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A Survey about the Use of Methods in German Industry

Sebastian Schneider
Technical University of Munich
Department for Product Development
Sebastian.Schneider@pe.mw.tum.de

Moritz Meissner
Technical University of Berlin
Engineering Design and Methodology Group
Moritz.Meissner@ktem.tu-berlin.de

Udo Lindemann
Technical University of Munich
Department for Product Development

Abstract
In many research projects was observed that engineering design methods can enhance design processes. Nevertheless when looking into industry there is a big lack regarding the successful implementation. This can be observed i.e. in studies about the use of methods. However these studies only ask about the frequency of the use and do not consider the success factors and obstacles. To obtain more knowledge about the causes for the (non-) use an internet-based survey was conducted within German industry. Beside the frequency of the use the motivation and the reasons for the use where asked. Also success factors and obstacles of methods in industry should be named. So a much more detailed picture arises.

Keywords: method implementation, industry, success factors.

Introduction
Methods in engineering design could help to enhance product development processes [8]. Nevertheless there is big difference between the (positive) experiences especially in research projects and the often unsatisfying results in industry projects ([1], [3], [6]). So far mostly single case studies have been conducted to investigate success factors and obstacles of method implementation [8, 9, 10]. For a better understanding of the implementation of methods in industry a broad questionnaire could be helpful. Until now there are only a few broad studies about method implementation, most of them only consider which methods are how often used. Further influence factors have not been considered. In this paper the results of an extensive questionnaire conducted in German industry will be presented. Beside the frequency of the use of methods also influence factors like motivation or knowledge are considered.

Former surveys
There are a lot of existing surveys which aim at the investigation of the utilization of product development methods (see Table 1), most of them are limited to one country [1, 2, 3, 4, 5, 6, 11, 12]. They vary regarding the participants (individuals, companies), the size of the sample, and the number and application area of methods which were asked. Some of the main results will be described below.

Araujo et al. [1,12] observed that "companies with broad-based quality strategies such as TQM are more likely to perceive benefit from methods than other companies". The frequency of the use of methods in German industry differs between up to 50% (market analysis, target costing, value analysis) down to 10% (QFD, variant management) [6]. Bonaccorsi and Manfredi [3] stated that the higher the number of methods adopted, the higher is the subjective evaluated product development performance. According to [11] there is less use of methods in New Zealand in comparison with UK. They noticed further that "because of the diverse nature of New Zealand's industry a single prescriptive model for product development is unlikely to be universally applicable". Arvidsson et al. [2] investigated the use and knowledge of methods for robust design in Swedish industry. "The results of the survey also reveal that application of robust design methodology, involvement in a Six Sigma program, QS 9000 certification, and the size of the company seem to be correlated with an increased use of these methods." A further study in Swedish industry [4] observed that methods help to reduce the problem of late-discovered product requirements. Fujita and Matsuo [5] made a survey and compared their results with the studies about UK [1,12] and New Zealand [11].

Table 1. Overview about existing surveys

source	sample	questionnaire
[1,12]	UK industry N=27 (companies)	31 methods, use and contribution to quality
[6]	German industry N>40 (individuals)	20 methods, frequency of use
[3]	Italian industry N=135 (individuals)	35 methods, frequency of use
[11]	New Zealand industry N=~109 (companies)	31 methods (according to Araujo et al. 1996), use of methods, stage of design when they are applied, degree of satisfaction
[2]	Swedish industry, N=87 (companies)	9 methods for robust design
[4]	Swedish industry, N=205 (companies)	10 methods for customer requirements elicitation
[5]	Japanese industry, N=221 (118 companies)	40 methods, frequency of use

The questionnaire

Previous investigations revealed that the intensity of the use of methods differs distinctly: market analysis or target costing are often implemented while others like QFD are only seldom used [6]. These differences in the frequency of application are caused by various influence factors, e.g.: the motivation of the user, the guidelines of the company and the chief, the effectiveness and efficiency of the method and several others.

To gain information about the use of methods in relation to influence factors a questionnaire with about 250 respondents from different companies in Germany was carried out. To get a broader field of answers product developers in all kinds of companies (branches, sizes, etc.) were addressed. The sample of 4500 manufacturers was taken from the 2005 editions of the "Hoppenstedt" company databases for small and medium 0 as well as large companies 0. Most of the addresses were related to public relations, and the cover letter contained a passage in which the recipients were asked to forward the questionnaire to a person who is familiar with product development.

