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Considering Success Factors of Risk Management for Green Retrofit on High-Rise Commercial Building

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Abstract: *The strategy to achieve sustainable environment in construction industry by reducing greenhouse gas is wide spread every year. Recently, the introduction to the green buildings concept is capable to reduce carbon footprint. However, the growth and expansion of existing building lately is starting to deficiency due to the poor lifecycle period. The previous concept to retrofit existing building is proven to provide improvement towards energy efficiency but with the expense of huge challenges and risks. The risks require solid assessment to ease in decision-making process among internal stakeholders starting from the early stage of the retrofit project. The retrofit concept in Malaysia construction industry is still open for research which motivates to determining the risk involves in planning stage. This paper aims to review risk in planning stage for green retrofit project for commercial buildings through gathering comprehensive literature review. As a result, three main category risks in planning stage (social risk, economic and political risk) is determined and extracted to identify risk. These risks are then quantified through analysis to support the retrofit design option. The proposed conceptual framework model is expected to assist retrofit practitioner to identify and assess the risk that are beneficial in decision-making process.*

Keywords: green retrofit, success factor, commercial building

1. Introduction

The approach to reduce environment impact is still debatable which require several sustainable mechanisms not only for new construction project, but to the existing building. As for retrofitting, it is an only way to revamp the building into sustainable building. Over the time, green retrofit are the methods that develop same concept as reduce, reuse and recycle (3R) which extending the lifecycle of the building instead of demolish or develop a new building. As green retrofit is a part of green building category which mainly focusing on sustainable existing buildings, it is well known for construction key players and researcher for both developed and developing countries. According to U.S Green Building Council (USGBC), green retrofit is an upgrade, specifically to existing building that beneficial to the building owner which technically focusing on several of sustainable aspect such as energy, water, thermal comfort, air quality and noise. Fundamentally, retrofitting is a term that was originated in the United States (US) in the first half of the twentieth century, stems from a blend of words “retroactive” and “fit” (Dixon, 2014). Similarly, Gleeson, Yang, & Lloyd-Jones, (2011) defined retrofitting as the refurbishment of buildings to improve their sustainability especially with regard to energy efficiency and carbon dioxide emissions.

According to Menassa, (2011) retrofitting as a capital improvement, which improves the performance of the building while extending the building use over an extended period. While research made by Tryson, (2016) suggests that the retrofit is the "change" of elements or components of a building. Similarly, Swan, Fitton, Smith, Abbott, & Smith, (2017) explains retrofit as upgrades to the fabric or system or physical characteristics of a property that reduces energy use, generate renewable energy and improve environmental performance. Therefore, the green retrofit defined well on how it can improve energy efficiency in existing buildings.

Although there are continuous improvement in energy efficiency policies in Malaysia, the construction key players does not respond well to the energy efficiency program to retrofit the existing building. Generally, any construction project have desire construction phase including retrofitting works and it is notably that the pre-construction stage is most critical part that required to determine in most appropriate guideline according to the energy efficiency objectives. As a matter of fact, to ensure the retrofitting practitioner in Malaysia aware of the important parts to obtain feasible energy efficiency retrofitting during pre-construction stage, it is important to understand the element in green retrofitting. In response, the aim of the research is to provide information on element contain in green retrofit project towards pre-construction stage in commercial buildings based on an existing literature review and supported by interview data collection.

2. Green Retrofit Project

Introduction

In any construction project, there will be workflow from the beginning until the project is closeout according to the project lifecycle. The typical project lifecycle for new construction project is almost the same as retrofit project phase but since the retrofitting involves existing buildings, the activity in each phase can be different. In new construction project lifecycle, there are eight phase such as pre-feasibility, feasibility, design, contract, implementation commissioning, handover and operation. However, according to Westland, (2006) the project lifecycle can be compress into four stages consists of initiation, planning, execution and operation.

In contrast, for green retrofit project lifecycle, there are five major phases consists of project setup and pre-retrofit survey, energy auditing, identification of retrofit option, commissioning and validation that will lead to the successful of the project (Ma, Cooper, Daly, & Ledo, 2012a). However, study showed by Less & Walker (2015), the retrofit process consists of five important phase including pre-planning, planning, construction, test-out and post-occupancy.

