



## MANAGEMENT SYSTEM OF BUILDING PRODUCTION PROCESS IN CENTRAL EUROPE

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**Abstract.** Management system and its components, the management system of quality inspection, management system of safety and health protection at work and management system of environmental protection are widely used within the building industry. Hence, processes like preparation, compliance and evaluation of the management system are clearly definable and they guarantee that the construction was built not only within the boundaries of the latest acts, decrees, and other important regulations, but also that the construction was constructed inside the framework of pre-defined elements of the management system. In terms of the actual building production process it is possible to define the parts of the management system with regards to its individual phases. These phases include the management system of investment preparation as part of the investment decision-making process, the management system of the pre- and in-design phase, management system of contractor selection, management system of building production process, management system for commissioning of the construction and the management system of utilization (including in- and post- term warranties and customer care).

In engineering practice, first of all a great emphasis is put onto the management systems of building production, which is often prepared improperly and insufficiently or is just partially neglected by the contractor. Basically, failures within the implementation of the elements of the management system do often lead to a breach of contracted terms, degradation of quality of building realisation and may ultimately lead to the rescission of contract between the client and the contractor.

**Keywords:** management, building production process, building production, degradation, quality, realisation.

**JEL classification:** A10, F00, L00, Q58.

### 1. Introduction

Guiding processes of the management system are often encountered within the branches of the building industry, since they are widely used in every days engineering practice. The usage of such a management system follows and refines the generally applicable rules of management systems valid inside certain fields, practically even within some of the branches of national economy (Ramachandran, Janakiraman 2009, Rastogi 2009; Maness, Zietlow 1993; Helmi 1998).

One of the areas in which a management system can be fully utilized is the area of sustainable development (Michalski 2008; Valach 1997).

The field of sustainable development, especially its branches focused on development of new technologies, correct utilisation and proper functioning, compliance with user guides and last but not least the overall efficiency of management system are an essential part of the management system, which by itself ultimately guarantees the pre-defined requirements of various building production processes, i.e. construction works. Nevertheless, the overall efficiency of the management system includes and requires some resources, for example: compliance with contractual terms, thrift of construction process, correct and a well-timed usage of pre-defined and planned available resources, etc.

Therefore a management system might be characterized by a set of partial control processes. These partial control processes are defined by their respective aims as much as by the primary objective of the management system. By fulfilling the objectives of partial control processes of the management system some findings may arise – findings that are crucial for the evaluation of previously finished and the ongoing control process, as much as they are important for the subsequent partial control processes of the overall management system.

One of the targets of the management system is related to the investment decision making process, which determines the share of each partial control processes within the defined management system. It can be stated that up till now there were no methodologies, theoretical approaches of case studies published by the utilisation of which it would be possible to point out the nature and character of the management system. There are no hints, recommendations, instructions or tools available for this particular field of the building industry – i.e. at the stage of investment decision making. It is therefore crucial to address the elements of the management system adequately throughout the stage of investment decision making process.

The prime target of the management system from the perspective of investment decision making process can be defined on the basis of shared characteristics (the share of each process inside the management system) of individual elements (control processes).

Within the management system it is necessary to take into account the partial results of control processes that have been obtained throughout the solution of individual control processes of the overall management system.

Thus it is required to take a detailed view at the output of the following management systems: management system of investment preparation as part of the investment decision making process, management system of pre- and in-design phase, management system of contractor selection, management system of building production process, management system for commissioning of the construction and lastly to take into account also the results of the management system of construction utilisation (including the in- and post term warranty and customer care) (Pickering 1998; Day, Crask 2000; Peppers, Rogers 2004; Smith, Colgate 2007).

## 2. Management system

The individual phases of the building production process may be defined as guiding processes (as well as partial guiding processes) of the overall management system (Salek 2007). The set of these processes do incorporate the following management systems: management system of investment preparation as part of the investment decision making process (Zeithaml 1988; Bejou 2006), (Ryals 2008), management system of the pre- and in-design phase, management system of contractor selection (Brealey, Myers 1996), management system of building production process, management system for commissioning of the construction and the management system of construction utilization (including the in- and post-term warranty and customer care).

