# UNIVERSITI TEKNOLOGI MARA

# LEAN CONSTRUCTION TOOLS FRAMEWORK IN REDUCING CONSTRUCTION WASTES FOR THE ENHANCEMENT OF TIME PERFORMANCE

**MOHD ARIF BIN MARHANI**

Thesis submitted in fulfillment
of the requirements for the degree of
**Doctor of Philosophy**
**(Specialisms of The Built Environment)**

**Faculty of Architecture, Planning and Surveying**

**March 2021**

# AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

| | | |
|---|---|---|
| Name of Student | : | Mohd Arif bin Marhani |
| Student I.D. No. | : | 2012265886 |
| Programme | : | Doctor of Philosophy (Specialisms of The Built Environment) – AP990 |
| Faculty | : | Architecture, Planning and Surveying |
| Thesis Title | : | Lean Construction Tools Framework in Reducing Construction Wastes for The Enhancement of Time Performance |
| Signature of Student | : | ..... |
| Date | : | March 2021 |

# ABSTRACT

Construction waste is consisting of physical and non-physical waste. The non-physical waste, which is an avoidable delay of project performance is a common root cause of construction projects' complexities, particularly in developing countries. Malaysia is no difference, where almost 80% of traditionally procured projects encounter time overruns. Delay can cause such circumstances as increased construction costs, loss of earnings due to low productivity and contract termination. Besides, the Malaysian construction project's scheduling and cost behaviour summarised that construction projects' overall cost behaviour is unsatisfactory, needing extreme consideration. Hence, the industry must certainly change its traditional methods of functioning to overcome the issue addressed. Lean construction (LC) is proposed in resolving the issue of these construction wastes. LC is a continuous improvement process for construction projects, helps a construction organisation sustain the growth and profitability. Furthermore, the framework or guideline of LC tools is not well explored and elaborated more on the specific LC tools to be implemented. This research aims to develop an LC tools framework that can enhance the contractor's time performance by reducing construction wastes at the site. This research conducted to determine the extent of construction waste affecting the time performance and identifying LC tools' potential in reducing construction waste. This research also analysed the most significant LC tools in reducing construction waste to enhance time performance and establish a framework of LC tools in reducing the construction waste for the enhancement of time performance for the Malaysian construction industry. A quantitative method approach is used to achieve this research's objectives, and the questionnaire survey was sent to 310 contractors in Malaysia for the main survey. The contractors registered with the Construction Industry Development Board Malaysia (CIDB) underclass G7 categories, were identified from the CIDB directory. Thus, the viewpoints from the respondents accorded to the research are restricted within the country exclusively. One hundred sixteen questionnaires were returned within eight months, with the response rate of 37.4%. The findings revealed that the levels of construction wastes variables in this research were at a moderate influence level. From the outcome also, the top six of most potential significant of LC tools in reducing the correction waste, which was supply chain management, computer-aided tools, the 5S process, the five's why, error proofing and Industrialised Building System (IBS). Meanwhile, the most potential significant LC tools that can reduce the over-processing waste was IBS, the 5S process, just-in-time, supply chain management and computer-aided tools. Furthermore, the top three most significant LC tools that can reduce the delay waste were value-based management, standard forms and error proofing. The findings also revealed how LC tools are essential to an organisation that can enhance time performance if a construction project faces a correction, over-processing, and delay waste. Besides, by having the LC tools framework, it can improve a construction project's time performance, and it is beneficial to the LC practitioners. Thus, it able to increase the future's construction products towards a greener environment.

# ACKNOWLEDGEMENT

Alhamdulillah, all the praises be to Allah. First and foremost, I thank Allah for the strengths and all His blessings given to me throughout this challenging yet incredible PhD journey.

I want to express my sincere gratitude to my main supervisor, Associate Professor Dr Aini Jaapar, you have been a tremendous mentor. My heartfelt gratitude goes to my second and third supervisor, Puan Nor Azmi Ahmad Bari and Associate Professor Sr Dr Mohammad Fadhil Mohammad. I am grateful for the excellent advice, support and friendship. Many thanks for both of your patience, motivation, enthusiasm and immense knowledge.

I would also like to thank my research colleagues for the stimulating discussions and insightful comments during this journey. My sincere thanks again go to Dr Mohd Reza Esa, Nurul Afida Isnaini Janipha, Dr Har Einur Azrin Baharuddin, Dr Siti Nor Azniza Ahmad Sekak, Dr Noor Akmal Adillah Ismail, Dr Raja Rafidah Raja Muhammad Rooshidi, Dr Shaza Rina Sahamir and Dr Norfashiha Hashim for their encouragement, never-ending kindness and help.

I am deeply thankful to my family, especially my parents Haji Marhani Jais and Hajah Rafta Othman. My in-law parents Khalib Mat and Noor Khaleeda Ahmad for their love, support, and sacrifices. To my beloved children Muhammad Iqmal Alif, Muhammad Irfan Azeem, Muhammad Iman Aqeeb and Nur Aisyah Sofea, thank you for being awesome and always cheering "Abah" up during the journey. And most of all for my beloved wife Nurhafizamurni Khalib, whose faithful support during the final stages of this PhD is so appreciated.

Finally, I would like to thank Universiti Teknologi MARA and the Ministry of Higher Education Malaysia for sponsoring this research.

Thank you.

# TABLE OF CONTENT