Questions regarding the frequency of the application of methods were supplemented by questions about the motivation for the use of methods (e.g. what are success factors and obstacles at method implementation, what is the motivation of the user, what are the boundary conditions (product, process, company, user, etc.)).

Results

In this section the results of the survey will be presented. First a short overview about the respondents will be given. After that the important results will be described.

The respondents

To better interpret the results some data concerning the respondents were collected (see Figure 1). Most of the respondents are employed in SME companies with less than 1000 employees. Within the companies only few persons are engaged in product development: about 60% have less than 10 developers, about 30% have up to 100 developers.

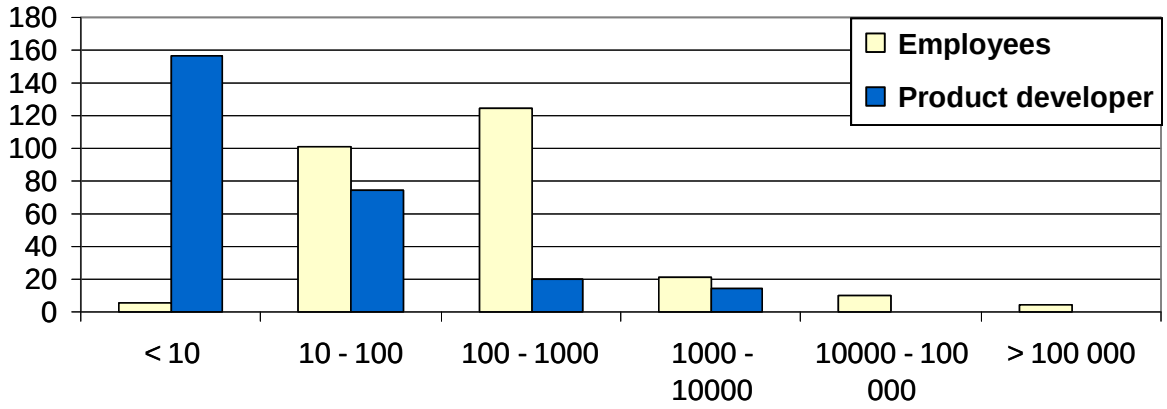

Figure 1. The original company of the respondents

Frequency of the use of methods

As observed in earlier surveys most methods are not used so often as expected by academic research (see Figure 2). There are only a few popular methods like market analysis, list of requirements, target costing or patent inquiry which are often implemented. When looking at the reasons for the implementation, methods which are fix specified in-house or by law are used quite often and successful. Examples are the list for requirements, target costing, patent inquiry, benchmarking and FMEA. Nevertheless except the list of requirements and the FMEA all other methods are mostly used as a result of own motivation/selection (50-65%). The reasons for these preferences may be found by investigating the next group: methods which are often used but mostly due to own selection (>65%). This group consists out of market analysis, trend analysis, easy creativity methods (brainstorming, etc.), simulation, easy evaluation methods and cost-benefit-analysis. The reasons for their more frequently use could be that the efforts (amount of time, etc.) are not so high and the benefit is quite clear. They are "secure" methods without big risk to fail and with an assured success. Besides they are easy to learn which furthermore reduces the risk to fail.

The last group are methods which are seldom used. Examples therefore are QFD, lead-user-analysis, TRIZ/bionics and a morphological chart. Here it is meaningful to look at the success ratio of the methods (see Figure 3), so how often the methods are used successful in relation to unsuccessful. A successful use of the method could be marked by the options "often used" and "seldom used, successful". The definition of the unsuccessful use is more difficult: As it was not possible to further divide the alternatives to answer there are two success ratios:

Success ratio I considers “seldom used, unsuccessfully” only, in success ratio II “never used” as well as “seldom used, unsuccessfully” are included. In fact, the reality will be in between these two success ratios: when a method is not used, than due to unsuccessful use and/or just without any negative barrier. In Figure 3 the ratio 1 is highlighted as it is the border between a more successful to a more unsuccessful ratio. Only TRIZ/Bionics have a very low success ratio. The reasons for this phenomenon could be the complexity of the method, the high efforts and difficulties while learning and using it, as well as the perspective to succeed. Almost if you are an expert the possibility to come to a satisfying solution is not so high. The other methods have at least a positive success ratio I. So it could be recommended to use them. When looking to the other methods which are quite often used than the success ratio is in general high and at least positive. All these methods can be doubtless recommended.