Importance of Literature Review in Research

The literature reviews selected are important because it describes how the intended research is related to prior research in statistics. It shows the originality of the research on retrofit and relevance of the research problem on how green concept can be integrated into the construction projects. There are many different types of literature reviews, each with its own approach, analysis, and purpose. Through rigorous review and analysis of literature that meets specific criteria, the systematic review identifies and compares to retrofit projects. At the first stage, the process of retrofitting will involve several project setup and pre-retrofit survey. Generally, the early stage before retrofitting involves internal stakeholder such as building owner, architect, and consultant in order to determine the scope of the work and the

project objectives by looking up the budget and the available important resources that influencing the retrofitting. The expert from architect or consultant is essential to clarify the building owner about the new green technologies that will be applied. In fact, lack of knowledge in retrofitting during early stage will lead to underperformance energy efficiency thus increasing potential risk in project financing criteria (De-Selincourt, 2015). In addition, most of the building owner are aware about retrofitting but lack of knowledge in sustainable technologies (Buys & Miller, 2011). This in line with the study by Gram-Hanssen, (2014) stated that building owner does not have knowledge in retrofitting hence losing interest towards retrofitting. Similarly, Jones & Bogus, (2010) highlights that building owner facing difficulties in evaluating and finding feasible retrofit strategy due to limitation of knowledge in engineering and financing. Due to lack of knowledge of amount investment required in retrofitting, the building will eventually turn up to poor performance retrofit building (Basarir, Diri, & Diri, 2012). For instance, Hosseinian et al., (2017) highlights that the building owner is important internal stakeholder for energy efficiency investment as it can influence the overall benefits in financial profit for the future. Similarly, a study by Jones & Bogus (2010) pointed out that retrofitting in bigger perspectives involve organization that manage different properties to generate gain profits from their investor. The decision process to retrofit is influence by organization step that will determine the budget and program of retrofit works.

A pre-retrofit survey may be required in order to achieve better understand towards building operational problems and tenants involve in the building. According to Ma et al., (2012), the pre-retrofit survey phase may be best carried out by a home energy professional knowing as Energy Services Company (ESCO) which has wide range of experience and knowledge in energy retrofit to survey the building at the first place towards developing feasible energy efficiency. Similarly, study by Bu, Shen, Anumba, Wong, & Liang, (2015) revealed the lack of knowledge by internal stakeholder such as architect and consultant in green retrofitting design will eventually affecting energy-saving measures which consequently affecting the decision making. Therefore, this phase is considerably first step to obtain retrofit idea between consultant and building owner to support decision-making process. A summary of the potential effect in first phase for green retrofit project delivery from literature is indicated in Table 1.

Table 1: Summary of potential effect in first phase for green retrofit project delivery

Author, Year	Potential effect
De-Selincourt, (2015)	• Underperformance energy efficiency
Bu, Shen, Anumba, Wong, & Liang, (2015)	• Affecting decision-making process
Buys & Miller, (2011)	• Underperformance energy efficiency
Jones & Bogus, (2010)	• Unknown retrofit strategy to apply

Next, the second phase comprises an energy audit and performance assessment where it is use to analyzing various energy resources before retrofitting such as building energy data, building energy usage, energy wastage, and low cost energy conservation measures (ECMs) towards the existing buildings. Performance assessment is employed to benchmark building energy use by using selected performance indicators or by using green building rating systems (Carreón, 2015). For instance, study by Sakina, Fassman, & Wilkinson, (2011) highlights that the energy retrofit might occurring underperformed due to unsuitable

technologies or system applied to the building. In addition, poor usage of energy benchmarking tool in energy audit and performance assessment is part of reason the retrofitted building is performing beyond expectation. According to Al-kodmany, (2014) stated through usage of DOE-2.2 energy tools for Empire State Building, the planning and design team are be able to analyze the energy saving prediction towards various parameters to ensure the project is executed within cost allocated. In contrast, Sun, Gou, Lu, & Tao, (2018) argued through case study in LEEDBOM project where the miscalculated of energy simulation through selection of retrofit strategies does not meet in actual energy saving. Therefore, the second phase of project delivery in retrofit technologies is important to ensure the feasible energy efficiency can be totally achieve by applying energy audit and performance assessment. A summary of the potential effect in second phase for green retrofit project delivery from literature is indicated in Table 2.

