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Impact of funding on cost-time aspects of public and social buildings

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Subject review

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Impact of funding on cost-time aspects of public and social buildings

The comparison of the traditional (budget-funded) public building procurement model with the public private partnership (non-budget funded) model is presented in the paper. Public service buildings procured based on the traditional model and those procured according to the PPP model are compared in the scope of research involving nine buildings realized in the Republic of Croatia. The results point to greater efficiency of the PPP model in the construction of public service buildings, with regard to both cost and time of construction work.

Key words:

traditional procurement model, PPP, public service buildings, costs, construction time

Pregledni rad

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Utjecaj načina financiranja na troškovno-vremenske aspekte javnih i društvenih građevina

U radu je prikazana usporedba tradicionalnog (proračunskog) modela nabave javnih i društvenih građevina s modelom javno-privatnog partnerstva (neproračunski model). Istraživanjem kojim je obuhvaćeno devet izgrađenih građevina s područja Republike Hrvatske, usporedno su analizirane javne i društvene građevine isporučene tradicionalno i po modelu JPP-a. Rezultati pokazuju veću efikasnost JPP modela u izgradnji javnih i društvenih građevina unutar planiranog proračuna i roka građenja.

Ključne riječi:

tradicionalni model nabave, JPP, javne i društvene građevine, troškovi, rok građenja

Übersichtsarbeit

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Auswirkungen der Art der Finanzierung auf die Kosten-Zeit-Aspekte öffentlicher und sozialer Bauten

In der Abhandlung wird der Vergleich des traditionellen (Haushalts-)Modells der Beschaffung öffentlicher und sozialer Bauten mit dem Modell der öffentlich-privaten Partnerschaft (Nicht-Haushalts-Modell) dargelegt. Bei der Untersuchung, mit welcher neun errichtete Gebäude auf dem Gebiet der Republik Kroatien umfasst wurden, wurden parallel öffentliche und soziale Bauten, die auf traditionelle und nach dem ÖPP-Modell ausgeliefert wurden, analysiert. Die Ergebnisse zeigen eine höhere Effizienz bei den ÖPP-Modellen beim Bau öffentlicher und sozialer Gebäude innerhalb des geplanten Haushalts und der Baufrist.

Schlüsselwörter:

traditionelles Beschaffungsmodell, ÖPP, öffentliche soziale Bauten, Kosten, Baufrist

1. Introduction

Public service buildings (PSB) are buildings that are used for conducting public sector activities such as those related to upbringing, education, teaching, science, culture, sports, healthcare, social welfare, national administration bodies and organisations, local and regional government units, citizen associations and religious communities, and for other similar activities [1].

Such buildings are usually funded using a traditional procurement model. In this traditional model, a public body assumes the role of the investor and owner of the public building, while also assuming all risks throughout the life of the project. Such public body usually defines the quantity and quality of works, and the building is built by private entrepreneurs that are awarded the contract via public bidding. The public body secures the funding needed to undertake the construction work (most often by obtaining loan) and, after construction, it becomes the owner of the building and assumes the obligation to maintain it throughout the life-cycle of the building [2].

At the level of the Republic of Croatia, there is a pressing need for public service buildings, which creates an additional pressure on the already burdened public sector that is faced with the lack of funds and with severe budgetary constrains. Attempts are being made to solve the problem by investing private capital into public service buildings, i.e. by making use of the practice known as the public-private partnership (hereinafter referred to as: PPP), which is implemented in practice through several distinct models [3, 4]. The government of the Republic of Croatia is aware of the possible role of PPP in the realisation of new public service buildings and, in this respect, it has issued a Framework Programme [5] through which it intends to fulfil current needs for the construction, extension and

renovation of such buildings through the PPP model. The PPP is the model involving a long-term contractual partnership between the public and private sectors. It can comprise financing, design, construction, operation and/or maintenance of infrastructure, and/or provision by private sector of the services that have so far been traditionally reserved to and provided by public sector. The PPP model offers new business possibilities in projects of general public interest, which have thus far been funded solely from national or local budgets [6].

A project is realized according to the PPP model only after a detailed analysis of all its phases (analysis of risks, preparation and development of the project, selection of private partner, etc.) [7], and after it has been established that it provides good value for money through a public sector cost comparator (Figure 1). Some authors [8] define the value for money as the best combination of the quantity, quality, features and costs as expected throughout the entire life-cycle of the project, or it is often simply stated that the value for money is the real value for the funds invested. The

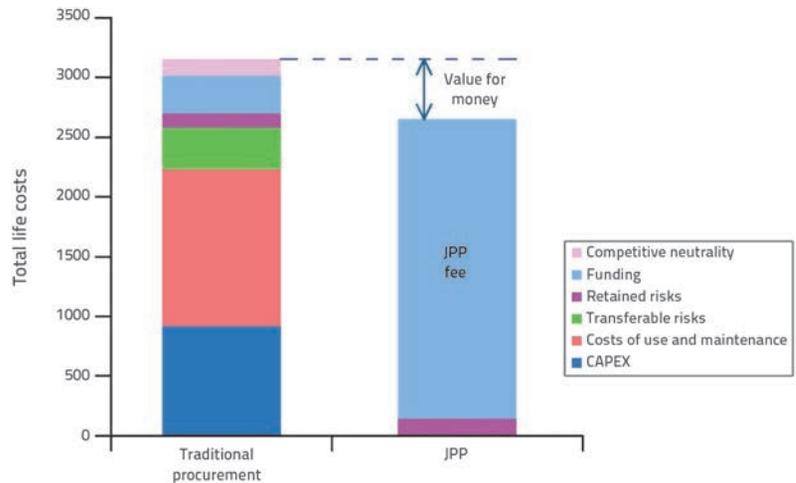


Figure 1. Value for money in PPP projects [11]

