

METHODS IN PRACTICE – A STUDY ON REQUIREMENTS FOR DEVELOPMENT AND TRANSFER OF DESIGN METHODS

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1. Introduction

Nowadays, methods play an important role in supporting design processes and activities. They help to reduce errors, shorten developing time and improve the overall quality of products. Nevertheless, a lot of potentially useful methods are only applied seldom or not at all. Additionally, methods are often not carried out in the intended way or are poorly adapted so that the intended goal of these methods – support of the designer in certain kinds of work – can not be achieved.

This paper presents research done on method usage in industrial daily job routines and also on requirements for development, transfer and implementation of methods in the industry. It gives an overview of necessary measures for better method usage in the industry and sets up a model that shows how all these measures work together.

2. Analysis of status quo in daily job routines

Development and usage of methods is dependant on culture. According to Grabowski (1997, p.88) most methods are developed in the USA or Japan (e.g. QFD, FMEA, brain storming, target costing, Benchmark, etc.) and taken over into other countries, for example European countries. This takes some time and furthermore, different cultural aspects impede the quick and accurate implementation of methods. E.g. in Japan, methods are more often and intensively used than in Germany due to the Japanese group-mentality, motivated employees and their identification with the company (Grabowski et al.; p. 89f).

This paper focuses on the development and the present situation of method implementation and usage in the German industry, however, we assume that the situation is rather similar to other European countries with comparable cultures. The data about method use and requirements for usage of methods is generally retrieved from German PHD-theses (like Jänsch, Reinicke and Zanker), the research project “New ways towards product development” (1995) and an interview research study conducted in 2007 by the BEMAP project, an interdisciplinary project of designers from the Darmstadt University of Technology and psychologists from the Otto-Friedrich University Bamberg.

2.1 Problems in acceptance and application of methods

The research project “New ways towards product development” was conducted in 1995 in association with the German federal ministry of education and research. It was initiated by the Berliner Kreis e.V. and aimed at locating general problems and deficits in the domain of product development, finding potential solutions for the future and producing measures to improve product design. The findings of the involved working groups and participants were published in the book “New ways towards product development” by Grabowski and Geiger (1997).

In an assessment of factors relevant to success, the study referred to strengths and weaknesses of product development in Germany. Although general and specific knowledge as well as aspects such as quality were rated quite high, other success-relevant factors like cooperation with different departments, companies or universities, pioneering spirit, customer orientation and social competence were shown to be lacking in German industry.

Further research revealed deficits and problems in the usage of methods in industry. It was shown that the most important methods were used only occasionally or not at all. The most popular methods are creativity techniques, methods to analyse markets and costs and methods to compare product solutions.

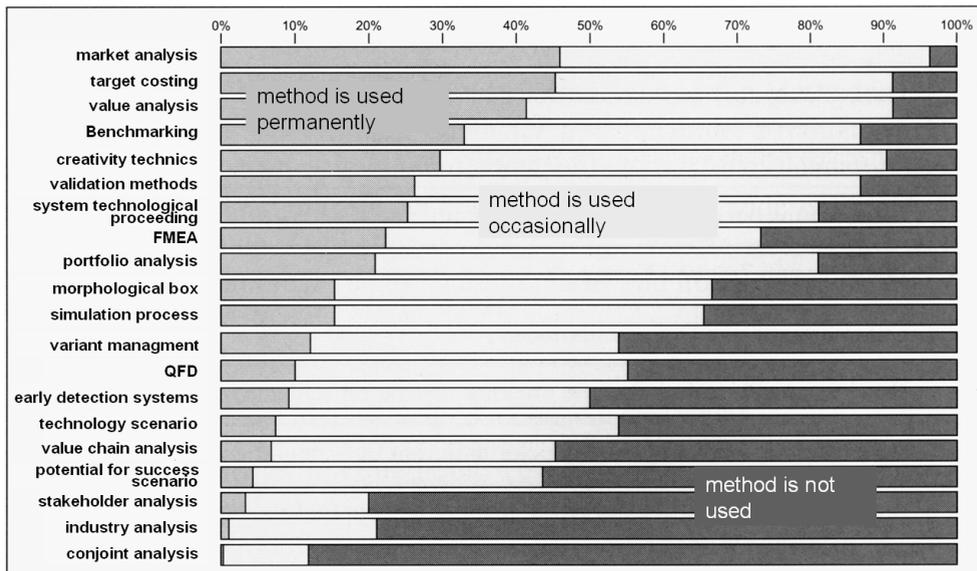


Figure 1. Usage of design methods in Germany in 1997 (Grabowski et al.)

