they are designed for an integral structure instead of a ModPA. Moreover, most of the methods come with high effort and are often not practical for the early development stages. Thus, a new concept to assess complexity costs of new modules of a ModPA has been developed.

4. Method for a complexity costs assessment

Companies implementing a ModPA aim to quantify the resulting complexity reduction [10]. Thus, the calculation of complexity costs appears to be a good decision basis when determining new modules and their variants. However, no adequate method exists, as shown in section 3. To ensure that the above mentioned requirements for the assessment of new module concepts are considered in a complexity costs calculation, a new method has been constructed. The aim of this method is to support a maintained ModPA by ensuring that the ModPF is only enhanced by new modules and its variants if they are advantageous to the modular structure and thus the benefits offset the complexity created.

Most methods for a complexity costs calculation are based on an activity based costing. This comes with an extensive assessment effort and requires detailed concept information which seldom exists in the early development phases. Therefore, a simplified costing method has been developed, which is based on activities and resources consumed. The different stages of this method are presented in Fig. 4.

As soon as a product request arises that cannot be captured with the existing modular construction kit a decision on new module variants and thus on how to refine the ModPF has to be made. First, possible module or module variant concepts

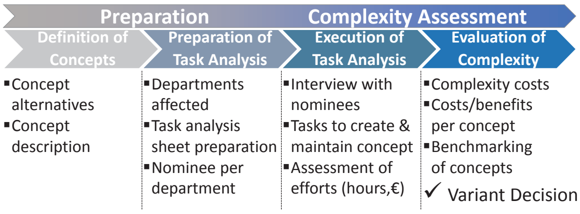

Fig. 4. overview of the complexity cost approach

need to be defined. A short description of these scenarios is useful, if possible in the early development phase.

In a second step, all departments affected by the new variant need to be specified. For each department an employee has to be assigned, to evaluate the effects of the new variant for his department together with a variant responsible. The designated individual is selected according to their level of experience; a more experienced employee will provide a better assessment. All departments and module concept scenarios are listed in a task analysis sheet. For each scenario, a placeholder for initial and recurring complexity costs is given [7]. This is required, as the recurring complexity costs summed up over the lifetime of a module were often higher than the initial complexity costs. An example of this type of task analysis sheet is shown in Fig. 5.

Third, the evaluation of the complexity occurred by a new module concept scenario based on the task analysis sheet is executed. Therefore, the individual responsible for the variant conducts a face-to-face interview with the nominees defined in step two. Initially, in the interview, the various tasks to create and maintain a listed variant scenario are specified. Throughout the interview, special attention is given to interfaces that could potentially violate the modular structure and thus, on a definition of all tasks to capture this violation. Thereafter, the initial and recurring effort for each task and variant scenario is assessed. Therefore, the nominee gives hourly or monetary values for each task and scenario. The hourly value is based on an assessment of the number of persons working on this task and their working hours required. The hours consumed are then multiplied by the department cost rates to quantify these in monetary values. Based on a direct comparison of the diverse scenarios a differentiation of the complexity costs is ensured.

A prerequisite for an impartial evaluation is an unprejudiced variant responsible. Additionally, the variant responsible has to ensure an independent assessment of the various efforts in the different departments. Therefore, he is

Task Analysis Sheet: Complexity Assessment of new module (variant) concepts

		Scenario 1		Scenario 2		...	Scenario ...	
	Module (variant) concepts fullfilling new market request	Module (Variant) Concept 1		Module (Variant) Concept 2		...	Module (Variant) Concept ...	
		Sketch Scenario 1		Sketch Scenario 2		...	Sketch Scenario ...	
		Description ...		Description ...			Description ...	
Departments affected	Tasks to create / maintain module (variant) (including assumptions)	initial	recurring per a	initial	recurring per a		initial	recurring per a
R&D								
PUR								
LOG								
...								

Fig. 5. task analysis sheet

asking carefully for the disciplines involved in each task. In case of interdisciplinary tasks he has to ensure that only values for the respective department are considered. Such tasks again have to be valued in the other involved departments as well, whereas the variant responsible is in charge for that.