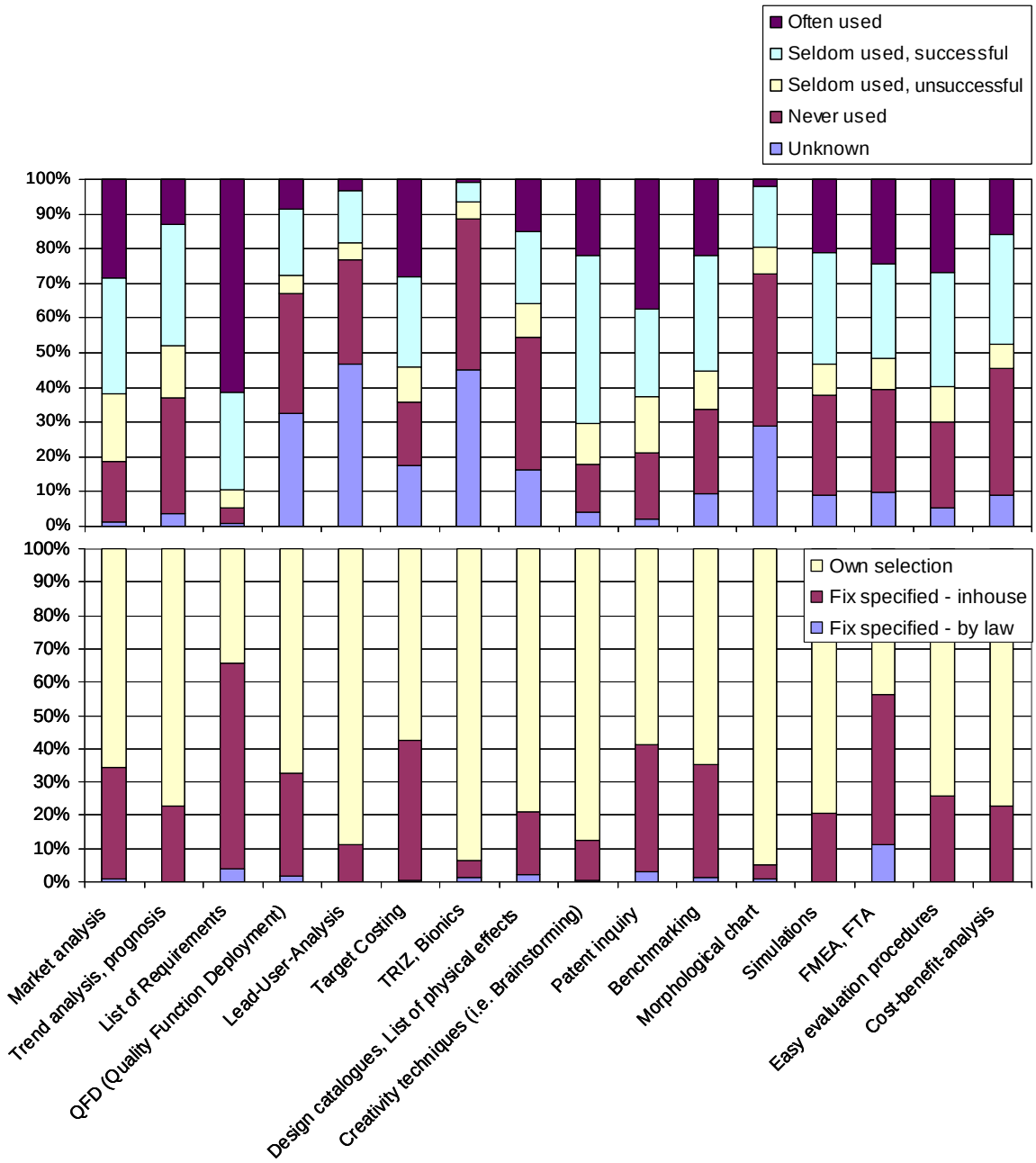

Figure 2. Frequency and reasons for the use of methods in industry

There are also further reasons for the use of methods which are not explicitly inquired in this survey. The cost-pressure could lead especially to the use of target costing and value analysis. Market analysis, portfolio-analysis and trend analysis should guarantee the market success which is difficult to reach due to fast changing and quite heterogeneous markets. Focusing on the early stages of product development the wish to increase the quality of the product may be leads to the implementation of methods like list of requirements, simulation or failure-mode-and-effect-analysis (FMEA).

