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Research paper

Errors in the list of works, supplies and services in public works tenders

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Abstract: The occurrence of errors in public works tender documentation is an undesirable phenomenon which is unfortunately often encountered in construction practice. Errors may have various causes and also have varying levels of negative effects on the successful implementation of the investment project. Taking this fact into consideration, this paper aims to identify and assess errors in terms of the requirements laid down by the applicable legislation in the Czech Republic, especially the Public Procurement Act and the associated implementing decree. A total of 126 public tenders were analysed in detail from this perspective. The results show that the occurrence of particular errors is relatively high, especially with regard to the specification of the bill of quantities and the requirement to include references to openly accessible price systems. Furthermore, errors relating to the specification of the quantity of works, units of measurement and descriptions of cost items were identified as having the largest impact on a project. Findings presented in this paper aim to highlight common errors in public tender documents and raise awareness of the need to improve their quality to ensure legislative compliance.

Keywords: bill of costs, construction works, error, public procurement, tender documentation

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1. Introduction

High complexity and an extensive scope of documents are typical for construction projects. Numerous labour-intensive processes on the construction site are usually associated with the use of costly resources and involvement of various participants [1] of which the most important are the investor and the contractor. The investor's chief interest is to ensure the project's success [2] in aspects such as the cost, time and quality [3]. In order to prevent project failure, various practices can be adopted and actions taken to secure particular benefits. For example, good partnering relations may bring benefits such as in terms of a reduction in the range of disputes, improved communication between project participants, increased client satisfaction and reduced exposure to risk [4]. The overall management process may be improved by using advanced information and communication technologies [5] and cost-efficient solutions should be supported by life-cycle cost considerations [6]. From this perspective, the early design stage is crucial for any construction project. In this stage, most key decisions are made as several design proposals may be outlined, e.g. with regard to sustainability [7]. The decisions are made while considering their effects of various criteria such as cost and non-economic criteria [8]. Therefore, it is vital to engage experienced personnel with the aim of facilitating higher quality and more effective solutions for the project [9].

With regard to the fact that costs, together with time and quality, belong to crucial factors determining a project's success, it is always important to be aware of potential inaccuracies in cost estimations. According to Akintoye and Fitzgerald [10], major causes of such inaccuracies include (1) poor practical knowledge of the construction processes on the part of cost estimators; (2) time pressure to prepare cost estimations; (3) poor tender documentation; and (4) subcontractors' prices variability. This paper focuses exclusively on point (3), i.e. the issue of errors in tender documentation. Dosumu claims that 68% of the errors in contract documentation occur in traditionally procured projects [11]. More specifically, results show the occurrence of the highest number errors in drawings, followed by bills of quantities and then specifications. As reported in [12] on the example of the United Kingdom, apart from inaccurate cost estimates, poor documentation also leads to claims and disputes. Shortcomings in the documentation were connected to clarification, missing and conflicting information, inadequate specifications, errors and mistakes, as well as software obstacles.

Detailed investigation of errors in design documentation with regard to public procurement in Poland was conducted by Juszczyk et al. [13]. Their results identified the most frequent errors in technical specifications, namely: incorrect layout of the specification, incompatibility of the specifications with the standards and other documents, copying texts from other documents, indication of specific products/brands, missing requirements for particular elements and unclear/imprecise wording. In an example of a mining megaproject, numerous errors and omissions (such as incorrect or inconsistent labelling) were identified as an obstacle hindering the engineers' ability to interpret information included in the tender documents correctly [14].

It was reported that the use of quality costing databases [15] and standardised documentation supports the quality and coherence of tender documentation [16]. From this perspective, creation of national technical regulations and standards has been suggested for use in preparing tender documentation in Montenegro [17]. Similar problems can also be found in the EU. In Poland, for example, facility demolition projects usually only have an incomplete paper documentation. Consequently, waste amount estimation requires time consuming analysis on the site [18]. It has been highlighted in [19] that a complete technical documentation is among important factors reflecting quality management issues in construction projects. As design errors are diverse in nature and severity [20], good communication between designers and contractors is imperative for the successful implementation of the project [21]. All errors should be communicated adequately [22] as the number of errors could be reduced by learning and knowing [20]. In this way it, may be possible to decrease the level of uncertainty regarding tender drawings, specifications and the scope of works [23].

