Risk analysis in the theory of Whole Life-cycle Costing

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Abstract

This paper deals with the whole lifecycle costing (WLCC) on the example of construction industry because WLCC methods is well elaborated in this area. The paper also highlights the importance of risk analysis, fundamental division of the analysis techniques and describes closer techniques which are used most frequently. In conclusion examples of risks are mentioned that may occur by the supplier or customer during execution of orders.

Key words

Whole Life-cycle Costing (WLCC), building, risk analysis

1. Introduction

The work deals with the whole life cycle costing (WLCC) product in construction. It also pays attention to the analysis and risks monitoring.

The construction industry has recently made a significant shift in its approach to delivering products and achieving customer satisfaction. Where in the past, design and construction teams have place great emphasis on the construction of buildings at the lowest investment costs it starts to prevail the effort to consider the whole life-cycle costs of buildings.

2. WLCC in buildings

Whole life cycle costing is a relatively new concept in construction, although this concept is based on analytical methods that have existed for several years. It is the developed life-cycle costing (LCC), which are now commonly used in many areas of public procurement.

Clients now want buildings that show value for money in the long term, and not only interested in the design, which is the cheapest. These changes stressed the importance of a whole life cycle approach (WLCC) and led to innovations in design construction and operation of buildings. This process was initiated by the client together with an increasing number of buildings acquired as part of Public Private Partnership mechanisms (PPP) led project participants to a greater interest in the decision-making procedure WLCC. One of the causes of the rise in popularity WLCC is that it provides a more accurate value of long-term cost effectiveness of the project than standard economic methods that focus only on the initial and operating costs within a short time. WLCC provides important information about the projects that are procured under the PPP, which requires long-term forecast of the cost of providing services to be contracted. Standard cost and value analysis techniques are typically used to quantify and evaluate the economic impact of building design. These techniques provide a basis for decisions on project cost. However, they often do not take into account many parameters that can affect the present value of the project or its cost. Unfortunately, current methods often can´t consider a crucial risk in pursuit of cost-benefit analysis. Investments in buildings are long term and involve some degree of uncertainty over the life of the building, operation and maintenance. If there is considerable uncertainty about the cost and time information, then WLCC analysis may have little value for deciding if this fails to take into account. It is therefore important to assess the degree of uncertainty associated with WLCC results. So that the following additional information into account in decision making.

3. Analysis and Risk Management

Unfortunately, the current calculation method can´t consider the crucial risks in the cost analysis. it is reason why the risk analysis and risk management are important for consideration in framework of WLCC process throughout the whole life cycle of building assets. In estimating the WLCC budget for construction activities there is uncertainty about almost every estimate or input data to be used in models to calculate WLCC. Estimated budget by WLCC is subject to change due to uncertain events that may affect the development and operation of assets. It is therefore of utmost importance that the influence of these uncertainties on the budget by WLCC was assessed along with the strategies for mitigation of these risks.

3.1 Risk assessment of WLCC is necessary for the following reasons:

- Data used to calculate WLCC are based on estimates,
- The uncertainty due to the scale of the project,
- The return on the cost and time uncertainty
- Uncertainty about the operating conditions,
- Uncertainty in investment indicators (taxes, inflation, etc.).

The above factors contribute to the uncertainty budget calculations WLCC budget estimates during the design phase.
Life Cycle Costing is trying to calculate the future. It is necessary to estimate a long time many of the above factors, such as operating costs and maintenance costs, discount rates and the inflation rate itself or disposal. Given that there are insufficient data, the measurement uncertainty in the information and data critical to the successful implementation of life cycle costing.
Risk management is a continuous process that occurs in all life cycle stages of construction. Risks and opportunities are evaluated in a feasibility study. The overall risk analysis is done at the design stage and entering the building, during the implementation and use. Risk variable is the sum of the probability that the risk of becoming plus worth of damage.

3.2 Risk management involves two basic procedures:

- Risk analysis
- Monitoring of risks.

Risk analysis consists of:

- Identification of risk (based on experience from previous projects)
- Risk assessment - identifying the possibility of damage and the expected (based on statistical calculations or expert estimates)
- Responding to risk (to find answers to the risks identified).

