

# Performance Measurement in Czech Construction Companies with Regard to Environmental Responsibility

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**Abstract** The importance of environmental protection is growing rapidly in the construction industry. Performance measurement as an important tool for a more effective construction process reflects this new direction of business thinking. Performance measurement systems have implemented new criteria for measurement with respect to the environment. The main aim of this paper is to evaluate whether Czech construction companies measure these newly implemented environmental criteria. Most important criteria such as waste management, emissions and water management were emphasised. Original data were collected using a questionnaire survey. The survey also focused on construction materials responsibility and recycle/reuse measurement. The results of the study show that less than half of construction companies in the Czech Republic actively measure the impact on the environment. However, almost three-quarters of companies are aware of its importance for the future of the construction industry and environmental responsibility. Only 2% of Czech construction companies believe that environmental responsibility is not important at all. The most frequently measured criterion is waste management; on the contrary, the number of recyclable materials used on the construction site is least frequently measured. There is a need to accelerate efforts to help construction companies identify appropriate ways to start measuring environmental criteria. Construction companies that do not measure environmental criteria need to be widely informed about the importance of sustainability in the construction industry. This could be best achieved by an information campaign. The appropriate form of such a campaign and its contents should be the main focus of a follow-up research.

## 1. Introduction

In recent years, the pressure on construction companies to improve the efficiency of their projects and eliminate their negative impact in terms of an accelerating climate change has increased significantly, also due to the accelerating pace of digitalisation and greater emphasis on environmental protection. As a result, construction companies are looking to implement contract measurement systems into their



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workflows to a much greater degree than before. In the past, it was not uncommon for some construction companies not to measure their contracted projects in this manner at all, which is practically unthinkable today. Environmental issues have forced business organisations across all sectors to continuously modify and evaluate their strategies, performance measurement, management systems and frameworks to flexibly reflect the changing market environment [1]. The aim of this paper is to determine how many construction companies are addressing environmental and sustainability issues in their contracted project measurement in the construction industry through an online questionnaire survey of construction companies.

## 2. Current situation

### 2.1. *Environmental responsibility in construction*

The construction industry is one of the major consumers of energy produced on our planet. The construction industry consumes 9% of all the energy produced globally [2], and at the same time, the construction of buildings and their quality has an impact on the energy consumption of residential and office buildings. These buildings consume as much as 30% of all the energy produced in the world [2]. In addition to energy consumption, the construction industry also contributes significantly to greenhouse gas emissions; in the European context, for example, the construction industry contributes produces as much as 36% of all CO<sub>2</sub> emissions [3]. For these reasons, it is clear that this sector has a key role to play in achieving a low-carbon economy [4] in order to avoid a rapid warming of our planet. As a processor of large quantities of materials, the construction industry is also a significant producer of waste. Recently, there have been increasing efforts to maximize recycling of materials used in construction. For example, in the area of insulation materials, many countries are moving away from traditional petroleum products towards natural materials such as hemp and straw [5]. Some construction companies themselves are actively approaching the investors during the construction process, offering them a replacement of the design materials with more environmentally friendly options; while this is the case only in a small percentage of companies, it is a good sign for the sector as a whole. Many construction companies are aware that environmental responsibility is important, but find it difficult to find the motivation to put in place the appropriate tools [6] to measure the criteria associated with this issue.

### 2.2. *Construction contract measuring criteria and the trend towards measuring environmental criteria*

The classic construction contract measurement models such as the KPI or Iron Triangle [7] originally dealt only with the measurement of a few basic criteria, mainly with respect to monitoring the cost of the construction work, the construction time and the quality of construction. Over time, the number of criteria has grown and the models have added new criteria such as job safety, client satisfaction with the work and communication among stakeholders (individual participants in the construction process). The Triple Bottom Line [8] system has brought a significant progress by expanding the areas for each criterion. It has added new criteria relating to the social impact on the surrounding environment, but most importantly, it has finally highlighted the importance of construction companies' environmental responsibility. It had introduced criteria such as the use of recyclable materials and waste and water management on the construction site. It has further introduced the prevention of the environmental impact of emissions from the construction site, not only in terms of greenhouse gas emissions, but also 'emissions' such as noise [9]. Many other measurement systems have built on the principles of the Triple Bottom Line model and have subsequently specified additional measurement criteria and tried to elaborate how to measure these new criteria. They also addressed which units of measurement should be used and how to subsequently work with the data. Globalisation and the ever-accelerating digitalisation are also bringing proven models from other industries, particularly engineering and automotive, into the construction sector. One such system is Total Quality Management (TQM) [10], which came from the Japanese automotive industry. TQM comprises not just quality management and performance measurement – it is an approach that permeates the entire philosophy of a company,

including managerial and strategic management. At the same time, it also touches on the planning of processes in the company and also on the standardised construction contract processes. The advent of this philosophy in the construction industry has brought much greater automation and prefabrication in the construction work [11] and thus contributed to reducing the amount of waste generated by the heterogeneity of the different activities on the construction site. An imperfect adherence to procedures in monolithic construction results in many defects and deviations; prefabrication of structures thus not only improves the efficiency of work [12], but also contributes to a better environmental performance of construction companies.