After defining and rating the different variant dependent tasks for every module concept for each department, the resulting complexity costs for the scenarios are calculated. This calculation is shown in equation 1. Complexity costs of scenario x, CC(x), are the sum of all initial efforts $t_{o,y,x}$ and yearly recurring efforts $t_{r,y,x}$ per department y, for scenario x, multiplied by the department cost rate r_y. The summarized monetary initial (one-time) $m_{o,i,x}$ and recurring $m_{r,i,x}$ efforts of each department for scenario x are added. The recurring time inputs $t_{r,y,x}$ and recurring monetary values $m_{r,i,x}$ are calculated by multiplying these with the modular lifecycle a_{ml}.

$$CC(x) = \begin{pmatrix} t_{o,1,x} \\ t_{o,2,x} \\ \dots \\ t_{o,y,x} \end{pmatrix} * \begin{pmatrix} r_1 \\ r_2 \\ \dots \\ r_y \end{pmatrix} + \sum_{i=1}^{y} m_{o,i,x} + \left(\begin{pmatrix} t_{r,1,x} \\ t_{r,2,x} \\ \dots \\ t_{r,y,x} \end{pmatrix} * \begin{pmatrix} r_1 \\ r_2 \\ \dots \\ r_y \end{pmatrix} + \sum_{i=1}^{y} m_{r,i,x} \right) * a_{ml} \quad (1)$$

Besides a complexity assessment of the different scenarios, estimated product cost and expected benefits per scenario are derived to benchmark the various concepts [7]. This cost information provides a good decision basis to select a module concept. This results in refinement decisions that are advantageous to the ModPF.

5. Case study in industry

The presented approach to calculate complexity costs of new modules and its variants, as well as to benchmark different design concepts has been verified at Bosch TT, which is one of the leading companies offering heating products and hot water solutions in Europe. One exemplary product, the Junkers Cerapur 9000, is shown in Fig. 6(a). A conceptual scheme of a modular boiler is shown in Fig. 6(b). This modular boiler consists of five modules, the heat cell, the hydraulic, the electronic, the expansion vessel and the structure. Based on this product the complexity costs assessment will be validated.

The market requested an easier boiler end-user interface. The operation of the end-user with the boiler is accomplished through the human machine interface, which belongs to the electronic module. Therefore, the variant responsible for the electronic module requested for concepts in order to solve this problem. The resulting four concepts were based on a modification of an existing electronic module.

The first concept offered advanced user guidance based on a touch concept performed with foil technology. This concept

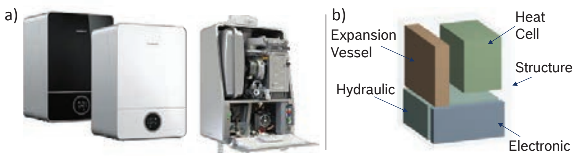

Fig. 6. (a) Junkers Cerapur 9000 (courtesy of Bosch TT); (b) modular boiler

would fulfill the market request in an optimal way, however, the expected module costs were high. The second concept was based on a touch concept performed with spring technology, thereby achieving simplified user guidance; the expected costs were lower than for the first concept. The third concept would result in two new variants, one with the simplified (concept two) and one with the advanced user guidance concept (concept one). Based on these two variants, various high and low cost markets could be handled, thereby achieving an optimization of the costs and features. The fourth concept similarly resulted in two variants, both based on the same foil technology, yet a graduation of the user guidance was possible. The average costs were expected to be higher than for concept three, but lower than for concept one, which always offered the advanced guidance. All concepts were based on an existing electronic module and no interfaces to other modules were required to be modified. Thus, an evaluation of the consequences of an interface violation was not needed. The different concepts are listed in Fig. 7.

Conjointly with the variant responsible associate, all departments affected by the complexity have been defined. These were the R&D, purchasing, design, marketing, production and logistics departments. For each department an employee with a high level of experience has been nominated and the task analysis sheet was populated with descriptions and sketches of the four scenarios; the affected departments; and nominated employee names (Fig. 7).