The presented review of available literature suggests that the occurrence of errors in tender documentation can have significant consequences for a construction project's success. The main aim of this paper is to contribute to the current body of knowledge in the investigated area and in particular to explore issues related to drawing up the list of works, supplies and services in civil engineering projects, which is a part of the tender documentation in public works tenders in the Czech Republic.

2. Materials and methods

According to applicable Czech legislation, each project implemented by a standard, public or sectoral contracting authority must comply with certain conditions. This legislation includes in particular Act No. 134/2016 Coll., on public procurement [24] (the Public Procurement Act), and implementing decree No. 169/2016 Coll., on specification of the scope of documentation in public works contracts and of the list of works, supplies and services with a bill of quantities [25].

As was emphasised in Section 1, despite the statutory definitions of what a tender procedure for a public contract should look like and what the legal conditions and assessment procedures are, it is a very complex process where errors can easily occur. The risk of errors increases with the lack of experience and knowledge of the technical project documents issued by the contracting authority.

2.1. Defining the dataset

It is important to mention that various contract procurement methods may be used for construction projects. These involve, among others, the Design-Bid-Build (DBB) and Design-Build (DB) methods as the two principal project delivery systems used in many countries [26]. Where the DB method is used, the responsibility for project documentation rests with the contractor. In this method, the contracting authority defines the purpose,

scope, standards and other performance criteria which the building must meet; documents used for a building permit and the contracting authority's standards usually serve as the basis for the documentation [27]. By its nature, the DB method does not require a list of works under implementing decree No. 169/2016 Coll. [25]; therefore, only DBB public tenders were included in the analysis presented in this paper. The dataset contains public tenders implemented in the period of 2016–2020 (i.e., from the date when the implementing decree came into effect). To be included, each contract had to:

- be publicly accessible;
- concern construction works, specifically in the area of civil engineering;
- have the expected value publicly available;
- have the project documentation publicly available;
- have the list of works, supplies and services publicly available.

Technical infrastructure projects were excluded from the dataset. Also excluded were those contracts which did not include a published value of the public contract and project documentation.

2.2. Definition of errors

The most frequent errors associated with the list of works, supplies and services, can be divided into several categories: (1) additional work – work that is necessary to complete the contract despite exceeding the contractual scope; (2) substantive errors – errors caused by inattention or ignorance on the part of the employee responsible for drawing up the list of works, supplies and services (quantity surveyor), for example an omission of items, use of incorrect procedure to calculate quantities, and errors in addition; (3) project documentation errors; and (4) errors linked to implementing decree No. 169/2016 Coll.

The quality of project documentation is one of the factors influencing the quality of the budget. Ideally, the documentation should be submitted without errors at a level which allows implementation of the project (selection of the contractor) and include all lists, specifications, drawings and reports, which also correspond to each other. The less perfect the project, the more effort it takes to draw up the bill of quantities and the higher the subsequent error rate. It is often the case that the investor needs to know the budget based on the building permit documentation. This documentation is significantly less detailed and it can thus easily lead to omissions in the budget or a different assessment by the quantity surveyor.

An error linked to implementing decree No. 169/2016 Coll. means a conflict with the basic legislative requirements. Meeting the requirement under this implementing decree is mandatory for all public contracts. Non-compliance with one or more of its provisions can lead to additional questions during the selection procedure, delays, cuts in subsidies or even cancellation of the tender.

2.3. Identification of errors and their importance

In each contract, or more precisely in each of the individual lists, the correspondence of the data with the requirement under implementing decree No. 169/2016 Coll. was studied

in detail (see Table 1). The absolute frequency of individual errors was studied, where each list was assigned a value – "0" for lists containing no errors and "1" for lists with errors. The frequency of errors was checked for the entire dataset and also in subdivisions according to the type of construction works. The occurrence of errors analysis was also conducted chronologically, that is for each year within the 2016–2020 period.

Table 1. Requirements under implementing decree No. 169/2016 Coll. for the list of works, supplies and services

Section of the decree	Legislative requirement (cause of error)
Section 2	List should be prepared based on the construction documents
Section 4	Budget structure corresponds to the project structure
Section 5	List items unambiguously define the contents of the item, but the business name or other limitations according to Act No. 134/2016 Coll. are not indicated
Section 6	The item includes:
Section 6(a)	Serial number
Section 6(b)	Price system
Section 6(c)	Item code
Section 6(d)	Item description
Section 6(e)	Unit of measurement
Section 6(f)	Quantity
Section 6(g)	Bill of quantities with respect to the indicated amount
Section 7	The bill of quantities contains unambiguous reference to the relevant part of the documentation and a verified calculation. Bill of quantities which is identical for a number of items, can be indicated by simple reference to the preceding item/bill of quantities
Sections 8, 9 and 10	Ancillary and other costs are defined
Section 11	Price system is indicated and freely accessible
Section 12	An electronic list of works, supplies and services is in an open format for use in various budgeting software tools. Consistent appearance of the list of works, supplies and services across the entire project