### Statistics and the management system

Selected characteristics as part of mathematical statistics (Hwang, Yoon 1981; Ginevicius, Podvezko 2006; Zavadskas *et al.* 2009) was used to create the management systems of the presented, already or partially realized buildings. For this particular case the selected characteristics is represented by the so called selective average (eq. 1).

$$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i, \quad (1)$$

where:

$X$  – random selection of range  $n$  corresponding to the statistical character  $X$ .

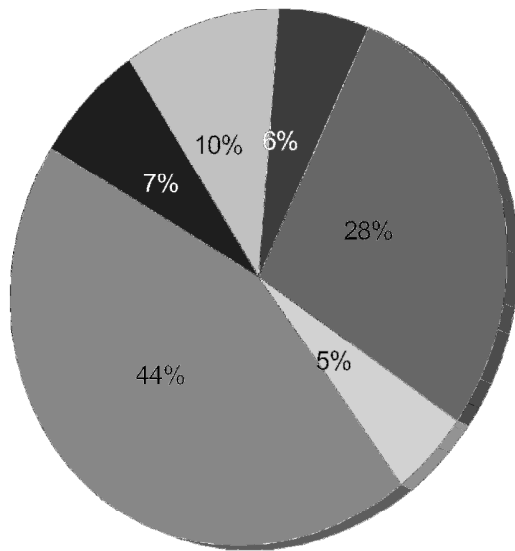
### Shared characteristics of management system

The complete management system (system of guiding processes of management system) can be defined by shared characteristics, more precisely by the shares (Ginevičius 2008; Behzadian *et al.* 2010) of the sub-processes themselves.

Figure 1 represents the shares of control processes (shares of partial control processes of the management systems) from the overall management system, including their value in percentage.

### Management system of building production process

In everyday building practice a special attention is to be paid on the management system of building production process.



- Management system of investment preparation as part of investment decision making process: 6%
- Management system of the pre- and in-design phase: 28%
- Management system of contractor selection: 5%
- Management system of building production process: 44%
- Management system for commissioning of the construction: 7%
- Management system of utilization (including warranty and customer care): 10%

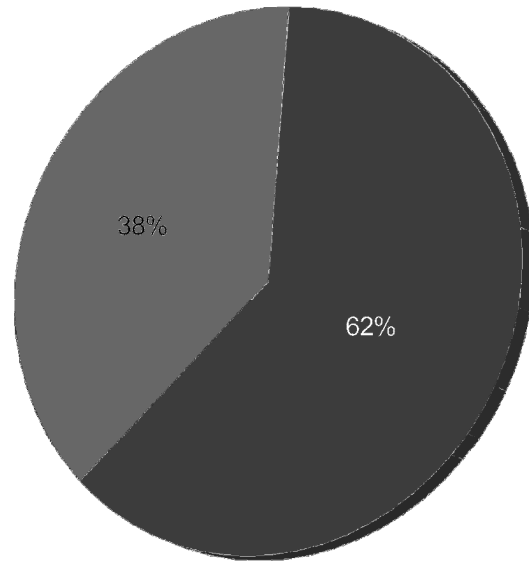
**Fig. 1.** The shares of guiding processes within the management system (prepared by authors)

This partial production process (management system of building production process) has several tasks, while one of its main objectives is to observe the results of individual stages of the management system, particularly the results of the management system of pre- and in-design phase, although it is not limited by it.

An integral part of the partial production process is also to take into consideration the currently identified requirements (including the concurrent requirements caused by an absentee or by additional amendment) which are contingent upon the feasibility of implementation of this production process. Mostly it handles about those requirements, which were incorrectly or insufficiently implemented into the earlier stages of the management system (pre- and in-design phase) because of an insufficient quality of production or just by time shortage. The missing requirements (results and conclusions) within the previous stages do often adversely affect the process of implementation of management system within the construction output, since it is also one of the direct

input factors of the management system of building production process (regardless, whether it handles about contracted deadlines/milestones, or just the end of contractual terms of the work) (Lapierre 2000; Lošťáková 2008).

Figure 2 represents the portions of adverse and other input factors which affect the stages of implementation of the management system of building production process. The shares of these input factors are represented in units of percentages with respect to the management system of building production process.