Regarding these findings, Reinicke (2004) listed main problems concerning the usage of methods. She claimed that methods are too complex and have too much theoretical overload. Users don't see the advantage of many methods but they see the great effort required to carry out the methods. Furthermore, implementation of methods in companies is often slow and not fitting to the needs of the company, the department and/or the users' needs. Another problem refers to the implementation of methods in companies: they are often chosen or conducted the wrong way or the designers don't have sufficient capacity or support for carrying out these methods. Also Badke-Schaub et al. (2005) highlight some major limitations of design methodology which are the missing adaptation in regard to the characteristics of the individual designer such as experience or cognitive overload, the missing adaptation in regard to the characteristics of the organisational environment such as time constraints, financial constraints, and constraints through multiple projects that must be treated simultaneously.

2.2 Study of the BEMAP-Project

The BEMAP-project conducted (as described by Geis et al., 2007) an interview study with 47 participants from different fields of mechanical engineering. The participants were asked questions about relevant aspects of teamwork (e.g. communication, leadership, shared mental models, time management, reflection, conflict management, information exchange, etc.), and were then asked to rate selected aspects of teamwork on a floating scale.

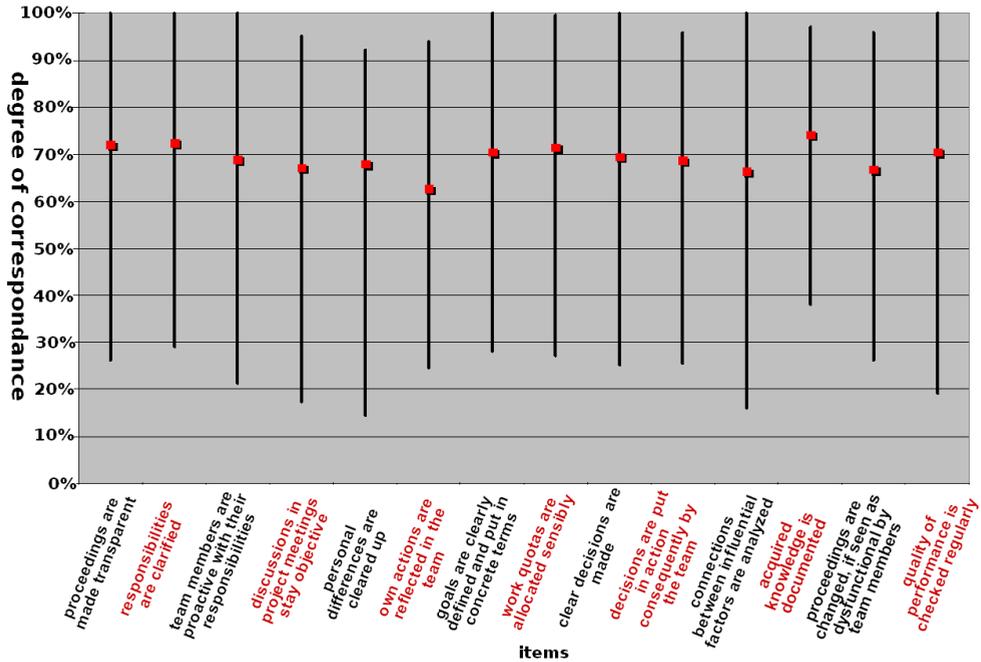


Figure 2. Results of the BEMAP-rating of selected aspects of teamwork

A direct comparison of the rating results shows that the statement “Own actions are reflected in the team” was rated worst, while “Acquired knowledge is documented” was seen as the most well-achieved item. In contrast to more social tasks (such as reflection, analysis of influences or adaptation of proceeding), standardized procedures like documentation, clarification of responsibilities were rated slightly better (over 70%). All aspects of team work were rated between 62,7% and 74,2% . Overall, the ratings reveal that, on average, there is a need for optimization, especially of the so called “soft skills”.

When asked about product development methods, the participants stated that they mostly use Brainstorming and FMEA. Assessment methods and methods to analyse market and requirements are used sometimes; most other methods are used only sometimes or never. It seems that in daily job routine, designers work mostly without methodical support.

When asked for wishes regarding new methods or methods in general, the following summarized requirements were mentioned by the participants of the study:

1. interaction:
 - methods should improve speed and effectiveness of communication
 - methods should support designers in presenting and discussing ideas competently and objectively
 - methods should help in reaching agreements
2. **planning:**
 - methods should help in planning, organizing and controlling projects or processes
 - methods should support analysis of the process (in general and actual state)
 - methods should ensure sustainability of actions and measures
 - methods should support individual time and project management
 - methods should help prioritize work quotas

3. usage of methods:

- methods should be simplified
- the flexibility of methods should be improved
- methods should focus on the output and have less theoretical ballast
- methods should be better integrated in the process
- methods should be improved from time to time according to the wishes of the users

As can be seen, users don't distinguish between development methods like the morphological box and other methods, but demand that methods support processes for planning and executing, as well as intrateam processes, as in communication or reaching consensus.

These findings are somewhat similar to the method requirements of the study "New ways towards product development" (Grabowski & Geiger, p.39f):

- improvement of processes
- reduction of iterative loops
- visualization of existing knowledge
- support in reaching targeted cost and deadlines
- savings of time and cost
- support of documentation
- help regarding technical and organizational decisions
- support reaching customer- and goal-oriented decisions
- support in accessing linked information

Similarly to the results of studies by the BEMAP-project and Grabowski et al., Zanker (1999) detected poor communication, complicated goal definition and decision making as weak spots in product design. Fixated thinking in hierarchies and lack of interdisciplinary work are also named as problems in the daily industrial job routine. Zanker further stated that implementation of methods is executed poorly and that implemented methods are inefficient, not flexible and do not fit the users' requirements

In summary, it seems that especially methods in the fields of communication, organization and planning of processes, project planning (time, costs, milestones, etc.) and in the consideration of market/customers have much potential. Wishes and requirements for an improvement of methods include better support of interactive behaviour (like communication) and of planning and executing behaviour. Methods should help to ensure quality in development and documentation and they also need to be easy to use, flexible and adaptable to the needs of the user. The findings of our BEMAP study also show that companies use only a few methods and many of them are not implemented appropriately.

2.3 Requirements for successful transfer of methods

From the previous sections, it can be concluded that implementation of methods in companies plays an important role in setting the basis for the later successful usage of methods. Jansch (2007) analysed reasons for problems of method-acceptance and she claimed that methods don't transfer into industry properly because of reasons similar to those stated by Zanker, Grabowski or Reinicke. In her research, she analyzed the low acceptance of methods and described attributes of successful designers, such as experience, flexibility, power of imagination in three dimensions and heuristic competence. These characteristics should be encouraged and supported by appropriate methods implemented in companies.

According to Jansch the difficulties of transferring methods into companies result from three types of main problems:

1. representation and documentation problems

Most often methods are too scientific and thus not be understood by the users. Additionally they are presented in different stages of abstraction without standardized representation. Thus

possible users are overloaded with useless information and cannot apply methods because the documentation is either incomplete or not applicable.

2. *teaching problems*

Often methods are not taught properly; without a method-moderator, without sufficient theoretical input about the benefits and properties of methods and appropriate exercises, it cannot be expected that method competence will be gained in the intended manner. Knowledge about methods is not identical with method-competence, which includes selection, adaptation and application of methods.