Besides the frequency of errors, opinions regarding the importance of the impact the individual errors had on the successful implementation of the construction project were collected from 23 experts. They evaluated the errors on the scale from 1 (least important) to 6 (most important). Establishing both aspects of the problem, i.e., the frequency of errors and their actual impact, allowed an evaluation of the importance of the individual types of errors in terms of their impact on construction projects.

Price system (Section 6(b)) represents and organized set of information on construction and assembly works, materials and products containing e.g. the classification of items,

detailed description of items, unit of measurement and determines unit price. In the Czech construction practice, there are two most common price systems that differ from each other, therefore it is crucial to indicate which one is used. Each price system is using its own item codes and descriptions.

3. Results and discussion

3.1. Basic description of the dataset

In total, documents from 126 public tenders have been collected for this study. The set of public tenders contains 613 individually analysed lists of works, supplies and services. More information about the dataset can be found in Table 2 (inclusive of public tender values).

Table 2. Introduction of the dataset

Description	Amount/Value	Unit of measurement
Number of contracts	126	Set
Number of individual lists	613	Amount/Value
Average contract price	34,776,397.70	CZK excl. VAT
Maximum contract price	108,578,240.00	CZK excl. VAT
Minimum contract price	5,213,310.10	CZK excl. VAT
Total price of all contracts analysed	4,381,826,114.50	CZK excl. VAT

3.2. Frequency of errors in public tenders

According to the procedure described above in Section 2.3, public tenders were analysed in significant detail. Figure 1 shows the total number of all lists containing errors broken down by the individual requirements of implementing decree No. 169/2016 Coll.

The most frequent error was the missing bill of quantities and references to the relevant part of the documentation (i.e., non-compliance with Sections 6 and 7 of implementing decree No. 169/2016 Coll.). Other very frequent errors consisted in the non-specification of the price system under Section 11 and inconsistent appearance across all the lists included in the particular contract under Section 12. Among the other requirements under the implementing decree, errors most often concerned Section 2, where 116 of 613 lists were not prepared in accordance with the tender documents prescribed by the implementing decree, and Section 6(c), where price system codes were missing. Only negligible number of errors (4 instances) were found with respect to Section 4 and Section 6(e), no errors were found with regard to Section 6(d) and (f) (item description and amount, respectively).

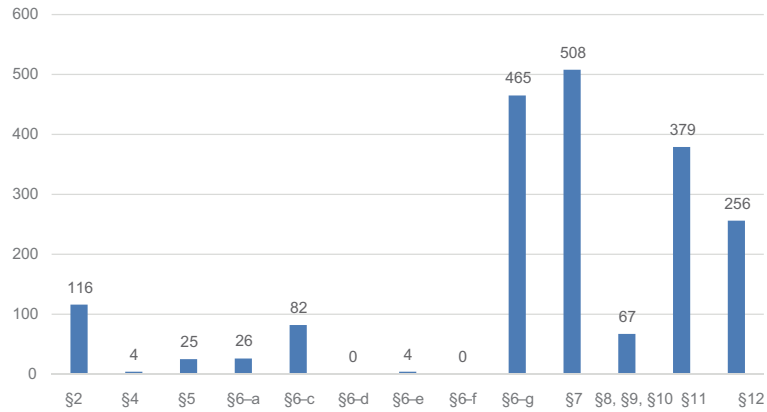

Fig. 1. Total number of lists containing errors according to individual requirements of the implementing decree [28]

Figure 2 provides detailed relative distribution of errors from the perspective of the different types of works (heating (T1), architectural and construction technical design (T2), light-current a data distribution systems (T3), electrical fittings (T4), instrumentation and control (T5), air-handling equipment (T6), sanitary installations – sewerage, water, gas (T7). The results indicate that there are no significant differences between individual types of works (T2–T7) in terms of the frequency of errors, except for category T1 (heating). Heating shows clearly and significantly lower occurrence of errors concerning requirements under Section 6 (c) and (g), Section 7 and Section 11. This can be explained by two interrelated causes. The first is the relatively small number of quantity surveyors who are capable of preparing the budget for parts other than heating (T1). Budgets are usually drawn up by the designers of the individual parts (sanitary-technical installations, air-handling

