UNIVERSITI TEKNOLOGI MARA
Cawangan Perak
Kampus Seri Iskandar

e-Proceeding

v-GOGREEN2020 29 - 30 SEPT

VIRTUAL GO-GREEN: **CONFERENCE & PUBLICATION**

"SUSTAINABLE ENVIRONMENT, RESILIENCE AND SOCIAL WELL-BEING"

Organiser :
Research, Industrial Linkages, Community & Alumni Network (PJIM&A)

Co-organiser :
Faculty of Architecture, Planning and Surveying (FSPU) & Centre for Post Graduate Studies (CGS)

Publication Date : 22nd February 2021

Virtual Go-Green Conference and Publication 2020

UNIVERSITI TEKNOLOGI MARA, PERAK BRANCH
February 2021

Main Committee
Virtual Go-Green Conference and Publication 2020

Advisor 1	*: Prof Sr Dr Md Yusof Hamid, AMP*
Advisor 2	*: Assoc Prof Dr Nur Hisham Ibrahim*
Chairman	*: Sr Dr Asmalia Che Ahmad*
Co-Chairman	*: 1. Sr Dr Yuhainis Abdul Talib* *2. Sr Dr Haryati Mohd Isa*
Treasurer	*: Mohamad Haizam Mohamed Saraf*
Secretary	*: Noorliza Musa*
Head of v-Conference	*: Sr Dr Nor Suzila Lop*
Head of e-Proceeding	*: Dr Junainah Mohamad*
Head of Scopus Indexed Journal Planning Malaysia Journal (PMJ)	*: Assoc Prof Gs Dr Mohd Fadzil Abdul Rashid*
Head of Scopus Indexed Journal Malaysian Construction Research Journal (MCRJ)	*: Sr Dr Natasha Khalil*
Head of Paper Reviewer	: *Dr Asniza Hamimi Abdul Tharim*

Committee Members
Virtual Go-Green Conference and Publication 2020

E-Proceeding Paper Reviewer

Noraini Md Zain
Shafikah Saharuddin
Nur Fatiha Mohamed Yusof
Farrah Rina Mohd Roshdi

E-Proceeding Formatting

Nurulanis ahmad @ Mohamed
Jannatun Naemah Binti Ismam
Najma Binti Azman

E-Proceeding Language Reviewer

Dr Hjh Shazila Abdullah
Dr Daljeet Singh Sedhu A/L Janah Singh
Zarlina Mohd Zamari
Dr Mary Thomas
Iza Faradiba Mohd Patel
Farahidatul Akmar Awaludin
Wan Faridatul Akma Wan Mohd Rashdi
Jeyamahla Veeravagu
Wan Nurul Fatihah Wan Ismail
Nazirul Mubin Mohd Noor
Noor Aileen Ibrahim
Noraini Johari
Dr Hajah Norakmarwati Ishak

Virtual Conference

Norazlin Mat Salleh	*Registration*
Shahela Mamter	*Auditor*
Mohd Esham Mamat	*Auditor*
Noor Anisah Abdullah @ Dolah	*Auditor*
Mohamad Tajudin Saidin	*Certificate & Conference Kit*
Fairiz Miza Yob Zain	*Logistic*
Mohd Firdaus Zainuddin	*Logistic*
Farah Hanna Ahmad Fuad	*Promotion & Publicity*
Mohamad Shahin Shahdan	*Promotion & Publicity*
Mohd Asrul Hassin	*Liason Officer*

Organiser:
Research, Industrial Linkage Community and Alumni Network Office (PJIM&A)
Universiti Teknologi MARA, Perak Branch, Seri Iskandar.
Malaysia

Co-Organiser:
Faculty of Architecture, Planning and Surveying (FSPU)
and,
Centre for Post Graduate Studies (CGS)
Universiti Teknologi MARA, Perak Branch, Seri Iskandar.
Malaysia

e ISBN 978-967-2920-06-9

9 7 8 9 6 7 2 9 2 0 0 6 9

LIFE CYCLE COST TO ENERGY PERFORMANCE IN GREEN OFFICE BUILDINGS: A REVIEW OF THE COMPONENT

Nurul Afiqah Yunus[1], Natasha Khalil[2] and Kharizam Ismail[3]
[123]Department of Quantity Surveying, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus, Seri Iskandar, 32610 Perak, Malaysia