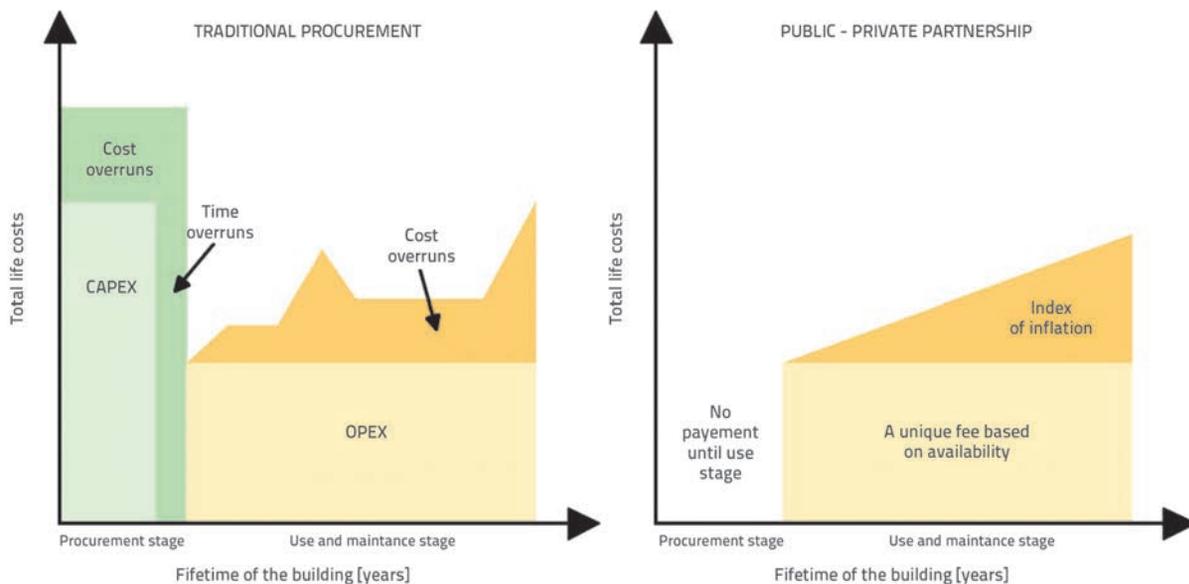


Figure 2. Comparison of traditional and PPP building procurement models [12]

public sector cost comparator is defined in the Public-Private Partnership Act [9] as the comparison of the present value of total costs within the specified time of the project according to the traditional procurement model, as compared to the same type of costs based on the PPP model. If the expected present value of total life-cycle costs based on traditional model is higher than the total life-cycle costs according to the PPP model, then it is considered justified to procure the building according to the PPP model as it can reasonably be expected that the implementation of this model will lead to savings in public expenditures [10].

A significant difference between the procurement models lies in the structure and allocation of costs (Figure 2). In case of traditional model, the costs incurred by the client occur in form of capital and operative costs, i.e. from the earliest phases of implementation of the project and until the end of its useful life and, at that, the project is burdened by construction time delays and cost overruns in all cost categories and, sometimes, by questionable quality standards during the life-cycle of the building. In case of PPP model, the client incurs costs during the use of the building and this in form of a fee that is dependent on the extent of services that have been agreed upon [2].

International research focusing on comparison of construction projects as related to procurement model used, reveals greater success of PPP projects in terms of costs, time, quality aspects and maintenance of buildings, when compared to the traditional model [13-22]. This research is also of interest to the Republic of Croatia, and the present paper is a contribution in this direction. The paper analyses in parallel public buildings in the Republic of Croatia, procured traditionally and according to PPP model, and this from the standpoint of cost and time. The aim of the paper is to present the results of the analysis, interpret these results, and point to the advantages and shortcomings of these models in the procurement of public sector buildings.

2. Overview of legal basis and current state of the art

The legal basis for the use of PPP in Croatia has been set based on the positions formulated by the European Union in its Green-Paper on Public-Private Partnership and Community Law on Public Contracts and Concessions [23].

First PPP contracts were concluded in the Republic of Croatia in 2006 and 2007, and the first law covering this area was passed in 2008. The current legal framework has been set by the Public-Private Partnership Act (Official Gazette 78/2012), Ordinance on implementation of PPP projects (official Gazette 88/2012), Byelaw on structuring and keeping register of PPP contracts (Official Gazette 16/2013), Byelaw on low-cost PPP projects (Official Gazette 23/2015), Public procurement Act (Official Gazette 120/16), and Concession Act (Official Gazette 69/17) [24].

Due credit must also be given to support documents - handbooks issued in 2012 by the Public-Private Partnership Agency which, each in its own segment, provide a valuable assistance to public clients and private partners by clarifying significant issues relating to preparation, procurement and implementation of PPP projects

(discounting, establishment of financial model, preparation of the public sector cost comparator, contract structuring, selection of private partners, advice on risk identification and allocation, etc.) [3, 4, 25].

The government of the Republic of Croatia has recognised the PPP potential and, in this respect, it defined in 2012, in the document entitled *Framework program for the construction, extension and renovation of public buildings according to the PPP form of contract* [5], its intention to meet through PPP the current needs of the country regarding construction, extension and renovation of buildings used in the fields of science, upbringing and education, school system, healthcare, legislature, culture, social care, defence, etc., as it has been established that considerable investments in this infrastructure are needed on the nationwide level [3-5]. It is emphasized in the Framework Programme [5] that the "contractual form of PPP has been recognised as a model that enables much faster implementation of such a demanding and extensive programme, and as a model through which conditions can be created in the Republic of Croatia for good-quality realisation of projects". In addition, "the public building procurement method implemented so far has resulted in non-uniform standards, and in the non-uniform quality and price of construction" and "investment realisation models used so far in this area are not considered satisfactory, both with regard to the investment realisation rate, and the quality and cost of projects, which resulted in time and cost overruns, and in various deviations in the realisation of public buildings" [5].

