

Implementation of Methods in Architecture and Civil Engineering

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Abstract

Whilst many methods for product development exist and are applied successfully in different industrial sectors, e.g. in mechanical engineering, these methods are widely unused in civil engineering and construction. The application of several methods in the planning of buildings and building parts is generally possible and reasonable, e. g. in terms of quality management and design for sustainability. Problems occur in implementing these methods in the planning process, which is often, especially in small and medium sized projects, unorganised and characterised by "information cuts" between planning, realisation and utilisation.

Due to the predomination of small architecture firms and building companies, where modern forms of design (e.g. teamwork) are rarely exercised and research concentrates on solving immediate problems rather than creating general solutions for multiple projects, the implementation of methods turns out to be a difficult change project.

To address the above mentioned problems, a strategy for implementation is presented. Process optimisation and the integration of methods into the design process are crucial pre-requisites for the use of methods.

Keywords

Methods, implementation, planning process.

1. Introduction

In mechanical engineering several methods and methodologies for product development are applied successfully (Lindemann, 2005; Cross, 1994). The methodical penetration of product development is already seen as a pre-requisite in several industrial sectors (Grabowski, 1997, p. 18), like plant construction, automotive engineering, chemicals industry, Software/IT, etc. In civil engineering there is only little knowledge about the utilisation of methods, methods are used here only sporadically (Müller, 1997). This paper deals with problems occurring by implementing methods in the civil engineering design process and with possible solutions for these problems.

2. Proceeding

2.1 Case Studies

Several case studies and questionnaires are made with architect firms, building system developers, property developers, and producers of prefabricated buildings. All of these enterprises are small firms between 5 and 40 employees within the planning offices. To all of them the use of methods in the planning process was unknown. However, two participants, one working as a general manager in a building system development company and the other working as a chairman in a company for prefabricated buildings, both actively involved in the design process, had basic knowledge about methods, resulting from their university studies in business administration. But both did not use their knowledge about methods in practice, since the studies concentrated on theoretical knowledge on methods and not on method training.

2.2 Used Methods

In a building company, specialised on developing building systems for housing and office use, several different methods could be tested, like e.g. checklists, mindmapping, market portfolios, morphologic boxes, list of requirements. In a student project with 5 students, in which a façade element was developed, the methods brainstorming, method “6-3-5”, design catalogues, weighted point rating and benefit-value analysis were also used. In order to optimise building components ecologically, besides several other methods, visualised problem models were used (Erdell 2005).

2.3 Clarifying Boundary Conditions

There are some general boundary conditions, which have to be considered in the implementation process, like organisation structure, qualification of employees, computer environment and software, existing methods, tools and strategies etc (Stetter, 2000). In addition, there are some important differences between mechanical and civil engineering. Different enterprise sizes (dominantly small enterprises in civil engineering versus dominantly large-scale enterprises in mechanical engineering) have to be kept in mind, since the utilisation of methods increases with the enterprise size (Bonnaccorsi, Manfredi, 1999). Different legal boundary conditions in civil engineering have to be included, like the Official Scale of Fees for Services by Architects and Engineers (Locher et al., 2002) or the construction product directive in the EU. The poor education of civil engineers regarding project management and methods is important, too.

3. Experiences and Feedback

3.1 Lack of Knowledge about Methods

A crucial handicap of using methods in civil engineering is the lack of knowledge about methods in architect offices and planning departments. This problem had to be discussed with all of the project partners or interviewees. Before talking about methods, one has to explain what methods are (in short: a guidance for action in the design process) and how methods work (e.g. by abstraction, visualisation, documentation, quantification) and for which tasks they are used (besides many others e.g. for clarification of requirements, supporting creativity when searching for solutions, validation, improving communication). The main reason for this is insufficient job training. In most of the German courses of studies related to civil engineering, methods are not mentioned at all, and if they are mentioned, there is no method training. Therefore the majority of architects and civil engineers has never heard about methods and if they had, they could not appraise the benefit of using methods.

3.2 Doubts about Benefits using Methods

All partners of the research project and the different interviewees have doubts about the benefits of using methods concerning the effort to run methods. This aspect was most problematic in firms with managers with a craftsmen background, as in that case there was no knowledge about methods at all. The common

statement was that such theoretical approaches to the planning process like methods could not fit to the well-rehearsed planning procedure that was dealt with over many years. It was very difficult to make clear the advantages of using methods. The prejudices could often not be attacked sufficiently and method implementation was not accepted by several companies.

