UNIVERSITI TEKNOLOGI MARA

A TWO-DIMENSIONAL INTEGRATED COMPLEXITY FACTORS ASSESSMENT FRAMEWORK FOR INFRASTRUCTURE PROJECT PERFORMANCE AND PHASES IN MALAYSIA

AKHTARUL NORFAIZA BINTI CHE NEN

Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Civil Engineering)

College of Engineering

August 2022

ABSTRACT

Complex infrastructure projects, such as highways, bridges, ports, airports, and mass transit, have been characterised as large-scale capital expenditure, longer completion period, require specific technical and more process complexity levels. Their complexity level regardless of their size, cost, longer duration, and less quality that expected prone to three main consequences during construction including, several design changes, land acquisition, and delaying approval process. Those consequences are warranted an ineffective tool for assessing and managing that complexity factors. So far, several empirical studies pertaining to complex factors reported on weak impact of tripartite project performance (time, cost, and quality) during triple project phases. Hence the project complexity tools still lacking and waiting to be explore either qualitative or quantitative measures throughout the project phases (pre-construction, construction, & post-construction). Therefore, this study aims to investigate the complexity factors in infrastructure projects related to tripartite project performance at triple project phases. In order to achieve the aim four objectives was specified including, (1) to identify the most significant complexity factors; (2) to analyse the level of complexity; (3) to evaluate the most effective mitigation plans in managing complexity factors to improve the infrastructure project performance, and (4) to develop and validate a complexity factors assessment framework. Thus, the mixed-method approach was deployed to hit those four objectives. For this a set of questionnaires survey was designed and administered to 106 construction stakeholders specified in infrastructure projects. So, six statistical analyses were executed using Rasch model and the empirical results were consolidated to construct a complexity factor assessment framework. The content analysis also was retrieved from semi-structured interview sessions with 19 experts involved in infrastructure projects. The finding obtained by this study indicated the most significant complexity factor that affected infrastructure project performance in terms of cost was errors of the original design during pre-construction phase. Meanwhile the quality regard lacks experience and knowledge of construction parties and the cost of incomplete defect work that affect the final certificate without issuing a certificate of completion of making good (CMGD) were the most significant complexity factors in construction and post construction phase respectively. By doing so, the five complexity factors level that affected infrastructure project performance (time, cost, & quality) were classified as very low complexity level (∞ logit to 0.51 logit), low complexity level (0.50 logit to 0.01 logit), moderate complexity level (0.00 logit), high complexity level (-0.01 logit to -0.50 logit), and very high complexity level (-0.51 logit to -∞ logit). From the result obtained the higher commitment of all project parties, close monitoring, and effective coordination were the most effective mitigation plans to address the effect of critical complexity factors on infrastructure project performance using logit ranking measures. Furthermore, a Two-Dimensional Integrated Complexity Factors Assessment Framework for Infrastructure Projects Performance and Phases constructed and validated. This study has made several contributions to the body of knowledge in terms on theoretical, methodological and practical aspects of infrastructure project performance. Evidently, this study is in line with Policy Enabler 3 (Twelfth Malaysian Plan) to enhance connectivity and transport infrastructure that has a crucial role in facilitating growth across all sectors of the economy.

ACKNOWLEDGEMENT

TABLE OF CONTENTS

CHAPTER THREE RESEARCH METHODOLOGY   **39**