Indicating Users' Risk in Building Performance Evaluation for University Buildings

Natasha Khalil [1, 2], Syahrul Nizam Kamaruzzaman [2],
Mohamad Rizal Baharum [2], Husrul Nizam Husin [1]

[1] Faculty of Architecture, Planning and Surveying,
Universiti Teknologi MARA Perak, 32610 Seri Iskandar, Perak, Malaysia
[2] Faculty of Built Environment,
Universiti Malaya, 50603 Kuala Lumpur, Malaysia

natashakhalil29@gmail.com

Abstract

Higher education building (HEB) is believed to be key functional. It spawns not only environment, but also human and economic resources. Initially, growing students' population with various learning activities has constituted risk emergence, inefficient of energy use and climate discomfort. Thus, it decreases the yearly total performance of the building. To sustain the building efficiency, Building Performance Evaluation (BPE) plays a vital role to improve performance issues in HEB. Hence, this paper explores the significance of users' feedback as the concept of building performance. This paper also describes literatures on the HEB's background including risk factors and performance issues.

Keywords: Higher Education Buildings, Building Performance; Risk; Users' Feedback

DOI: https://doi.org/10.21834/aje-bs.v3i10.312

1.0 Introduction

A higher education building (HEB) is a symbol of physical and intellectual replenishment. HEB defines as a place for teaching and learning, engaging community of scholars in the pursuit of knowledge, social and cultural connotations (Edwards, 2000). The main agenda in constructing higher education building is to disseminate knowledge and simultaneously functions as a 'hub' to local communities for various purposes. For example, higher education building is considering as a factor in the production of future leaders. Additionally, the absence of a building that caters for tertiary education may impede the dissemination of knowledge among researchers and scholars. Malaysia has witnessed rapid growth in the higher education sector with more than 420% in allocation to the education sector in the last 20 years (Olanrewaju, Khamidi, & Idrus, 2010a). In 2012, the country located a budget of about MYR12billion (USD3.75billion) for higher education. Interestingly, out of the total budget, MYR10billion (USD3.1billion) allocates to operating expenditures, whereas the rest, MYR2billion (USD650million) allocated to development expenditures (Tenth Malaysia Plan, 2011-2015). The rapid expansion of universities and colleges in recent years shows the efforts by the national higher education sector in transforming Malaysia as a hub for higher education regionally and internationally.

Since HEB hosts a large number of users with various needs, it generates the feeling of community in whole and in part because HEB provides the environment, human and economic resources. Therefore, in order to provide 'value for money' on the development of higher education building, there needs to be a better understanding of how the interaction between people, buildings and the organisation influence the delivery of organisational goals (Amaratunga & Baldry, 1999). Ideally, if a wider range offers in the operation building, diversity in building performance issues will occur in various aspects.

1.1. Building Performance and Risk Issues

The higher education sector is currently engaged in a large building programme. To cater the programmes, development of education institutions would include expanding facilities and spaces. This is spirally a welcoming sign on the growth of tertiary educational programmes. According to James and Hopkinson (2004), if the expansion initiatives are rely on the principles of sustainable construction, higher education sectors will be able to reduce operating costs over the building's lifetime. As supported by Olanrewaju (2010), the most significant asset of a university organization demarcates on its building; thus, the assertion can be reinforced considering the investment a university makes on development and operations of their building facilities. However, assessment upon building condition does not explicitly address the relationship between the building's physical forms and various educational activities that take place within the building (Doidge, 2001). The increasing number of students and learning activities in higher education building has contributed to the risk occurrence, inefficient of energy use and climate discomfort (Gillen et al., 2011; Altan, 2010; Sapri & Muhammad, 2010; Hassanain, 2007) and these may decrease the total performance system of the building year by year. Although it shows that university building

facilities are still in need of wider supply, holistic requirements for the building users must be thoroughly prioritized.

Like other buildings, university buildings built for learning is also disposes to the forces of change released by various factors. Edwards (2000) stated that handling the forces of change within buildings requires recognizing distinctions between various elements of construction so that parts can be replaced or changed without distorting the whole. Growing number of students, diversification of academic activities with sophisticated equipment and the increase in complexity of research activities that raised the energy cost also contributed to a higher operation cost in HEB (Altan, 2010). Concurrently, allocating proper monitoring assessment on the building is critically allied to the changing needs on operations and functions. Inherently, there is a need to identify the means in ensuring that the main asset of a university (i.e. the building) fit to face various challenges in meeting the growing demands from the patrons.