You can hardly prove the benefit of using methods, especially at the beginning of the research project as there was no example project. Examples from mechanical engineering are problematic, as the boundary conditions are seen to be very different in mechanical and civil engineering. Serial production versus unit production, in-house product development versus separated planning and field erection etc. were mentioned hereby. In fact, these prejudices are generally not true. However, in mechanical engineering many product development departments are structured differently as in civil engineering. The reason for this is mainly the different company size (see section 2.3)

3.3 Improvisational Planning Process

Escorting several stages of planning processes for smaller buildings, it turned out, that the planning process is not structured or documented, but problem-driven. Occurring problems are solved whenever they appeared, respectively when they were noticed, but there is no overall view on the planning process. This leads to several problems, e.g. concerning the interaction with sub-planners. Besides this, the planners often can not define the actual stage within the planning process at a certain point of time, since multiple planning tasks are dealt with at the same time. For example, the clearing of the basis of the project for a new building system of a kiosk was still in progress when a first prototype of it was already built. This means, that special methods for certain planning phases could not be implemented before having cleared actual planning status.

5. Results

5.1 Regarding the change project

Method implementation in civil engineering turns out to be a rather difficult change project. Information has to be provided about the later method user, about the mode of action of methods, about important boundary conditions (like team size, necessary tools, hard- and software etc.) and about using and adapting methods. Besides this, motivation is crucial. The possible benefits of using methods have to be pointed out very well. On the other hand, the effort to implement methods has to be clear, too, to make a decision whether to use a given method or not. A method trainer is very helpful in order to motivate the later user and to accompany the first method applications. When problems occur, he can help very easily. The first time use of methods only on the basis of literature is regarded as risky. The usually generally lacking knowledge about methods provokes mistakes, and the duration to implement these methods is also very high then to inexperience. Once disappointments in using methods have emerged, it is difficult to try to implement methods again.

5.2 Organising the planning process

The planning process has to be organised, even if only on a very abstract level. Usual process interpretations with hundreds of process modules (e.g. Scheifele, 1991) seem to be too complex and too time-consuming to adopt and use within small planning projects such as single-family houses, multi storey blocks or medium sized office blocks. The Munich Procedural Model (MPM) (Lindemann, 2005) is a very helpful and easy-to-use utility to structure the planning process especially for small planning projects or for special process sections within a greater planning process (see figure 1). Choosing methods for the named process tasks is then easier. A good approach for more complex planning projects is the project-guideline-table (table 1).

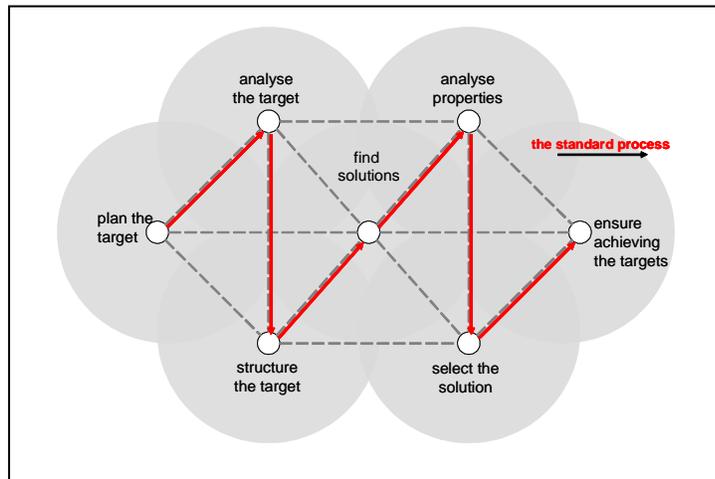


Figure 1: Munich Procedural Model (MPM)

Table 1: Project-guideline-table

Phase	Objective	Topic	Team	Methods
Project pre phase	- decision: project? - determined structure. - ...	realise project - analyse the target - ...	- builder - architect - financial adviser	- requirement lists - checklists - rating methods - ...
Review, documentation				
Determination of planning context	- project analysis. - analysis of boundary conditions. - clarification of goal conflicts (quality, costs, time)	target - room program - function schedule - location analysis	- architect - technical experts	- requirement lists - checklists

With this overview it is possible to create a project-oriented process table. The planner or project manager should fill out the cells of this table in order to provide a good identification and understanding of the process steps and the related auxiliary means. Doing this he has to concretise the target contents, the work packages, the persons in charge, applied software/tools and deadlines.

5.2 Choosing Methods

At the beginning, easy-to-use methods with a low effort to teach, like the Pareto-Analysis or simple Weighted Point Ratings, should be chosen first. Once the use of methods is more familiar and the first benefits of using methods are clear, more complex methods can be utilised, like e.g. Market Portfolios or Failure Mode and Effects Analysis (FMEA). A good idea is to make use of methods addressing a contemporary problem of the planner. The planner may thank it by a higher motivation using other methods, too. For this, an experienced method trainer is necessary to choose the right method for the given problem and situation. Long term method utilisation can only be achieved, if the affected persons are able to get

information about methods on their own. The interviewees stated, that they would use the internet to get this information. Therefore portals about methods like e.g. www.cidad.de (Ponn et. al., 2005) can be useful.

6. Conclusions

Primary problems when using methods in architecture and civil engineering are the lack of knowledge about methods, doubts about benefits using methods and a prevailing unorganised planning process. These problems can be addressed by good information and motivation of the later user, by easy initial projects and an organised planning process. This project was founded by the State of Bavaria and Bay FORREST.

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