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Structural Engineering Managers – Innovation Challenges for their Skills

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Abstract. The profession of a structural engineer is highly responsible, because the consequences of a structural engineer's errors result not only in economic damage to the property and often irreversible damage to the environment, they can also lead to direct loss of lives. In the current turbulent, dynamically developing society the managerial methods of structural engineers should not stagnate at the level of the last century applications.

This paper deals with the challenges which the ongoing century poses to structural engineers and managers. It compares the results of research regarding the current state of managerial skills of structural engineers in Czech building companies to the defined skills of the 21st century's managers according to the global research programme ITL Research and according to the Vision for the Future of Structural Engineering, drawn up by Structural Engineering Institute – SEI ASCE.

1. Introduction

High responsibility borne by structural engineers results mainly from the far reaching and often even irreversible consequences of their errors, which may result in the loss to the environment, lives and health of people and their property. Professional building-technical skills are the natural requirement for managers in building companies and at construction sites. At present, they also include relevant language skills and good ability to manage information technologies. This knowledge, which managers acquire by education and practice, is examined by the Czech Chamber of Certified Engineers and Technicians Active in Construction at authorization testing and by the International Project Management Association (IPMA) in the case of project managers.

However, structural engineering managers must also have specific managerial qualities and skills, which enable them to cooperate in sequential teams, often at the international level. According to the

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surveys carried out, these so-called soft skills are underestimated in the Czech Republic. Only building practice proves the ability or inability of a particular person to cope with these qualities and skills.

The survey shows that training in managerial skills in the companies are either totally missing or non-systematic, which is particularly characteristic of small and medium-sized companies. Issues required by legal regulations (occupational health and safety protection) and technical standards (ČSN – Czech National Standards) remain the focus of education and training of structural engineers and other professionals in the industry.

Similar problems are probably faced by structural engineers in other countries and also by engineers and managers in other professions (see new programmes [1] and professional materials [2]).

2. Methodology

The **aim of the current research** is to determine the current state of management skills in construction companies in the Czech Republic. In this article, surveys drawn up since 2010 to date have been used to find out the current state of their managerial skills. The target groups of these surveys include managers, site engineers and foremen on the one side and building workers in the position of subordinate personnel on the other side. The surveys examined in particular the situation in the building companies participating in smaller building contracts in which, in most cases, the leading and managing of the working crews fall under the competence of site foremen or site managers. The surveys are also based on the statistic data of persons working in civil engineering, which are published by the Czech Statistical Office at its website every year. [3]

The surveys are based on the questionnaire surveys and talks conducted with persons in civil engineering. The following qualities and skills were examined in particular: the skills of planning, organization, checking, decision-making, motivation, cooperation, communication, running a risk, quick response to situations, as well as the ability to correctly allocate financial resources.

The skills to be possessed by structural engineers in the future (until 2033) were taken from the available materials. “Engineers must become more visionary. They require more business skills and must be better leaders. Not only must they be better leaders, they must be perceived as leaders. Additional skill sets (oral and written communication, business strategies, and leadership techniques) can be incorporated with coursework already present in the university curriculum.” [2]

3. Results

Today’s building companies need productive management more than ever in the past. Reaching of the set goals, their timeliness and performance quality also depend on the managerial skills and approach of the superiors to their co-workers. Only the surveys that best characterize the requirements for the qualities and skills of structural engineering managers have been chosen from the surveys carried out to date.

3.1. *Qualities and skills of structural engineering managers*

The surveys carried out among employees and managers of building companies in 2012 were evaluated using the scoring method. The respondents assigned values of 1 to 7 points, where value 1 was quite insignificant and value 7 was ascribed to the most important quality or skill.