The development of building performance evaluation in HEB is not only able to resource allocation in universities. It must also leads to the development of approaches for commercial competitive advantage. It is imperative for institutions to manage their facilities by adopting good practices in various aspects of their operations (Khalil, Husin, & Nawawi, 2012). Crucially, performance failure of the building also creates various risk issues in HEB. Thompson & Bank (2007) stated that as buildings have become larger and house more people, political and societal issues have become more complex, and risks associated with occupying buildings have changed. It is inevitable that campus operations and infrastructure are vulnerable from the performance failure of buildings. Isnin, Ahmad, & Yahya (2013) described that building materials has an effect of exposure to users' health and the environment, thus, information on the content, risks and safety measures of the materials should be conveyed to the users. Even for recycled materials, previous studies indicated that some of these recycled materials were contaminated and could raise the potential health risks (Isnin et al., 2013). Therefore, by identifying the latent risks impacted from the building performance, HEB potentially have opportunities in enrol adaptation and solutions for the rest of society in campus operations.

1.2. Performance Failure and Risk Impact to Building Users

The building stakeholders commonly recognized the awareness and the importance of maintaining and developing the existing building stock and already existing buildings (Lützkendorf & Lorenz, 2006). Within this context, it addresses the requirement to develop new (or to adjust and extend existing) tools for the description and assessment of existing buildings. Typically, buildings need to provide physical protection of its occupants and assets including protection from crime, vandalism, terrorism, fire, accidents, and environmental elements. Issues on risks impacting building users are common. Concerns on the matter are not prioritising as the main aspect among previously established criteria in HEB performance assessment such as maintenance, energy issues, environmental issues and facilities management. It asserts that building users are likely affected by the performance of the building and likewise, the building is also affected by the activities of its users (Olanrewaju et

al., 2010b). Users have the potential and capabilities to take actions or decisions if their value system is not adequately met. This is because of appropriate functioning of the building that the users desire and not only the physical condition of the building. The ability of an emergency response team to attain information from such assessment could substantially reduce risks to the responders, building occupants and the general public (Wong et al., 2011). This transpires the ability of building performance assessment in revealing risks prevalence to be beneficial to its users at large.

There are adequate studies to validate that the poor performance of educational buildings has a significant impact on the building users, including students' performance and staffs' productivity (Altan, 2010; Amaratunga & Baldry, 1999; Amole, 2008; Harb & El-Shaarawi, 2006; Hassanain, 2007; Khalil, Husin, & Zakaria, 2010; Mat et al., 2009; Najib, Yusof, & Abidin, 2011; Olanrewaju et al., 2010a, 2010b; Olanrewaju, 2010; Sapri & Muhammad, 2010; Shabha, 2004; Shafie et al., 2011; Wong & Jan, 2003). Although new buildings help to upgrade educational facilities and provide better quality education, buildings cannot remain pristine throughout their life span. In response to this significant change, university buildings in Malaysia requires to incorporate elements for users' risk in building performance management that will support and facilitate learning, teaching and research activities (Olanrewaju, Khamidi, & Idrus, 2010). Therefore, a more holistic approach is indispensable to assess the overall long term performance of a building in which the building performance evaluation (BPE) can play an important role.

1.3 Research Aim and Objectives

The introduction and the problem statement above led to the formulation of the research aim and objectives. The main aim of this research is to develop a building performance rating tool that integrates users' risks on health, safety and environmental aspects. The objectives for this study are as followed:

- To identify the concept of building performance assessment used for higher educational buildings (HEB)
- To identify the performance indicators, that constitute health and safety risk to HEB users

2.0 Methodology

A qualitative approach is used to identify the concept of building performance and risk approach by using various literatures as instruments. Indicators or variables for building performance and risk criteria are then validated through semi structured interview with the HEB's building operators. The need of inputs from building operators is to obtain suitability of the indicators for building performance rating assessment to be used in the local HEB. As the interview for this research is currently still ongoing, hence, this paper discusses the findings of literature and relates the significance of users' feedback in the concept of building performance evaluation (BPE).

3.0 Literature Review

Sustaining the performance of building lifespan in HEB has become a global issue and a focal point of concern. According to Altan (2010), the rapid expansion of the higher education sectors, institutions and in particular the universities have become large employers and major poles of economic and social growth. Inevitably, it shows that building sustainability in universities is vital to support the adequacy of educational activities. To sustain the performance and anticipate long-term performance, building diagnostics has potential of rapidly becoming a major tool in building appraisal as to evaluate the suitability and to assess risk (Almeida et al., 2010). As described by Douglas (1996), a more holistic approach is need to assess the overall long term performance of a building.

Building is a structure that provides basic shelter for humans to conduct general activities. In common prose, the purposes of buildings are to provide humans with comfortable working and living space, as well as to provide protection from the extremes of climate. To that end, cost reduction is a primary consideration for many building owners and occupiers (Mcdougall et al., 2002). Since not all buildings change in the same rate, Haapio & Viitaniemi (2008) mentioned that the relevant building stakeholders should give focus on how buildings are design, build, and operate fit for its purposes.

The basic concept of building performance upraises various issues and characteristics with various objectives. As illustrated in Figure 1, the performance concept involves BPE combined with recommendations for improvement and it is use for feedback and feed into the performance of similar buildings (Amaratunga & Baldry, 1998).

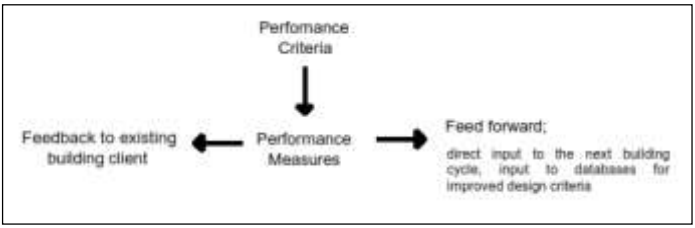

Fig. 1. Building process and the performance concept (Amaratunga & Baldry, 1998)

Figure 1 shows how performance is measured and compared to criteria. The results from the performance measurements are used as feedback to improve the evaluated building performance. The notion of assessing building performance is to understand how the building meets the design, function, capability and technical objectives. This surfaces the significance of users' feedback in obtaining current issues in building operations, including potential risk impact to the building users. A survey by Amaratunga & Baldry (1999) shows that 100% of staffs (4.71 mean score; 0.49 s.d.) and 70.1% of students (4.02 mean score; 1.08 s.d.) agreed that functional performance in HEB must avoid putting occupants, visitors and passers-by at risk. It demonstrates the significance of addressing the risk impact that could potentially jeopardize the building users by having optimization of building performance. Building diagnostics has rapid potential of becoming a major tool in building appraisal to

evaluate the suitability and to assess risk (Almeida et al., 2010). Seeing this importance, determining the risk indicators on the evaluative criteria derived from the building users in HEB is rational to be incorporated for performance assessment.

3.1 The Concept of Users' Feedback in Building Performance Evaluation (BPE)

Responses from the users on how well buildings performed are considering as feedback. Feedback is a process of learning and understanding from valuable information and responses in a current building situation (Bordass & Leaman, 2005). It means that the understanding lean from what people have informed, ensuing actions from the information and improving from the actions as lessons learned. Zimmerman & Martin (2001) accentuated that lessons learned is retrieved from the building users that are useful to improve the fit of the existing and to be reused in the design research and programming of the next building. Lesson-learned is feasible to be established from the feedback or responses of building users, which significantly experience the impact from the occupied buildings. Sinopoli (2009) states that feedback from building users, whether they are office workers, shoppers or teachers are invaluable input to building operations or the design of the next building. This sgradually enhances through the changing needs of the users and the criteria for judgment do not only depend on the suitability of the building orientation and facilities towards the users.

To improve the overall building performance in a changing market, the industry and its clients need to identify opportunities and pitfalls by means of rapid feedback (Cohen et al., 2001). This associates to the concept of building performance that acquire feedback in occupancy stage to meet the client's goals and objectives in the preliminary stage of building development. According to Lützkendorf and Lorenz (2006), feedback derived from occupants' satisfaction represents a key performance indicator that may replace some other buildings partial indicators. Significantly, this indicator reveals a very close relationship between the social aspects of sustainable development (in terms of health, comfort and well-being) and economic or financial considerations. Therefore, it is undoubted that many studies have shown an increasing awareness on the direct impact of responses gathered from the feedback of building users.

3.2 Benchmarking User's Feedback for Risk Mitigation

Lowrance (1976) as cited in (Wolski et al., 2000) affirmed that problems relate to risk are filtered through human perceptions. A risk, therefore, can be perceived to be associated with ordinary (small) consequences. It is rather typical to relate risk with safety and security factors in buildings such as crime and vandalism. Somehow, risks could also generate by the poor building morphology, deterioration and poor design orientation. Recently, several studies had shown that inefficiency of energy in buildings presents vulnerability of risk towards the safety and health of building users (Almeida et al., 2010; Altan, 2010; Cole, 2000; Lützkendorf & Lorenz, 2007, 2006; Meacham, 2010; Wolski et al., 2000; Zalejska-Jonsson, 2012). This has significantly proved that prioritizing risks as the main constituent that might initiate a failure of other performance factors is somewhat to be deliberated.

Altan (2010) revealed that heating and lighting requirements of vast estates, reliance on and heavy use of computers and research equipment has affected the comfort and health of building users in his research. A survey on building materials used in HEB by Isnin et al. (2013) has summarised that there is a need for accessible information system that outlines the risks and safety precautions to highlight the effects to users' health. This summarises that inappropriate provisions of facilities in the building also prompted risk to be transpired. Within this understanding of risk frames, it can be seen that the principles in risk tend to minimize the impact of building performance, then controlling for health, safety and well-being of the building occupants (Woods, 2008). Hence, any information concerning the performance impacts of building and risks for occupants/users will need to be described and assessed in the future.

According to Badayai (2012) , the exposure to the hazardous environment can make the workplace uncongenial and thus, might affect the concentration of the people who work in the building. The risk approach advocates similar principles because it is based on the presumption that individuals and society are ultimately affected by the various sources of risks (Almeida et al., 2010). Consequently, risks can have a direct impact towards end users, society and individuals or to the whole building. Benchmarking the risk in building performance can be framed as a health risk, a safety risk, an environmental risk, an economic risk, a political risk and others (Meacham, 2010; Almeida et al., 2010; Meacham et al., 2005). It predicts the significant impact towards individuals and society that are ultimately affected by those sources of risks. Therefore, for the purpose of this study, the schematic relationship that can relate the building performance, risk and building users is depicted in Figure 2. It describes the fundamental theory of performance failure in buildings that increased the tendency of risks. The cycle forwards to the building occupants who perceived the risk that emerges from building performance failure. It can be imparted that there is the significance in providing good quality of building performance that can engage the tendency of risk occurrences in buildings.

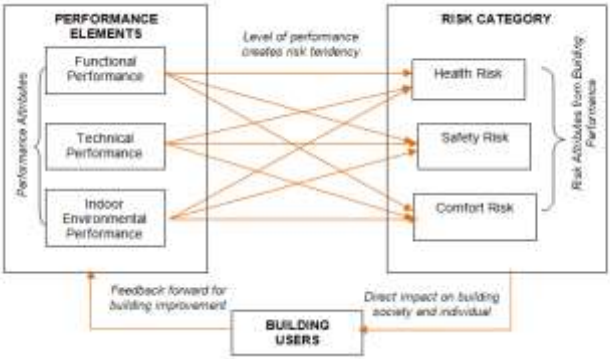

Fig. 2. Schematic Relationship of Building Performance, Risk Frames (category) and Building Users

4.0 Conclusion

This research concludes that Building Performance - Risk Management (BPRM) is an emerging field of academic enquiry intersecting two previously distinct fields: building performance (BP) and risk management (RM). The above literature explores how risk identification can help to boost building performance by linking performance optimization towards the building users' comfort and satisfaction. Valuable data and input on risk are appropriate to be collected during occupancy stage as the building users are able to illustrate the credible data for further assessment. It also supports for continuous assessment of building necessity on a regular basis is essential. Hence, this research recommends that integrated risk-performance rating tool is needed to cover the lacking of the social aspect in Building Performance Evaluation (BPE). Since the concept of building performance acquires feedback from building users, the selected risk frames in this research context were relatively allied on the impact towards building users, as social factors. In developing a new rating tool, the initial step is to select the assessment areas that should be rated in the method. The next important step is to determine the parameters, variables, attributes or indicators that can be used for measuring the selected aspects.

Acknowledgement

The authors wish to acknowledge the support of fund for this research under Exploratory Research Grant Scheme (ERGS) Phase 1/2013 from Ministry of Higher Education, Malaysia (MOHE).

References

Almeida, N., Sousa, V., Alves Dias, L., & Branco, F. (2010). A framework for combining risk-management and performance-based building approaches. *Building Research & Information*, *38*(2), 157–174. doi:10.1080/09613210903516719

Altan, H. (2010). Energy efficiency interventions in UK higher education institutions. *Energy Policy*, *38*(12), 7722–7731. doi:10.1016/j.enpol.2010.08.024

Amaratunga, D., & Baldry, D. (1998). Appraising the total performance of higher education buildings: A participator y approach towards a knowledge- base system. In *Construction and Building Research Conference 1998 : Proceedings (COBRA) 2nd-3rd September 1998, Oxford Brookes University* (pp. 1–17).

Amaratunga, D., & Baldry, D. (1999). Building Performance Evaluation In Higher Education Properties: Towards A Process Model. In *COBRA 1999*.

Amole, D. (2008). Residential satisfaction in students ' housing q. *Journal of Environmental Psychology*, 1–10. doi:10.1016/j.jenvp.2008.05.006

Badayai, A. R. A. (2012). A Theoretical Framework and Analytical Discussion on Uncongenial Physical Workplace Environment and Job Performance among Workers in Industrial Sectors. *Procedia - Social and Behavioral Sciences*, *42*(July 2010), 486–495. doi:10.1016/j.sbspro.2012.04.214

Bordass, B., & Leaman, A. (2005). Making feedback and post-occupancy evaluation routine 1: A portfolio of feedback techniques. *Building Research & Information*, *33*(4), 347–352. doi:10.1080/09613210500162016

Cohen, R., Standeven, M., Leaman, A., & Bordass, B. (2001). Assessing building performance in use 1 : the Probe process. *Building Research & Information*, *29*(2), 85–102. doi:10.100080/09613210010008018

Cole, R. J. (2000). Building environmental assessment methods : assessing construction practices. *Construction Management and Economics*, *18*(8), 949–957. doi:10.1080/014461900446902

Doidge, C. (2001). "Post Occupancy Evaluation." *Architectural Education Exchange 2001*. Retrieved November 15, 2009, from http://cebe.cf.ac.uk/aee/abstracts/aee.html

Douglas, J. (1996). Building performance and its relevance to facilities management. *Facilities*, *14*(April), 23–32. Edwards, B. (2000). *University Architecture*. Spoon Press (Taylor & Francis Group), UK.

Gillen, A., Wright, A., & Spink, L. (2011). Student perceptions of a positive climate for learning: a case study. *Educational Psychology in Practice*, *27*(1), 65–82. doi:10.1080/02667363.2011.549355

Government of Malaysia. (2011). *Tenth Malaysia Plan (2011-2015)*. Jabatan Percetakan Negara, Kuala Lumpur.

Haapio, A., & Viitaniemi, P. (2008). A critical review of building environmental assessment tools. *Environmental Impact Assessment Review*, *28*(7), 469–482. doi:10.1016/j.eiar.2008.01.002

Harb, N., & El-Shaarawi, A. (2006). *Factors Affecting Students' Performance* (No. 13621) (pp. 1–17). Al-Ain, UAE. Retrieved from http://mpra.ub.uni-muenchen.de/13621/

Hassanain, M. A. (2007). Post-Occupancy Indoor Environmental Quality Evaluation of Student Housing Facilities. *Architectural Engineering and Design Management*, *3*(4), 249–256.

Isnin, Z., Ahmad, S. S., & Yahya, Z. (2013). Lessons Learned from Exposure to Building Materials. *Procedia - Social and Behavioral Sciences*, *85*, 128–138. doi:10.1016/j.sbspro.2013.08.345

James, P., & Hopkinson, P. (2004). Sustainable Buildings Can Benefit Higher Education - A Briefing Paper. Retrieved January 10, 2011, from www.heepi.org.uk

Khalil, N., Husin, H. N., & Nawawi, A. H. (2012). An Analytical Literature: Strategic Improvement of Sustainable Building Performance Tool for Malaysia's Higher Institutions. *Procedia - Social and Behavioral Sciences*, *36*(June 2011), 306–313. doi:10.1016/j.sbspro.2012.03.034

Khalil, N., Husin, H. N., & Zakaria, S. R. (2010). Performance Evaluation of Indoor Environment towards Sustainability for Higher Educational Buildings. In *The 8th JTEFS/BBCC conference "Sustainable Development. Culture. Education", 17-19 May 2010, Paris, France*.

Lützkendorf, T., & Lorenz, D. (2007). Integrating sustainability into property risk assessments for market transformation. *Building Research & Information*, *35*(6), 644–661. doi:10.1080/09613210701446374

Lützkendorf, T., & Lorenz, D. P. (2006). Using an integrated performance approach in building assessment tools. *Building Research & Information*, *34*(4), 334–356. doi:10.1080/09613210600672914

Mat, S., Sopian, K., Mokhtar, M., Ali, B., Hashim, H. S., Rashid, A. K. A., … Abdullah, N. G. (2009). Managing Sustainable Campus in Malaysia - Organisational Approach and Measures. *European Journal of Social Sciences*, *8*(2), 201–214.

Mcdougall, G., Kelly, J. R., Hinks, J., & Bititci, U. S. (2002). A review of the leading performance measurement tools for assessing buildings. *Journal of Facilities Management*, *1*(2), 142–153.

Meacham, B., Bowen, R., Traw, J., & Moore, A. (2005). Performance-based building regulation: current situation and future needs. *Building Research & Information*, *33*(2), 91–106. doi:10.1080/0961321042000322780

Meacham, B. J. (2010). Risk-informed performance-based approach to building regulation. *Journal of Risk Research*, *13*(7), 877–893. doi:10.1080/13669871003703260

Najib, N. 'Ulyani M., Yusof, N. A., & Abidin, N. Z. (2011). Student residential satisfaction in research universities. *Journal of Facilities Management*, *9*(3), 200–212. doi:10.1108/14725961111148108

Olanrewaju, A. A. L., Khamidi, M. F., & Idrus, A. (2010). Appraisal of the building maintenance management practices of Malaysian universities. *Journal of Building Appraisal*, *6*(3/4), 261–275. doi:10.1057/jba.2011.3

Olanrewaju, A. L. (2010). Case for alternative approach to building maintenance management of public universities. *Journal of Building Appraisal*, *5*(3), 201–212. doi:10.1057/jba.2009.19

Olanrewaju, A. L., Khamidi, M. F., & Idrus, A. (2010a). Building Maintenance Management in a Malaysian University Campuses : A Case Study. *Australasian Journal of Construction Economics and Building*, *10*(1/2), 76–89.

Olanrewaju, A. L., Khamidi, M. F., & Idrus, A. (2010b). Quantitative analysis of defects in Malaysian university buildings : Providers '. *Journal of Retail & Leisure Property*, *9*(2), 137–149. doi:10.1057/rlp.2010.2

Sapri, M., & Muhammad, S. (2010). Monitoring energy performance in higher education buildings for sustainable caumpus. *Malaysian Journal of Real Estate*, *5*(1), 1–25.

Shabha, G. (2004). An assessment of the effectiveness of e-learning on university space planning and design. *Facilities*, *22*(3/4), 79–86. doi:10.1108/02632770410527815

Shafie, F., Wan Zahari, W. Y., Martin, D., & Sidi, N. S. S. (2011). Application of Facilities Management (FM) Helpdesk in Higher Educational Institutions in Malaysia. In *2011 International Conference on Management and Artificial Intelligence* (Vol. 6, pp. 37–41).

Sinopoli, J. (2009). How Do We Measure The Performance Of A Building ? *Smart Buildings LLC*. Retrieved May 10, 2013, from http://www.smart-buildings.com/uploads/1/1/4/3/11439474/howdowemeasure0809.pdf

Thompson, B. P., & Bank, L. C. (2007). Risk Perception in Performance-Based Building Design and Applications to Terrorism-Resistant Design, (February), 61–69.

Wolski, A., Dembsey, N. A., & Meacham, B. J. (2000). Accommodating perceptions of risk in performance-based building "re-safety" code development. *Fire Safety Journal*, *34*, 297–309.

Wong, A. K. D., Wong, F. K. W., & Nadeem, A. (2011). Government roles in implementing building information modelling systems: Comparison between Hong Kong and the United States. *Construction Innovation: Information, Process, Management*, *11*(1), 61–76. doi:10.1108/14714171111104637

Wong, N. H., & Jan, W. L. S. (2003). Total building performance evaluation of academic institution in Singapore. *Building and Environment*, *38*(1), 161–176. doi:10.1016/S0360-1323(02)00021-5

Woods, J. E. (2008). Expanding the Principles of Performance to Sustainable Buildings. *Real Estate Issues*, *33*(3), 37–46.

Zalejska-Jonsson, A. (2012). Evaluation of low-energy and conventional residential buildings from occupants' perspective. *Building and Environment*, *58*, 135–144. doi:10.1016/j.buildenv.2012.07.002

Zimmerman, A., & Martin, M. (2001). Post-occupancy evaluation: benefits and barriers. *Building Research & Information*, *29*(2), 168–174. doi:10.1080/09613210010016857