The key question is whether the PPP model can really enable a more successful realisation of the public building construction program, as compared to the traditional model. Numerous studies have been conducted worldwide to answer this question (Table 1) [13-22]. In addition to public service buildings, these studies also focus on other infrastructure projects. Duffield [13] points out that the main problem in such studies is the lack of data for an overall comparison between PPP projects and traditional projects. The data on lifetime cost of traditional projects are very often missing, and it is precisely these data that are very important for PPP projects. Furthermore, some authors [26, 27] emphasize that a clear system for the standard of space and services has not been established in the traditional procurement model, while the opposite is true in PPP projects where this system is the basis for achieving value for money. This fact makes it even more difficult to objectively consider the influence of procurement model on the final value for the taxpayers' money.

The comparison of the two models mainly involves measurement of project success from the aspect of time and cost, i.e. measurement of the planned construction time and cost overrun. In the Mott MacDonald study [14], the "optimism bias" is defined as the "tendency for a project's costs and duration to be underestimated and/or benefits to be overestimated". It is expressed as the percentage difference between the estimate at appraisal and the final outturn (in terms of cost and time). The following formula (1) is used in calculation:

$$\text{Optimism bias} = 100 \cdot \frac{\text{actual value} - \text{planned value}}{\text{planned value}} \% \quad (1)$$

The estimate of typical levels of "optimism bias" provides the public sector with a level of confidence with regard to the planned costs and project duration, and expected benefits. In public sector, the objective of risk management is to eliminate the issues that cause time and cost overruns, and benefit shortfalls. Project costs, duration, and benefits are considered to be optimistic when they do not fully reflect the chances of cost and time overruns or shortfalls in the delivery of project benefits. At any stage during the project life-cycle, the project costs and time required to deliver the project benefits are difficult to forecast accurately. Evidence has shown that public sector estimates tend to be optimistic. It is important that the appraisal of costs, duration and benefits should include assessments of, and allowances for, the associated risks and uncertainties. An appraisal should also assess the risks and uncertainties associated with project risk areas that have not been valued monetarily [14]. The results of individual studies, given in Table 1, are presented as average values.

These studies have not been systematically conducted in the Republic of Croatia. It is only recently that Juričić and Marenjak [26] have conducted a research focusing on the value for money in Croatian PPP projects. Based on the sample of ten projects, they concluded that the use of the PPP model may increase the possibility of achieving greater value for taxpayers' money. In both models they proposed a similar system of space and services standards over the total life-cycle of public buildings as

this would, according to these authors, lead to a higher value for the money taxpayers spend for procurement of public projects and for the delivery of public services made possible through realisation of such projects.

The results presented in Table 1 show that PPP projects are more successful from the aspect of cost and time compared to traditional procurements. On an average, overruns are smaller in PPP projects, both with regard to cost and time of construction. Previous studies also point to a higher construction cost in case of PPP projects. Blanc-Brude [20] considers that higher cost of PPP projects is due to the transfer of construction risk from public to private partner and to the use of better-quality materials so as to achieve a higher quality of services and reduce maintenance cost, i.e. the cost over the total life-cycle of the building. In case of projects realised through traditional procurement in the Republic of Croatia, the construction work tendering procedures used to be conducted until entry into force of the new Public Procurement Act [24], based on the lowest price principle, which greatly influenced the quality of construction work and often resulted in higher cost of building maintenance [2]. After implementation of the new Act, the economically most advantageous offer was introduced as an obligatory criterion. Hanak [28] indicates that the lowest cost practice in project procurement is still present in a number of countries.

In the traditional procurement model, project-related activities (design, construction) are mostly realised separately [29].

Table 1. Overview of studies involving comparison of cost-time aspects of projects as based on procurement model (prepared by the authors)

Study	Number of project under study	PPP results		Traditional procurement model results	
		Construction costs	Construction time	Construction costs	Construction time
Treasury Taskforce, 2000 [15]	21	17 % of cost savings	-	-	-
Mott-MacDonald, 2002 [14]	50	1 % of planned cost overrun	- 1 % of planned time overrun	47 % of planned cost overrun	17 % of planned time overrun
Haskins, Gale i Kelly, 2002 [16]	<10	30-40 % of cost savings	-	-	-
NAO, 2003 [17]	37	78 % of projects within planned costs	76 % of projects within planned time	27 % of projects within planned costs	30 % of projects within planned time
Fitzgerald, 2004 [18]	8	9 % of cost savings	-	-	-
Allen Consulting Group, Duffield i Raisbeck, 2007 [19]	54	11.6 % of planned cost overrun	13.2 % of planned time overrun	35.3 % of planned cost overrun	25.6 % of planned time overrun
NAO, 2008 [17]	114	65 % of projects within planned costs	69 % of projects within planned time	54 % of projects within planned costs	63 % of projects within planned time
Duffield, 2008 [13]	67	23.8 % of planned cost overrun	17.4 % of planned time overrun	52 % of planned cost overrun	15.4 % of planned time overrun
Blanc-Brude, Goldsmith i Väililä, 2009 [20]	227	24 % of planned construction cost overrun	-	-	-
Chasey, Maddex i Bensal, 2012 [21]	12	0.81 % of planned cost overrun	- 0.30 % of planned time overrun	12.71 % of planned cost overrun	4.34 % of planned time overrun
Atmo, Duffield, Zhang i Wilson, 2017 [22]	56	5.4 % of planned cost overrun	54 % of planned time overrun	5.3 % of planned cost overrun	83 % of planned cost overrun