A collaboration between experts in the measurement of construction contracts and experts on environmental issues from the University of Jaén (Spain), the University of Granada (Spain) and the University of Science and Technology in Bydgoszcz (Poland) resulted in a draft set of criteria for environmental responsibility [13], based on three main areas:

- Types of materials used and their recyclability;
- Emissions produced on the construction site;
- Water management

These three basic areas are then linked to a list of specific criteria which a construction company can use to assess how much attention it gives to the issue of sustainable construction:

- Our company uses efficient technologies for material recycling.
- Our product is easy to modify and repair.
- Our company has a system to measure the amount of recyclable materials.
- Our company aims to increase the proportion of recyclable materials used.
- We strive to reduce our carbon footprint.
- We reduce energy-related indirect greenhouse gas emissions.
- We are reducing our environmental and energy footprint.
- Are we trying to reduce the amount of wastewater produced during the project?
- We are trying to improve our solid waste recycling ratio.
- We are using less and less hazardous waste.
- We are managing waste efficiently.
- We have introduced or plan to introduce a system to measure and prevent unnecessary waste.
- We are committed to a gradual reduction in the amount of non-recyclable waste.
- During the production process, we monitor waste generation in detail for each production process. [14]

Unfortunately, many construction companies in the Czech Republic do not place much importance on these issues, which is one of the reasons why it is very helpful that there is a growing effort by professionals to raise awareness of these issues among construction companies. However, the lack of skilled staff in construction companies to address this issue (caused by the time requirements) currently poses a major obstacle in this regard.

### **3. Methodology**

For the purpose of data collection for this paper, an online questionnaire survey was created with a set of questions dealing with the environmental responsibility of construction companies. The questions were chosen to address both the measurement of environmental criteria and the issues of waste management and the use of recyclable materials on construction sites. The questions were drawn up on the basis of extensive international research and also based on the experience of the co-operating

companies gained within their own practice in the Czech construction sector. E-mail addresses for suitable respondents were subsequently identified. These respondents were selected to evenly cover all areas of the construction sector and also all regions of the Czech Republic. Subsequently, the questionnaire was sent to 250 selected contact e-mail addresses of companies from various sectors of the construction industry. During the first half of 2021, fifty-eight respondents sent their answers. Subsequently, the percentage (p) of respondents' individual responses was evaluated for each question. Detailed results and commentary are provided in the Results and discussion section.

#### 4. Results and discussion

The first question concerned the construction sector in which the individual construction companies (respondents) operate. Four main areas of the construction industry were selected, namely: residential and public construction; industrial construction; transport and utility construction; and finally water engineering construction. The percentage share of each sector is provided below.

**Table 1.** Percentage share of individual answers to question 1: “In which sector of the construction industry does your company operate?”

Answer	<i>p (%)</i>
residential and public construction	70
industrial construction	22
transport and utility construction	4
water engineering construction	4

The results show that respondents willing to provide answers were concentrated mainly among residential and public construction companies, where 70% of active respondents answered, while companies in the field of water engineering construction were least responsive. Subsequently, several questions were asked about the behaviour of these construction companies with respect to the environment. These questions also asked about waste disposal and management, the use of recyclable materials and considerations for the environment surrounding the construction site during the construction process. The first question asked whether construction companies already did evaluate their contracts in terms of their environmental impact.

**Table 2.** Percentage share of answers to question 2: “Do you evaluate contracts in terms of their environmental impact?”

Answer	<i>p (%)</i>
Yes, we do so in all our contracts.	34.9
Yes, but not in all contracts.	9.3
No, but we plan to start in the future.	14
No, but we understand it is important.	39.5
No, and we do not consider it important.	2.3

The resulting percentages in answers to this question clearly show that over 30% of construction companies already do evaluate their contracts in terms of their environmental impact. A further approx. 9% evaluate at least some of their contracts from an environmental sustainability perspective, and 14% of construction companies plan to start doing so in the future. A further 39.5% of companies recognise the importance of this issue and, therefore, it be assumed they have already taken initial steps to steer themselves towards better environmental responsibility and will start measuring these criteria in the near future. The next question focused on waste treatment and management, obviously with regard to the negative impact on the environment.

**Table 3.** Percentage share of answers to question 3: “Do you evaluate (measure) waste management (with regard to environmental impact)?”