Abstract

In today's critical economy, expectations have gone beyond the designand construction of a green building. The major barrier for growth in the green building market is the perception of higher first costs associated with these buildings. It has long been acknowledged that it is unacceptable to appraise the costs of projects only based on their initial costs. Hence, Life-Cycle Cost (LCC) is beneficial in allowing owners and clients to make an informed decision on the building materials. Through LCC, the total ownership of cost that includes operation and maintenance costs for a building item calculated in the design stage to get a more accurate projection. Ideally, the criteria or components of LCC should be determined before deciding to proceed with the project. However, the LCC components for green projects are fragmented and the items are not kept in a proper system. This situation can be challenging for the decision-makers to adopt LCC exercise as there is no proper guidance on the LCC components for green projects. Hence, this paper aims to review LCC components to energy elements in green office buildings from literature and desktop studies. The findings showed that the LCC components in the green building have similarities with conventional buildings such as acquisition cost, installation, operation and maintenance cost. However, green buildings acquire additional components such as energy consumption cost, building energy audit cost, and emission factors (non-monetary). The findings will serve as a basis of the LCC framework towards energy elements in green building.

Keywords: *life cycle cost, energy performance, green building, cost component*

1.0 INTRODUCTION

The construction industry is developing rapidly and has become one of the backbones of the country. One of the 11th Malaysia Plan related to the construction industry is to achieve sustainability of economic development, social and environmental, without compromising future generations (Rum, & Akasah, 2012). Due to the budget blow, expectations have gone beyond designing and constructing a green building in today's critical economy. The significant barrier for growth in the green building market is the perception of higher first costs associated with these buildings. It has long been acknowledged that it is unacceptable to appraise the projects' costs only based on their initial costs. Hence, Life-Cycle Cost (LCC) is beneficial in allowing owners and clients to make an informed decision on the building materials towards sustainability. Through LCC, the total ownership of cost that includes operation and maintenance costs for building items calculated in the design stage to get a more accurate projection.

When it comes to energy performance measures, the building sector represents 40% of the world's energy consumption and contributes to one-third of GHG emissions. Therefore, the Ministry of Energy, Technology, Science, Climate Change, and Environment (KeTTHA) or currently known as the Ministry of Energy and Natural Resources (KeTSA), have created the Low Carbon City 2020 policy to achieve Sustainable Development and Climate Change Agenda and energy efficiency towards low carbon cities (Mustafa, 2012). Ideally, LCC's criteria or components in energy performance should be determined before deciding to proceed with the project. Therefore, this paper aims to review LCC components to green office buildings' energy elements of literature and desktop studies.

2.0 PROBLEM STATEMENT: ECONOMIC ASPECTS IN ENERGY PERFORMANCE

Economic performance measurement is vital for decision-makers to assess and distribute recognisable value from initial capital and operating costs to appropriate shareholders in the life cycle of assets. Value for money for construction products and its facilities should not be viewed only in terms of design and construction costs. Instead, it is vital to consider other key variables, such as operations, maintenance, renovation, replacement, and end-of-life costs. In Malaysia, the policy and legal framework in regards to LCC utilization are highlighted in the short-term action plans of green government procurement (GGP) on products and services (KeTTHA, 2012). The leading enabler of the government construction project, the Public Works Department (PWD), issued the standard LCC guideline known as “Garis Panduan Kos Kitaran Hayat” in the year 2012 (PWD, 2012). The guidelines comprise a crucial component of costs that should be addressed in each project phase. However, the listed LCC components in the published guidelines are more applicable to conventional buildings. According to Zainol et al. (2014) sustainable buildings' maintainability has economic, environmental, and social impacts because sustainable operations and maintenance are always costly, impractical, and difficult to implement. Therefore, it is vital to differentiate LCC's essential components for green buildings, where passive and active sustainable design is considered in green buildings. Besides, it takes deliberation of the sustainable or low carbon materials used in green buildings. However, it is not clear to verify the component that contributes to high maintenance for green buildings. This is also supported by Shabrin and Kashem (2017), that the payback period decreases due to low operational costs in the green building.

In order to achieve optimum energy performance in buildings, it is essential to reduce energy cost in the total life cycle budget (Dwaikat and Ali, 2018). Gopanagoni and Velpula (2020) highlighted that the energy cost contributes 67% of the whole life cycle estimates, which is higher than the initial building cost. An explicit calculation of energy consumption derives from active devices, such as air conditioning and lighting devices. It is also influenced by the building's design or orientation, which can also reduce building energy consumption. However, it is necessary to determine the most optimum components that lead to the total cost of ownership towards energy performance in green buildings. Hence, it is required to explore the LCC components towards achieving optimal energy performance in building lifespan.