This separate realisation sometimes generates problems as to technical feasibility of design solutions, which leads to modification of design solutions. Separate realisation of these phases does not enable the use of a possible synergic effect that could be generated as a result of this synergy. This primarily concerns the use of contractor's knowledge and experience already at the design stage. According to the Lawrence National Centre for Policy and Management [30], these problems could result in a lower quality of work, in cost overruns, and in failure to respect time limits set for completion of construction work, which is often the case in real-life situations. In traditional procurements, the public body assumes the role of the investor during preparation and realisation of the project, and finances construction directly from the budget or through loans and, after construction, it assumes the role of the owner, and is responsible for the maintenance of its infrastructure. The private sector assumes responsibility only during the design and construction, i.e. until completion of construction works. The public sector assumes the risk of possible project cost overrun, which may arise from problems and delays during construction work. In the PPP model, project phases, i.e. design, construction and maintenance of the building, are integrated in a single contract [31], which is aimed at finding the best possible way to provide the required services within the contract time. The private sector is responsible for initial financing of the project and for implementation of all stages of the project, throughout the duration of the contract. Public sector becomes the purchaser of services, and private sector assumes the role of investor and, temporarily, the role of the owner. The private partner is required to keep the constructed facility/building in good state of repair, so that basic public services can be provided in such facility/building. The public partner is required to pay a fee to the private partner for the delivery of services [2].

According to report provided by Clayton Utz [32], yet another factor that influences successful realisation of PPP projects is the high level of stringency loan providers apply during estimation and monitoring of the project, when all delays and deviations from planned objectives are penalised. In addition, the private partner is highly motivated to complete the project on time because of financial incentives built into the PPP model. The payment of services by the public partner starts only after the building has been completed and service rendered. The success of PPP projects is also due to additional effort public partner invests in the preparation of PPP projects. The reason for this is the long-term nature of PPP projects, their high value, and participation of financial agencies.

The above statements show that the PPP model has partly solved the problems burdening the traditional project-realisation model. These problems are related to construction risks, i.e. construction time and cost overruns, and to a more economical behaviour during all phases of the project.

However, the participation of entrepreneurs in the realisation of public tasks also brings some risks. In fact, one of significant characteristics of the PPP model is an appropriate allocation

of risks between the public and private partners, the aim being to make the contract implementation process as efficient as possible, and to reduce the probability of disputes during the life-cycle of the building [33]. Risks must be allocated to the party that has at its disposal better techniques for alleviating such risks [34]. Regardless of contract-based allocation of risks, there are some other risks that must be taken into account, and that must be explained in due course to both public and private partners. This will reduce possible negative effects of such risks. At that, a significant element is an appropriate education and knowledge the parties must have about PPP models. In case of complex, long-term and financially demanding contracts, negative effects of contract errors and oversights can be avoided by thorough understanding of the problem. In any case, it is important that the public partner be aware of the need to play an active role at all stages of the project. This active role becomes particularly prominent at the stage of design and implementation, as lapses in the quality and functionality of the building can be avoided by appropriate requests and interventions by the public partner. Obviously, properly articulated requests by the public partner with regard to reporting obligations are an important precondition enabling this partner to be well informed and capable of assuming an active role in the project. Some PPP risks identified by the World Bank Group are presented below [35].

"Development, bidding and ongoing costs in PPP projects are likely to be greater than for traditional procurement processes - the public sector should therefore determine whether the greater costs involved are justified, i.e. it must be determined whether the PPP project will generate the value for money during the life-cycle of the project. There is no unlimited risk bearing - private companies will be cautious about accepting major risks beyond their control. If they bear the risk, then their price will reflect this. Private sector will do what it is paid to do and no more - therefore incentives and performance requirements need to be clearly set out in the contract. Government responsibility continues - citizens will continue to hold government accountable for the quality (and lack of quality) of utility services. The public sector will also need to retain sufficient expertise to be able to understand the PPP arrangements, to carry out its own obligations under the PPP agreement and to monitor performance of the private sector during implementation of the project. The private sector will probably have more expertise and after a short time have an advantage in the data relating to the project. It is important to ensure that there are clear and detailed reporting requirements imposed on the private operator to reduce this potential imbalance. A clear legal and regulatory framework is crucial to achieving a sustainable solution. Given the long-term nature of these projects and the complexity associated, it is difficult to identify all possible contingencies during project development and events and issues that may arise during implementation of the contract. It is more likely than not that the parties will need to renegotiate the contract

to accommodate these contingencies. It is also possible that some of the projects may fail or may be terminated prior to the projected term of the project, for a number of reasons including changes in government policy, failure by the private operator or the public partner to perform their obligations or indeed due to external circumstances such as force majeure, including natural disasters of measures taken by competent administration that prevent realisation of work. While some of these issues will be able to be addressed in the PPP agreement, it is likely that some of them will need to be managed during the course of the project" [35].

Of course, these risks are also present in the PPP projects realized in the Republic of Croatia. As already indicated, the government of the Republic of Croatia has recognised true potential of PPP projects with regard to the realisation of an extensive and demanding public infrastructure program, especially as considerable needs have been identified in all parts of the country. At that, it should be emphasized that the PPP model is also an opportunity to solve current problems involving nonuniform standards with regard to the price and quality of such buildings, and the problems of frequent time and cost overruns, as has also been pointed out by the government in its Framework Program [5]. It is therefore important to stress that the above-mentioned potential risks should not be allowed to prevail and curb possibilities for realisation of the PPP potential, i.e. for implementation of this significant program.

Some authors [36] indicate that correct estimation of risk, provision of value for money, and protection of public interests and end users, are crucial for PPP projects, and that all this can only be achieved through an optimum identification, evaluation, distribution and management of risks from the perspective of the project life-cycle, as well as through harmonisation of interests between public and private partners, and end users of products and services.