- Disadvantageous input factors of the building production management system: 62%
- Other input factor influencing the building production management system: 38%

**Fig. 2.** Shares of defined input factors within the management system of building production process (prepared by authors)

### 2.1. Adverse input factors of the building production process management system

The building production process management system, as described earlier, might have some input factors which may negatively affect the whole process of management system. These factors can be grouped, especially from the perspective of the observer, who may be either the investor or the contractor. Although, it might be a third person, too.

Within the frameworks of the pre- and in-design phase of management system from the viewpoint of the investor these adverse factors are the following:

- the absence of direct decision making factor (unmet financial criterion only);

- inadequate funding of surveys throughout the pre-design and in-design phases by the customer;
- missing or incomplete surveys in the branches of:
  - archaeology connected to the plot (whether there have been any settlements or not, earlier);
  - architecture (Brans, Mareschal 2005), while the main focus of the survey is put onto the historical aspect of the discussed or surrounding buildings;
  - building technologies including the location of state of engineering networks and constructions allowing traffic;
  - in the field of geological/hydro-geological surveys.
- absence of studies proving the feasibility of construction works;
- failure in compliance of generally applicable procedures and principles;
- bad choice of structural solution caused by the incomplete or unprofessionally provided surveys (Zavadskas, Kaklauskas, Turskis, Tamošaitiene 2008), (Podvezko, Podviezko 2009);
- unsuitable choice of technological processes or assembly procedures of selected construction works;
- lacking time flexibility of the client when it comes to some changes which are to be approved;
- the absence of studies connected to construction realisation technologies (or missing description of construction erection technology) which would define the basic time schedule and progress of implementation of building realisation, whereas the customer estimates and sets the deadlines for the completion of construction works on his own, possibly under the pressure of conditions defined within grants (while the funds may come from regional operating programs, from the ministry, etc. ), without the utilization of a proper time schedule or another type of calculation defining the reasoning behind the deadline for the completion of construction realisation (Pecinová, Vávra 2008).

Another of the viewpoints which might be essential for the investor is the choice of contractor. The adverse input factors which can be connected to this phase are the following:

- the tender documents related to the construction, therefore even to the building re-

alisation does not take into consideration the requirements given by the project documentation prepared earlier, which forms a major portion of the tender and is also one of the foundations of the contract between the client and the contractor;

- tender (or at least its interpretation) does often include such conditions, which were not originally defined within the tender documentation. Sometimes the legal requirements of the tender do use a different terminology in comparison to that commonly used by the latest valid Building Code.
- tender documents related to the constructions and therefore even to construction works define some requirements that are not a subject of the contract (not a subject of the contracted work), or the tender documentation of the client specifies some requirements other than those listed in the contract of work;
- throughout the competition and thus also within the realisation process of a building, the client often makes some notes, which make the previously obvious facts unclear;
- customer does not always have adequately experienced or qualified personnel, whose task would be to carry out a proper assessment and a proper evaluation of the contractor selection by the end of the competition.

And lastly the negative effects influencing the pre- and in- realisation phase are discussed. Among these the worst negative factors are:

- incomprehensibility of actual contractual documents;
- missing methodical planning and building realisation management, such as an inadequately prepared technological project of the contractor concerning the implementation of construction erection technologies throughout the construction process (i.e. plan and deployment of resources over time and last but not least also concerning the inappropriately chosen deadlines for the completion of construction works).
- insufficient resources;
- insufficient manufacturing capacity (for example technical background, construction site facilities, etc.);
- lack of qualified personnel, human potential;
- insufficient machinery and technical equipment.
- inadequately and often inaccurately made documentations of sub-projects by the contractor (and sub-contractors), etc.

- errors within the time flexibility of contractor regarding some changes and corresponding procedures;
- lack of coordination with sub-contractors;
- lack in daily control and in the verification of provided construction works within the pre- and in-realisation stages.

