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To cite this article: Miloslav Vyskala *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **471** 112071

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Analysis of Obligatorily Used Price Systems in Public Works Contracts Procurement

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Abstract The issue of public works and supply contracts in terms of bidding is closely related not only to the individual cost calculation of individual bidders, but also to the tools that can be used within the calculations. For the standardisation of the technical and economic parameters, comprehensive price systems can be used, while the use of these price systems is obligatory in the legal environment of the Czech Republic. The aim of this paper is to analyse the price systems used in the Czech Republic and to compare them in terms of costing of construction works and supplies. In particular, this paper offers a comparison of specific construction works in the area of building engineering and water management structures.

1. Introduction

The issue of public contracts is closely related not only to the bidding process, but also to creating conditions for costing of the subject of a public contract. In the area of public contracts, this mostly involves the supply of assembly works and services. These supplies must be specified in detail both in technical and economic terms. This means that for each pre-defined assembly work or supply, a set of technical and economic characteristics can be assigned.

Contracting partners involved in the public contract awarding process and its preparation, the competition and finally implementation should thus be acquainted with the qualitative and quantitative characteristics of the contract, which should ideally remain the same over the course of the entire process.

In the case of contracts for construction-assembly works, technical characteristics comprise chiefly technological processes and procedures and the related choice of construction materials. Economic characteristics mean especially the price of the construction-assembly work (from the perspective of the contracting authority) and the necessary costs expended to implement the construction-assembly work (from the perspective of the contractor).

All characteristics are defined by the project documentation, its texts and drawings, which should be free of commonly occurring errors [1]. The economic supplement of a project documentation comprises a list of works, supplies and services with a bill of quantities. The list of works is further supplemented with the price of the individual works to constitute an itemised budget.

An important factor influencing the process of awarding a public contract is the fact that while the technical characteristics (defined by the project documentation) remain the same, the economic characteristics (price and costs) can change depending on external factors such as the general economic situation in the construction sector and the current offer of and demand for construction works [2].



A certain unifying element of economic characteristics can exist in the form of comprehensive price systems containing a clear technical definition of construction works. The use of these price systems in Czech public contracts is mandatory.

However, a challenge to costing construction works on the basis of price systems is posed by the fact that there can be multiple competing price systems, which can cause inaccuracies in costing and the resulting weaker position of the contracting authority. Price systems operate with so-called indicative prices of construction works, which are generally based on the national average. The indicative price is not binding on the contractor.

This paper aims to analyse the price systems in the Czech Republic and evaluate their influence on the final price of the public contract.

2. Price systems

Price systems serve as a basis for cost estimation, allowing to prepare an itemised budget for individual structures and the building (project) as a whole. They constitute a comprehensive system for construction production costing and contain databases of price lists for materials and construction-assembly works [3, 4]. Materials based on the price systems can subsequently be adjusted to reflect specific needs.

The use of price systems is historically associated with the effort to make construction production more efficient. The basis of the price systems is formed by the classification and numbering lists for the individual types of construction production (materials, construction-assembly works, wage tariffs etc.). Each construction work is defined by a set of resources and tasks that must be expended to implement it. Estimation of costs of a construction work is carried out using a cost calculation which includes all the costs plus reasonable profit. The costs are subsequently summarised using a calculation formula, the exact form of which is based on local customs or the nature of the subject of the contract [5, 6, 7].

3. Comparison of price systems

To analyse the differences between price systems and the bidding and indicative prices of construction works, we used the budgets submitted by various contractors within bids for public buildings. Budgets of basic building constructions were used preferentially. The comparison includes the price systems issued by two companies: ÚRS Praha, a.s. (hereinafter “URS”) and RTS Brno, spol. s r. o. (hereinafter “RTS”).

3.1. Analysis of the calculation formula

The calculation formula expresses the sum of the costs; in both price systems being compared, the following types of costs are included [3, 4]:

- Direct costs: (PN)
 - direct materials (H, main used materials)
 - direct wages (M, wages of production workers)
 - direct costs of machinery (S, construction machinery)
 - other direct costs (OPN, statutory social and health insurance contributions)
- Indirect costs: (NN)
 - production overhead (RV, costs associated with manufacturing)
 - administrative overhead (RS, costs associated with company administration)
- Profit: (Z)
 - profit (Z, company profit margin)

Direct costs are established in direct connection to the use of materials, machinery and human resources; indirect costs, on the other hand, are charged as a percentage of the base, which usually consists of the sum of direct costs excluding materials. Figure 1 shows a comparison of the calculation formulas of the individual price systems.