3. Research objective

3.1. Research problem

According to information published in this field, the PPP significance has been rising in a number of countries [37]. The oncoming years will show whether advantages of the PPP model in the realisation of projects will reach their full expression in the Republic of Croatia. This field requires detailed analyses and comparison of PPP projects with similar projects based on traditional procurement processes [38]. The objective of the PPP procurement is to achieve a more economical, effective and efficient way of supplying public services and products [39, 40]. It will however be necessary to prove in practical terms whether the PPP can actually fulfil this objective. As construction industry has a poor record with regard to the overrun of planned construction time and cost [41], it is very interesting to compare project cost and time aspects between the two models. Only results obtained by calculation - based on collection of real-life data, scientific processes and analyses - can be considered as a realistic basis for making conclusions and for future-project planning.

3.2. Research hypothesis

Public buildings realized in the Republic of Croatia according to the PPP model exhibit lower cost and time overruns, and are more economical during realisation and use of buildings, when compared to buildings based on traditional procurement processes.

3.3. Research strategy

Based on data collected on public buildings realised in the Republic of Croatia, the cost and time aspects of these projects are compared, depending on whether they were procured traditionally or based on the PPP model. It is necessary to recognise benefits and deficiencies of both procurement models, and to present measures and recommendations for improvement. The research is presented in greater detail in Section 4.

4. Presentation of research

The research was conducted so as to determine differences in time and cost aspects between the projects involving construction of public buildings funded from the budget, and similar projects financed according to the PPP model. The data on public buildings realised in the Republic of Croatia were gathered for the purposes of this research. The following methods were used to collect the data:

- Interview: The semi-structured type of interview was conducted. In this type of interview, the respondents were not asked the same questions but rather the questions were put in accordance with professional profile of respondents. The objective was to obtain the data about general characteristics of the buildings such as the area, intended use, planned and actual cost of construction, construction time, estimate of maintenance and use costs, and information about possible problems that occur during the building use. When answering the questions, the respondents were also invited to provide their opinion and observations.
- Study of documents: the documents obtained from respondents, and the documents found on the Internet, were analysed [42-45].

The research covered nine public buildings located in the Republic of Croatia. Five of them were built based on the traditional procurement model, while the remaining four were built using the PPP model. The buildings were built in the second half of the past century and in the beginning of this decade. The buildings were analysed by conducting interviews involving participation of main participants in the projects - project sponsors and project managers, management board members, and managers and professionals involved in particular segments of the work - finance managers, personnel managers, technical service managers, and users. In addition to interviews, all available documents about the buildings were analysed in full detail. Apart from procurement model, the buildings also differ according to their occupancy, technical and architectural complexity, type of construction contract, total construction cost, etc.

Table 2. Public building data analysed in the research (prepared by authors)

Procurement model	Traditional procurement model				
	1.	2.	3. [46]	4. [46]	5. [46]
Occupancy	Sport	Sport	Education	Education	Education
Gross area * 1 000 (m ²)	14.1	27	14.3	21	16.4
Planned construction cost * 1.000.000 (kn)	100	190	-	-	-
Real construction cost * 1.000.000 (kn)	135	290	97	135	97
Construction cost per m ² * 1.000 (kn/m ²)	9.6	10.7	6.8	6.4	5.9
Planned construction time (years)	1	1.5	2.5	2	2.5
Real construction time (years)	1	5	3.2	3.5	5
Monthly cost during use * 1.000 (kn)	110	345	150	225	173
Procurement model	Public-private partnership				
	6.	7.	8. [46]	9. [46]	
Occupancy	Sport	Sport	Education	Education	
Gross area * 1.000 (m ²)	20.2	28.5	13.1	2.6	
Planned construction cost * 1.000.000 (kn)	181	300	-	-	
Real construction cost * 1.000.000 (kn)	200	380	75	13	
Construction cost per m ² * 1.000 (kn/m ²)	9.9	13.3	5.7	5	
Planned construction time (years)	1.2	1.2	1	<1	
Real construction time (years)	1.2	1.2	1	<1	
Monthly cost during use * 1.000 (kn)	2 800	3 100	880	97.5	

Building characteristics, i.e. the building data considered significant with regard to the theme and objective of the research, are briefly presented in Table 2. Construction costs are presented as net values, not including the VAT.

The information about the names of the buildings can be obtained from the authors of this paper.

Table 2 contains data about the gross area, planned and real construction values (design, construction and supervision), planned and real construction time, and monthly cost incurred by users during the life-cycle of the building. The comparison of planned and real costs shows that, in both models, the real costs increase significantly when compared to planned costs. Furthermore, it can be seen that the information on planned cost is missing from some buildings for both models. This is due to difficulties incurred during collection of data, especially financial ones, from both investors and contractors. When planned and real construction periods are compared, the advantage is clearly on the side of the PPP model. In fact, it can be observed that all buildings were completed on time. This is quite expected as private investors usually assume the building-availability risks. In the traditional procurement model, monthly costs during the life-cycle of the building include the overhead, maintenance and

cleaning costs. These costs do not take into account financing costs, and the costs of retained and transferable risks. In the case of PPP buildings, monthly use costs consist of the use and maintenance fee. The cost of financing and the cost of retained and transferable risks are included in this fee. It is important to note that these monthly use costs are expressed from the aspect of the monthly financial cost incurred by the user depending on the procurement model selected. It should also be pointed out that all users of the buildings built according to the PPP model have expressed satisfaction with the speed of response and removal of deficiencies on their buildings. At the same time, some users of buildings built according to the traditional model have expressed dissatisfaction with deficiencies noted on the buildings, with contractor response when asked to remove such deficiencies, and with the quality of removal of deficiencies within the defects liability period.

5. Comparison of procurement models and research hypothesis testing

The following algorithm will be used to compare the models and test the research hypothesis:

Procurement model comparison indicators will be established. Indicator values will be calculated for the traditional model and the PPP model.

Indicator values will be compared and appropriate explanations will be given.

