ENHANCING THE APPLICATION OF LIFE CYCLE ASSESSMENT IN THE CONSTRUCTION INDUSTRY: USE OF MODIFIED QUINTUPLE HELIX INNOVATION MODEL

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Thesis submitted in partial fulfilment of the requirements for the degree of Master of Science by Research

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September 2020

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Further, I acknowledge the intellectual contribution of my research supervisors Dr. Chandanie Hadiwattege for the successful completion of this research thesis. I affirm that I will not make any publication from this research without the names of my research supervisors as contributing authors unless otherwise, I have obtained written consent from my research supervisors.

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ABSTRACT

Life Cycle Assessment (LCA) is identified as a systematic analytical tool used to assess the total environmental burdens related to any product, process, or activity by assessing all upstream flows and all downstream flows throughout the whole value chain. LCA has been applied significantly in developed countries, as a sophisticated assessment method to strengthen the decision-making process in the construction industry. Although LCA applications in the construction sector have been implemented comprehensively in the international arena, it is challenging to discover evidence in the Sri Lankan construction sector as a developing country. Also, the Sri Lankan construction industry has been in the position of highly vulnerable to face environmental degradation as a result of the booming nature of constructions, which drastically increases environmental challenges. Hence, it has become a key requirement for establishing LCA in the Sri Lankan construction industry as a solution to reduce the increasing adverse environmental impacts. Therefore, this study targets to bridge the research gap by solving the research problem of 'how to establish LCA practice in the construction industry through a Quintuple Helix Innovation approach?'. Literature findings emphasised the twelve (12) number of strengths and opportunities enjoyed by developed countries, which have improved the capacity of LCA applications. Further, literature findings indicate the eleven (11) number of weaknesses and threats faced by developing countries in establishing LCA. The qualitative research approach was adopted and an expert interview survey was used as the research method. Data was collected with the use of the Repertory Grid Interview (RGI) technique, and data collection was limited to twenty (20) expert interviews representing five (05) contenders in the Quintuple Helix Innovation Model. Data was analysed using manual content analysis. The empirical investigation highlighted that 'ability to identify opportunities for environmental improvements with the use of LCA' as one of the extremely important strengths identified by all contenders. 'Positive growth in the country to achieve environmental sustainability' identified as one of the extremely important opportunities by all contenders. 'Unavailability of experienced LCA professionals' identified as one of the weaknesses by all the contenders. 'Unavailability of accurate LCA data' categorized as one of the extremely influential threats by all the contenders. Then, individual SWOT analysis was developed for each of the contenders by identifying their respective strengths/opportunities and weaknesses/threats. Further, 'government intervention by providing financial incentives' and 'development of LCA database' are identified as some of the strategies to overcome the identified weaknesses and threats in establishing LCA for the construction industry. Finally, a Modified Quintuple Helix Innovation Model was developed and it could be employed to motivate all the related contenders to apply LCA as a decision-making tool to assess and mitigate environmental impacts generated by the Sri Lankan construction industry.

Keywords: *Academia, Construction Industry, Environmentalists, Government, Life Cycle Assessment, Quintuple Helix Innovation Model, Society*

ACKNOWLEDGMENT

The successful completion of my MSc thesis is not a single attempt that was taken by me. Therefore, I make this an opportunity to express my sincere gratitude to every individual who encouraged and supported me by giving their assistance for the successful completion of this research.

First and foremost I would like to convey my sincere gratitude to Dr. Chandanie Hadiwattege for her supervision, guidance, and encouragement to make this research successful as my supervisor. I would like to extend my sincere gratitude to all the academic and non-academic staff of the Department of Building Economics for their immense assistance provided during the research period.

Further, I wish to extend my sincere gratitude to Senate Research Committee of the University of Moratuwa for providing funding to undertake this research under SRC/LT/2019/23. My sincere gratitude is extended to all the interviewees who supported throughout the data collection process in this research and assisted in many ways to deliver the final outcome of this study.

Moreover, I would like to convey my respectable gratitude to my family members. Finally, my appreciation goes to all my friends who have helped me directly and indirectly to make this research a success.

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BIM	-	Building Information Modelling
CED	-	Cumulative Energy Demand
CPR	-	Construction Products Regulation
EPD	-	Environmental Product Declarations
ERA	-	Environmental Risk Assessment
GBCSL	-	Green Building Council of Sri Lanka
GHG	-	Green House Gas Emission
ISO	-	International Organization for Standardization
LCA	-	Life Cycle Assessment
LCI	-	Life Cycle Inventory
LCIA	-	Life Cycle Impact Assessment
MFA	-	Material Flow Analysis
MFA	-	Material Flow Analysis
RGI	-	Repertory Grid Interview
SCP	-	Sustainable Consumption and Production
UK	-	United Kingdom
USA	-	United States of America
WLC	-	Whole Life Cycle