Figure 1 and Table 1 clearly demonstrate that the RTS system assigns a significantly higher percentage to production overheads in comparison to URS, which creates differences both in the overall price and the prices of the individual construction-assembly works. Nevertheless, both price systems use the same base for calculating overhead costs, which affects the final price.

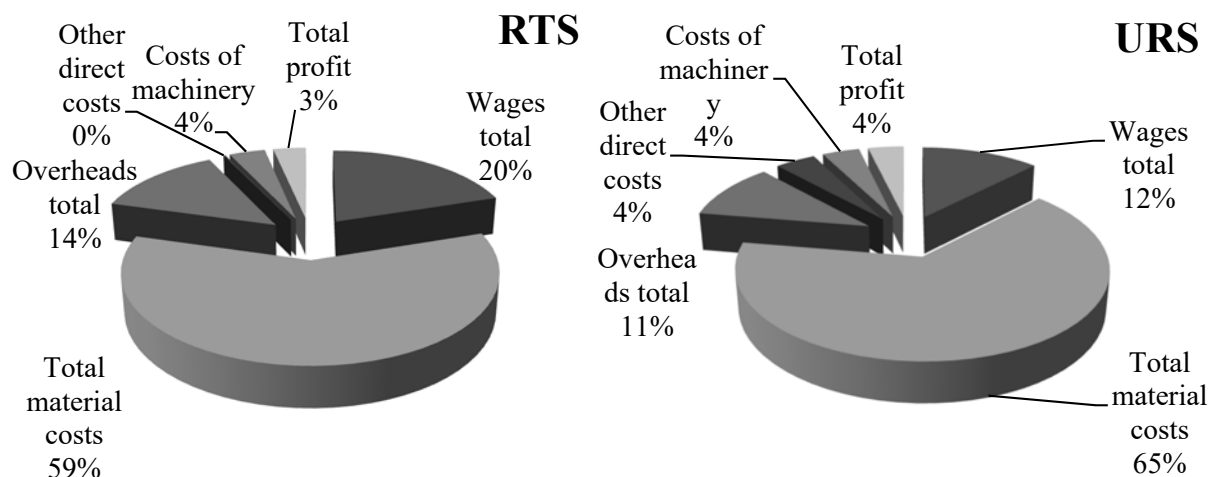


Figure 1. Comparison of the calculation formulas of the price systems [8]

Table 1. Analysis of the differences in calculation of overheads and profits between URS and RTS [9, 10]

Part of the calculation formula	RTS	URS
Production overhead	36%	14%
Administrative overhead	20%	20%
Profit	14%	12%

3.2. Analysis of wage costs

Direct wages costs form an important part of the final bidding price. In both price systems, wage costs are divided into performance tariffs according to the workers' qualifications. The amount of wages is also important in terms of its influence on the calculation of overhead costs.

URS price system [9] assigns wages on the basis of tariff classes and groups; all workers without exceptions are assigned into them based on their roles. In RTS [10], workers are classified based on tariff classes, which are then measured based on the work performed – ordinary construction works and other works. The comparison is clear from Tables 2 and 3.

Table 2. Analysis of wage costs in URS [9] (CZK/hour)

Tariff group	Tariff class		
	T1	T2	T3
S2	-	97.80	123.00
S3	82.50	110.00	132.50
S4	97.80	123.00	148.50

Table 3. Analysis of wage costs in RTS (CZK/hour) [10]

Ordinary construction works						
Class	3	4	5	6	7	8
CZK/hour	105.00	120.00	135.00	152.00	170.00	185.00

Tables 2 and 3 show significant differences among wage tariffs according to the individual jobs. For the sake of completeness, Table 4 compares wage tariffs for selected jobs with the average earnings according to the statistical methodology of the Information System on Average Earnings (*Informační systém o průměrném výdělků*, ISPV) of the Czech Ministry of Labour and Social Affairs [11]. ISPV is a system for regular monitoring of earnings and working hours of employees in the Czech Republic. The data obtained in regular statistical surveys are included in the programme of statistical findings announced by the Czech Statistical Office. The table indicates deviations from statistical values.