Based on the results from the above item, the assertions made in the hypothesis will be either confirmed or refuted.

5.1. Procurement model indicators used in comparison

Based on the entire research and hypotheses set for comparison of procurement models, the following quantitative and qualitative indicators have been defined:

- Construction costs per square meter of gross area of the building.
- Construction cost variation coefficient, per square meter of gross area of the building.
- Planned construction cost overrun.
- Overrun of construction time specified in contract.
- Construction time variation coefficient.
- Financial cost during the life-cycle of the project.
- Qualitative model-application indicators.

5.2. Comparison of construction costs per square meter of gross area

By comparing costs per on square meter of gross area, it was established that the price of sports buildings built according to the PPP model exceeds the price of the buildings built according to the traditional model by 14 %. The situation is almost exactly the opposite in the case of educational buildings. In traditional procurement model, the price per square meter of educational buildings exceeds that of PPP buildings by 19 %.

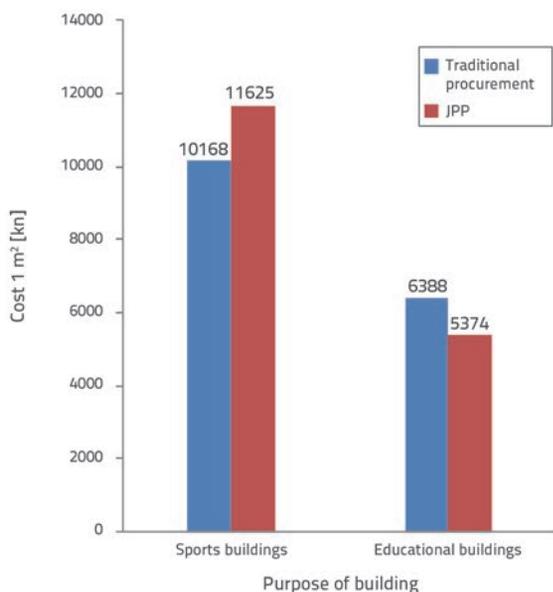


Figure 3. Comparison between traditional and PPP procurement models based on construction cost per square meter of gross area

A possible explanation lies in the complexity of design solutions. As sports facilities are often built for large sports events for which stringent requirements must be met, the solutions are likely to be more complex and hence more expensive. Higher cost may also be due to complex aesthetic and shaping solutions often used for such buildings. This can be more pronounced in situations when PPP model is used, i.e. when the public client does not need the have at its disposal all required funding at the start of the project. In the case of educational buildings, usual design solutions are often adopted, especially in PPP models, as it is more likely that the expected value for money will thus be obtained, and there are no specific reasons/nor requirements to seek solutions that exceed usually applied standards. As to maintenance, such buildings are more predictable and simpler, which is a factor that is usually taken into account by private investors. In traditional procurement models, public investors are sometimes inclined to use more complex design solutions, especially if they managed to secure sufficient funding. These data are graphically presented in Figure 3.

5.3. Comparison of construction-cost variation coefficients per square meter of gross area

The coefficient of variation or variation coefficient is adopted as statistical parameter for defining the extent of uniformity of construction work undertaken in the Republic of Croatia in terms of cost, time, quality or other indicators. The coefficient of variation is defined as the ratio of the standard deviation to the arithmetic mean. It is expressed as percentage [47]. The lower its value, the less the data are dispersed around the arithmetic mean.

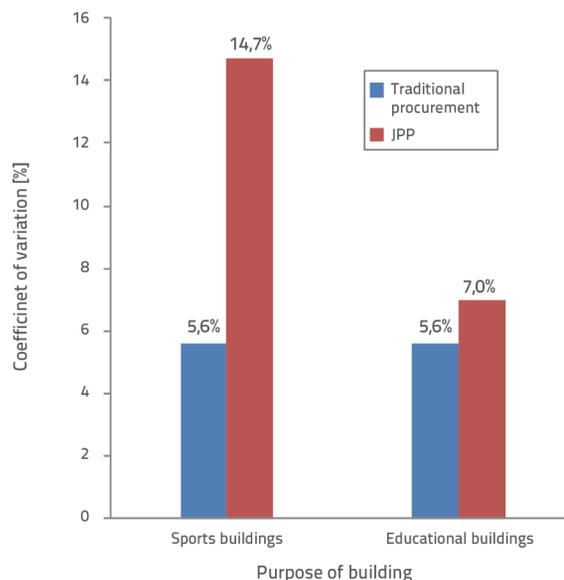


Figure 4. Comparison between traditional and PPP procurement models based on construction cost variation coefficients per square meter of gross area

The coefficient of variation of construction cost per square meter of gross area amounts to 36.7 % for PPP buildings, while

it is 24.1 % for traditional procurement processes. Although large sets of data are usually used for calculating the coefficient of variation, even this small sample is sufficient to recognise cost variation in case of construction of public buildings. When sports and educational buildings are viewed separately, the coefficients of variation values are as shown in Figure 4. The results show greater uniformity of construction cost per square meter of gross area in case of traditionally procured buildings, while somewhat greater oscillations can be observed in case of PPP projects. The oscillations are greater for PPP sports buildings, which can be explained by reasons already given in previous section.

5.4 Comparison of planned construction cost overruns

Planned construction cost overruns of buildings under study, and construction period overruns, are given in Figure 5.