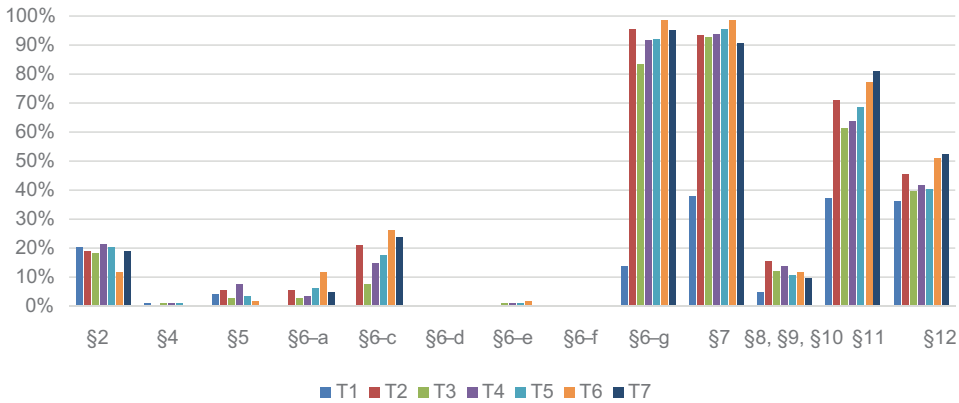

Fig. 2. The relative distribution of errors according to individual requirements of the implementing decree broken down according to the different types of works

equipment etc.), or the software design tool they use automatically generates a list of materials and they mistakenly believe this list constitutes a budget. The lack of knowledge of the implementing decree, calculation methods and pricing thus often subsequently leads to the occurrence of errors in the list. Another explanation lies in the missing items in the relevant price system. As was the case in the first cause, there is a relatively low number of database-calculated items associated with the price system.

3.3. Analysis of the occurrence of errors from a temporal perspective

The follow-up analysis was focused on the progression of the total number of errors in the dataset over the reviewed period. Specifically, it evaluated the average number of all errors in a list for each individual year in the 2016–2020 period. The results are provided in Figure 3.

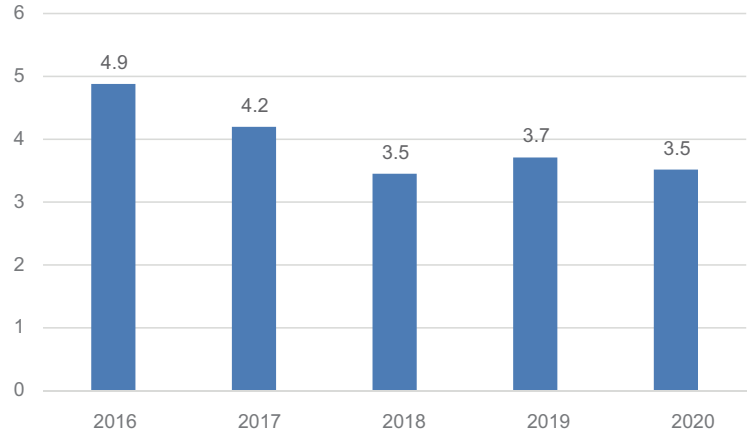

Fig. 3. Average number of all errors in a list over the reviewed period

Figure 3 clearly shows a decreasing trend in the number of all errors in individual lists between 2016 and 2018. This decrease can be attributed to the fact that the implementing decree became effective only in 2016. Hence, responsible persons did not have sufficient experience with the new requirements and, consequently, the number of errors was relatively high in 2016 (4.9). Later on, with increasing familiarity and practical experience, the number of errors continuously decreased to 4.2 and 3.5 in 2017 and 2018, respectively. For the last two years of the reviewed period, the number of errors has stabilised at values between 3.5 and 3.7.

Furthermore, it seems that despite several years of experience, the “natural” number of errors in the tender documentation is equal to approximately 3.6 per list. Hence, it is important to raise awareness of the practical need to ensure regular checks separately for each project. If checklists are used appropriately, a further reduction in the error rate could be achieved.

3.4. Importance of errors

Table 3 shows the importance of errors in terms of impact on a successful implementation of a construction project. The data show the average value assigned by 23 experts, where 1 was the minimum value and 6 was the maximum.