## 2.2. Other input factors of the building production process management system

The other inputs of the building production management system should not be neglected since these are crucial, too. Alongside that, these do make up a substantial part of building realisation phase. These are the following:

- availability and location of the construction site (whether it is close to a road or railway, or not);
- willingness and readiness of the client to maximize the possibility of cooperation between him and the contractor;
- willingness, readiness and performance of the drafts men, i.e. the author of the tender documentation, to maximize the cooperation between him and the contractor;
- willingness, readiness and performance of the representative of the client to maximize the possibilities of synergy between him in person and the contractor;
- the effects of traffic engineering decision and traffic measures;
- influence of material and time schedule onto the induced and related investments;
- readiness of the contractor to fulfil the agreed terms with respect to:
  - readiness in personell/i.e. human resources;
  - state of concurrently realised constructions by the contractor (hints out whether the contractor is going to have time to do the contracted works).
- the ability of sub-contractors to fulfil the contracted terms with respect to:
  - inadequate personnel;
  - improperly met contractual terms because of lack in readiness;
  - lack of co-ordination between various sub-contractors.
- unsatisfying co-ordination of construction and assembly process of building realisation.

## 2.3. Scheduling of building production process management system

Scheduling of construction works, and therefore even the management system of building produc-

tion is a required and indispensable element of the overall management system. It guarantees the previously defined and contracted time limits, whereas it creates a harmony between given contractual dates. Dates given for the beginning of construction works and that of contracted milestones. Nonetheless it may even include the deadline of construction works, i.e. the end of the building production process. The process of time planning of the building production management system is based on a proper and detailed analysis of required works prepared within the framework of technological design of structures. A showcase of a time schedule is shown of Figure 3.

## Plan and schedule of construction works

Since the processes (including the analysed ones too) of time planning and scheduling of building production management system are from time to time created only superficially, or are only applied at an insufficient rate, it is possible to introduce some of the negative attributes connected to time planning of the management system of building production.

## Fundamental negative attributes of time planning of building production management system

The most trivial negative attributes of are:

- insufficiently prepared technical documentation which is inevitable for the proper realisation of a construction work (for example an incomplete project documentation, missing contractual amendments and other papers, improper organizational charts of all parties, including their rights and obligations, that may influence the system of building realisation process as much directly as indirectly, etc.);
- inadequately elaborated analysis of provided constructions throughout the construction - missing assessments and evaluations of consequences and risks, which might arise from the contractual relationship such as: sanctions and penalties, warranty and customer care, etc.
- missing organisational chart for the deployment of available resources with respect to:
  - human resources and potential;
  - machinery, mechanization and technical equipment.
- absence of technological analysis;

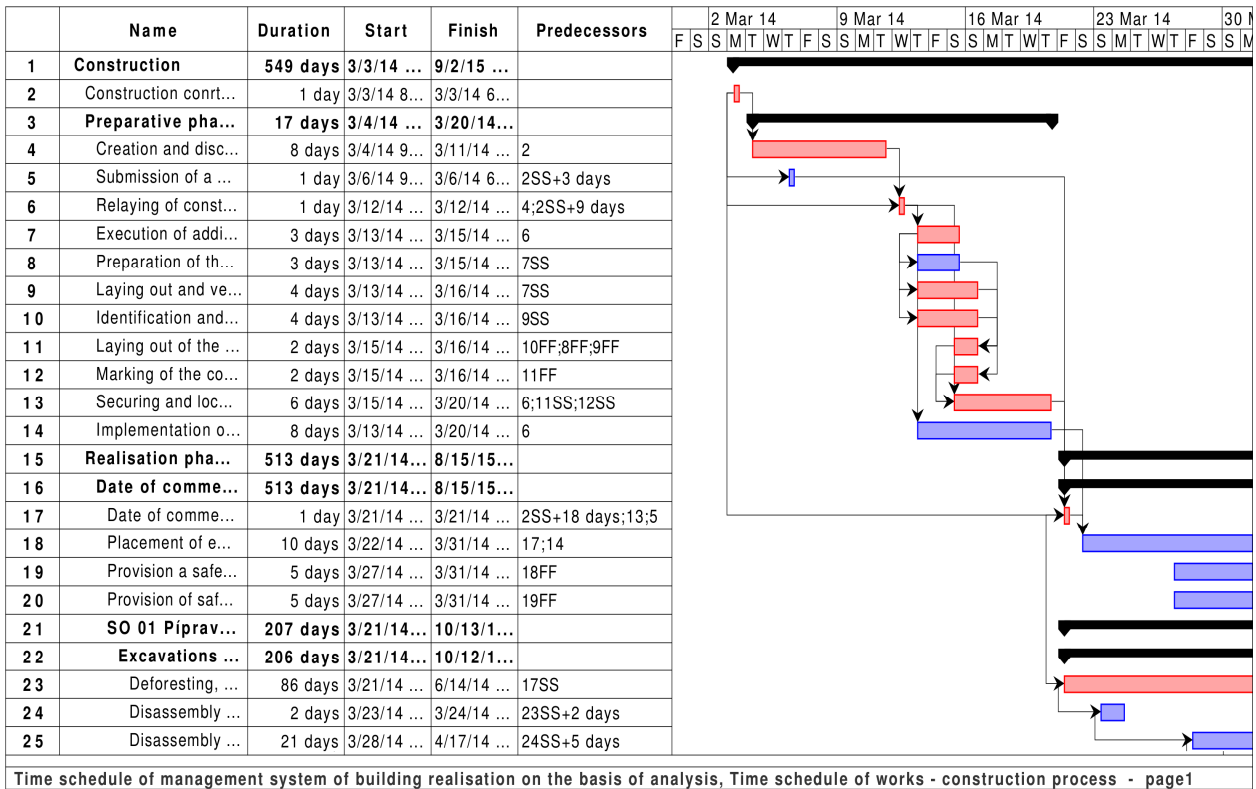


Fig. 3. Schedule of a standard Central European building production process (Source prepared by authors)

- absence of working width/depth analysis of available technologies, including the lack of analysis with respect to minimal, average and maximal working width of technology;
- missing performance standards for working units (crews);
- missing determination of productivities of working units (crews);
- missing determination of production performances of working units (crews);
- missing composition of working teams;
- absence of schedules;
- absence of detailed short- and long-term operational plans;
- absence of proper overall operational plans of labour, materials and supplies defined for each technological activity;
- absence of proper overall operational plans of labour, materials and supplies provided by foreign agents and done within the framework of foreign cooperation within the context of individual technological activities;
- absence of determination of necessary wages (including the statutory charges and payments);
- missing assessment of costs related to production (cost of construction site preparation including the assumed energy consumption, etc.);

- missing financial analysis of costs and expenses, including the lack of analysis of costs expenses of the total contractual relationship (Droms 2003).

### 3. Conclusions

The overall management system can be characterized as a system made up from partial control processes, while allowing each of these control processes to have its own individual objective. Therefore, it is evident that these partial control processes because of the shared characteristics do directly affect the resulting management system. While taking the previous statements into consideration, it is apparent that one of the most important partial control processes is the management system of building production.

The management system of building production is an important process which controls, coordinates and evaluates the sub-processes ongoing throughout the realisation of construction works. These sub-processes do also offer an overview about the state of completed or still ongoing activities required by the realisation process. Thus a proper development and application of the management system of building production process is quite essential and it should be done in a way that it might demonstrate the effectiveness and efficiency in the first place. Nevertheless the output of the management system of building production



process should not be focused on its sub-processes only. It should also show the efficiencies and effectiveness of other phases of the management system, for example the management system of investment preparation as part of the investment decision making process, management system of pre- and in-design phase, management system of contractor selection, management system of building production process, management system for commissioning of the construction and the management system of construction utilisation (including in- and post-term warranty and customer care).

Therefore the management system is an integral part of the investment decision making process. Such a management system (based on the characteristics of the individual management processes) can be applied onto a huge variety of constructions, even onto buildings that might different society-wide importance.

At the moment the investment decision making process of construction works does require a comprehensive set of information that adequately represents and takes into consideration all of the factors which might influence the investment decision making process, may those factors be advantageous or disadvantageous.

It can be stated that the presented paper draws its content from engineering practice. Especially from experience gained by the management of the building production process, hence the significance of this phase is directly reflected on the effectiveness and efficiency of the implementation of construction works.

The data included in the paper comes from already erected and still ongoing construction works that have been and are still carried out using the management system of building production process.

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