3.0 LIFE CYCLE COST FOR ENERGY EFFICIENCY IN GREEN BUILDING

Life-cycle cost (LCC), in turn, is defined as the entire cost of the product or system towards its complete life or the duration of the period of study, whichever is the shorter. It is taken into account the cost elements incurred from the initial investment, to ownership and operation until subsequent disposal (Norman, 1990). According to the International Organization for Standardization (2017), LCC is a cost of an asset, or its parts throughout its life cycle, and fulfilling the performance requirements’ (ISO 15686-5:2017) (as shown in Figure 1). Meanwhile, Dwaikat and Ali (2018) defined LCC as the overall cost involved with building design and construction, building operation, and maintenance, until the building disposal at the end of the building life cycle. Therefore, when applying an LCC analysis, an initial value can increase. Still, due to LCC's mechanics, it is a tradeoff for less financial commitment in the future; for example, maintenance and operation costs decrease. It was proven in Gopanagoni and Velpula’s (2020) study that building operational, maintenance, and disposal costs are higher than the initial cost. The life-cycle cost to the green building also has the same meaning as the life-cycle cost to conventional buildings. However, it is not clear in terms of detailing its component, thus, this research will review the LCC component towards green buildings and focus on energy performance measures.

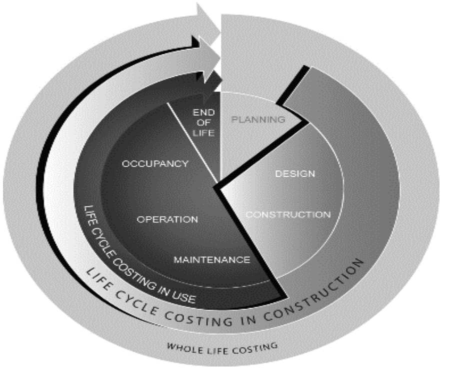

Figure 1: Whole life cycle cost separated by stages
(Source: BS ISO:15686-5, 2017)

4.0 METHODOLOGY

Qualitative synthesis is used as the methodology for this paper. Sources of literature were compiled from the leading database such as Academic Search Premier, Google Scholar, Emerald and Scopus database. Search string usingthe keyword “Life-Cycle Cost”+“Green Buildings”+”Energy Performance” is used to extract the pilot articles and the study has retrieved twenty (20) articles , ranging from the year 2007 until 2020. The next section provides the entailing result and discussion, focusing on the involved components and stages in project development.

5.0 THE RESULT AND DISCUSSION ON SYNTHESIS ANALYSIS OF LCC COMPONENTS

Table 1 shows the initial list of LCC components to green office buildings' energy elements from twenty (20) articles. The components of LCC are divided according to the scope of work, namely planning, design, procurement, construction, testing, operation, maintenance, and demolition. During the planning phase, consulting service cost is the most focused LCC component (Alshamrani, 2020; Hoar, 2007; PWD, 2012; Shabrin & Kashem, 2017; Tsai et al., 2014; Xue et al., 2020) followed by management costs (PWD, 2012; Shabrin & Kashem, 2017; Xue et al., 2020; Zhang et al., 2018), acquisition costs (Hajare & Elwakil, 2019; Hoar, 2007; Shabrin & Kashem, 2017; Tsai et al., 2014), and training values (Illankoon et al., 2018; PWD, 2012; Shabrin & Kashem, 2017; Zhang et al., 2018). There are only design and professional fees in the design phase mentioned by a few authors (Alshamrani, 2020; Dwaikat & Ali, 2018; Gopanagoni & Velpula, 2020; Hoar, 2007; PWD, 2012; Shabrin & Kashem, 2017; Tsai et al., 2014). In the procurement phase, Wang et al. (2020) and PWD (2012) revealed the involved components are documentation costs and advertisement costs. However, in the construction phase, all authors contributed similar points in addressing the construction contract costs as the main components. It shows that constructions contributed to the LCC's numerous costs, including materials costs (Alshamrani, 2020; Zhang et al., 2018), equipment costs (Illankoon et al., 2018; Tsai et al., 2014; Zhang et al., 2018), and installation cost (Manso et al., 2020; Shabrin & Kashem, 2017; Jansen et al., 2020). The findings also show the reuse, recycling, remanufacturing costs, and carbon emission cost are the LCC components during the operation phase, as highlighted by Tsai et al. (2014), Jansen et al. (2020) and Zhang et al. (2018). It also depicts functional testing cost and commissioning cost as the cost component in the operation phase (PWD, 2012).