Nevertheless it should be kept in mind that these survey results are all subjective impressions of the participants of the survey. To get more (objective) information about the use and especially about reasons for the (non-) use of methods more detailed investigations within industry are necessary.

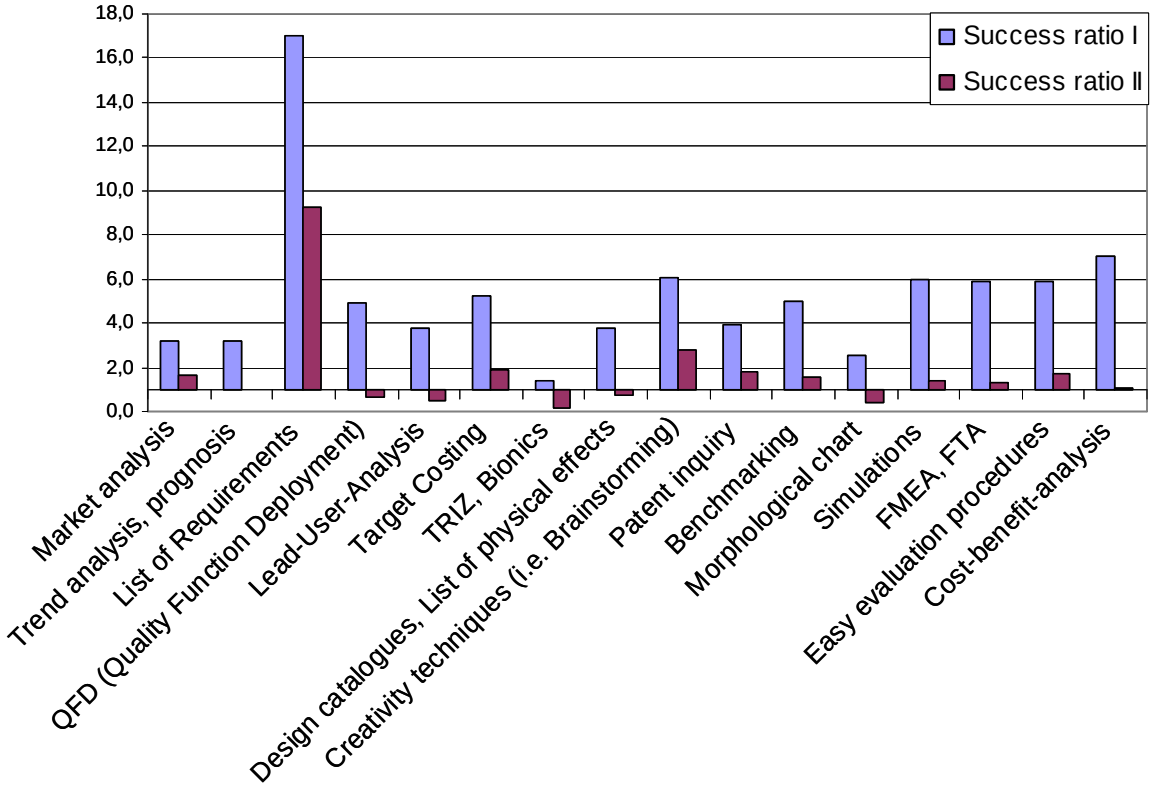

Figure 3. Success ratio for the use of methods

Success factors and obstacles

In industry various strategies are implemented to support the successful application of methods. A question was set up to find out which strategies are successful, which not and which are not used often yet but could be successful. The results were analyzed according to two steps: 1. Which strategy is used, how often, un-/successfully, 2. The success ratio successful/unsuccessful use of a strategy was derived.

Further training, accompanying documents, pilot projects, templates, support by executives and the reflection of the method implementation are common (> 50%) and successful strategies. These are also the strategies with the highest success ratio. Hence a company which wants to enforce the internal use of methods should “inoculate” their executives, initiate pilot projects and further trainings, and deliver accompanying documents and

templates. To improve the reflection it could be meaningful to develop a systematic template and provide it to all product developers.