Risk evaluation can be made quantitative (probability value and a loss is determined numeric variable) or qualitatively (evaluation of the probability scale by an expert).
Responses to risk can be:

- Admission of risk
- Transfer risk to another entity (eg insurance)
- Reducing the risks - design measures that reduce the probability or loss
- Avoiding risk
- Creation of reserve (time, cost, source)
- Contingency plan (contingency plan) in case the risk occurs.

Every action comes with a cost – their amount should not exceed the quantity of risk (eg insurance).
In the process of tracking identified risks, whether the changed value of risk (change in the conditions leading to the possibility of scaling or loss), whether a new risk is discovered, whether the risk persists, whether is actual to implement measures in response to the risk (eg an insurer). The document which contains a list of all of the observed risk is known as risk register.

3.3 List of recommended methods for risk analysis

Recommended methods for risk analysis when calculating the total cost of construction - for qualitative risk assessment (techniques that use subjective scoring techniques):

- Brainstorming sessions
- Risk matrix
- Risk scoring
- Event tree
- SWOT analysis

Recommended methods for risk analysis when calculating the total cost of construction - for quantitative risk assessment (statistical and probabilistic approaches to quantification):

- Artificial intelligence
- Fuzzy sets theory
- Simulation Monte Carlo
- Mathematical/analytical technique

4. Supplier risks

In most contracts of building construction the contractor bears most of the risks associated with the construction phase but the responsibility of contractor responsible for the entire life of the building is relatively low. However, in PPP projects, the situation is different; the supplier carries more risks during use and therefore its overall risk throughout the life cycle increases.

In the current contracts the risk is placed on contractors and major risks should include the following: labor, material and equipment, availability of machinery. Availability and quality of labor, material and equipment can have serious consequences for WLCC and success of the project during construction. Currently, the availability of skilled labor represents serious risk for project and many projects are affected by this problem which leads to cost overruns.

Industrial disturbances

The risk of a strike of workers on site may have negative consequences for the calculation WLCC. The existence of salary negotiations with the unions can substantially reduce this risk. Bad links on the site can easily lead to problems.

Coordination of subcontractors

This risk has been identified particularly with regard to professional subcontractors. Failure to plan their work can lead to critical delays and cost overruns WLCC. The work of professional contractors can represent a high percentage of total capital costs.

Health and safety

Compliance safety and health is not just a legal requirement but also an important component of risk reduction during construction. A strict security regime will help the contractor to comply with the law while reducing the risk of accidents and the cost of downtime from work because of their non-compliance.

Performance

Risks associated with poor execution can make problems not only in the construction phase but also throughout the lifetime of the building. In the construction phase poor performance leads to revision of the project and increase costs, but over the life of the construction this bad work could contribute to

the overall failure. Design directly affects WLCC because it is closely related to the life of components and buildings.

5. Risk customers

Risks to the customer during construction are not the same as the risk for suppliers. Risks for consumers are obvious in the time of building utilization when it is necessary to count with funding of rent and further development. In PPP projects, the client assumes that the risk is reduced. The main risks for the client during the construction phase are listed below.

Poor quality advice
If the advice provided to the client on the wrong level, then it could lead to improper management practices in the construction phase, improper procurement, failure to provide required level of quality of buildings and too expensive to build, which will inevitably lead to higher WLCC.

Profit is lower than expected.
The potential opportunity that construction will not bring the expected income over the life of the building can bring considerable risk, particularly with regard to the agreed project funding. Many WLCC calculations which expect these revenues to cover costs represent such a risk.

Delay in completion
These risks are similar to those already mentioned. The delay, which could be caused by defects, industrial disputes, poor work and financial problems, it may again lead to an increase WLCC.

Unforeseen costs of the project
Include particular deviations from the original project, but may also include the cost over the lifetime, as a direct result of the construction cost, the defective design of specific defects and faulty construction. The unforeseen costs of the project must be re-assessed in WLCC model.

6. Summary

WLCC provides a more accurate value of long-term cost effectiveness of the project than standard economic methods that focus only on the initial and operating costs within a short time. Unfortunately, the current calculation method can´t consider the often crucial risks in the implementation of cost analysis, so the risk analysis and risk management are important methods in decision-making in the framework of WLCC process in the construction industry, but also in other industries. Risk management is a continuous process that occurs in all phases of building life cycle (product).

7. References

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