Besides that, the utility cost, HVAC cost and cleaning cost are the LCC components, as highlighted by Alshamrani (2020), Dwaikat and Ali (2016), Hajare and Elwakil (2020), Hoar (2007), Li et al. (2020), Oduyemi et al. (2018), Tsai et al. (2014), Wang et al. (2020), Wouterszoon Jansen et al. (2020), Hajare and Elwakil (2019) and Shabrin and Kashem (2017). It shows that these components are an enormous contribution to green buildings' whole life cycle costs. Although energy cost is calculated via consumption, it was arguable that the breakdown of energy cost could differ according to construction materials and products. The majority of LCC components are repair and replacement costs when it comes to maintenance costs (Dwaikat & Ali, 2018; Hajare & Elwakil, 2019; Illankoon et al., 2018; PWD, 2012; Li et al., 2020; Manso et al., 2020; Oduyemi et al., 2018; Shabrin & Kashem, 2017; Tsai et al., 2014; Wang et al., 2020; Jansen et al., 2020; Zhang et al., 2018; Corrado et al., 2017), followed by the service budget costs, HVAC costs, electrical installations costs, lift, escalator, conveyor costs, periodic maintenance costs, ground maintenance costs, FM costs, and modification costs (Alshamrani, 2020; Chew et al., 2017; Dwaikat & Ali, 2016; Hajare & Elwakil, 2019, 2020; Hoar, 2007; PWD, 2012; Li et al., 2020; Manso et al., 2020; Oduyemi et al., 2018; Shabrin & Kashem, 2017; Tsai et al., 2014; Wang et al., 2020; Jansen et al., 2020; Xue et al., 2020). Under demolition costs, it was found that the residual value and demolition work costs are among the majority (Dwaikat & Ali, 2018; Hajare & Elwakil, 2019; Hoar, 2007; Illankoon et al., 2018; Manso et al., 2020; Shabrin & Kashem, 2017; Tsai et al., 2014; Jansen et al., 2020). From the analysis, there are a plethora of LCC components for green building, as discussed in the above. However, detailed items and breakdown of each element should be further investigated through the further stage of this study. Another key point that should be lookedinto is green cost, as an increment cost between purchasing conventional to green materials.

The result showed that the green building's LCC components have similarities with conventional buildings such as acquisition cost, installation, operation, and maintenance cost. However, it was found that green buildings acquire additional components such as energy consumption cost, building energy audit cost, carbon emission cost, reuse, recycling, and remanufacturing costs. This is parallel to Kale et al. (2016) that mentioned energy consumption cost as the key component to reducing the LCC and the significant annual expenditure. Hence, this list will help design professionals use this framework during the concept design and detail design stages. In any construction project, cost-effectiveness plays a crucial role. It is a rationale that the LCC analysis can provide a method of determining the entire cost of a structure over its expected life and operational and maintenance cost for green buildings.

6.0 CONCLUSION

The importance of LCC to building construction stems from long-term investments and valuation models for all costs and benefits throughout the length of ownership. This study has concluded that it is crucial to have reliable data by identifying LCC's essential green buildings components. It is a decision-making approach before an owner decides to proceed with green projects. The findings will embark plans on further investigation on the components' reliability and validity in the Malaysia green projects.