Table 2: Summary of potential effect in second phase for green retrofit project delivery

Author, Year	Potential effect
Sakina, Fassman, & Wilkinson, (2011) Sun, Gou, Lu, & Tao, (2018)	• Improper technology or system • Miscalculated energy model • Energy perform less well than expected

Next phase involves the identification of retrofit options and can be determine by using appropriate energy models, economic analysis tools and risk assessment methods. The selection of buildings retrofit option is quite difficult to carry out due to variety of complex building systems since it influencing the overall energy performance and the (Kaklauskas, Zavadskas, & Raslanas, 2005). Similarly, Shaikh, Shaikh, Sahito, Uqaili, & Umrani (2017) highlights that the combination of each retrofit technologies to obtain performance-effective with cost-effective is quite challenging due to various characteristic of building condition and tenants behavior. For this reason, since there are wide ranges of retrofit technologies to be apply on the buildings, the combination each of the retrofit packages should not be repetitive as to avoid same results with specific cost (Grete Hestnes & Ulrik Kofoed, 2002).

However, every retrofit option can be assessed quantitatively about the performance in the particular buildings by prioritizing based on the relevant energy and non-energy. According to Ma et al., (2012), each of the retrofit option possess energy models that influencing the budget of the projects by estimating the energy savings that can be achieve with various of retrofitting works. For an example, material selection and efficient design strategies are important and play a major role in minimizing the impacts associated with building retrofit projects. This in line with Liu et al., (2018) that highlights the advanced material is interrelationship with the cost as each of the selection in retrofit option resulting different outcome to the energy and cost. The study concludes that replacing appropriate material from aluminum to plastic in windows section resulting same energy efficiency but with less cost. Furthermore, the findings by Jha & Bhattacharjee, (2018) revealed that the selection to retrofitting of walls section such as structurally insulated panels, ventilated walls, passive solar walls, light-weight concrete walls, walls with latent storage and vacuum insulation panels will give various results for energy efficiency due to different on the material properties and composition. Therefore, cautious retrofits can reduce operational costs and environmental impacts and at the same time increase building adaptability, durability and resiliency (Al-Kodmany, 2014).

The retrofitting option can be determine through generating the design draft to obtain the energy efficiency results. The decision to selecting retrofitting design is either supported by tools or based on the current state of the building. According to Nielsen, Jensen, Larsen, & Nissen (2016), the tools to accumulate performance estimation after designing of retrofitting can be assist by computers software in running the design simulation and calculation of the energy. In fact, the tool is important to simulate energy model since it can avoid performance gap that will affect occupant (Mohareb, Hashemi, Shahrestani, & Sunikka-Blank, 2017). Similarly, study by Rospi, Cardinale, & Negro, (2017) revealed that the simulation can provide energy improvement with techno-economic result to select best retrofit option. In addition , Mathew et al., (2015) highlights that each design can be simulate according to the selection of wide retrofitting option in order to benchmark the energy performance. Taking as example tools call as 'Encompass', it use pre-simulated energy simulations stored in a database to be used as reference buildings in benchmarking.

After the detail of energy simulation is obtain, the next step is to identify the cost impact and risk is through economic analysis and risk assessment. According to Ma, Cooper, Daly, & Ledo, (2012) highlighted that the selection of retrofit measures is a trade-off between capital investment and benefits that can be achieved due to implementation each of the retrofit measures. Similarly, the study by Aste & Del Pero, (2013) revealed that by doing economic analysis for evaluating the proposed retrofit option, it can show the actual payback period of retrofitting. By applying economic analysis which facilitates the comparison among alternative retrofit measures, it can present a sign of whether the retrofit options are cost effective along with energy efficiency. This in line with the findings by Tadeu et al., (2016) that the full-cost investment in any retrofit technologies application does not always reflecting great performance although it is significantly reducing energy usage. Since the retrofit project involve huge investment, the uncertainty in performance is still exist to perceive by internal stakeholder decision during planning stage (Lee, Choi, & Gambatese, 2014). Also, the findings by Kontokosta, (2016) highlighted that the long payback period will increase the difficulty by building owner in decision-making to retrofit.

