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Hierarchical model of factors of ecological maturity of construction enterprises

Key words: ecological maturity, risk management, construction

Introduction

A construction industry has highly advanced relationships with environmental problems. Building construction is followed by a direct interference with the environment. The interaction between buildings or non-building structures, and the eco-system continues throughout their life cycle. The lives are influenced by decisions in the early phase of construction projects: programming of investments, and planning the course of execution of construction projects – in the construction phase – as well as during the maintenance processes. Environmental awareness of entities involved in tasks in particular phases of the construction projects determines their correct coexistence with the eco-system (Górecki, 2018).

Ecological maturity of the enterprise can be defined as an ability of professional management with regard to ecological factors.

Therefore, a dissemination of the idea of Ecology Maturity in Construction Enterprises (EMCE) among building contractors is becoming more and more important. Continuous improvement of the functioning of construction companies should take into account the concept of EMCE as a determinant of their development. A high level of EMCE means achieving business goals, along with meeting environmental and social expectations. It favours achieving investors' satisfaction, which builds a positive image of the contractors. In a construction company, EMCE means that business and technological-organisational problems are treated equally both at the bottom level of particular posts (workplaces), processes as well as the entire organisation. It is an important success factor of a construction

company involved in shaping the natural environment.

In creating the concept of EMCE, the problems of shaping the maturity of companies in various dimensions of their functioning must be taken into account.

It can be noted that there were attempts to focus on construction project management maturity (Górecki, 2015) or process maturity (Brajer-Marczak, 2015). These two types of company's maturity are inter complementary, and are interdependent. However, there are a few basic differences between the process and project approach, referring to the nature of processes (e.g. repeating, routine) and projects (e.g. uniqueness, lack of routine) (Cieśliński, Chomiak-Orsa, & Mierzyński, 2014).

A significant success factor of construction projects is the ecological maturity of construction enterprises.

An increase in the level of ecological maturity, through the development of rational thinking, and good practices in the field of environmental performance in an enterprise, means a greater efficiency of the business.

A maturity of construction companies, in the area of environmental performance, described as EMCE, manifests itself in understanding the close interdependence of company's success and respect for the environment owing to the application of ecological knowledge in the company. At the same time, the idea of EMCE in the organisation has to be implemented at both a strategic and an operational level, also in relation to individual, executed construction objects. Such approach stimulates success factors of the business.

Theoretical framework

This part describes a theoretical context of the research on EMCE. The literature review enabled for a better explanation of EMCE idea, and its connections with construction management processes.

Ecology Maturity Construction Enterprise in construction sector

In enterprises, current market trends are introduced to the management philosophy. It is treated as a recipe for success. As an example, it can be given a challenge for environmentally friendly behaviour resulting from the growing environmental awareness of societies around the world. Researchers investigating in the field of ecological problems led to the formulation of the Ecodesign Maturity Model (EcoM2) (Pigosso, McAloone & Rozenfeld, 2013; Pigosso, Rodrigues & McAloone, 2017).

The development of EMCE, on the other hand, consists in implementing environmental protection strategies based on continuous, integrated preventive measures in relation to processes, goods and services, aimed at increasing productivity and service efficiency, as well as reducing risk for people and the natural environment (Górecki, Swoiński & Bizon-Górecka, 2018). In a construction company, the production process is combined with the concept of reducing the use of resources and the impact of the product on the environment. This applies to all stages of the life cycle of construction projects (Czaplicka-Kolarz, Kruczek & Burchart-Korol, 2013).

Ecological maturity of the company in a strategic and operational perspective

Strategic goals of the organisation, with a long time horizon (including mission statements), determine the set of criteria in making decisions about the development. The implementation of projects requires an adoption of implementation strategies in the design of production system structures based on specific criteria. The set of tasks set up by the decision-makers is a range of strategies, whereas at the operational level, it is decided on how to accomplish these tasks. Operational level problems can contribute to the verification of the strategy. Hence, there is a consistency of actions at the strategic and operational level.

Strategic management in the enterprise refers mainly to building the potential that allows achieving the assumed goals, consistent with the adopted vision and the mission statement of the organisation. The strategic level is a platform for generating internal projects, with objectives leading to the company's goals. Ecological management at the strategic level promotes the creation of an innovative organisational culture. Strategic projects mostly lead to restructuring towards a resource-strategic orientation. They adapt the organisation to undertaking ecological construction projects.

Management at the operational level, on the other hand, requires firstly to establish a relationship between the company's goals and the objectives of the executed projects, which provide mutual benefits. At the operational level, project management should be seen mainly as ecological management. This applies both to the way of involvement and the portfolio of projects, and in particular the distribution of the company's activity in construction projects on the timeline. A selection of the project portfolio, with taking into account the schedules of individual projects, should take into account the use of environmentally friendly resources. Among others there is a low energy equipment, the use of which in individual projects depends on the project portfolio schedule.