Table 4. Analysis of wage costs, comparison of URS, RTS and the national statistic (CZK/hour)

URS [9]		RTS [10]		ISPV methodology [11]	
Designation	CZK/hour	Designation	CZK/hour	Designation	CZK/hour
Worker S2,T2	97.80	concrete worker	135.00	Construction worker – concreting work	116.10
Machine operator S2,T2	97.80	Slinger	152.00	Slinger	111.80
Machine operator S3,T2	110.00	Carpenter	152.00	Formwork carpenter	116.70
Worker S3,T3	132.50	Bricklayer, class 6	152.00	Bricklayer	103.80
Worker S3,T3	132.50	Insulation worker, class 6	152.00	Construction worker – insulation work	116.10
Worker S3,T2	110.00	Steel fixer, class 6	152.00	Steel fixer – machine operator in prefabricated parts manufacturing	155.70
Worker S3,T2	110.00	Scaffolder	135.00	Scaffolder	116.10
Driver S3,T2	110.00	Driver, class 6	152.00	Mobile crane driver	143.40
Worker S3,T2	110.00	Prefabricated components assembler	152.00	Machine operator in prefabricated parts manufacturing	155.70
Worker S3,T1	82.50	Worker, class 3	105.00	Labourer in main construction production	88.00
Worker S3,T1	82.50	Plasterer	152.00	Stuccoer	116.10

3.3. Analysis of other differences

A closet analysis of direct costs of the individual construction-assembly works reveals that even with identical works, identical general material characteristics are not always used, or different technological procedures are considered (e.g. the use of different machine equipment).

Some construction-assembly works are indicated using different units of measurements, which may distort the total calculated quantities. The RTS price system also uses “aggregated items”, which represent combinations of multiple construction-assembly works within a single item. A disadvantage of aggregated items lies in the fact that the individual costs may be distorted by incorrect calculations.

The breakdowns of the individual items often use different inputs of standardised values of material, machine and human resources, which further affects the price calculation and the final price. An example of the different standardisation is provided in Table 5. The table shows the time (measured in standard hours) necessary for completing one measurement unit of the given construction-assembly work. The specific examples given include completion of strip foundations of mass concrete (Table 5a) and completion of foundation walls of sacrificial formwork blocks (Table 5b).

Table 5a. Cost analysis according to standard hours (CZK/unit of measurement) [9, 10]

Strip foundations of mass concrete					
URS			RTS		
Employee	Standard hour	CZK/Standard hour	Employee	Standard hour	CZK/Standard hour
Worker S2,T2	0.194	97.80	Concrete worker	0.194	135.00
Worker S4,T1	0.26	97.80	Worker	0.26	120.00
Machine operator S2,T2	0.13	97.80	Slinger	0.023	152.00
Total	0.584	293.40	Total	0.477	407.00
Total CZK/UoM		171.35	Total CZK/UoM		194.14

Table 5b. Cost analysis according to standard hours (CZK/unit of measurement) [9, 10]

Foundation masonry, formwork blocks					
URS			RTS		
Employee	Standard hour	CZK/Standard hour	Employee	Standard hour	CZK/Standard hour
Worker S3,T2	0.592	110.00	Concrete worker, class 6	0.14	152.00
Worker S3,T3	0.100	132.50	Bricklayer, class 6	0.94	152.00
Worker S4,T1	0.40	97.80	Bricklayer, class 8	0.14	185.00
Worker S4,T2	0.08	123.00			
Machine operator S2,T2	0.038	97.80			
Total	1.21	561.10	Total	1.22	489.00
Total CZK/UoM		678.93	Total CZK/UoM		596.58

4. Discussion

As the previous chapters demonstrate, the used price systems diverge especially in the following areas:

- different calculation formula for overhead costs, despite identical calculation base;
- different costs of direct wages;
- different technological procedures and machine equipment in identical construction-assembly works;
- different standards for materials consumptions and performance standard hours;
- different units of measurements.

Generally speaking, itemised budgets prepared using the URS price system operate with a lower indicative price than the itemised budgets prepared using the RTS price system. This fact is documented especially by the different calculation of overhead costs and the amounts of tariff wages.