However, different analytical methods are used to perform the cost-benefit analysis of energy efficiency projects although it depending on theoretical computer simulation which is unknown whether the expected energy savings can be realized. The study by Tan, Yavuz, Otay, & Çamlibel (2016) revealed that methodology using mathematical programming to analyzing cost and environmental optimization of energy efficiency between each energy retrofitting measures. In contrast, Sağlam, Yılmaz, Becchio, & Corgnati (2017), presented a cost optimal approach integrating each retrofit measures related to building envelope, building energy systems and renewable energy to evaluate existing building retrofit. Both recent studies of economic retrofit analysis are lean on computer simulation without knowing actual energy saving in real situation. As a matter of fact, study shown by Liu, Liu, Ye, & Liu (2018) revealed that the retrofit energy economic analysis based on calculation of cost-benefits over lifecycle building is lower compared to the theoretical calculation made by computer. Therefore, the activity in this phase is important as it will determine the energy saving made in designing retrofit to the existing buildings.

In risk assessment, it will provide building owner and related stakeholders to create solid decision making by determining the qualitative and quantitative value of risks according to the current condition as well as the threat that they will encounter in retrofitting works begin. This is proven by previous research that highlighted retrofitting is uniquely characterized by the high degree of risk and uncertainty which will influence the management of such a

project (Ali, Au-Yong, & Ling, 2014; Reyers & Mansfield, 2001). In addition, recognizing uncertainty in actual energy savings and the risk of underachieving projected energy savings are the primary factor that prevents investors and building owners from pursuing a retrofit (Krieske, Hu, & Egnor, 2014). A study by Tollin (2011) revealed that the risk of not achieving considerable savings can lead to owner and tenant dissatisfaction. Therefore, it clearly shows that risk assessment is essential to provide decision makers to select and determine the best retrofit solution. A summary of the potential effect in third phase for green retrofit project delivery from literature is indicated in Table 3.

Table 3: Summary of potential effect in third phase for green retrofit project delivery

Author, Year	Potential effect
Ma et al., (2012) Liu et al., (2018) Jha & Bhattacharjee, (2018) Mohareb, Hashemi, Shahrestani, & Sunikka-Blank, 2017) Aste & Del Pero, (2013) Tollin (2011)	• Project budget • Cost-benefit • Performance or energy gap • Various result from each option • Performance or energy gap • Estimate payback period • Dissatisfaction among building owner and tenant

In overall, the three important phases in pre-construction for green retrofit project is clearly shows that to obtain feasible energy efficiency in existing building required several of strategies and technique to be use by internal stakeholder. Throughout the review from past study, it can conclude that the green retrofit is facing uncertainty to achieve optimum energy efficiency and it should be systematically analyze to avoid unworthy investment for the building owner. Therefore, Figure 1 illustrates the main element of green retrofit in pre-construction stage.

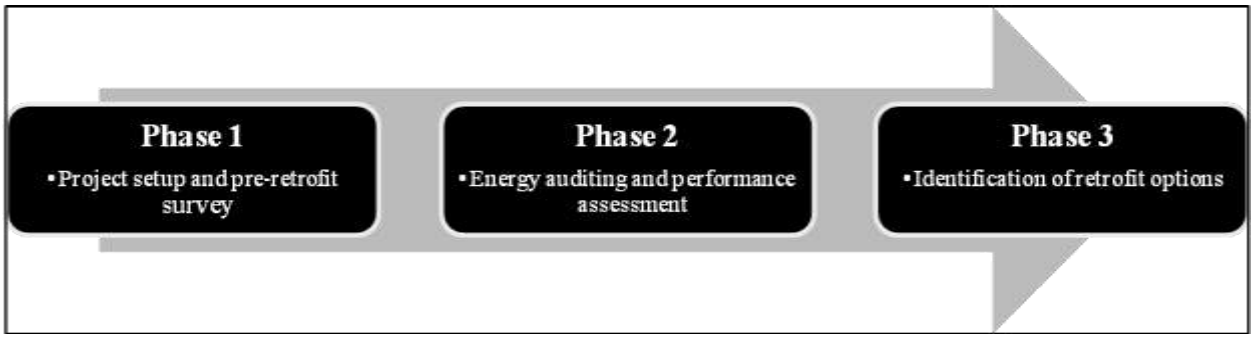

Figure 1: Main element of green retrofit in pre-construction stage (Source: Ma et al., 2012)

3. Methodology

Research methodology is a process used to collect information and data for the purpose of making business decisions. The methodology includes publication research, interviews, surveys and other research techniques, and could include both present and historical information. The purpose of this section is to describe the methods that were used for this paper. For this research, the semi-structured interview has been chosen since the literature review regarding of retrofit in Malaysia is currently low while it is flexible to obtain rich information and data. Qualitative interview is able to capture how respondents view and to understand their individual perceptions through their past experience (Yahya et al 2019) . The

respondent is selected based on the experienced practitioner in order to gain significant input from the interview session. The interview is conducted face-to-face to ensure the findings are strong and provide better understanding.