3. *acceptance and usage problems*

Beside the teaching and representation problems, methods are not accepted and used properly by the users. This transfer problem is based on doubts and reservation toward methods. Also there is a large barrier towards implementation of methods, because this requires significant adaptation of the development process and team organization. Furthermore, the methods do not fit the experiences of the users and their benefit is not proven from the users' point of view.

Thus, Jänsch suggests the following measures for successful development, adaptation and transfer of methods:

- *create more operational procedures for application*: more focus on practicability, hints, tips and advice, description of benefit of usage, etc.
- *creation of user-specific methods*: consideration of knowledge/expertise, identification of user- and department-specific needs, etc.
- *company specific adaptation of methods*: usage of identical and homogenous terms and visualization, adaptation of abstraction degree, adaptation of methods according to product and industrial sector, etc.
- *education*: usage of existing concepts of education and continuing education in companies for method implementation.

3. A model for successful development, transfer and usage of methods in industry

Similar to Jänsch this paper identifies the transfer of methods not as a single operation or procedure to get through once, but as a complete set of actions, that has to be taken into account. There are different responsibilities within these steps to successful method transfer: some steps need to be taken by science, some taken by the companies/industry and some others by both.

A transfer model for successful improvement of implementation and usage in the daily job routine has been developed. It is based on four pillars:

- simplification of (application of) methods
- adaptation of methods
- promotion of methods
- development and implementation of appropriate training of design methods

3.1 Simplification of application of methods

Although science has gone through many developments and findings, most methods are still too theoretical for practical usage. While developing methods, researchers should focus on application thereof and on the existing requirements of methods, as described for instance by Birkhofer et al. (2005). There is a high demand for useful and applied design methods in general. Although methods exist that are useful, applicable and proved by their benefit, a lot of designers are reluctant to use these methods (see also section 3.3.). The findings of existing studies need to be considered by scientists and researchers, when designing new feasible methods.

3.2 Adaptation of methods

When methods are developed, they are designed according to scenarios to support designers in specific situations. For example, the 635-method (Brainwriting) requires six persons that create solutions in a minimum of 30 minutes in total. But in daily routine, the general conditions of these

scenarios often do not apply (e.g. less than six persons). Thus, methods have not only to be chosen, but also to be adapted. While adapting methods, tasks, general conditions, resources and situations have to be taken into account (see Braun & Lindemann, 2004). Therefore, the adaptation of methods reflects tasks, information, goals, and the given situation including a comparison of existing conditions with the method criteria (e.g. “How many team members do I need?” with “How many team members do I have?”). Then it must be decided whether or not a method is appropriate at all. Before this decision can be made, an analysis is necessary to be sure that the objectives of the method deployment can be reached by modifying the method (e.g. shorter time for development, less participants, uncertain information, etc). Method moderators should help companies to select methods that will suit their procedures and adapt methods specifically to their needs.