With each nominee a task analysis interview was executed. The initial step was to deliberate which tasks have to be executed to create, and thereafter maintain, a new module variant concept. The concept that originally appeared to be the most complex one was used for the task definition, which was concept three. The other concepts therefore required the same tasks or a proper subset of these, due to their lower complexity.

In a second step the effort for each task defined in step one was valued, either by estimating the time needed to fulfill this activity or by a monetary quantification. An example for an activity valued in time units would be the design of the new concept or the preparation of the documentation. Here the nominee assigned hours to each task by stating the number of persons involved and their working hours required for this task. The resulting hours were than multiplied with the corresponding department cost rates to price the efforts coming with a new variant. A pure monetary evaluation, for instance, were costs for samples or cost of the tied-up capital. It has to be ensured that not only the initial costs to create the new variant are considered, but also the recurring costs to maintain a variant in series production. Therefore, the recurring efforts for re-designing an existing variant due to cost saving topics, component discontinuation notices or other reasons need to be assessed. Experts at Bosch TT stated, that such efforts are often low in the beginning of the module lifecycle but increase exponentially the longer the module is in series production. An average value has to be assumed.

During the interviews, it was observed, that the variant responsible has to be unprejudiced in order to ensure an impartial complexity assessment. If this is the case, it can be assured in the interviews that a favored concept is still valued objectively by moderated estimates. For consistency reasons assumptions made for an assessment were additionally noted in the task activity sheet.

The interviews for that specific variant scenario decision had to be executed by one assigned variant responsible. He had to ensure an independent assessment of the various efforts in the different departments by asking thoroughly for the reasons of the given values and checking for each task and effort the disciplines of the persons involved to ensure only effort within the own department was considered. Additionally, the variant responsible had to provide a list with all department interdependent tasks to ensure these were considered in all departments with department specific efforts.

Ultimately, the complexity costs per concept were calculated based on the input during the task analysis interview. Following equation 1 the initial hour units per department were summarized and multiplied by the corresponding cost rate of each department. These results were summed up. Additional initial monetary values were added. The same procedure was executed with the recurring efforts. These were furthermore multiplied by the corresponding electronic module lifecycle.

Due to confidentiality reasons, it is not possible to present the detailed results of the complexity assessment of the electronic module variants; although it is possible to show the concept deviations in percent (Fig. 7). Therefore, concepts two, three and four were benchmarked to scenario one (100%). In terms of complexity costs, concept two is the most beneficial one with 85%, followed by concept one, which is benchmarked to 100%. The two concepts providing only a single variant are lowest in complexity, which was expected. In case two user guidance concepts are favored, due to differentiation, concept four (114%) should be preferred over concept three (122%). Surprisingly, the complexity costs differences that lead to this result were only minor in the R&D department, in which two technologies had to be developed instead of one, while the biggest differences were observed in other departments such as logistics and manufacturing.

For the concluding decision, information of expected costs, as well as benefits for each concept, were added. The results

