REGULAR ARTICLE

A REVIEW OF THE GLOBAL EVIDENCE: COMPARISON OF OCCUPANT SATISFACTION BETWEEN GREEN AND NON-GREEN CERTIFIED BUILDINGS

Abdelfatah Bousbia Laiche[1]*, Nur Dalilah Dahlan[1]*, Zalina Shari[1] and Mohamad Fakri Zaky Jaafar[1]
[1]Department of Architecture, Faculty of Design and Architecture,
Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

* Corresponding authors:
fatehbousbia39@gmail.com
nurdalilah@upm.edu.my

ABSTRACT

In the past 30 years, various green building rating systems, standards, and guidelines have been established to meet the need to measure and benchmark building performance levels in the green revolution. Several post-occupancy investigations have been done over the past decades to evaluate the satisfaction of green building occupants in various countries; nevertheless, there is a lack of systematic review of these studies. This study aimed to review global evidence to assess if green buildings are highly satisfactory compared to conventional buildings. The evidence about green buildings outperforming conventional buildings is still inconclusive. Green buildings' performance with regard to occupant satisfaction showed inconsistent which differing from study to another. Despite of the inconclusiveness and inconsistency, this research determines two main global contexts which are the Western (primarily U.K. and U.S.), which no significant differences have been identified between green and conventional buildings on occupant satisfaction, and the Eastern (primarily South Korea and China), where occupants of the green building revealed a significant satisfaction than conventional building occupants. This study contributes to recognizing the socio-economic factor influencing the satisfaction of green building occupants, and presenting evidence for institutional and commercial sectors where green buildings are being used to increase worker satisfaction.

Keywords: *green certification, green office building, indoor environment quality, occupant satisfaction, post occupancy evaluation.*

1. INTRODUCTION

By the 1970s, the green revolution is taking place in the building sector in response to the irreversible and serious climate event (Yudelson, 2010a). This movement is mainly about green building, with the goal of radically changing the built environment by developing energy-conscious, productive, and healthy buildings that decrease the significant effects of buildings on global ecosystems and urban life (USEPA, 2009). Over the last 30 years, a variety of green building rating systems (GBRSs), standards and guidelines such as U.K. BREEAM, U.S. LEED, China's GBL, and Australia Green Star were established in order to address the need to benchmark and assess the achievement of building in the green movement (Yudelson, 2010a, 2010b). These tools demonstrated their success in real estate markets, nonetheless, their contribution to enhancing the experience of users still unclear in green building (Altomonte et al., 2016).

Work productivity is indeed a new goal in building construction in relation to commercial buildings with a purpose to increase employee productivity, which represents a new direction for building environment in order to provide an acceptable workspace for users to accomplish the target of high productivity (Fassoulis & Alexopoulos, 2015). As the method of green construction becomes more common, achieving high energy efficiency is

considered as one of its objectives to decrease the effect on the environment and save energy. Since worker-related costs consider as the highest operating costs amongst all business expenses, involving rental costs and energy bills; occupant satisfaction is therefore of great significance for many organizations, essentially in institutional and commercial office environments, to improve overall profitability and performance. This highlights the importance of user viewpoints in assessing green building's overall performance. In addition, subjective well-being is considered as a self-reported measurement of well-being, typically gained by questionnaire (Sahai & Mahapatra, 2020). Occupant satisfaction surveys are an efficient way of studying building performance from the viewpoint of the occupants. They could be utilized as a diagnostic tool to assist designers, operators and building owners, and tenants assess how well their buildings function from the viewpoint of the occupants. The surveys could also be utilized as a research tool for particular projects requiring occupant response assessment, or for wider benchmarking and comparative performance analysis of specific technologies, building design, and operation strategies (Brager & Baker, 2009).

Although various studies of post-occupancy evaluation (POE) have been conducted over the past decades to examine the satisfaction of green building occupants in different regions, there is still a lack of systematic review about these studies, whereas research on energy and water conservation had been examined and well recognized in prior studies (Allen et al., 2015; Sediso & Lee, 2016). Moreover, All GBRSs follow a similar concept on sustainable design, construction as well as operation to optimize the use of energy and resources and boost user health and comfort (Gou & Xie, 2017). Nevertheless, green buildings are built in different contexts of socio-economic. Therefore, there is a need to study green buildings from different contexts of socio-economic. Hence, this study aims to collect global evidence to check that green buildings could improve the satisfaction of occupants through carrying out a systematic quantitative review for literature on the satisfaction of green building occupants. Reviewing the global evidence could assist researchers to comprehend better the difference of socio-economic of occupant satisfaction in green building, it could also assist to inform institutional and commercial sectors of investing in the green building to enhance the satisfaction of their workers.

2. METHODOLOGY

Through employing a systematic quantitative literature review method (Pickering & Byrne, 2014), major scientific databases which are Science direct, Scopus, Google Scholar, and Web of Knowledge were used in order to search and identify the relevant original research papers for this study. The search was narrowed to publications that used quantitative methods to provide empirical evidence about comparative studies, therefore, this research aimed at reviewing the empirical arguments related to green building performances with comparison to non-green buildings. In order to identify literature sources that comply with the selection criterion, they were limited by the assumption of terms "Indoor environment quality", "Green office building", "occupant satisfaction", and "Green certification" are used under the title of articles, in abstracts, or on keyword lists. The type of document was restricted to "article". Via the database search, further papers from the list of references in the papers found were identified.

Initially, an overall of 92 papers were obtained (involving articles and reviews). Nevertheless, it was noted that many papers evaluated green building performances while a small number of papers examined the performance of green buildings with reference to conventional buildings particularly in terms of green office buildings. For example, (Ravindu et al., 2015) studied occupant satisfaction between Green and non-Green buildings in a factory. Hence, 23 papers were chosen for the literature review as they achieved selection criteria by examining directly the correlation of green rating tools with occupant satisfaction using the quantitative research method as listed in Table 1. These studies conducted a comparison between occupants' responses in green and conventional office buildings in order to know the positive feedback or complaints of occupants from each case separately and then to know the significance and strength of the negative or positive responses when compared to prior comparative studies. This assists to determine the common favorable or problematic IEQ features in the IEQ of both green and conventional buildings and thereafter see whether they enhanced or actually worsened in green buildings. A variety of green and conventional case studies were gathered from the studied papers in order to identify the significance of findings as well as the generalization validity. Occupant satisfaction survey tools were used in these papers as a research methodology. Therefore, the review of selected papers lists methodology specifications and some key research characteristics in Table 1. The systematic review of the literature showed that the most frequently studied certification programme was LEED buildings. Most studies concentrated on each building's individual occupant responses instead of overall average scores. As a consequence, the responses number was another criterion utilized to assess research significance.

Table 1: *Summary of studies comparing green buildings using surveys of occupant satisfaction with their conventional counterparts.*

Reference and Date	Country	Type of building	Green building programme	Sample		Responses
				Conventional	Green	
Western						
Abbaszadeh et al. (2006)	Europe and North America	Commercial offices	LEED	160	21	33285
Altomonte & Schiavon (2013)	Europe and North America	Commercial offices, governmental offices, academic offices	LEED	79	65	21477
Altomonte et al. (2016)	UK	Commercial offices	BREEAM	2	2	203
Baird et al. (2012)	Europe and North America	Commercial offices, governmental offices, academic offices	BREEAM, LEED	109	31	2035
Brown et al. (2010)	Canada	Commercial offices	LEED	1	1	249
Leaman & Bordass (2007)	UK	Commercial offices, governmental offices, academic offices	-	-	-	-
Leaman et al. (2007)	Australia	Commercial offices, governmental offices, academic offices	Green Star Australia	23	22	-
Lee & Kim (2008)	US	Commercial offices	LEED	200	15	40488
Menadue et al. (2014)	Australia	Commercial offices	Green Star Australia	4	4	600
Newsham et al. (2013)	Canada, US	Commercial offices, governmental offices, academic offices	LEED	12	12	2545
Paul & Taylor (2008)	Australia	Academic offices	-	2	1	93
Thatcher & Milner (2016)	South Africa	Commercial offices	Green Star South Africa	2	3	280
Zhang and Altan (2011)	UK	Academic offices	-	1	1	223
Eastern						
Gou et al. (2012a)	Hong Kong	Commercial offices	LEED	A sample	2	-
Gou et al. (2012b)	Hong Kong	Commercial offices	LEED	1	2	216
Gou et al. (2014)	China, Hong Kong	Commercial offices	GBL, LEED	5	9	1251
Liang et al. (2014)	Taiwan	Commercial offices	EEWH	2	3	133
Lin et al. (2016)	China	Commercial offices	GBL	8	10	604
Liu et al. (2018)	China	Commercial offices	GBL	-	-	4086
Öz & Ergönül (2015)	Turkey	Commercial offices	LEED	1	1	226
Pei et al. (2015)	China	Commercial offices	GBL	42	10	-
Sediso & Lee (2016)	South Korea	Commercial offices	G-SEED	2	2	222
Tham et al. (2015)	Singapore	Commercial offices	Green Mark	1	1	65

3. ANALYSIS

The research papers which constitute 23 papers have evaluated the relation between the indoor environmental quality and green certification Through analysing the satisfaction of users with some factors, for instance, air quality, thermal comfort, noise, and lighting. In addition, 18 papers addressed different building design parameters and also facilities management (BD&FM), for

example, cleanliness, environmental control, aesthetics, maintenance, needs, image, furniture, interaction easy with co-workers, productivity and health.

With regard to BREEAM studies, articles that examining indoor air quality (IAQ) revealed low satisfaction scores in BREEAM buildings when compared to non-BREEAM buildings (Altomonte et al., 2016; Leaman & Bordass, 2007). In two studies (Baird et al, 2012; Zhang & Altan, 2011) recorded higher satisfaction scores with related to overall thermal performance, whilst one article (Altomonte et al., 2016) reported comparable satisfaction scores in BREEAM and conventional buildings without significant differences. There were no significant differences perceived in the performance of noise in BREEAM buildings in comparison to non- BREEAM buildings (Altomonte et al., 2016; Leaman & Bordass, 2007; Zhang & Altan, 2011). Noise from outside scored lower satisfaction according to one paper (Leaman & Bordass, 2007) in BREEAM buildings in comparison with non-BREEAM buildings. Lighting performance, however, was slightly better compared to other IEQ parameters in BREEAM buildings, where two articles indicated higher (Baird et al., 2012; Zhang & Altan, 2011), while two studies (Altomonte et al., 2016; Leaman & Bordass, 2007) showed no significant differences in satisfaction. One paper (Altomonte et al., 2016) revealed that there were no high differences level in the satisfaction between both groups in terms of sound privacy, the interaction easily with colleagues, workplace satisfaction, and cleanliness. The same article indicated that visual privacy was scored lower satisfaction level in BREEAM buildings in comparison to non-green buildings.

In terms of LEED, most studies about IAQ revealed high satisfaction levels in LEED buildings in comparison with non-LEED buildings (Abbaszadeh et al., 2006; Huizenga & Zagreus, 2005; Issa et al., 2011; Kim et al., 2015; Lee & Kim, 2008), however, LEED buildings provided a less satisfactory result in another study (Altomonte & Schiavon, 2013) by indicating no significant differences compared to non-green buildings. Thermal comfort satisfaction in LEED buildings was perceived higher in most studies when compared with conventional counterparts (Brown et al., 2010; Lee & Kim, 2008; Newsham et al., 2013; Thatcher & Milner, 2016; Zhang & Altan, 2011). Nevertheless, two papers (Altomonte & Schiavon, 2013, Altomonte et al., 2016) showed no significant difference between LEED and non-green buildings in terms of thermal performance. The noise and lighting performance of LEED buildings in the literature revealed significant inconsistency. with regard to noise performance, LEED buildings had been the least successful as many studies either indicated no high differences levels (Abbaszadeh et al., 2006, Altomonte & Schiavon, 2013, Altomonte et al., 2016, Baird et al. 2012), or low satisfaction levels in LEED buildings compared to their conventional counterparts (Brown et al., 2010, Lee & Kim, 2008). However, one study revealed that noise performance in LEED buildings achieved a high satisfaction level (Newsham et al., 2013), while reported that the performance of noise from the HVAC system in LEED buildings was perceived as being more satisfactory. ln most papers (Abbaszadeh et al., 2006, Altomonte & Schiavon, 2013, Altomonte et al., 2016), lighting performance showed in LEED buildings there were no significant differences in levels compared to non-green buildings. However, two papers reported a higher satisfaction result (Baird et al. 2012, Zhang & Altan 2011), and two articles (Brown et al., 2010, Lee & Kim, 2008) indicated a lower satisfaction result in LEED buildings. Most studies showed a high satisfaction level in LEED buildings with regard to BD&FM (Brown et al., 2010, Lee & Kim, 2008, Newsham et al., 2013, Thatcher & Milner, 2016).

In China, Various studies have conducted comparisons between green building performance (GBL or LEED) with their conventional counterparts (Gou et al., 2012b; Gou et al., 2014; Liang et al., 2014; Lin et al, 2016; Liu et al., 2018; Pei et al., 2015). Green Building Label (GBL) is China's most commonly used rating tool. whereas, LEED is a different common green label. With regard to IAQ, two studies (Lin et al., 2016, Pei et al., 2015) examining GBL buildings reported high satisfaction levels in green buildings, whereas there were no high differences level that had been detected in another article (Gou et al., 2012b). IAQ was studied in more depth in one article (Gou et al., 2012a) through examining seasonal differences and revealed that LEED building performance was better in summer compared to winter performance in Hong Kong. An article (Gou et al., 2014) investigated the effect of office layout and ventilation systems on satisfaction results in commercial office environments and summarised that high cubicles and mixed-mode resulted in increased occupant satisfaction. The majority of studies (Gou et al., 2014, Lin et al., 2016, Pei et al., 2015, Sediso & Lee, 2016) reported a high score in thermal satisfaction level in green buildings, whereas, in one study (Gou et al., 2012b) no significant differences level of thermal satisfaction scores between green buildings and non-green buildings. Only two studies indicated no high

differences level between green buildings and conventional building with regard to noise and lighting performance (Gou et al, 2012a; Gou et al., 2012b); while, another paper (Pei et al., 2015) reported higher perceived in lighting scores in green buildings than non-green counterparts. In relation to BD&FM, high satisfaction levels were achieved in green buildings in productivity and health (Gou et al., 2014), as well as operation and maintenance (Lin et al., 2016). In the Taiwanese context, one paper (Liang et al., 2014) revealed that green buildings outperformed conventional buildings in all IEQ parameters.

In Australia, no high differences level were revealed in these studies in green buildings performance compared to Non-green buildings, mainly in ventilation, noise , lighting (Paul & Taylor, 2008), and the overall thermal comfort (Menadue et al., 2014; Paul & Taylor, 2008). However, in one paper (Leaman et al., 2007), performances of green buildings were obvious, with several green star buildings performing better when compared to non-green buildings, but some of the green star buildings underperformed compared to their conventional counterparts. The same paper illustrated that, in general, the green star building outperformed the non-green building in terms of BD&FM, such as buildings image, addressing occupant needs, and perceived health.

In Turkey, the green buildings performance were better in IEQ parameters and BD&FM. in relation to most IEQ parameters, One paper (Öz & Ergönül, 2015) showed that green buildings in Turkey attained higher scores with regarding to IAQ, thermal comfort, noise, and lighting; whereas, the same study indicated a higher satisfaction in green building in terms of BD&FM, particularly in cleanliness. With regard to South Korea, South Korean green certification tool (G-SEED) buildings reported a highly satisfactory performance in some IEQ parameters, namely lighting, thermal comfort, as well as in all BD&FM parameters, which are furniture, operation and maintenance, and cleanliness (Sediso & Lee, 2016). The study also showed no significant differences in IAQ and noise between green and conventional buildings. In Singapore, one article (Tham et al., 2015) was studied sick building syndrome in green mark building and showed that green building perform better than conventional building with relation to furniture ergonomics and ventilation; while the sick leave and perceived health there were no significant differences reported in both building groups.

From the global comparison, some consistency in a certain context was noticed in this research with similar cultural and geographical similarities. Hence, the comparison study in this research was divided into two main parts resulting from cultural and geographical similarities: Western countries and Eastern countries. Table 2 presents the literature review that summarizes findings throughout the two main global contexts. these studies were classified into three categories which are: higher satisfaction level in green buildings, no differences in level between green and conventional buildings, as well as lower satisfaction level in green buildings. It is obvious that many studies from Eastern countries reported higher satisfactory performance levels in green buildings, whereas researches from the Western countries randomly distributed amongst the three groups.

The systematic review of the literature showed a contradicting number of papers (Table 2). it could, however, be summed up that many studies with relation to IAQ and thermal comfort, revealed higher satisfaction performance with green buildings. With regard to noise, most research revealed similar results for green and their conventional buildings and showed no significant differences. A higher inconsistency was detected from lighting performance, as slightly lower than 50% of the research reported higher perceived performance in green buildings, and approximately 50% of studies showed no significant differences between green and conventional buildings. In terms of BD&FM parameters, the majority of articles reported improved performance in green buildings, specifically in cleanliness, furniture, operation and maintenance, productivity, and health. Therefore, further studies are needed on green buildings to reveal the real performance in view of the literature review as well as the contradictory results.

To perform a quantitative comparison of findings, articles describing green rating tools, such as effect sizes (Rho), the differences in mean values (ΔM), and statistical significance values, were chosen based on the available quantitative data. Only one study was found for each certification tool from the search in the literature review (a total of four articles). The comparative parameters were limited to focus on the five major IEQ factors widely used in all four articles. These parameters involve overall building satisfaction, IAQ, thermal comfort, noise, and lighting. Interestingly, articles which examined tools in the Western countries: BREEAM (Altomonte et al., 2016) and LEED (Altomonte & Schiavon, 2013) showed effect sizes (Rho), while, in the Eastern countries, papers that concentrated on tools: GBL (Pei et al., 2015), and G-SEED (Sediso & Lee, 2016) showed p-values (statistical significance).

Table 2: *Summarizing the findings of the literature review from the three regional and cultural contexts.*

Parameter	high level of satisfaction in green buildings		No differences		Low level of satisfaction in green buildings	
	Eastern	Western	Eastern	Western	Eastern	Western
Overall IEQ	Liang et al. (2014) (Liu et al., 2018)		(Gou et al., 2012b)	(Altomonte et al., 2017)		
Overall building	(Liu et al., 2018)	(Zhang & Altan 2011)		(Altomonte & Schiavon, 2013) (Altomonte et al., 2016)		
Air quality overall	(Liang et al., 2014) (Lin et al., 2016) (Liu et al., 2018) (Pei et al., 2015)	(Abbaszadeh et al. 2006) (Lee & Kim, 2008) (Thatcher & Milner, 2016)	(Gou et al., 2012b) (Sediso & Lee, 2016)	(Altomonte & Schiavon, 2013)		(Altomonte et al., 2016)
Air quality in winter					(Gou et al., 2012a)	
Air quality in summer	(Gou et al., 2012a)					
Ventilation/ air freshness/ odours	(Liu et al., 2018) (Tham et al., 2015)		(Gou et al., 2012b)			(Leaman & Bordass 2007)
Thermal comfort overall	(Gou et al. 2014) (Liang et al., 2014) (Lin et al., 2016) (Öz & Ergönül, 2015) (Pei et al., 2015) (Sediso & Lee, 2016)	(Abbaszadeh et al. 2006) (Baird et al. 2012) (Brown et al. 2010) (Lee & Kim, 2008) (Newsham et al. 2013) (Zhang & Altan 2011)	(Gou et al., 2012b)	(Altomonte & Schiavon, 2013) (Altomonte et al., 2016)		
Temperature in winter				(Leaman & Bordass 2007)	(Gou et al., 2012a) (Leaman et al. 2007)	
Temperature in summer	(Gou et al., 2012a)					(Leaman & Bordass 2007) (Leaman et al. 2007)
Noise	(Liang et al., 2014) (Liu et al., 2018) (Öz & Ergönül, 2015) (Pei et al., 2015)		(Gou et al., 2012a) (Gou et al., 2012b) (Sediso & Lee, 2016)	(Abbaszadeh et al. 2006) (Altomonte & Schiavon, 2013) (Altomonte et al., 2016) (Baird et al. 2012) (Leaman & Bordass 2007) (Zhang & Altan 2011)		(Brown et al. 2010) (Lee & Kim, 2008)
Noise from HVAC		(Newsham et al. 2013)				
Noise from outside						(Leaman & Bordass 2007)
Sound privacy				(Altomonte & Schiavon, 2013) (Altomonte et al., 2016)		
Visual privacy				(Altomonte & Schiavon, 2013)		(Altomonte et al., 2016)
Lighting	(Liu et al., 2018) (Öz & Ergönül, 2015) (Pei et al., 2015) (Sediso & Lee, 2016)	(Baird et al. 2012) (Zhang & Altan 2011)	(Gou et al., 2012a) (Gou et al., 2012b)	(Abbaszadeh et al. 2006) (Altomonte & Schiavon, 2013) (Altomonte et al., 2016) (Leaman & Bordass 2007)		(Brown et al. 2010) (Lee & Kim, 2008)
Glare						(Brown et al. 2010)

Parameter	high level of satisfaction in green buildings		No differences		Low level of satisfaction in green buildings	
	Eastern	Western	Eastern	Western	Eastern	Western
ease of interaction with colleagues				(Altomonte & Schiavon, 2013) (Altomonte et al., 2016)		
Operation and maintenance	(Lin et al., 2016) (Liu et al., 2018) (Sediso & Lee, 2016)	(Baird et al. 2012) (Lee & Kim, 2008)		(Altomonte & Schiavon, 2013)		
Personal control				(Baird et al. 2012)		
Furniture	(Sediso & Lee, 2016) (Tham et al., 2015)	(Lee & Kim, 2008)	(Gou et al., 2012b)	(Altomonte & Schiavon, 2013)		
Cleanliness	(Liu et al., 2018) (Sediso & Lee, 2016)	(Lee & Kim, 2008)	(Altomonte & Schiavon, 2013) (Altomonte et al., 2016)			
Health	(Gou et al. 2014)	(Brown et al. 2010)	(Thatcher & Milner, 2016)	(Tham et al., 2015)		
Productivity	(Gou et al. 2014)	(Brown et al. 2010) (Thatcher & Milner, 2016)				
Workplace			(Altomonte & Schiavon, 2013) (Altomonte et al., 2016)			
Aesthetics		(Newsham et al. 2013)				
Image		(Newsham et al. 2013)	(Thatcher & Milner, 2016)			
Needs		(Leaman et al. 2007)				
View to outside		(Newsham et al. 2013)				
Office layout					(Lee & Kim, 2008)	

Table 3 illustrates the variations in the effect sizes and mean values between five parameters for the Western context, primarily programmes of BREEAM (Altomonte et al., 2016) and LEED (Altomonte & Schiavon, 2013). The effect size in both rating tools was small in terms of the overall building satisfaction, indicating that green-rated building performance was not significantly different compared to non-rated buildings. With regard to IAQ, there were no significant differences in LEED buildings with comparison to conventional buildings, whereas, in BREEAM rated buildings, IAQ obtained lower satisfaction. In BREEAM and LEED studies, thermal comfort results in green and conventional buildings were not significantly different. In terms of noise, overall satisfaction in the two studies was revealed to be unsatisfactory in green buildings compared to non-green buildings. Perceived noise satisfaction achieved quite small effect size in BREEAM and LEED and that could be viewed as insignificant. Despite the effect size was quite small in BREEAM and LEED buildings with relation to noise performance, the negative effect sizes revealed that green-rated buildings slightly underperformed non-rated buildings. The lighting performance between the BREEAM and LEED studies was consistent. in the comparison between green and non-green buildings, no significant differences reported in terms of the overall lighting in both studies (BREEAM and LEED).

Table 4 illustrates the variations in p-value and mean values between five parameters for the Eastern context, primarily programmes of Chinese GBL (Pei et al., 2015) and South Korean G-SEED (Sediso & Lee, 2016). The overall satisfaction scores for green buildings were significantly higher in the two studies. With regard to IAQ and thermal comfort, all two serial studies showed consistent findings in green rated buildings by revealing a significantly higher satisfaction. GBL and G-SEED studies indicated significantly higher scores in terms of satisfaction of overall lighting in green-rated buildings. Similarly, GBL and G-SEED research indicated significantly higher scores in green buildings. In summary, in green-rated buildings, GBL and G-SEED studies showed significantly higher satisfaction results in the Eastern countries.

Table 3: *The effect sizes and mean differences in BREEAM and LEED compared to their conventional counterparts.*

Parameter	Western			
	BREEAM		LEED	
	ΔM	Rho	ΔM	Rho
Overall building performance	-0.66	-0.16	0.01	0.02
IAQ (winter)	-0.93	-0.27	0.40	0.12
Thermal comfort (winter)	-0.45	-0.14	-0.01	0.00
Noise	-0.62	-0.16	-0.10	-0.03
Lighting	-0.48	-0.12	-0.40	-0.09

Table 4: *The statistical significance and mean differences in GBL and G-SSED compared to their conventional counterparts.*

Parameter	Eastern			
	GBL		G-SEED	
	ΔM	Sig.	ΔM	Sig.
Overall building performance	0.30	0.000	0.76	0.001
IAQ (winter)	0.50	0.000	1.34	0.001
Thermal comfort (winter)	0.34	0.000	1.67	0.001
Noise	0.20	0.000	0.57	0.001
Lighting	0.30	0.000	0.73	0.001

4. DISCUSSION

The review studies of occupant satisfaction in green building utilized similar survey items which covered three essential aspects, namely building design with facilities management, and indoor environmental quality, these studies also utilized similar Likert-scale ranging from 1 (very unsatisfactory) until 7 (very satisfactory). In addition, their methods were similar by considering non-green buildings as a benchmark for evaluating green buildings. Hence, bringing them together to produce such a systematic review makes sense. Through a systematic review of these studies across various regions and countries, it was noticed that there is no clear global proof that green buildings have been more satisfactory than conventional buildings. There were many reasons to clarify the inconsistency.

1. The variation of green characteristics from building to another, where the green building concept encompasses a whole life cycle of the building involving design, construction, as well as operation and destruction, and also includes features and strategies relevant to many other effecting parameters involving site specifications, urban context, and building systems (Gou, 2016). Occupant satisfaction is based primarily on these features that influence user experiences, such as facilities management and ventilation systems.
2. It is worth mentioning the sample size here due to sample sizes and features might have affected previous research findings. Some research had fewer respondents in conventional buildings, whereas other studies had fewer respondents in green buildings. The effect of sample sizes was not taken into account by the majority of studies.
3. The period of occupancy is considered as influential on occupant satisfaction. If occupants moved to a new green building and the survey was carried out after a short time of occupancy, after that there was bias in this survey. Several studies have shown that working history at workstations and in buildings effects satisfaction scores by showing artificially higher satisfaction results from participants who stayed less than one year at current workstations, and in their existing buildings (Schiavon & Altomonte, 2014; Singh et al., 2010).

Despite the lack of global consistencies, this study identified two global contexts in order to classify studies. these studies from the U.K. and the U.S. which surveyed BREEAM and LEED buildings respectively showed slight differences in satisfaction results between green and non-green buildings in almost all aspects of IEQ. On the contrary, studies from South Korea and China that respectively surveyed G-SEED and GBL certified buildings reported significantly higher satisfaction for green-rated buildings compared with conventional buildings.

Both systems and their socio-economic backgrounds present the two main global contexts: the Western and Eastern. The industrial revolution with related modernisation introduced high standard for building design and also maintenance to Western countries such as the U.K. and U.S. The corresponding building services codes and standards established by CIBSE (British Chartered Institution of Building Services Engineers) and ASHRAE (American Society of Heating, Refrigerating, and Air Conditioning Engineers) are rather advanced. Hence, the baseline of satisfaction and occupant comfort in the U.K. and the U.S. is high. the movement of green buildings has occurred lately and it introduced universal technologies and tools (Darko & Chan, 2016). The enhancement made by these technologies and tools would be negligible in the developed countries, where standards were already high and

stringent (Darko et al., 2017a; Darko et al 2017b). Consequently, the resulting user experience enhancements were small. Contrarily, services standards and the building design were established late in Eastern countries such as South Korea and China and the green building improvements could significantly enhance maintenance standards and building design when the baseline had not been high (He et al., 2014; Zhao et al., 2015), and this also contributed in improving experiences of user in these buildings.

5. CONCLUSION

A series of occupant satisfaction studies were performed globally about the green building after the implementation of green building certifications. This investigation provides a systematic review to evaluate whether the occupants of the green building in these studies were more satisfied compared to those of conventional buildings. The study was hampered by biases primarily about green features, occupancy period and sample size. Generally, the conclusion about green building outperforming conventional buildings is not totally supported in terms of the satisfaction of occupants as some studies have revealed that conventional building users are more satisfied.

However, this study identified two global contexts in order to comprehend the patterns of occupant satisfaction in green building. The western is the first global context where there is a high baseline as well as the enhancement from the green building could contribute to small increases in satisfaction. The Eastern is the second context where the baseline was not high and the enhancement from the green building could result in significant increases in satisfaction. This has a significant impact on the development of green buildings in the world. Hence, green buildings in Eastern countries can enhance user experiences effectively. This phenomenon, yet, has not been addressed in previous research which is one of the significant findings of this review article. To support this conclusion, more studies are needed to develop a further sophisticated meta-analysis. This study contributes to comprehending the socio-economic factors influencing the satisfaction of green building occupants as well as providing evidence for institutional and commercial sectors, where green buildings are being used to increase the satisfaction of workers.

Nevertheless, because of two limitations, this review paper should be interpreted with caution. the sample size is the first limitation. Despite the selected of 23 papers were distilled to ensure their scientific merits in a rigorous review process, the sample size in this investigation was small. Statistical indicators are the second limitation. Different researchers with different academic backgrounds carried out these occupant satisfaction research, suggesting that the survey methodology was not consistent and that the result of these investigations was not standardised. This resulted in some investigations lacking certain statistical parameters such as the effect size. Statistical techniques and standard survey processes should be utilized in future occupant satisfaction research.

6. REFERENCES

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