Answer	<i>p</i> (%)
Yes, we do so in all our contracts.	47.6
Yes, but not in all contracts.	4.8
No, but we plan to start in the future.	11.9
No, but we understand it is important.	33.3
No, and we do not consider it important.	2.4

The result shows that more than half of the construction companies evaluate (measure) waste management in their contracts and 47.6% of the companies even do so in all their contracts; 12% of the companies that do not yet measure waste management are already planning to start in the near future. The remaining 33% of businesses at least recognise that it is an important topic and only 2.4% are neither interested nor consider it important. The answers to this question show that waste management is a topical and important issue for construction companies in the Czech Republic. Another question aimed at the use of recyclable construction materials by the individual construction companies.

**Table 4.** Percentage share of answers to question 4: “Do you measure the amount of recyclable materials used in the performance of construction contracts?”

Answer	<i>p</i> (%)
Yes, we do so in all our contracts.	18.6
Yes, but not in all contracts.	14
No, but we plan to start in the future.	16.3
No, but we understand it is important.	46.5
No, and we do not consider it important.	4.7

Here the result was not as good as with regard to the question focusing on the waste management measurement. Only 18.6% of Czech construction companies measure this criterion in all their contracts; 14% do measure, but only in selected cases, while 16.3% plan to start measuring the amount of recyclable waste in the future. Almost half of the respondents do not measure or plan to measure this aspect in the future, but recognise its importance. It would be worthwhile, as part of further research, to inquire about the reasons why companies do not measure their contracts even though they recognise the importance of doing so. This might potentially be due to a lack of staff in these businesses or there might be other reasons, such as financial or time constraints. There is also the question of how much information companies have regarding the ways of measuring this criterion, which units of measurement to use and how to properly evaluate the results of such measurement. The next question concerned measuring the impact on the construction surroundings such as compliance with noise limits, occurrence of dust and other emissions.

To this question, 33.3% of construction companies responded that they measure impact for all their contracts and 29.2% measure at least some of their contracts, which is a surprisingly high number. Thus, a total of 62.5% of construction companies are measuring the impact on the surrounding areas. In contrast to the other questions, there is a low percentage of companies planning to start doing this in the future; a total of 33.3% of businesses recognise the importance of such measurement, but do not employ it themselves. It would also be interesting to follow up this study with a further survey to find out why companies behave in this way, what are the reasons for not measuring their contracts even though they recognize the importance of this aspect. On a positive note, none of the companies responded that they did not consider measuring the impact on the surrounding environment to be

important. This shows a high degree of responsibility among Czech construction companies towards the surrounding area and the community.

**Table 5.** Percentage share of answers to question 5: “In the performance of your contracts, do you measure the impact on the surrounding environment during construction, e.g., in terms of noise limits, dust and other emissions, etc.?”

Answer	<i>p</i> (%)
Yes, we do so in all our contracts.	33.3
Yes, but not in all contracts.	29.2
No, but we plan to start in the future.	4.2
No, but we understand it is important.	33.3
No, and we do not consider it important.	0

## 5. Conclusions

The survey presented in this paper indicates that most companies operating on the Czech construction market are interested in environmental responsibility issues, but only a third evaluate and measure environmental criteria. Based on this research, efforts should therefore be made to inform companies about the possibilities offered by current performance measurement systems with regard to environmental responsibility. As was demonstrated on a survey of the current situation, there are many suitable systems in place that already include a wide range of measurable criteria aimed at environmental protection. Construction companies are better placed to measure waste management, with just under 60% already measuring this aspect, while 48.9% of companies in this set measure it in all their contracts. Looking specifically at measuring the use of recyclable materials, 32.6% of companies actively measure the amount of recyclable materials and of these only 18.6% measure the amount of recyclable materials in all their contracts. However, it is important to note that the rest of the companies plan to start doing this or at least recognise its importance. Only 4.7% do not consider it important at all, which is a positive outcome. A very positive trend was also demonstrated by the result of construction companies' consideration for the construction site's surrounding environment, represented for example by the measurement of compliance with noise limits, the occurrence of dust emissions and the impact of construction site traffic on the surrounding area. None of the companies responded that they did not consider this important, which is an excellent result. However, only about 60% of businesses measure these aspects already, with the remainder either planning to start or recognising the importance but not planning to start any time soon. Therefore, the academia should strive to inform construction companies about the importance of protecting the environment and moving towards sustainable construction. Construction company staff are often quite busy with their core project tasks and, therefore, a suitable awareness campaign could help to make construction companies more environmentally responsible. This article should be followed up by a survey into why such a high percentage of companies recognise the importance of measuring various criteria, but do not actually measure them themselves and do not plan to start in the future. The follow-up research will thus aim to identify how to inform companies about the ways they can introduce contract measurement, which tools to use and how to properly evaluate the results. Construction companies should be aware of the importance of the sustainability in the development of the construction industry as a whole in relation to the future of their construction business. Also, more and more investors are examining candidates during the tender procedure based on how they approach environmental responsibility; consequently, companies that take this into account can gain an important competitive advantage on the Czech construction market.

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