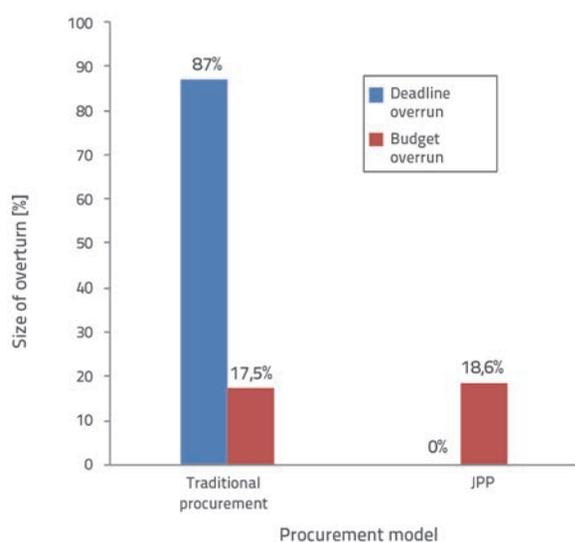


Figure 5. Cost and time overruns for traditional and PPP procurement models

The overrun values were obtained on the basis of the "optimism bias", i.e. the real cost value is first reduced by the planned value, and is then divided by that value. The result is expressed in form of percentage. The diagram shows somewhat greater, but not much greater, overrun of construction cost in case of PPP buildings. It can be said that this result is, in general terms, unexpected. In fact, it could be expected that the cost burden will be significantly lower in case of PPP buildings, compared to traditional ones. However, in the case under study, the traditionally procured education buildings were built based on the "turnkey" system, and so the construction cost could not in fact be exceeded. In the case of "turnkey contracts", contractors construct buildings based on cost estimate descriptions, design documents, and possibly descriptions provided by the client, for the price that is fixed and invariable. If a quantity is wrongly calculated in the cost estimate, or if some works from the cost estimate are wrongly presented

or are not presented at all, the contractor does not have the right to claim additional cost [48]. If the said buildings were not constructed based on the turnkey system, then - according to the estimate made by the project manager - the cost overrun would amount to 10 % of the initial investment, and the results would show that cost overruns are almost two times greater in case of traditionally procured buildings compared to PPP projects, i.e. the cost overrun would amount to 33 %. Based on current practice, such result could be considered as expected, as already stated in the introduction.

5.5. Comparison of planned construction time overruns and construction time variation coefficients

In case of traditional procurements, an average overrun of construction time amounts to 87 %, while all PPP projects under study were built within the time defined in the contract, i.e. on schedule. According to Radujković [1], the causes of such great overruns usually lie in an unrealistic and overoptimistic planning, short construction time, design changes, financing conditions, adverse weather conditions, delay in delivery of materials and parts, insufficient manpower, relations between participants, poor preparation and organisation, inaccurate technical documentation, etc. On the other hand, timely delivery of PPP projects is understandable because of significant characteristic of PPP projects. The building availability risk the private partner has to assume, i.e. the penalties it has to pay in case the building is not available (delivered) on time, influence the respect of contract deadline significantly. Every available measure is taken to avoid payment of - often very high - penalties. In addition, completion on time also means the start of provision of services, i.e. the start of payment of services by the user, and payment of fee by the public partner.

The construction time variation coefficient calculated per one square meter of area amounts to 40 % for traditional procurements, while this coefficient is lower for PPP projects and amounts to 24 %. In other words, the results for PPP projects are more uniform, i.e. they vary less around the arithmetic mean. This is understandable in the light of previous explanations.

5.6. Comparison of financial costs during life-cycle of projects

The analysis of public sector costs during life-cycle of projects was based on data collected by comparison of average values, separately for sports and separately for educational buildings. In the PPP model, public sector incurs no costs during the construction work, i.e. it incurs costs only after the building becomes operational and then in form of a PPP fee. Figures 6 and 7 show public sector cost variations over 25 years for sports and educational public buildings procured traditionally and according to the PPP model. The cost of construction, operation and maintenance is presented for the traditional model, while only a monthly fee is presented for PPP projects.

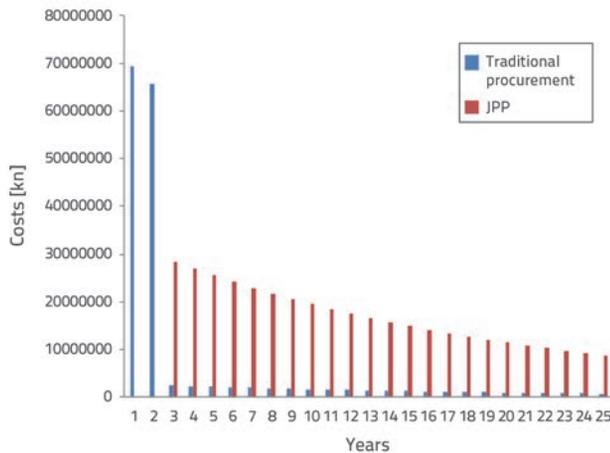


Figure 6. Public sector costs over 25 years for procurement of a sports building using traditional and PPP procurement models

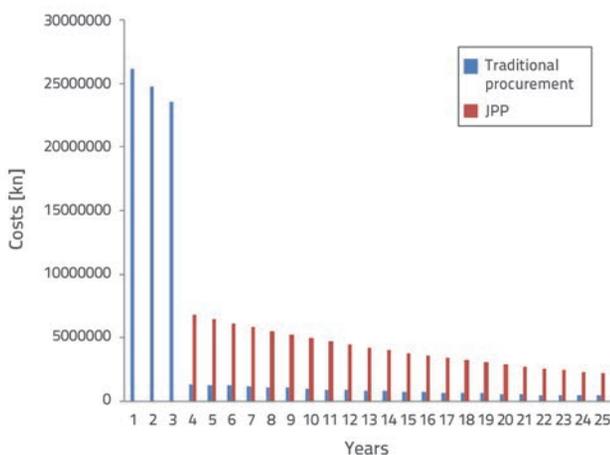


Figure 7. Public sector costs over 25 years for procurement of an educational building using traditional and PPP procurement models

Total average life-cycle costing of projects, presented in Figures 6 and 7, is expressed in form of an expected present value. The present value of costs is expressed using the discounting method. The presented costs are obtained by discounting at the discount rate of 5.5% over the period of 25 years. The 5.5% discount rate for the Republic of Croatia is indicated as a reference value at Internet pages of the Agency for Investments and Competitiveness [49]. For the educational building, the discounted values of costs points to lower overall life-cycle cost in case of PPP model. For the sports building, the total life-cycle cost is lower in case of the traditional model. It should be noted that in case of the traditional model the costs of financing, and the cost of retained and transferable risk, are not taken into account in neither of the building types. In case of PPP model, these costs are already included in the cost of the PPP fee, and they greatly contribute to the achievement of the value for money. The diagram shows that the financial burden incurred by public partner is more uniformly spread in case of PPP projects, and also that the financial burden is delayed compared to the traditional procurement model.