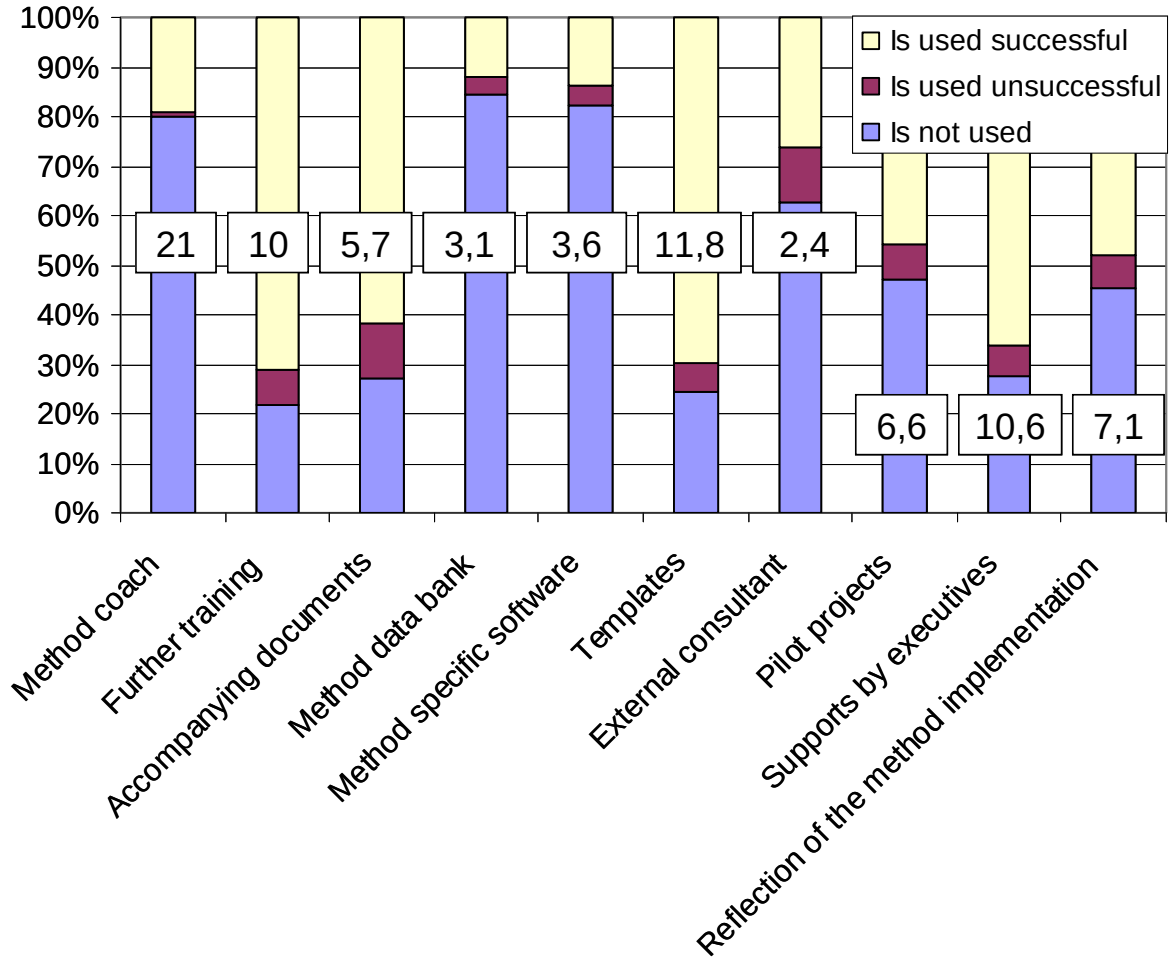

Figure 4. Support

External consultants should be evaluated quite differentiated: they are applied in just under 40% of the cases, but the success ratio is the lowest. There could be various reasons for this result: maybe consultants are not accepted by the employees in the company, their way of implementing the methods could be too unspecific and not adapted to the companies requirements or they are called into already failed projects.