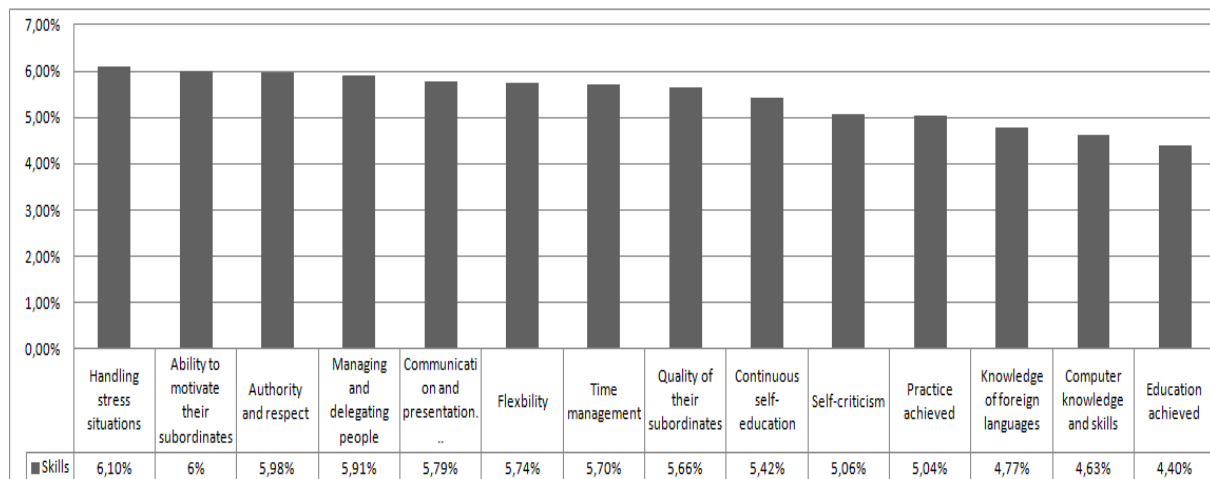


Figure 1. Required skills of structural engineering managers from the point of view of subordinate employees. [4, p. 44].

The graphs represent the average value of all received answers and individual elements in the graphs are arranged in the descending order by the average value. Employees have the following requirements for the qualities and skills of their managers (see figure 1).

From the point of view of managers in civil engineering, the situation looks as follows:

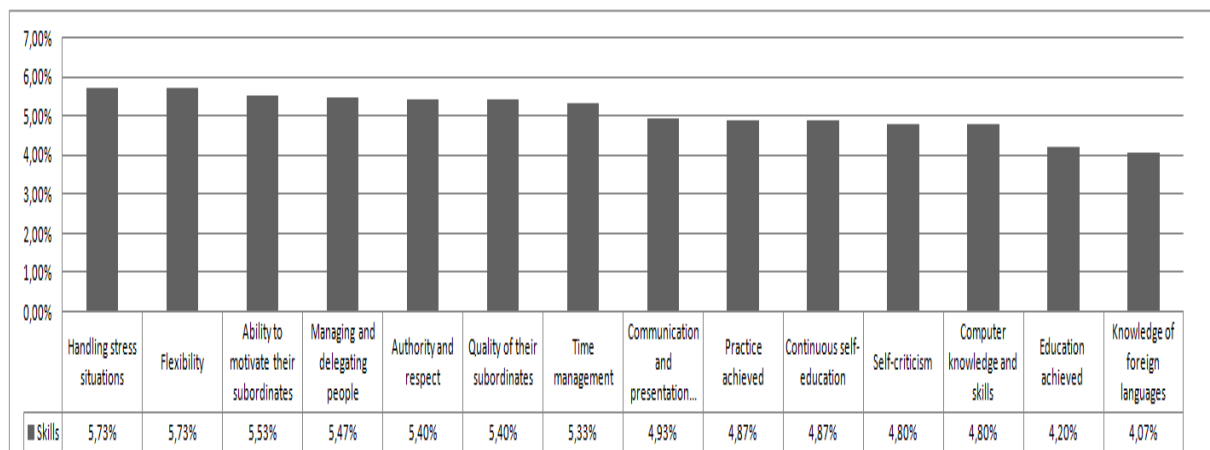


Figure 2. The required skills of structural engineering managers from the view of managerial staff. [4, p. 46].