4. Conclusion

The study presented the three important phases in project delivery for green retrofitting to achieve energy efficiency target in building retrofits. An overview of previous studies related to the investigation toward each phase is provided. The findings shows that the project setup and pre-retrofit survey, energy auditing and performance assessment, and identification of retrofit options process are contributing to the overall strategy to achieve energy efficiency in retrofit. In addition, the finding from each phase of green retrofit project in term of potential effect revealed additional support to achieve feasible energy efficiency. Since Malaysia is committed towards in reducing greenhouse gas and carbon footprint, it is important for retrofit practitioner to focus on every aspect and it potential effect in pre-construction stage phase activity as it will significantly affecting energy efficiency in green retrofit project. Although retrofitting involve existing buildings with various of uncertainties conditions, these project delivery is needed as to ensure energy efficiency through each of retrofit measures obtained with minimum risks. However, future study should relate the risks embedded in every phase in green retrofitting project due to potential influencing in overall energy efficiency objectives. The conclusion allows you to have the final say on the issues you have raised in your paper, to synthesize your thoughts, to demonstrate the importance of your ideas, and to propel your reader to a new view of the subject. It is also your opportunity to make a good final impression and to end on a positive note.

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References

Al-Kodmany, K. (2014). Green Retrofitting Skyscrapers: A Review. Buildings, 4(4), 683–710. https://doi.org/10.3390/buildings4040683

Aste, N., & Del Pero, C. (2013). Energy retrofit of commercial buildings: Case study and applied methodology. Energy Efficiency, 6(2), 407–423. https://doi.org/10.1007/s12053-012-9168-4

Basarir, B., Diri, B. S., & Diri, C. (2012). Energy efficient retrofit methods at the building envelopes of the school buildings Energy Efficient Retrofit of School Buildings. Retrofit 2012, 1–13.

Bruce, T., Zuo, J., Rameezdeen, R., & Pullen, S. (2015). Factors influencing the retrofitting of existing office buildings using Adelaide, South Australia as a case study. Structural Survey, 33(2), 150–166. https://doi.org/10.1108/SS-05-2014-0019

Bu, S., Shen, G., Anumba, C., Wong, A., & Liang, X. (2015). Literature review of green retrofit design for commercial buildings with BIM implication. Smart and Sustainable Built Environment, 4(2), 188–214. https://doi.org/10.1108/SASBE-07-2016-0015

Buys, L., & Miller, E. (2011). Retrofitting Commerical Office Buildings for Sustainability: Tenants' Expectations and Experiences. Management and Innovation for a Sustainable