5.7. Qualitative indicators of model implementation

Both project procurement models are burdened by some problems in all phases of project implementation. Sometimes demanding architectural solutions make construction of traditionally realised public buildings more costly and time consuming, often resulting in higher energy consumption and maintenance costs. Design documents are sometimes incomplete. In addition, design documents are being modified for a variety of reasons. Often times, deficiencies in the quality of realisation cause problems during the use of the building (façade damage, sound bridges, heating deficiencies, cooling problems, flat roof leakage, etc.). Contractors do not eliminate such deficiencies even within defects liability periods. Users are often forced to pay for the removal of such deficiencies out of their pockets, so as to be able to conduct their activities. The maintenance services are regular but should be available more quickly and at a higher level. Some projects have proven to be unprofitable, as shown by the State Audit Office of the Republic of Croatia [42-45]. Some specific architectural solutions may generate higher energy costs even in the case of PPP projects. Quality defects have been revealed during building commissioning on some PPP projects. However, such defects are usually remedied because of contractual obligations assumed by the private partner within the time specified in contract for removal of irregularities. Regardless of the procurement model adopted, selection of an optimum, rational and functional design solution, and a fully active role of the client and future beneficiary at the design and construction stages, are of highest significance for achieving full functionality and usability of the building throughout its life-cycle.

5.8. Comparison of procurement models according to specified indicators with regard to adopted hypothesis

According to indicators based on the data about the buildings under study, it can be concluded that the buildings erected according to the PPP model are being constructed on schedule. Buildings built according to the traditional procurement model are very frequently completed with significant delay. Financial burden incurred by clients is more uniform during the life-cycle of buildings erected according to the PPP model, which involves later start of payments by the client as compared to traditional procurement models. Available results do not permit us to define with certainty whether the unit rate of construction (design, construction and supervision) according to one model can be deemed more favourable compared to the other model. In fact, cost overruns are possible in both procurement models, although higher overruns can be expected when a traditional procurement model is used.

6. Conclusion

Although the traditional procurement model is still more often used in the Republic of Croatia, the implementation of the PPP model is expected to grow in the future, mainly due to the lack of budgetary funding and the need to meet public needs despite funding difficulties.

Regardless of such evident potential of the PPP model, this procurement model may still not be the decision of choice for all projects. Public authorities must define, for every particular project, whether the PPP will provide societal benefits that exceed those that can be realised through traditional procurement models. Successful implementation of PPP involves proper education of participants, thorough preparation with full analysis of all aspects of the project, and proper control of the implementation process. The primary aim of the paper is to compare the cost and time aspects of the construction of public infrastructure buildings realised either by the traditional procurement method or according to the PPP model. The following has been established for the projects under study:

- With regard to the overrun of initially planned costs, a negligibly greater overrun value can be observed in PPP projects when compared to the traditionally procured buildings (the difference amounts to 1.1 %). However, these results do not provide a realistic estimate of the situation, as traditionally procured educational buildings are built according to the turnkey contract model that does not allow for cost overruns. If a general project managers' estimate of cost overrun, amounting to 10 % of the initial investment, is taken into account, then the results would show that the cost overrun is almost two times greater in case of traditionally procured buildings compared to PPP projects, i.e. the cost overrun would amount to 33 %.
- Average overrun of construction time amounts to 87 % in case of traditional procurement of buildings (because of unrealistic planning, short construction time, design modifications, poor preparation and organisation, etc.), while all PPP buildings considered in this study were built without any delay. The reason for this lies in significant properties of the PPP model. In fact, timely completion of the construction process also means the start of the provision of services, payment for such services by the user, and payment of fee

by the public partner. The overrun also involves very high penalties, which is to be avoided by any means.

- The comparison of discounted values of costs during a 25-year life-cycle of projects reveals that total life-cycle costs are lower on PPP projects involving educational buildings. In case of sports buildings, the total life-cycle costs are lower in the traditional procurement model. In the PPP model, the total life-cycle cost involves fee payment. The traditional model involves payment of construction, operation and maintenance costs, and the model does not take into account the financing cost and the cost of the retained and transferable risk, through which the value for money is largely realised on the PPP projects.
- Beneficiaries of buildings realized according to the PPP model have expressed greater satisfaction with the building maintenance over the life-cycle of the project.

Advantages and deficiencies of both procurement models are identified in the paper. This points to the need for a thorough analysis and comparison of the procurement models prior to each particular investment. In order to improve performance of projects procured in one of the two ways described in the paper, all phases of the project must be realized in accordance with best project management practices, and in line with economic and societal goals set for the project. In the preliminary phase, a special attention must be paid to project task, which must be clearly defined by the public partner. Technical, functional and energy-related parameters of the building must be unambiguously defined. This is the responsibility of the public partner, and any failure made in this segment will be difficult or impossible to correct at a later stage. Regardless of the key role the private partner has in the implementation of PPP projects, the public partner should keep an active role involving monitoring and, if needed, making interventions. This increases the probability that the public partner and the end beneficiary will be satisfied with the final result.

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