Creative Construction Conference 2016

Impact of the Operational Expenditures on the Public Sector Procurement Process

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Abstract

Ever-changing needs in the built environment create new incentives for enhancements in the process of building design. Increasing prices of building operations and utilities have a profound impact on the conceptual design and implementation of sustainable architecture. The main aim of this paper is to present Life Cycle Cost Inspector (LCCI), which is a tool for assessing building design in regards to the whole asset life cycle and thus promoting sustainable solutions. LCCI is a quantitative comparator of the overall planned capital investment and the operational expenditures (OPEX) over a specific period of time. This method is based on dividing the selected project into separate components (e.g. heating, plumbing or ventilation) that have their own operational characteristics. Subsequently, projected cash flows are estimated over a chosen time period based on preferred criteria, square meters and a life span of each component. An additional feature of the comparator allows calculating vice versa, which means that the investment costs can be adjusted, based on the targeted operational performance of the asset, which could be directly specified.

As any other device, LCCI is based on a simple idea – to create a tool, which enables the owner to execute the present process more efficiently. Specifically, the main aim is to transform the given and limited resources into such product, which represents the highest value for money achieved, of course in regards to the process and human limitation.

The overall process of operational expenditures assessment and optimization of the capital costs indicates higher value for money achieved through sustainable architecture; and thus, advocates higher initial capital cost during the tendering process. Therefore, within this research, the traditionally perceived concept of the lowest cost selection is questioned and a new perception of value for money is introduced and applied within the quantitative comparator's environment.

Keywords: capital expenditures; operational expenditures; public sector; value for money

1. Introduction

The building industry is continuously facing economical, technological and social challenges. The recent financial crisis caused changes in overall perception of building projects' design and construction. Almost every stakeholder within the construction process is seeking to make savings and reduce costs. Building contractors are being forced to reduce their bidding cost in order to maintain their competiveness, whereas project owners are experiencing difficulties in renting their assets to tenants who are looking for buildings with low operational costs and rent.

The main aim of the LCCI is to present a comparative analysis of different investment options and further assess all costs related to the whole asset life cycle. This method takes into account not only the investment costs, but also all costs linked with the asset operation, maintenance and removal. The whole life cycle costs of a particular asset indicate the inevitable fact that the operational costs have the major impact on the investment effectiveness, which promote the aspects of the sustainable design.

Two main questions are addressed: What are the main obstacles in delivering sustainable buildings within the Czech public sector? How can the LCCI overcome the barrier to more sustainable design and investment options?

2. Overview of the Czech Public Sector Procurement

The Czech procurement process of construction works indicates strong focus on reducing capital expenditures and thus improving economic effectiveness of public sector tenders. To understand the true impact of the capital and operational expenditures on the construction projects financed by the public initiatives it is necessary to describe current public sector practices and the overall amount of resources, which can be affected. The total amount of resources allocated for the construction works are summarized in Table 1, which also divides the total amount of contracts according particular sector (supplies, services or construction works) [1].

Table 1. Overview of the Czech public sector contracts [1]

Contracting authority		Type of contracts			Total
		Supplies	Services	Construction Works	
Public authority	Value of public sector contracts in mil. Euros	4,929	1,036	3,321	259
	Value as percentage	53.2%	11.0%	35.8%	100.0%
Sector authority	Value of public sector contracts in mil. Euros	1,036	1,857	1,250	4,179
	Value as percentage	24.9%	44.8%	30.3%	100.0%
Total 2014	Value of public sector contracts in mil. Euros	5,964	2,893	4,571	13,429
	Value as percentage	44.4%	21.5%	34.1%	100.0%

3. Example of the comparative method

According to the current Czech legislation (public bidding and procurement law §78) there are two main criterions for evaluation the received bids:

- the overall economic impact, or
- the lowest bid price.