The above overview indicates that the use of price systems in public contracts may lead to distorted prices. This is caused especially by the fact that the value of the public contract is set using just one price system. The contracting authority thus operates with a price which does not necessarily have to

provide an accurate picture. Given the above facts, the contracting authority must decide which of the price systems to use.

From the point of view of the bidder, there can be a significant consideration in the sense of the possibility to create a higher cost reserve with the assumption of a higher indicative price resulting from the use of the price system. Or, conversely, the assumption of competitive advantage in comparing the indicative price prepared in both used price systems. This problem can be studied further by conducting a questionnaire survey aiming to answer certain questions concerning individual calculations and the use of price systems.

5. Conclusions

In competitions for public contract, the main assessment criterion consists in the economic favourability of the offer. Economic favourability of the offer is defined as a proportion of the quality and price of the building; in some cases, the lowest bidding price may be the only criterion. In submitting their offers, bidders are partially bound by the use of price systems. However, the price system may include their individual calculations and costs. As noted earlier, wage and overhead costs are the most significant. In order to succeed in the tender procedure, it is important to carefully determine the individual calculation formula and reduce these costs, if possible.

From the perspective of the contracting authorities, which first operate with the indicative price and, subsequently, with the bidding prices, the awarding of project documentation and the selection of a suitable price system is important. It must be noted, however, that the final tender price is mostly determined by market conditions.

Acknowledgment

The project presented in this article is supported by research grant FAST-S-18-5154 entitled “Management podnikových nákladů a nabídkových cen ve stavebnictví” (*Company costs and tender prices management in the construction sector*).

References

- [1] M. Juszczak, R. Kozik, A. Lesniak, E. Plebankiewicz, K. Zima, “Errors in the preparation of design documentation in public procurement in Poland”, *Procedia Engineering*, vol. 85, pp. 283-292, 2014.
- [2] T. Hanák, “Electronic reverse auctions in public sector construction procurement: Case study of Czech buyers and suppliers”, *TEM Journal*, vol. 7, no. 1, pp. 41-52, 2018.
- [3] L. Hajčkalová, “Kalkulace a rozpočtování staveb” (*Building calculations and budgeting*). Praha: Vysoká škola ekonomická, 1998. ISBN 80-7079-010-5. (in Czech)
- [4] H. Kalivodová, “Kalkulace cen stavebních prací a materiálů: praktické postupy pro tvorbu rozpočtů a oceňování stavebních prací” (*Calculating prices of construction works and materials: practical procedures for budgeting and costing of construction works*), Praha: Verlag Dashöfer, 2005. ISBN 80-86897-05-2. (in Czech)
- [5] B. Dimitrov, V. Žileska-Pančovska, “Structure of price elements for construction works on water engineering systems”, *Gradevinar*, vol. 67, no. 4, pp. 363-368, 2015.
- [6] S. Bezak, “Change in price structure of construction work”, *Gradevinar*, vol. 55, no. 8, pp. 457-461, 2003.
- [7] C. Pasquire, A. Pennanen, G. Ballard, Y. Haahtela, “Target costing and designing to targets in construction”, *Journal of Financial Management of Property and Construction*, vol. 16, no. 1, pp. 52-63, 2011.
- [8] P. Pospíšilová, “Analýza rozdílů mezi směrnou a nabídkovou cenou stavby” (*Analysis of the differences between the target and the offer price of construction*), Brno, 91 p., Brno University of Technology, Bachelor Thesis, 2017. (in Czech)
- [9] ÚRS Praha, “Příručka rozpočtáře: rozpočtování a oceňování stavebních prací” (*Budgeter's handbook: budgeting and costing of construction works*). Praha: ÚRS, Cenová soustava ÚRS.

- 206 p. ISBN 978-80-7369239-1, 2009-., available at: www.urs.cz (in Czech)
- [10] Cenová soustava RTS (*RTS price system*), available at: www.rts.cz/cenova_soustava (in Czech)
- [11] ISPV - Informační systém o průměrných výdělích (*Information System on Average Earnings*).
Available at: <http://www.mpsv.cz/ISPV.php?sfera=1&sz=7&txt=&ok=Najdi&szp=3> (in Czech)