Table 1. Life cycle cost components to energy element

Life Cycle Cost Component	(Li et al., 2020)	(Alshamrani, 2020)	(Hoar, 2007)	(Hajare & Elwakil, 2020)	(Wouterszoon et al., 2020)	(Gopanagoni, 2020)	(Wang et al., 2020)	(PWD, 2012)	(Manso et al., 2020)	(Oduyemi et al., 2018)	(Shabrin & Kashem, 2017)	(Chew et al., 2017)	(Tsai et al., 2014)	(Illankoon et al., 2018)	(Zhang et al., 2018)	(Dwaikat & Ali, 2018)	(Hajare & Elwakil, 2019)	(Xue et al., 2020)	(Gangolells et al., 2020)	(Corrado et al., 2017)
1. PLANNING																				
Consulting Services Cost		✓	✓					✓			✓		✓					✓		
Management Cost								✓			✓				✓			✓		
Value Management Laboratory Cost								✓												
Research and Development and Training Costs								✓			✓			✓	✓					
Acquisition Cost			✓								✓		✓				✓			
2. DESIGN																				
Design and Professional Fees		✓	✓			✓		✓			✓		✓			✓		✓		
3. PROCUREMENT																				
Documentation Cost							✓	✓												
Advertisement Costs								✓												
4. CONSTRUCTION																				
Construction Contract Costs	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	✓	
Finance Costs														✓						
Equipment Cost		✓													✓					
Materials Costs													✓	✓	✓					
Manufacturing Costs					✓															
Transport Costs					✓													✓		
Installation Costs					✓				✓		✓									
Reuse, Recycling and Remanufacturing Costs					✓										✓					
Carbon Emission Costs													✓							
Variation Order (VO) Cost								✓												
Safety Management Costs								✓												
Insurance			✓													✓				
5. TESTING AND COMMISSIONING																				
Functional Testing Cost								✓												
Commissioning Cost								✓												

Table 1. Life cycle cost component to energy element (cont'd)

Life Cycle Cost Component	(Li et al., 2020)	(Alshamran1'i, 2020)	(Hoar, 2007)	(Hajare & Elwakil, 2020)	(Wouterszoon et al., 2020)	(Gopanagoni, 2020)	(Wang et al., 2020)	(PWD, 2012)	(Manso et al., 2020)	(Oduyemi et al., 2018)	(Shabrin & Kashem, 2017)	(Chew et al., 2017)	(Tsai et al., 2014)	(Illankoon et al., 2018)	(Zhang et al., 2018)	(Dwaikat & Ali, 2018)	(Hajare & Elwakil, 2019)	(Xue et al., 2020)	(Gangolells et al., 2020)	(Corrado et al., 2017)
6. OPERATIONS																				
Administrative and Management costs										✓										
Utility Cost	✓				✓		✓	✓		✓						✓				
Energy Audit Costs																				✓
Lighting Cost				✓																
HVAC Costs	✓	✓	✓	✓									✓			✓				
PV Cost				✓																
Electricity Costs													✓					✓		
Cleaning Costs	✓		✓	✓						✓	✓				✓	✓	✓			
Overheads Costs										✓										
Security and Health Costs	✓															✓				
Taxes / Subsidies							✓			✓							✓			
Energy Costs (general)	✓		✓		✓	✓	✓	✓			✓		✓		✓	✓		✓	✓	
7. MAINTENANCE																				
Service Budget Costs																✓				
HVAC Costs	✓	✓	✓	✓									✓			✓				
Electrical Installations Costs	✓		✓				✓													
Lift, Escalator, Conveyor Costs	✓	✓																		
Repair Costs					✓		✓	✓		✓	✓		✓		✓	✓				
Periodic Maintenance Cost			✓					✓												
Grounds Maintenance Costs										✓		✓	✓		✓	✓				
Facility Management Costs								✓												
Replacement Costs	✓						✓	✓	✓					✓		✓	✓	✓		✓
Modification / Upgrade Costs								✓			✓									
8. DEMOLITION																				
Residual Value			✓		✓						✓						✓			
Demolition Costs					✓				✓				✓	✓		✓	✓			
Disposal Cost				✓	✓	✓			✓				✓	✓		✓				
Waste and Waste Transportation Cost				✓	✓	✓							✓							