Built Environment, (June).
Carreón, J. R. (2015). Review on techniques, tools and best practices for energy efficient retrofitting of heritage buildings. Retrieved from https://scholar.google.co.uk/scholar?hl=en&as_sdt=0%2C5&q=Review+on+techniques%2C+tools+and+best+practices+for+energy+efficient+retrofitting+of+heritage+buildings&btnG=
Corrado, V., Ballarini, I., Paduos, S., & Tulipano, L. (2017). A new procedure of energy audit and cost analysis for the transformation of a school into a nearly zero-energy building. Energy Procedia, 140, 325–338. https://doi.org/10.1016/j.egypro.2017.11.146
De-Selincourt, K. (2015). The risks of retrofit. In K. Hall (Ed.), Green Building (Fourth, pp. 28–37). United Kingdom: Green Building Press.
Dixon, T. (2014). Scaling up commercial property retrofitting: challenges and solutions. The Estates Gazette, pg. 86.
Gleeson, C. P., Yang, J., & Lloyd-Jones, T. (2011). European Retrofit Network : Retrofitting Evaluation Methodology Report. London, UK.
Gram-Hanssen, K. (2014). Retrofitting owner-occupied housing: Remember the people. Building Research and Information, 42(4), 393–397. https://doi.org/10.1080/09613218.2014.911572
Grete Hestnes, A., & Ulrik Kofoed, N. (2002). Effective retrofitting scenarios for energy efficiency and comfort: results of the design and evaluation activities within the OFFICE project. Building and Environment, 37, 569–574.
Hosseinian, S., Choi, K., & Bae, J. (2017). IRIER: A Decision-Support Model for Optimal Energy Retrofit Investments. Journal of Construction Engineering and Management, 143(9), 05017016. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001362
Hwang, B.-G., Zhao, X., See, Y. L., & Zhong, Y. (2015). Addressing Risks in Green Retrofit Projects: The Case of Singapore. Project Management Journal, 46(4), 76–89. https://doi.org/10.1002/pmj
Jafari, A., & Valentin, V. (2017). An optimization framework for building energy retrofits decision-making. Building and Environment, 115(November), 118–129. https://doi.org/10.1016/j.buildenv.2017.01.020
Jha, B., & Bhattacharjee, B. (2018). TOOL FOR ENERGY EFFICIENT BUILDING ENVELOPE RETROFITTING. Building Performance Analysis Conference and SimBuild, 1–8.
Jones, B., & Bogus, S. M. (2010). Decision Process for Energy Efficient Building Retrofits: The Owner's Perspective. Journal of Green Building, 5(3), 131–146. https://doi.org/10.3992/jgb.5.3.131
Kaklauskas, A., Zavadskas, E. K., & Raslanas, S. (2005). Multivariant design and multiple criteria analysis of building refurbishments. Energy and Buildings, 37(4), 361–372. https://doi.org/10.1016/j.enbuild.2004.07.005
Kontokosta, C. E. (2016). Modeling the energy retrofit decision in commercial office buildings. Energy and Buildings, 131, 1–20. https://doi.org/10.1016/j.enbuild.2016.08.062
Krieske, M., Hu, H., & Egnor, T. (2014). The scalability of the building retrofit market: A review study. 2014 IEEE Conference on Technologies for Sustainability, SusTech 2014, 184–191. https://doi.org/10.1109/SusTech.2014.7046241
Lee, H. W., Choi, K., & Gambatese, J. A. (2014). Real Options Valuation of Phased Investments in Commercial Energy Retrofits under Building Performance Risks. Journal of Construction Engineering and Management, 140(6), 05014004. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000844
Less, B., & Walker, I. (2015). Deep Energy Retrofit Guidance for the Building America

Solutions Center. Ernest Orlando Lawrence Berkeley National Laboratory.

Leung, B. C. M. (2018). Greening existing buildings [GEB] strategies. Energy Reports, 4, 159–206. https://doi.org/10.1016/j.egyr.2018.01.003

Liu, Y., Liu, T., Ye, S., & Liu, Y. (2018). Cost-benefit analysis for Energy Efficiency Retrofit of existing buildings: A case study in China. Journal of Cleaner Production, 177, 493–506. https://doi.org/10.1016/j.jclepro.2017.12.225

Ma, Z., Cooper, P., Daly, D., & Ledo, L. (2012a). Existing building retrofits: Methodology and state-of-the-art. Energy and Buildings, 55(December), 889–902. https://doi.org/10.1016/j.enbuild.2012.08.018

Ma, Z., Cooper, P., Daly, D., & Ledo, L. (2012b). Existing building retrofits: Methodology and state-of-the-art. Energy and Buildings, 55, 889–902. https://doi.org/10.1016/j.enbuild.2012.08.018

Ma, Z., Cooper, P., Daly, D., & Ledo, L. (2012c). Existing building retrofits: Methodology and state-of-the-art. Energy and Buildings, 55(February 2018), 889–902. https://doi.org/10.1016/j.enbuild.2012.08.018

Mathew, P. A., Dunn, L. N., Sohn, M. D., Mercado, A., Custudio, C., & Walter, T. (2015). Big-data for building energy performance : Lessons from assembling a very large national database of building energy use. APPLIED ENERGY, 140, 85–93. https://doi.org/10.1016/j.apenergy.2014.11.042

Menassa, C. C. (2011). Evaluating sustainable retrofits in existing buildings under uncertainty. Energy and Buildings, 43(12), 3576–3583. https://doi.org/10.1016/j.enbuild.2011.09.030