The last group are strategies which are only used seldom (< 20%): Method coaches, method data banks and method specific software. Here it is interesting to look at the success ratio: method coaches have out of all strategies the highest success ratio. Method data banks and method specific software in contrast have a quite low, but positive (>1) success ratio. This is not surprising as existing software is either very special (i.e. software for TRIZ) or not developed far enough like most of the method data banks. Nevertheless there is a big potential if the software is developed more customer-friendly.

There are also a lot of typical obstacles which prevent a broad use of methods. To find out which of the obstacles are how important the respondents had to evaluate them (see Figure 5). The three main factors (> 40%) are lack of time, too high expenses for the methods, and too much theory of some methods. This relates to the results regarding the frequency of use (see Figure 2): easy (to use, to learn, etc.) methods are used often while complex methods (with

high efforts) are only used seldom. The clearness of the benefit of the method (28%) is at least important: when the user does not know why he should use the method and what the result could be he will not proceed as determined as if he knows it. Hence he will not be as successful. The other reasons (wrong team composition, lack of computational/software support, too fixed implementation of the method, no support by executives, lack of support (method coaches, trainings) in the company, negative answer of involved employees, deficient visualisation, too difficult to learn) are not seen so critical by the participants. Nevertheless they should not be neglected.

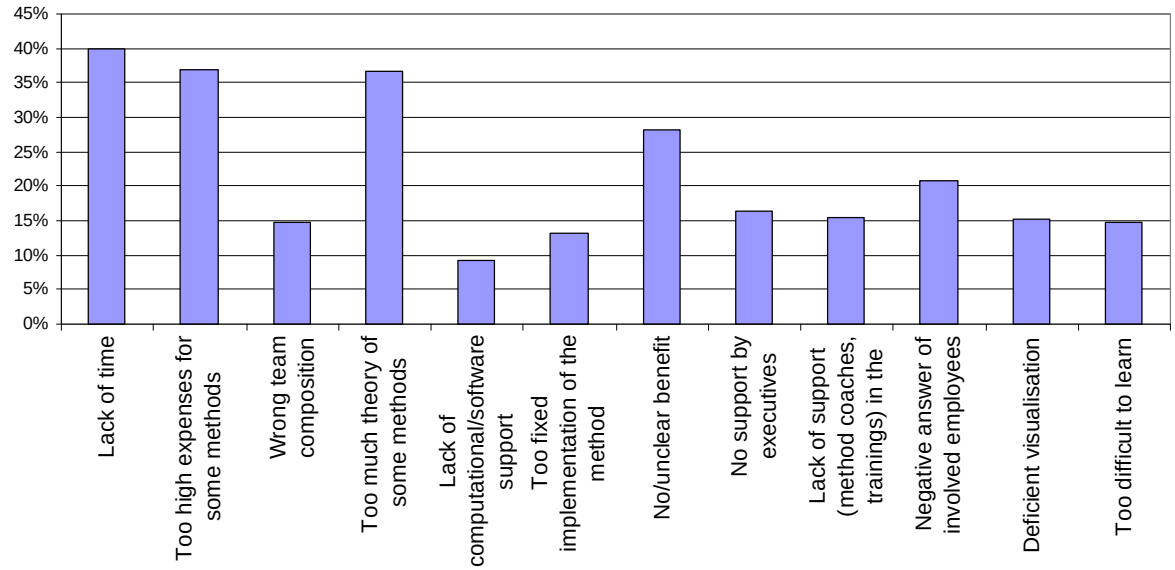

Figure 5. Obstacles for the use of methods

Critical reflection

When analyzing the results the following things should be considered: All answers are subjective answers of the participants out of their point of view. While the frequency of the use is quite objective to evaluate the success is subjective. Each product developer has his own perceptions how the result of the method should look like. Beside these are also very rough results. When looking i.e. to the motivation of the user or the success factors/obstacles of some methods a more detailed analysis would be desirable. This was not possible in this survey, otherwise due to larger extent of the questionnaire the number of respondents would have been much smaller.

Conclusion

Like in previous surveys it was observed that methods are not used as often as expected by their creators. In contrast to previous surveys also reasons (motivation of the user, success factors, obstacles) were analysed. They helped a lot getting more insight why methods are used or why they are rejected by the users in industry. Beside the success of different strategies to support the implementation of methods were evaluated. All explicit results were extensively discussed within the paper.

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