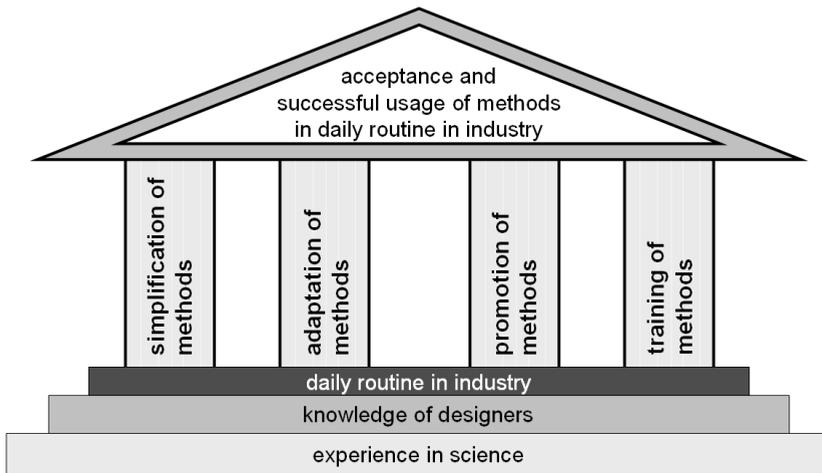


Figure 3. Method transfer model

3.3 Promotion of methods in companies

Implementation of methods in companies is a complicated and long lasting process and therefore must be supported by measures to guarantee sustainability. It is advised to promote methods using the concept of change management. Change management can help to implement methods step by step in companies and to establish a positive culture towards methods in parallel. Price and Chahal (2006) provide an overview of strategies and types of change management and give a framework for successful change management. This overview can be transferred to product design.

As the basic conditions for a change, the company must be prepared for the change (including transparent decisions, discussions to raise awareness and changing beliefs), and vision and implementation plans have to be developed. After that, it is important to check these plans and communicate with the designers affected by these changes, to empathize with them. If resistance against the implementation is reduced and acceptance is reached, the changes can be implemented (and evaluated after some time...).

Establishing a culture positive towards methods means promoting methods. A lot of possible users are resistant to methods. Birkhofer (2002) describes some of the reasons for designers’ resistance to methods. Often designers choose their first solution, although this one is not necessarily the best one. In the past successful solutions and products have been developed without the usage of methods, thus users don’t see the necessity of applying methods. Furthermore, methods are often poorly presented and have too much theoretical overload. This leads to prejudices against and dislike of methods.

Therefore, designers must be convinced (in the first phases), that they benefit from methods. Together with a sound change management in companies, the implementation of methods should be successful, when regarding the other aspects in the transfer model in Figure 3.

3.4 Specific training of methods

Especially experienced designers don't spontaneously start using methods. Methods have to be taught and practiced at appropriate events. Therefore it is important to combine different learning concepts such as lectures, workshops, seminars or simulations. It is best if this training takes place in a neutral environment, like an external venue where the participants can be absolved from all their other duties. Cross-checks, presentation of results, discussions and feedback need to be included in the training, so that trainings are fully interactive and contain all the elements of expert learning, such as self-assessment, strategic learning, etc. (see also Jänsch 2007). During the execution of the exercises, there can be changing parameters, to see whether teams adapt or continue on in formalism.

The BEMAP-Project is currently designing a training for developing and enhancing method competence, which includes all the proposed measures in combination with different presentation and teaching concepts supporting expert learning styles. The training includes theoretical input, practical workshops and exercises with following presentation, cross checks and feedback from the trainer. After the exercises are conducted, repeated and finished, reflection and feedback is given and the training is concluded. Throughout the exercises, the training parameters change to prevent routine answers; uncertain information and requirements have to be handled in order to make the participants continuously reflect, examine and cross-check their work and behaviour.

By designing and conducting training seminars with these flexible and alternating components, it is aimed that by using methods in special exercises and followed by recapitulation, analysis, assessment and the derivation of measures, method competence will be gained and transferred in daily work routines.

4. Conclusion

This paper reveals how methods are poorly used in daily job routine, and lists users' requirements for a better acceptance of methods. It is well known that methods have great potential to support designers in planning and executing the design process, taking customers requirements and wishes into account, designing high-quality solutions that cost less money, and further more. However, most methods are too complex and theoretically overloaded. Method inventors and researchers should consider also the application of methods whilst developing new methods. Methods need to be adapted slightly, depending on the specific situation. Designers in the daily job routine still have prejudices against methods and need to be convinced that product development can be better, quicker and/or easier using methods. One way to convince designers can be specific method trainings that teach the participants how to adapt and use methods properly, which means improved method competence.

This paper promotes the overall idea that successful method usage in the industry can only be achieved when the whole procedure is set on four pillars: developing simple methods, adaptation of methods for the use and needs in companies, promotion of methods among the future users and, last but not least, appropriate training in the use of methods. Therefore science and industry have to work together closely to ensure that all relevant aspects for improvement of acceptance and usage of methods in companies are taken into account. Having achieved this, methods are used by motivated and convinced designers who develop successful products as a result.

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