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Cost Estimation Methods for Transport Infrastructure: A Systematic Literature Review

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Abstract

Nowadays, large amount of money is invested on infrastructure projects within transport section. This attracts policy and decision makers a lot. Especially, project cost is one of the most discussed factors. This paper aims to investigate different types of cost estimation methods used in transport projects, identify their attributes that make them unique to specific infrastructure, and finally study their applications on transport infrastructure. In addition, the research looked to see if there is trend change on using cost estimation methods over time and checked the applications of methods in each transport infrastructure. The study used a systematic literature review (date cube creation, data filtering using primary and secondary search clusters, content analysis, etc.) to include as many estimation methods as possible. To find the trend, the study carried out a quantitative data analysis to investigate the frequency of each method over time in different modes of transport infrastructure. As a result, the research identified about 12 cost estimation methods and discusses them with three major cost estimation attributes i.e. accuracy, usability/application and easiness to understand. The quantitative analysis showed that parametric, Artificial Neural Networks and unit cost methods are the most used methods across the transport infrastructure. In addition, road infrastructure projects received the highest diversity and frequency of the cost estimation methods.

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1. Introduction

Transport infrastructure plays a fundamental role in the economy of each country since it has the ability to enhance

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growth and social welfare [1]. A routine project evaluation includes cost estimation as an instrument for investment choice [2]. Moreover, considering the substantial building costs of transport infrastructures and their impacts, it is very important that decision makers are provided with reliable estimations of final costs [3].

Considering the importance and the long history of cost estimation, one would assume that it has achieved a level ensuring a relatively smooth and clear procedure. Yet studies have showed that cost overruns happen everywhere, all the time and within all major transport infrastructure projects such as roads, railways, bridges etc. [4-8]. Therefore, a number of researches was performed to find the factors affecting cost estimation. Also, different variables have been put forward such as strategic behavior, project complexity level, lack of adequate information, project size [6, 9-13].

Furthermore, there were studies indicating cost estimation methods as a major cause of cost overrun [8, 11, 14-20]. Therefore, there is a need to learn about the cost estimation methods in depth and see how diverse they are. It is also important to study the methods' attributes that separate them and make them stronger or weaker to be used in a specific transport infrastructure.

However, studying cost estimation methods is not new. There were a number of papers which have done such study, namely [2, 18, 21], but what separates this study from past studies is that the scope here is broader. For instance, all of the aforementioned researches were limited to one specific transport mode. In this study, we considered all modes of transport although the sea construction infrastructure did not show up any results.

The rigorous literature review on cost estimation methods led to defining the research question as the following: what are the cost estimation methods used in transport infrastructure construction? Why are there different estimation methods? What are the estimation methods used in each transport mode? What is the trend in application of different cost estimation methods? Furthermore, after finding cost estimation methods which have been used the most, a deeper comparison among them is also presented.

2. Methodology

To address the questions posed in the previous section, a systematic literature review method was used. The literature review would reveal the history behind the topic, reflect the attempts that has been taken so far, and pinpoint the potential areas for future studies [22].

This study employed two scientific databases, namely Scopus and Web of Science (final search performed on 12.12.2016). The searching procedure considered title, abstract, keywords, concluding remarks, and the content of the search results.

2.1. Data selection process

This section is divided into three steps: establishing search clusters, topical data screening, and content screening:

I. Search clusters: In order to attain relevant results, the search terms were divided into two clusters: primary and secondary. The primary search terms were cost, estimation, and infrastructure; such terms were present in every search. The secondary cluster consists of the terms unit cost, parametric, judgment, capacity, America, Europe, Asia, Australia; only one of these terms was available in every search. For Web of Science, the aforementioned search terms were searched by "title and topic" with cost in the title. For Scopus, the same search clusters were used with "TITLE-ABS-KEY" category.

Moreover, another set of search terms was devised to give the holistic view of cost estimation within specific transport modes. To elaborate, the term "cost estimation" was used in combination with secondary terms of tunnel, rail, and road in both Scopus and Web of Science. The total number of hits added up to 564 from which 36 passed all the filters and were considered relevant.

II. Topical data screening: The hits were filtered based on their title, abstract and keywords first. If deemed irrelevant, such hits were not considered for further investigation.

III. Content screening: As for the final step, the whole document was obtained and examined to see if the content was relevant. Any search result which passes this step is included in the study. Needless to say, non-academic publications such as meeting results, news, book reviews are not considered for this study.

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