Mohareb, E., Hashemi, A., Shahrestani, M., & Sunikka-Blank, M. (2017). Retrofit planning for the performance gap: Results of a workshop on addressing energy, health and comfort needs in a protected building. Energies, 10(8). https://doi.org/10.3390/en10081177

Nielsen, A. N., Jensen, R. L., Larsen, T. S., & Nissen, S. B. (2016). Early stage decision support for sustainable building renovation - A review. Building and Environment, 103, 165–181. https://doi.org/10.1016/j.buildenv.2016.04.009

Nimlyat, P. S., Kandar, M. Z., & Zango, M. S. (2016). Green building and environment sustainability: A retrofit of chemical engineering pilot plant building Universiti Teknologi Malaysia [UTM]. Indian Journal of Science and Technology, 9(46). https://doi.org/10.17485/ijst/2016/v9i46/107119

Palmer, K., Walls, M., Gordon, H., & Gerarden, T. (2013). Assessing the energy-efficiency information gap: Results from a survey of home energy auditors. Energy Efficiency, 6(2), 271–292. https://doi.org/10.1007/s12053-012-9178-2

Piette, M. A., Hong, T., Sun, K., Zhang, R., Lee, S. H., Chen, Y., … Price, P. (2015). Commercial Building Energy Saver: An energy retrofit analysis toolkit. Applied Energy, 159, 298–309. https://doi.org/10.1016/j.apenergy.2015.09.002

Rospi, G., Cardinale, N., & Negro, E. (2017). Energy performance and economic feasibility study of historical building in the city of Matera, Southern Italy. Energies, 10(12). https://doi.org/10.3390/en10122009

Sağlam, N. G., Yılmaz, A. Z., Becchio, C., & Corgnati, S. P. (2017). A comprehensive cost-optimal approach for energy retrofit of existing multi-family buildings: Application to apartment blocks in Turkey. Energy and Buildings, 150, 224–238. https://doi.org/10.1016/j.enbuild.2017.06.026

Sakina, M. A., Fassman, E., & Wilkinson, S. (2011). Risks Associated in Implementation of Green Buildings. 4th International Conference on Sustainability Engineering and Science. Retrieved from http://www.thesustainabilitysociety.org.nz/conference/2010/papers/Mokhtar-Azizi-

Fassman-Wilkinson.pdf

Shaikh, P. H., Shaikh, F., Sahito, A. A., Uqaili, M. A., & Umrani, Z. (2017). An Overview of the Challenges for Cost-Effective and Energy-Efficient Retrofits of the Existing Building Stock. Cost-Effective Energy Efficient Building Retrofitting: Materials, Technologies, Optimization and Case Studies, (October), 257–278. https://doi.org/10.1016/B978-0-08-101128-7.00009-5

Sun, X., Gou, Z., Lu, Y., & Tao, Y. (2018). Strengths and Weaknesses of Existing Building Green Retrofits : Case Study of a LEED EBOM Gold Project. Energies, 11(1936), 1–18. https://doi.org/10.3390/en11081936

Swan, W., Fitton, R., Smith, L., Abbott, C., & Smith, L. (2017). Adoption of sustainable retrofit in UK social housing. University of Salford. https://doi.org/10.1108/SS-12-2012-0039

Tan, B., Yavuz, Y., Otay, E. N., & Çamlibel, E. (2016). Optimal selection of energy efficiency measures for energy sustainability of existing buildings. Computers and Operations Research, 66, 258–271. https://doi.org/10.1016/j.cor.2015.01.013

Tollin, H. M. (2011). Green building risks: It's not easy being green. Environmental Claims Journal, 23(3–4), 199–213. https://doi.org/10.1080/10406026.2011.593442

Tryson, L. (2016). Commercial Buildings & the Retrofit Opportunity. Retrieved from https://www.contractingbusiness.com/commercial-hvac/commercial-buildings-retrofit-opportunity

Westland, J. (2006). The Project Management Life Cycle (1st ed.). United States of America: Kogan Page Limited.

Yahya M Y, Waziri A A, Mohamed S & Mohd Yassin A (2019) Contributing Factors Of Poor Construction Project Performance In Nigeria, INTERNATIONAL JOURNAL OF PROPERTY SCIENCE, UM , 10, 1, ISSN:22298568