Table 3. Importance of errors

Error section designation	Sec. 2	Sec. 4	Sec. 5	Sec. 6 (a)	Sec. 6 (b)	Sec. 6 (c)	Sec. 6 (d)
Importance	4.86	4.65	4.82	2.73	3.62	3.38	5.13
Error section designation	Sec. 6 (e)	Sect. 6 (f)	Sec. 6 (g)	Sec. 7	Sec. 8, 9 and 10	Sec. 11	Sec. 12
Importance	5.17	5.61	4.68	3.61	4.43	3.41	3.65

Three errors in the set were judged very important in terms of their potential impact and were assigned values of 5.61, 5.17 and 5.13 (Section 6(f) – amount; Section 6(e) – unit of measurement, Section 6 (d) – item description). Only one error was considered less significant (Section 6(a) with a value of 2.73); other errors were judged to be of medium importance ranging from 3 to 5. However, it is very important to consider the errors in terms of their relative occurrence and impact when taken together. Results are shown in Figure 4.

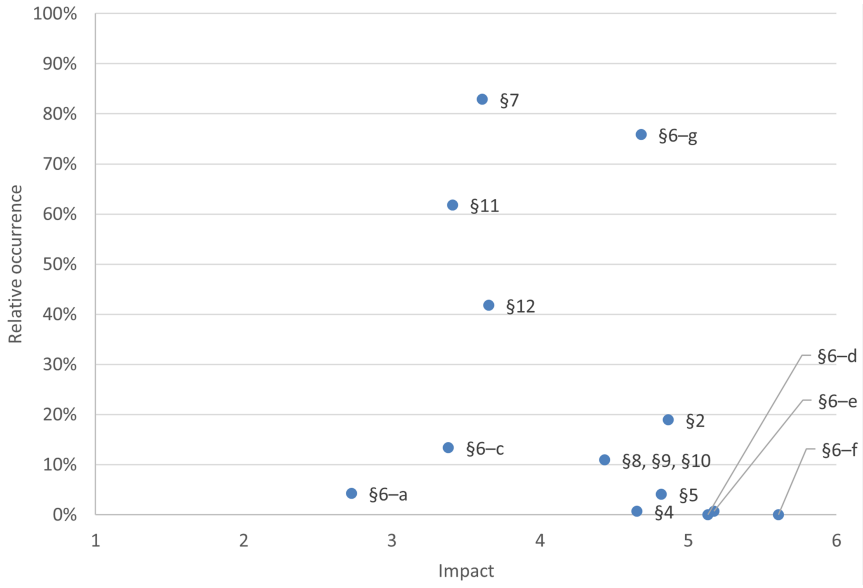

Fig. 4. Importance of errors

It has been shown that all three errors ((Section 6(d), (e) and (f)) with the highest impact have very low occurrence in tender documents. On the other hand, another three errors should be considered important as they have a medium-level impact and relative occurrence above 50%. Specifically, these errors relate to the bill of quantities (Section 6(g)), references to documentation (Section 7) and the price system (Section 11). In this regard, it should be noted that errors relating to the bill of quantities and the price system subsequently cause problems with invoicing of the performed construction works; a missing reference to the relevant part of the project documents can lead to disputes regarding correct specification of the scope of work performed. Regarding errors linked to Section 6 (b) and (c), it has to be checked that the item stated in a specific case is actually included in a standard price database; if it is not and it was created ad hoc, then the missing data do not constitute an error in terms of the implementing decree.

4. Conclusion

This paper analysed the occurrence of errors in relation to the legislative requirements for public tender documentation in the Czech Republic and their impact on construction projects. On the sample of 126 public tenders including 613 individual lists, it was demonstrated that particular errors relating to the specification of the bill of quantities, as well as to the requirement to indicate a publicly available price system, occur very frequently in construction practice. A poor tender documentation quality may have significant consequences for the construction project in terms of specification of a correct scope of work and unambiguous invoicing at the project implementation stage.

From the theoretical perspective, the paper contributes to the current body of knowledge by offering an evaluation of the importance of individual types of errors in the Czech construction public procurement. The main managerial implications of this paper relate to outlining the possible negative impacts of errors on project success.

It is to be concluded that a large room for improvement exists, especially in relation to three types of errors (concerning Section 6 (g), Section 7 and Section 11 of the implementing decree) characterised by a medium-level impact combined with a high rate of occurrence. The use of a simple checklist to ensure tender documents' compliance with legislative requirements should be considered as a basic, mandatory and necessary precondition for announcing a public tender by contracting authorities.

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