The above-mentioned graph shows that the employees of building companies consider handling stress situations to be the most important factor for their managers. Value 7 was ascribed by 138 respondents, which is 53% of the answers, while 28% evaluated it by value 6, which is another 28%. The second is the ability to motivate subordinates (value 7 in 48% and 6 in 27% cases). The factor of authority and respect in subordinates ended up in the third place.

From the point of view of managing staff, resistance against stress along with flexibility are again in the forefront (value 6 in 47% and value 7 in 33% cases). Motivation, which the employees placed in the second place, appeared in the third place among the managing staff. Education along with language and computer skills are possibly considered a standard, but according to this survey they are assigned the least significant position. Apparently, the respondents expressed the opinion that there is no substantial difference between bachelor's and master's degree and thus additionally acquired knowledge is not so significant.

The results of the survey conducted in 2014 are shown in figure 3.



Figure 3. The required skills of structural engineering managers. [5, p. 52].

Communication skills (35%) are required most significantly. Professional knowledge (29%) is followed by the requirement for the ability to handle problematic situations (18%) and organizational skills (14%). It is interesting that knowledge of the language and computer skills again have negligible values. [5]

3.2. Roles and goals of structural engineering managers

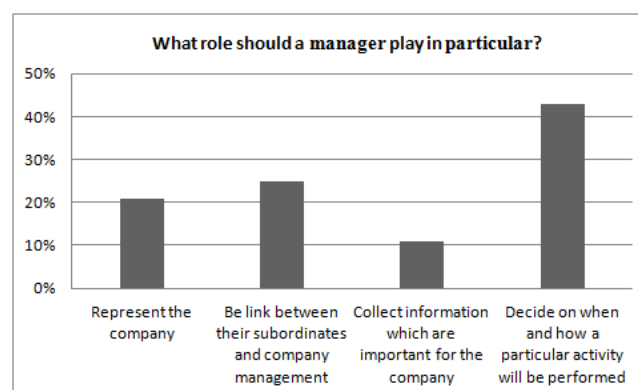


Figure 4. The required roles of structural engineering managers. [5 p. 53].

According to the respondents from the building companies, the most important role of managers is to decide on where and how a particular activity will be performed. This option was selected by 43% of the respondents. 25% pointed out that managers mainly have to be a connecting link between subordinates and company management. 21% of the respondents think that a manager primarily represents the company. According to 11% of the received answers, managers should mainly deal with obtaining information important for the company.

The declared goals of managers are shown in the figure below.

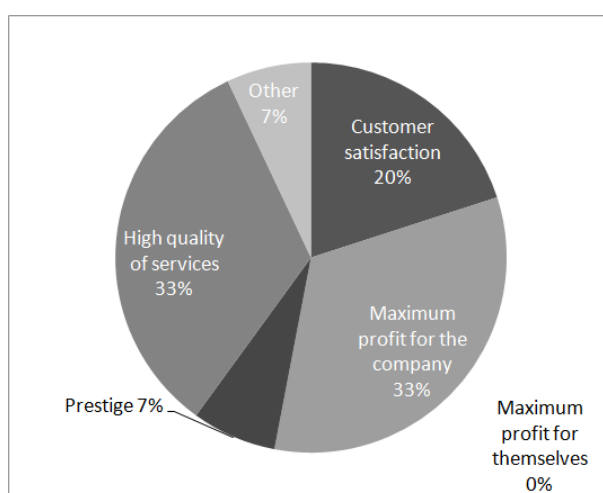


Figure 5. The required goals of structural engineering managers. [5, p. 55].

The main working goal of managers, in their opinion, is to achieve the maximum profit and, at the same time, to provide high quality of services. Such goals as creating an effective work team, satisfaction of employees, building the company goodwill, environmental impacts, etc. did not appear in this survey at all.

4. Discussion

The above-mentioned surveys conducted in the Czech Republic show that structural engineering managers often think that they meet the current demands for their profession. However, the amount of information and the complexity of solutions for upcoming problems increase and such situations occur more and more often and one cannot prepare for them in advance.

From the point of view of leading and managing personnel, “there is no significant difference between Human Resources Management and Personnel Management”[7].

More and more frequently not only companies, but also individuals need to immediately react to the changing conditions, they need to improvise. However, improvisation and the necessary flexibility are in no case substitutes for preparations and planning, they rather supplement them naturally.

The required skills and abilities of future managers of the 21st century are dealt with by the global research programme ITL Research. The necessary competences which will be added to the current demands include: collaboration, knowledge construction, self-regulation, real-world problem-solving and innovation, the use of ICT, skilled communication [1].

According to our opinion, also the ability to use both critical logical thinking and intuition, awareness of the consequences and sense, humour and control are necessary as the sources for creativeness and

innovation. One must be aware that “leadership is the ability to lead the company beyond the current boundary of its economic horizons, give the company and especially the employees a vision for the future and react to the changes in global market demands or even create them. This way of leadership is often linked to magic terms and personal attributes, such as: “leader”, “charisma”, “mission” and “radiate” [6]. Obviously prerequisite are also ethical criteria (e.g. [8], [9]).

The Vision for the Future is drawn up according to the study of the Structural Engineering Institute. The expectations and Role of the Future Structural Engineer presents an opportunity, if not a mandate, to transform structural engineering education, training, and practice in ways that will foster an enduring and creative profession. Desired Outcome is to explore and define what the structural engineering profession is. The next generation of structural engineers need to have education, practical knowledge, and technology applications that should be developed throughout a career [2 p. 4]. Abilities and skills that must be developed are specified in the study. They include redefined technical skills, soft skills, advanced professional ability, creativity and curiosity. The study clearly shows that it is also necessary to set new mechanisms to enable the desired changes.

In the CEI survey, the respondents when asked about the next 10-30 years repeatedly identified technology, delivery methods, education, and globalization as the drivers of change; and current practitioners see these drivers as threats rather than opportunities [2. p. 40]. This also corresponds to the previously obtained conclusions of the surveys carried out in the Czech Republic. Final figures and statistical comparison of the state of managerial skills in our country and the world will be performed after the completion of the ongoing research in the country.

5. Conclusion

The above-mentioned surveys and studies show that the need of innovations in the work of structural engineers and managers is perceived as a necessity by personnel in civil engineering also in other countries. It is apparent that the requirements for structural engineering managers will significantly change within several years. The emphasis will be placed on the above-mentioned qualities and skills which are usually summarized under a uniform term “soft skills”. “It means skills including communication and presentation skills - along with a full complement of the modern soft skills related to a high emotional intelligence quotient - such as an engaging personality, flexibility, adaptability, self-direction and self-control, and perseverance.” [2. p. 18] According to that research, they are mainly communication and organizational skills. It is urgently needed to develop these skills at schools, as it is shown in figure 3, along with a strong ability to choose and unite subordinates and superiors into one efficient and cooperative team. Similar results have been obtained by the team under the leadership of the head of an international research team, Professor Ansgar Zerfass from the Leipzig University, who have conducted the European Chief Communication Officers Survey (ECCOS) [10]. 579 leaders of communication and public relations departments took part in the research in the European companies. As stated above, the profession of a structural engineer is a very responsible profession, because the consequences of structural engineers’ errors are far-reaching. In the current society, it is no longer possible that the managerial methods of structural engineers stagnate. This is also confirmed by the previous results of the ongoing research in the Czech Republic that are listed in this article.

The profession of an engineer will still be an important profession. However, it will be necessary to be more aware of possible risks, economic and sustainable utilization of valuable resources, and the use of innovative technologies. It is also important to create inspiring structures and mechanisms which will allow and support the oncoming changes.

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