Tender evaluation based on the overall economic impact is scarcely used as since it presents a significant risk of possible disputes if not properly set. Thus, majority of public tenders for construction works are evaluated according the lowest bidding cost, which is straightforward and certainly defensible if any objections from other tenderers arise. Nonetheless, the lowest price criterion absolutely omits impact of the operational expenditures needed throughout the whole asset life cycle

4. Value for Money and Discounting

The overall economic impact of the public sector contracts can be assessed through the total value for money achieved for a particular contract/tender. This method is well known and frequently used especially for assessing economic effectiveness of projects delivered through alterative procurement methods such as partnership of the public and private sector. The aforementioned method empathizes importance to reflect the market cost of capital otherwise it could crowd out more beneficial private investment. It is argued that the timing of payments is economically significant because people value consumption today over consumption in a year's time or later. This is the time preference argument. Both these economic costs, the cost of capital and time preference, are expressed in a single rate known as the discount rate [2].

Discount rate is normally used for transforming the future cash flows into the present cash cost. However, taking into account the economic costs, the discount rate includes more than just time difference between the future and present value of money.

More than that, the discount rate also includes factor of uncertainty. Life Cycle Cost Inspector, which will be described more in detail later, takes into account the cost of some potential risks linked with constructions in general and applicable for particular building materials, processes or systems.

The discount rate is the key factor, which determines the present value of the future cash flows [3]. Nevertheless, calculating the present value creates a great challenge since there are various methods how to measure it. The key assumption is that the present value for money is worth more than the same amount in a few years later. This is caused by inflation and by a possibility to invest money with a certain interest rate now, which would ultimately lead to positive earnings in the future (but only for investment with the minimal risk possible).

In this case, Net Present Value is used and calculated according the following formula [4]:

$$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t} \tag{1}$$

where CFt is net cash flow in the time t
where r is discount rate
where t is time of the cash flow
where n is number of periods

Different investment options for different timeframes can be only compared when the time value for money is considered thus Net Present Value is used for each researched variants within the LCCI interface.

5. Life Cycle Cost Inspector

Life Cycle Cost Inspector (LCCI) is designed as a tool for qualitative and also quantitative comparison of several options in regard to their capital investment and subsequent operational expenditures and investments linked with the removing or disposal of the asset/service. Advantage of this tool is that it can be applied not only for works linked with construction but also for other disciplines such as procurement of ongoing goods, investments or services.

As any other device, LCCI is based on a simple idea – to create a tool, which enables the owner to execute the present process more efficiently. Specifically, the main aim is to transform the given and limited resources into such product, which represents the highest value for money achieved, of course in regards to the process and human limitation.

5.1. *Life Cycle Cost Inspector Case Study – The Whole Building Assessment*

Within the LCCI software interfere there two main types of buildings assessment. The fist type focuses on the building itself. It breaks down the whole building into separate components (components division is based on Building Cost Information Service of RICS [5]) and each component is subsequently researched. Based on the material and quality characteristics the Operational Expenditures are predicted. An example of a project break down is summarized in Table 2 [6].

Table 2. Building's components indicating operational costs

Component	Capital Expenditure (EUR)	LCC Cycle (Yrs)	Total Cost of Replacement (65 years) (EUR)
Substructure	823,302 €	70	0 €
Frame	4,838,803 €	70	0 €
Upper floors	1,756,362 €	70	0 €
Roofs	664,938 €	25	1,488,924 €
Stairs	2,073,773 €	30	357,013 €
External walls	1,676,847 €	30	1,198,653 €
Windows and external doors	2,485,059 €	30	3,552,768 €
Internal walls and partitions	379,847 €	20	1,013,470 €
Wall finishes	413,317 €	10	2,185,142 €
Floor finishes	413,317 €	10	2,052,185 €
Ceiling finish	413,317 €	15	721,743 €
Sanitary appliances	119,015 €	10	666,010 €
Water installations	153,018 €	15	533,308 €
Space heating and air treatment	1,645,553 €	10	5,558,375 €
Ventilating system	3,091,121 €	10	23,063,999 €
Electrical installation	4,856,285 €	10	36,234,539 €

Total	25,803,873 €	78,626,130 €

The Total Costs of Replacement (the last column in Table 2) is estimated according a life span of each component, incudes preliminaries, risk allowance, maintenance and renewal costs. Further, the operational expenditures are discounted in order to reflect the time value of money – that is summarized in the Table 3.