Ecological risk manager

Turbulent economic environment and specific demands of business within which the organisation works prompt the necessity to flexibly manage changes across the enterprise (Bizon-Górecka & Górecki, 2017). Risks in the organisation must be treated in a total way – they must refer to all the activities in the enterprise: both at the operational and strategic level. On account of the multi-faceted and multi-level interference of risks, their management should be dynamic.

The risk of management in the organisation can also be considered individually, with reference to particular subsystems. For example, in ecology management, it is ecology that is the subject of considerations of risk. The level of not fulfilling ecology requirements can be a measure of risk in this area.

In risk management, a risk manager is the one who supports the subjects of management in the organisation through the information and communication system – managers managing specific subsystems, and who, in the situation of complex business interrelations (Fig. 1), take the risk of management (Haber, 1998).

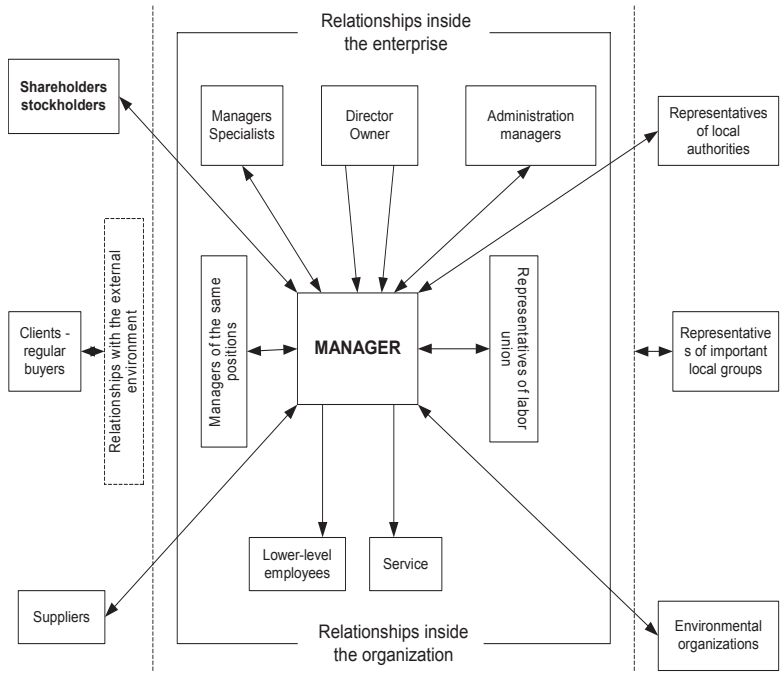

FIGURE 1. Business interrelations resulting from the perspective of the manager (Haber, 1998)

Methodology

Based on the literature, a list of criteria for EMCE was specified as:

- emphasizing the importance of ecology in construction processes,
- treating construction as a factor in shaping ecosystems,
- environmentally friendly management of building production resources,
- formation of human resources sensitive to the environment,
- understanding the idea of circular economy,
- selection of environmentally friendly partners of the business,
- using eco-friendly business artefacts,
- raising the confidence of construction project stakeholders.

All above eight criteria (X_i) were analysed through an expert assessment conducted on-line.

The research was conducted from December 2018 to January 2019. Thirty random respondents assessed an importance of each factor, expressing the opinion numerically in a five-point scale based on Likert's approach to scaling responses in survey research: 1 – strongly not important; 2 – almost not important; 3 – medium importance; 4 – important; 5 – very important. The collected dataset underwent a prioritising process based on calculated weighted averages.

Results

An online survey included two basic parts. The first one contained two questions about the respondent's role played in the professional life, and her/his experience. The largest number of respondents (43.33%) were project managers. Followed by site managers (senior), qualified civil engineers (33.33%), and contract managers (junior), civil engineers (23.33%), as shown in Figure 2. A structure of the respondents, regarding their experience and seniority in the profession, is presented in Figure 3.

Analysing a professional practice of respondents, the largest was a group with over 15 years of experience (33.33%), next group was less than 5 years (30.00%), from 10 to 15 years (23.33%), and the smallest group was

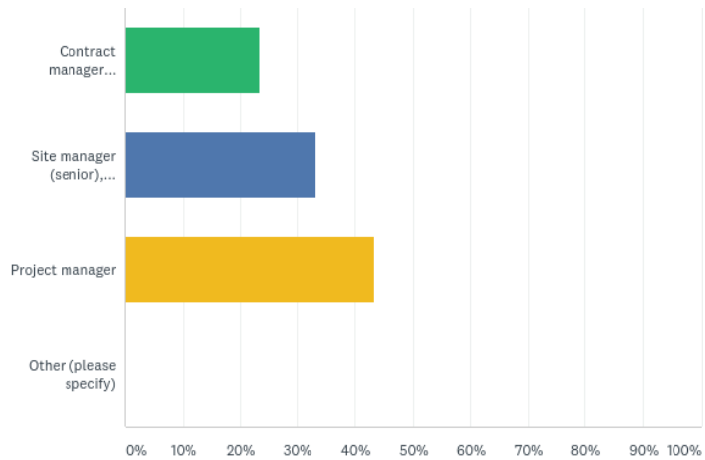

FIGURE 2. Leading roles of the sample (own elaboration)

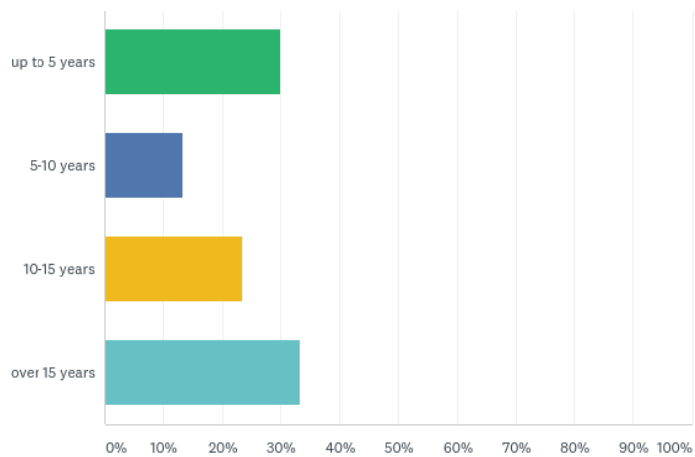

FIGURE 3. Declared experience of the sample (own elaboration)

from five to 10 years (13.33%) of professional experience.

In the second part of the survey, there were proposed eight factors that are important during the process of building the EMCE. The table presents the most important findings of the conducted research – prioritised list of factors of the EMCE.

The empirical research has revealed that building entrepreneurs notice a need for strengthening EMCE. The results allow to articulate ecological factors of the maturity of construction companies.

The proposed eight factors (X_i) may occur useful for the process of building EMCE. Among the highest rated factors, there are:

TABLE. List of prioritised factors for EMCE according to the survey (own elaboration)

Factor	Name of factor	Weighted average	Min	Max	Rank	Reliability
X_1	Emphasizing the importance of ecology in construction processes	3.63	1	5	1	65.33
X_2	Treating construction as a factor in shaping ecosystems	3.57	2	5	3	63.67
X_3	Environmentally friendly management of building production resources	3.63	2	5	1	65.33
X_4	Formation of human resources sensitive to the environment	3.60	1	5	2	61.00
X_5	Understanding the idea of circular economy	2.73	1	5	7	54.00
X_6	Selection of environmentally friendly partners of the business	3.17	1	5	5	53.33
X_7	Using eco-friendly business artefacts	2.80	1	5	6	53.00
X_8	Raising the confidence of construction project stakeholders	3.33	1	5	4	61.67

Discussion, conclusions and future research

Executing projects in construction companies is associated with deep and long-lasting interference in the environment. The activity often impacts the environment, both in the construction phase, as well as during the maintenance and decommissioning. This is due to the features of construction products (building or non-building structures).

- emphasizing the importance of ecology in construction processes,
- environmentally friendly management of building production resources,
- formation of human resources sensitive to the environment.

Ecological maturity of a construction company can be considered as a determinant of the success of construction projects. It can be a significant competitive advantage on demanding construction

market. It can decide about the success of construction investment projects.

It is worth to add that achieving the maturity is a long-lasting process that brings benefits in the long-term perspective.

Consideration of an environmentally friendly behaviour of companies is a starting point not only for researchers of ecological maturity in construction enterprises and the implementation of eco-friendly ideas into projects, but also for professionals and public administration. Articulated ecological maturity factors can be used to measure a degree of advancement, in construction companies, environmental principles of executed projects throughout their life cycle.

An assessment of the impact of ecological maturity in construction enterprises on the ecological quality of executed projects will be the subject of next studies.

Summary

Hierarchical model of factors of ecological maturity of construction enterprises. A construction project shapes the natural environment of human beings throughout its life cycle. Therefore, problems related to the ecological quality of the applied solutions require special interest. A method of solving these problems can be directly related to stakeholders involved in the projects. The role of a construction company in the context of decision making problems, and in particular its ecological responsibility, has become one of the fundamental elements of the genesis of this research. Linking ecological maturity of the stakeholders participating in the implementation of construction projects, and taking into account the environment friendly approach, related to the scarce resource management and the possibility of reducing their environmental impact, became the main goal of the article. The detailed objectives of the conducted research can be connected with promoting eco-friendly strategies among construction companies and increasing the awareness of construction entrepreneurs about the current EU requirements regarding the environmental issues of business. There is also a need for building ecological maturity of construction companies. Research conducted among the management staff of construction companies allowed to specify some factors of the ecological maturity in construction enterprise (EMCE) and their priorities.

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