How environmental impacts can be part of the DB (Design and Build) Tendering?

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The need to implement environmental impacts as a part of tendering process has increased during last years. This need has grown from the general pressure to give more value to the environmental matters. In infrastructure and especially in road sector the Design and Build (DB) procurement method has been the most commonly used during last decade in Finland. There have been two research projects to combine the environmental impacts as a part of DB tendering. The first one 'Pilot projects for life cycle studies in road maintenance' was in years 2002 – 2005 and the second one was 'Ecoefficiency as a part of DB procurement' in years 2006 -2007. The second one was based on the results of the first research project and it concentrated on the most important and potential environmental impacts. The 'Pilot project' was financed by Tekes and former Finnish Road Administration (Finnra nowadays Finnish Transport Agency) together with Technical Research Centre of Finland (VTT).

In the 'Pilot project' a method to implement life cycle studies to DB tendering was developed in co-operation of Road Administration and researchers. This implementation was done through two in-situ pilot projects. The objective of the research was to create preconditions for implementation of a life cycle approach into pavement procurement. The other objective was to recognize the most important issues for life cycle analysis that need more research and development. VTT and Finnra together compiled the functional, technical and environmental requirements used in invitations for tenders in the pilot projects. The weightings of requirements, design methods and the ground of evaluation in the evaluation of tenders have also been created.

The 'Pilot project' presented and tested ideas about implementation of life cycle studies in practical procurement. The implementation was made in co-operation with Finnra, researchers and the practitioners in the field of pavement maintenance and construction. The co-operation was secured through the Management Committee of the research project where the consultants, contractors and material deliverers had their representatives. Public discussion and information occasions were also arranged. The research was primarily aimed at Finnra's work but the results were transparent so that they could be applied by other parties.

Two pavement maintenance works were chosen as pilot projects. The first one was improvement of Road 307 between the towns of Valkeakoski and Tykölä in the year 2003. The second pilot project was the improvement of the Highway 9 between the towns of Turku and Lieto in 2004. Both pilots were DB-projects, which included both the design and construction work.
The research started by defining the accustomed methods to compare tenders and the contents of the orders of tenders in the Design and Build procurement.

Based on this information, new innovative comparing methods were developed, which also included life cycle studies. The life cycle studies were implemented though new tools, which were unfamiliar to the contractors and their designers. Thus, a short education course was arranged for the contractors and their consultants about the use of the tools. The used tools were the pavement design program APAS, the environmental impact calculation program Meli and the continuous settlement calculation program Tsarpix.

In the development of the new comparing methods and requirements, the aim was to include as many life cycle aspects as possible. Both pilot projects had narrow financial limits, which was taken into account in the development. However, the new methods had to allow clear calculations and evaluations for comparison.

The design life of the pavements in both pilots was chosen to be 20 years and the duration of the guarantee period was five years. A modified version of the accustomed comparison method was applied in the first pilot project (Road 307). The developed method was focused on the environmental impact calculations, service life-based pavement design and extra user delay costs. The quality and technical requirements of the pavement structure were amended to better describe the life cycle aspects.

The objective of the second pilot project was to have wider life studies than in the first pilot. To simplify the comparison of the different factors, the price of the project was fixed. So, the tenders were compared to each other on the bases of the scope and quality of the tendered pavements. The comparison method was developed to promote constructions that were evaluated to present the best life cycle quality. The constructions were evaluated on the quality of the pavement, its lifetime and evenness. The subgrade of the second pilot was merely thick clay. Thus, after the construction over forty years ago the pavement has suffered from large settlements, unevenness in the longitudinal direction and flattening of the cross-section. The aim of the pavement rehabilitation was to correct all unevenness and to prevent it in the future. The new evenness evaluation method was developed to promote solutions with many little actions instead of concentrated wider ones. This meant that changes in the vertical geometry of the pavement were also calculated as actions.

The comparison of the tenders in the second pilot was done with a multivariate analysis. The interviews afterwards showed that the experiments of this comparison method were mainly positive. Yet, some thought that the price exclusion was a problem. The progression speed of the development as experienced by tenders was sometimes reported as either too quick or too slow. A very positive attitude was found towards continuous design methods like Tsarpix.

The research proved that some parts of the life cycle studies can already be applied today. These factors are extra user delay costs and environmental impacts of construction work. The research raised many factors that limit studies and their reliability. The most important limiting factor is the quality and deficiency of the site investigation data. The life cycle studies need more input data and know-how from all partners of the construction and design than accustomed procurement.

According to the research the most urgent research issues are:

- development of the service life-based design, including deterioration models
- development of an ecoindicator system and its tools
- development of the coherent evaluation methods.

The basic problem with life cycle studies is how to merge different units of the components, like money, environmental impacts and performance. The alteration can be done by changing all components to prices or to a defined point system.

The conclusion of the 'Pilot project' was that life cycle studies can and should be implemented in all phases of the construction process, not only for the comparison of tenders. The advantages of the life cycle studies are felt by the whole society with better balance of the investment costs and improved environmental quality.

To facilitate implementation a study of 'Ecoefficiency as a part of DB procurement' was done. The study concentrated on the most important environmental impacts, which could be taken into account in DB tendering. Because in the maintenance and construction many environmental impacts can no longer be affected, it is important to pay attention to those, which the contractor and designer still can affect with their choices. The study proved that most important impacts were:

- the use of material resources (natural or crushed rock, soils, aso.),
- changes in ground water resources (quality and quantity)
- climate change
- physical and mechanical impacts (noise, dust, vibrations).

It was found out that the contractors purpose to minimize costs improves in most cases also ecoefficiency. If an ecoefficient solution increases the construction costs it should be ordered or either the contractor should be imposed to act more ecoefficient by sanctions and guidelines. In DB tendering different guidance methods or their combinations can be used. The methods and their combinations should be chosen project specific. In simple projects only some methods should be used, while in more complex projects wider variation of methods is needed. In ideal cases the methods could be chosen during preliminary design phases. Besides the chosen evaluation methods the limitations of the projects and combination of projects and their duration can affect to the design solutions and thus environmental impacts.

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