Task Analysis Sheet: Complexity Assessment of *new electronic module variant* concepts																	
		Scenario 1				***Scenario 2***				***Scenario 3***				***Scenario 4***			
	Module (Variant) Concepts fullfilling new market request:	**Electronic Variant Concept 1**				**Electronic Variant Concept 2**				**Electronic Variant Concept 3**				**Electronic Variant Concept 4**			
	Easier end-user boiler handling	User guidance *foil technology*				Simplified guidance *spring technology*				(Simplified) guidance *spring&foil technology*				(Simplified) guidance *foil technology*			
	Tasks to create and maintain module variant	initial		recurring per a		initial		recurring per a		initial		recurring per a		initial		recurring per a	
R&D	Task R&D 1	25	TU	1	TU/a	25	TU	1	TU/a	34	TU	1	TU/a	27	TU	1	TU/a
	Task R&D 2	400	k€	50	k€/a	400	k€	50	k€/a	420	k€	60	k€/a	405	k€	55	k€/a
	Task R&D 3: Assumption 2	30	TU	0	TU/a	30	TU	0	TU/a	34	TU	0	TU/a	32	TU	0	TU/a
	...																
	Task R&D 11	20	TU	3	TU/a	20	TU	3	TU/a	28	TU	4	TU/a	23	TU	4	TU/a
PUR	Task PUR 1	4	TU	0	TU/a	4	TU	0	TU/a	5	TU	0	TU/a	4	TU		TU/a
	Task PUR 2	2	TU	0	TU/a	2	TU	0	TU/a	3	TU	0	TU/a	2	TU	0	TU/a
	Task PUR 3: Assumption 3	2	TU	0	TU/a	2	TU	0	TU/a	3	TU	0	TU/a	2	TU	0	TU/a
	...																
	Task PUR 13: Assumption 7	5	TU	4	TU/a	5	TU	4	TU/a	6	TU	4	TU/a	5	TU	4	TU/a
...																	
LOG	Task Log 1: Assumption 13	0	k€	22	k€/a	0	k€	22	k€/a	0	k€	33	k€/a	0	k€	22	k€/a
	Task Log 2	0	k€	9	k€/a	0	k€	9	k€/a	0	k€	11	k€/a	0	k€	9	k€/a
	Task Log 4	0	k€	837	k€/a	0	k€	627	k€/a	0	k€	955	k€/a	0	k€	982	k€/a
	...																
	Task Log 26: Assumption 14	0,8	TU	0	TU/a	1,5	TU	0	TU/a	2	TU	0	TU/a	2	TU	0	TU/a
	summarized time inputs	267	TU	14	TU/a	264	TU	15	TU/a	315	TU	31	TU/a	288	TU	17	TU/a
	summarized monetary inputs	740	k€	932	k€/a	713	k€	723	k€/a	888	k€	1.080	k€/a	785	k€	1.088	k€/a
	complexity cost benchmarking	**100 %**				**85 %**				**122 %**				**114 %**			

Fig. 7. task analysis sheet for new electronic variant

were subsequently presented in a management meeting and a decision for scenario four was made. The reason for this was that this concept offered the highest flexibility and thus benefits, caused by different markets that could be served. Although scenario three was beneficial when looking on module cost, the higher complexity costs could indicate that scenario four is the overall advantageous concept.

The management was satisfied with the outcomes of the complexity assessment. The effort for the evaluation was justified by the module variant decision outcomes. The list of activities combined with the evaluation of the initial and recurring costs allowed a comprehensible variant assessment. The characteristics of the ModPA could be satisfied in the complexity costs assessment by ensuring that the modular design rules were not violated and thus, did not have to be evaluated and that the modular lifecycle was considered. The nominees with a high level of experience enabled an assessment of complexity in very early development stages.

The presented complexity costs assessment method helps to ensure a maintained ModPF by supporting decisions on the modular structure that lead to an advantageous refinement.

6. Conclusion and outlook

The implementation of a ModPA has become increasingly relevant [2]. The initial modular construction kit is implemented with high efforts [4]. During the usage phase of the ModPA, market requests will occur that cannot be captured with existing modules. This results in a refinement of the ModPF and thus, in decisions on new modules. These decisions are often made based on the expected module cost. However, when considering complexity costs the decision could be another one. Thus far, only inadequate methods exist to calculate with a reasonable effort complexity costs in the very early design stages of new modules by ensuring the modular design rules are taken into account.

The presented approach to calculate complexity costs for decisions on ModPAs closes this gap. A case study at Bosch TT was able to validate the feasibility of the method. Design engineers and management agreed on the reasonability of this method and appraised the structured, simple approach. Based on the outcomes of the evaluation, the likelihood of refining the modular structure in an advantageous way is high.

The theoretical assessed complexity costs could not be verified against the actual complexity costs due to the early stage of the electronic module lifecycle. Hence, the actual occurring efforts to create and maintain a new module or module variant, recorded in working hours or in a retrospective budget, should be summarized. This is only possible at the end of the module lifecycle to ensure the entire costs of complexity are compared with the heuristically calculated ones using the presented method.

This method offers a simplified way for a complexity costs evaluation. The assessment nevertheless comes with a certain effort and is dependent on the level of experience of the involved team members. Thus, an enhancement to further reduce the expenditures and to additionally ensure consistency of the resulting complexity costs from decision to decision should be discussed. Moreover, further evaluation aspects besides cost should be taken into consideration.

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