Table 3. Overall cost of replacements

Type of Cost	Total
Cost of replacement - annual (65 years)	3,049,031 €
Cost of replacement - total (65 years)	78,626,130 €
Discounted cost of replacement - annual (65 years)	17,483 €
Discounted cost of replacement - total (65 years)	5,953,008 €

A specific discount rate, which is estimated for each new building analysis according the specific risks, inflation and low-risk investments, allows for the difference between present and future money.

5.2. *Life Cycle Cost Inspector Case Study – Options for Heating and Cooling*

To demonstrate the second assessment process of the LCCI – the component analysis - it is necessary to select the components, which will be researched. For purpose of this study a comparison of induction units (cooling beams) and more traditional fan coils has been used.

The option A is defined as a technical solution where the distribution of fresh air and temperature treatment is achieved by induction units, which are usually placed visibly under the ceilings, and are expected to last for 20 years with minimum operational expenses [6].

Induction units are significant by their cost savings during the whole life cycle. First of all, induction units provide energy savings due to lower (or higher) needed temperature as in standard heating and cooling systems. Moreover, maintenance costs are reduced due to omitting of all moving parts, which are present in the fan-coil systems. The only maintenance requires annual cleaning – dust wiping and vacuum cleaning, but absence of moving components like fans and absence of filters decrease in general danger of potential failures and additional operational expenses.

As an Alternative A to the Induction Units the Four-pipe Fan Coil system has been chosen. It is expected that the four-pipe Fan Coil system is usually replaced every 15 years, which is 5 years less than the lifespan of the induction units. Four-pipe Fan coil contain: filter, fan and two coils (heating and cooling coil), so that there are four connection pipes. Hot water or chilled water is always available. The system is able to instantly switch from the heating mode to the cooling mode, or vice versa, and can provide heating to some rooms while simultaneously providing cooling to other rooms. Because of high flexibility the fan-coil system create noticeable incentive for implementation.

The Four-pipe Fan Coil system requires substantial expenses in terms of maintenance and operation. It is expected that fans will be replaced every three years. In addition to that filter cleaning and minor replacement must be performed every six months.

Therefore, the Four-Pipe Fan Coil system will accumulate significantly more operational expenditures than induction units. The total overview is depicted in Fig. 1.

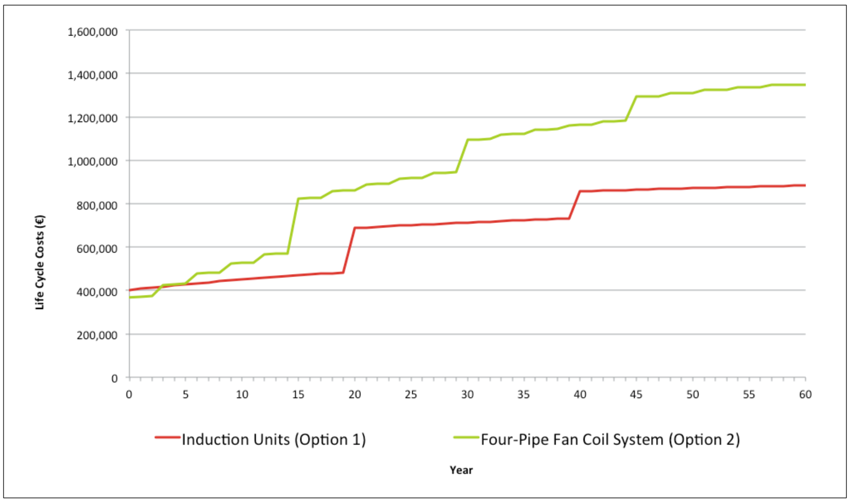

Figure 1. Component analysis - Induction Units vs. Fan-coil Units

Data specifics of the component analysis are visible in Table 4, where both options reflect their performance in 25 and 60 years and in simple and discounted terms.