REFERENCES

Alshamrani, O. S. (2020). Initial cost forecasting model of mid-rise green office buildings. Journal of Asian Architecture and Building Engineering, 00(00), 1–13. https://doi.org/10.1080/13467581.2020.1778005
Chew, M. Y. L., Conejos, S., & Asmone, A. S. (2017). Developing a research framework for the green maintainability of buildings. Facilities, 35(1–2), 39–63. https://doi.org/10.1108/F-08-2015-0059
Dwaikat, L. N., & Ali, K. N. (2016). Green buildings cost premium: A review of empirical evidence. Energy and Buildings, 110, 396–403. https://doi.org/10.1016/j.enbuild.2015.11.021
Dwaikat, L. N., & Ali, K. N. (2018). Green buildings life cycle cost analysis and life cycle budget development: Practical applications. Journal of Building Engineering, 18(October 2017), 303–311. https://doi.org/10.1016/j.jobe.2018.03.015
Gopanagoni, V., & Velpula, S. L. (2020). An analytical approach on life cycle cost analysis of a green building. Materials Today: Proceedings, xxxx. https://doi.org/10.1016/j.matpr.2020.04.226
Hajare, A., & Elwakil, E. (2019). Life cycle cost analysis of energy efficient single family residence. ISEC 2019 - 10th International Structural Engineering and Construction Conference, 1–6. https://doi.org/10.14455/isec.res.2019.102
Hajare, A., & Elwakil, E. (2020). Integration of life cycle cost analysis and energy simulation for building energy-efficient strategies assessment. Sustainable Cities and Society, 61(May), 102293. https://doi.org/10.1016/j.scs.2020.102293
Hoar, D. W. (2007). An Overview of Life Cycle Costing Techniques. Property Management, 6(2).
Illankoon, I. M. C. S., Tam, V. W. Y., Le, K. N., & Wang, J. Y. (2018). Life cycle costing for obtaining concrete credits in the green star rating system in Australia. Journal of Cleaner Production, 172, 4212–4219. https://doi.org/10.1016/j.jclepro.2017.11.202
Li, S., Lu, Y., Kua, H. W., & Chang, R. (2020). The economics of green buildings: A life cycle cost analysis of non-residential buildings in tropic climates. Journal of Cleaner Production, 252, 119771. https://doi.org/10.1016/j.jclepro.2019.119771
Manso, M., Teotónio, I., Silva, C. M., & Cruz, C. O. (2020). Green roof and green wall benefits and costs: A review of the quantitative evidence. Renewable and Sustainable Energy Reviews, 135(August 2020). https://doi.org/10.1016/j.rser.2020.110111
Mustafa, M. F. (2012). Low Carbon Cities Framework And Assessment System. Retrieved from http://www.jpbdselangor.gov.my/Laporan/mampan/KETTHA.pdf
Nor Azizah Mohammed Rum, & Zainal Abidin Akasah. (2012). Implementing Life Cycle Costing in Malaysian Construction Industry: A Review. Journal of Civil Engineering and Architecture, 6(9), 272–280. https://doi.org/10.17265/1934-7359/2012.09.012
Norman, G. (1990). Life cycle costing. Property Management, 8(4), 344-356.
Oduyemi, O., Okoroh, M. I., Fajana, O. S., & Arowosafe, O. (2018). The need for economic performance measures for life cycle costing of sustainable commercial office buildings. Journal of Facilities Management, 16(1), 54–64. https://doi.org/10.1108/JFM-08-2017-0035
PWD, (2012). 10. Garis Panduan Life Cycle Cost (LCC). Public Work Department.
Shabrin, N., & Kashem, S. B. A. (2017). A comprehensive cost benefit analysis of green building. Proceedings of 94th The IIER International Conference, February. http://www.worldresearchlibrary.org/up_proc/pdf/811-149302733207-15.pdf
Tsai, W. H., Yang, C. H., Chang, J. C., & Lee, H. L. (2014). An Activity-Based Costing decision model for life cycle assessment in green building projects. European Journal of Operational Research, 238(2), 607–619. https://doi.org/10.1016/j.ejor.2014.03.024
Wang, J., Yu, C., & Pan, W. (2020). Relationship between operational energy and life cycle cost performance of high-rise office buildings. Journal of Cleaner Production, 262, 121300. https://doi.org/10.1016/j.jclepro.2020.121300
Wouterszoon Jansen, B., van Stijn, A., Gruis, V., & van Bortel, G. (2020). A circular economy life cycle costing model (CE-LCC) for building components. Resources, Conservation and Recycling, 161(December 2019), 104857. https://doi.org/10.1016/j.resconrec.2020.104857
Xue, Z., Liu, H., Zhang, Q., Wang, J., Fan, J., & Zhou, X. (2020). The impact assessment of

campus buildings based on a life cycle assessment-life cycle cost integrated model. Sustainability (Switzerland), 12(1), 1–24. https://doi.org/10.3390/su12010294

Zainol, N.N., Mohammad, I.S., Baba, M., Woon, N.B., Ramli, N.A., Nazri, A.Q. and Lokman, M.A.A.(2014), “Critical factors that lead to green building operations and maintenance problems in Malaysia: a preliminary study”, Advanced Materials Research, 935, 23-26.

Zhang, L., Wu, J., & Liu, H. (2018). Turning green into gold: A review on the economics of green buildings. Journal of Cleaner Production, 172, 2234–2245. https://doi.org/10.1016/j.jclepro.2017.11.188

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar