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ScienceDirect

Procedia Engineering 208 (2017) 114–124

Procedia Engineering

www.elsevier.com/locate/procedia

2nd International Joint Conference on Innovative Solutions in Construction Engineering and Management: 16th Lithuanian-German-Polish colloquium and 6th meeting of EURO working group Operational Research in Sustainable Development and Civil Engineering 24 May- 2nd International Workshop on flexibility in sustainable construction, ORSDCE 2017, 24-26 April 2017, Poznan-Puszczykowo, Poland

FLEXIBLE APPROACH FOR CONSTRUCTION PROCESS MANAGEMENT UNDER RISK AND UNCERTAINTY

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Abstract

This article presents the basic conditions for the application of a flexible approach to the management of construction processes, resulting primarily from high levels of risk and uncertainty. On the one hand, for simple projects whose implementation is not exposed to dynamically changing environments, the use of flexibility is not justified; on the other hand, in the case of complex, innovative projects implemented in a turbulently variable environment, flexibility gives the opportunity to continue processes despite difficulties. Flexibility can be successfully applied at different levels of management and at different phases of the life cycle of a building. Different flexibility options have been presented based on the approach to real options. A procedure for implementing flexibility in building management was proposed. The flexible approach is illustrated by examples of its use.

Peer-review under responsibility of the scientific committee of ORSDCE 2017.

Keywords: flexibility, options, flexibility enablers, risk, uncertainty

1. Introduction

By analyzing typical problems in construction as an industry with a high degree of complexity, volatility and uncertainty, it is important to emphasize its differentiation as an industry. The characteristic features of the building

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1877-7058
Peer-review under responsibility of the scientific committee of ORSDCE 2017.
10.1016/j.proeng.2017.11.028

are:

- Long life cycle of buildings
- Long-term construction period
- Seasonality of production
- Complex and long quality chains
- Still a significant share of craft production resulting from a very limited scale of automation and robotics in construction industry
- Dependence on the changing environment both at the operational level (e.g. weather), tactical (ensuring the viability of the project with continuous changes in market conditions - often turbulent, e.g. Luxleaks 2014) and strategic (ensuring profitability of conducted business activity in a given specialization).

Severe problems in the construction industry are: exceeding the budget, failure to meet assumed deadlines or failing to meet quality requirements. Comparison of the productivity of manufacturing processes in construction and other industries shows a grossly low efficiency of construction processes [1]. Failure to meet quality requirements in the construction industry can result in an increase in cost in the range of 300-400% compared to the correct execution at the first time. Examples of airports in Modlin or Berlin (Brandenburg Airport) point to the importance of these issues. In the case of investment of this rank should be considered not only the problems of the contractor and the investor, but also the social costs of not finishing in time [2]. Analysis of this type of case indicates the necessity to revise existing planning practices [3], for example by using a flexible approach to ensure the expected effects despite numerous changes.

The aim of this paper is to indicate the possibility of improving management in the construction industry by introducing flexibility. Examples of applying a flexible approach in different decision situations are presented, taking into account the different management levels and the different phases of the building life cycle.

Following is the introduction of the justification for the use of the flexible approach, which also describes the genesis of this approach in building management. Next, basic flexibility options have been characterized, which allows different applications of flexibility in the construction industry. New options for improving construction management are also emerging, based on new initiatives such as Industry 4.0, Project Management 2.0, Made in China 2025 and BIM. Following are examples of the application of flexibility. The article ended with the conclusion.

2. Justification of flexible approach in Construction Management

Typical activities in planning and implementing construction processes involve the adoption of a deterministic approach (which in simple projects is justified). Often, the lack of involvement in risk analysis and uncertainty can be explained by too many sources and difficulties to estimate their impact. This is combined with difficult-to-predict factors (from weather factors or groundwater levels to material prices at operational level in the implementation phase).

In order to avoid these unfavorable phenomena, it is necessary first of all to look for proper methods of managing production processes in the construction industry. Analyzing these methods (FIG. 1) can be concluded that predominates the traditional approach, which is largely based on the principle operation of the static environment. Typical methods are planning schedules (introduced more than 100 years ago) and network models (the first use of more than 50 years ago). Of course, they are systematically upgraded (e.g. PERT21 [4]), but still require realistic data on duration, cost and performance, which is problematic [5]. Naturally, numerous initiatives are being undertaken to improve the management of construction processes such as RFID dynamic planning [6], 3D printing [8], expert systems [9], fuzzy logic [10], risk management [11, 12], multicriterial analysis [13, 14]. A typical design approach, however, is based on one-step investment and, in one implementation procedure, usually adopts the most favorable implementation scenario. A serious problem is often to rely on the planning and design of production processes on a single value (often the average), whereas in a turbulently variable environment one should take into account a relatively wide range of variability. It is common to strive for maximum savings, which hampers optional planning. A serious problem is the risk and uncertainty that exists at all levels of management in the construction industry. It is difficult in these circumstances to plan. The key elements of risk [15] in the immediate future at global level are: water crises, failure of climate-change mitigation and adaptation, extreme weather events.