Table 4. Summary of the component analysis – Induction Units vs. Fan-coil Units

Type of Cost	Induction Units (Option 1)	Four-Pipe Fan Coils (Option 2)
Initial Cost	401,517 €	368,157 €
Life Cycle Cost (25 years)	951,483 €	1,245,408 €
Life Cycle Cost (25 years) - discounted (25 yrs)	701,172 €	918,073 €
Net Savings (25 yrs)	293,926 €	0 €
Net Savings (25 years) - discounted	216,901 €	0 €
Life Cycle Cost (60 years)	1,554,890 €	2,680,392 €
Life Cycle Cost (60 years)	882,546 €	1,349,265 €
Net Savings (60 yrs)	1,125,502 €	0 €
Net Savings (60 years) - discounted	466,719 €	0 €

The induction units have marginally higher initial cost than the four-pipe fan coil system. However, after three years of operation this difference is reduced due to lower maintenance cost of induction units. Since “Year 3” the difference is steadily growing and the four-pipe fan coil system is becoming highly uneconomical. Longer replacement intervals, lower operational costs and lower probability of damages are creating incentives for procuring induction units instead of the four-pipe fan coil system option.

Now, let’s assume that the principal selection criterion is the lowest cost – in this case it would be the initial cost (Table 4). Based on a simple comparison, the Option 1 (Fan-coil units) would be chosen over the Option 2 (Induction units). But it is obvious that the operational savings of the preferred Option 1 would be 466,719 € (Net Savings (60 years) – discounted), and that indicates additional expenses for operation, which could have been avoided by selecting the Option 1 – Induction Units.

6. Conclusion

The true purpose of the Life Cycle Cost Inspector’s methodology is creating a simple tool, which promotes straightforward assessment of different investment options in regard to the capital and operational cost. Even though the software processes are rather computational; the outcome of each assessment must be presented with a clear narrative summarizing all qualitative and quantitative findings. Only based on that, the preferable option can be selected and thus the value for money achieved.

Based on our results the lower initial capital cost does not ultimately lead to the more effective investment. In the context of the whole life cycle, the sustainable design positively affect the operational costs and thus decreasing the overall burden on the public sector budget.

Without a clear evaluation paradigm, which defines the preference of the value for money rather than the initial cost, the public sector representatives will always incline to the philosophy of selection the lowest cost, which promotes “safer” and easier procurement path but never truly reflects the operational phase of the asset.

Acknowledgement

This paper originated as a part of a Czech Technical University in Prague, Faculty of Civil Engineering research project SGS15/017/OHK1/1T/11.

References

[1] *Výroční zpráva o stavu veřejných zakázek v České republice za rok 2014. Ministerstvo pro mistni rozvoj [online]. 2015, 2015(3): 1-79 [cit. 2015-12-07]. WWW:* <http://www.portal-vz.cz/getmedia/e404b766-77d0-488b-8809-6951c53c0eb9/Vyrocni-zprava-o-stavu-verejnych-zakazek-v-Ceske-republice-za-rok-2014_final.pdf>.

[2] *POLLOCK, Allyson, Shaoul JEAN a Neil VICKERS. Private finance and “value for money” in NHS hospitals: a policy in search of a rationale. British Medical Journal. 2002, 2002(7347): 1205–1209.*

[3] *Macek, D. (2011). Renovation and Maitenance Planning for Buildings. VI International Eurasian Symposium (pp. 63-68). Ekaterinburg: Ural University Publisher.*

[4] *BURTONSHAW-GUNN, Simon. The essential management toolbox: tools, models and notes for managers and consultants. Hoboken, N.J: Wiley, 2008. ISBN 04-705-1837-5.*

[5] BCIS Building Running Costs [online]. United Kingdom: RICS, 2015, 2015-11-01 [cit. 2015-11-01]. WWW: < http://www.rics.org/us/knowledge/bcis/>.

[6] *Arcadis CZ (2015). Green Buildings: Case Studies. Prague.*