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The Relationship of Green Office Buildings to Occupant Productivity and Organizational Performance: A Literature Review

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ABSTRACT

The purpose of this paper is to identify and critically evaluate previous research that examines the link between green office buildings and the productivity of commercial building occupants. The overarching approach is to highlight and critique the key findings from a variety of researchers that attempt to find links specifically between indoor environmental quality (IEQ) and individual productivity. This is done to develop a theoretical model that links green building features and initiatives (GBFIs) in office buildings to individual productivity and organizational performance. This paper first provides a background of the emergence of green buildings, specifically with regards to utility costs, which led to changes in design and hence to the indoor environment. The core focus of this study is to provide a literature review of the research that attempts to link GBFIs to productivity. Various studies focus on a single or multiple components of GBFIs within different settings, such as controlled laboratory settings, field studies, or longitudinal studies. Other studies choose to focus on occupant health, comfort, and organizational outcomes in relation to GBFIs. The present study attempts to consolidate this area of research by presenting the studies and their findings thus far to develop a new theoretical model. The proposed model links GBFIs to increased individual productivity and organizational performance which results in increased building value, thus justifying the initial capital expenditure for the implementation of GBFIs.

KEYWORDS

Green buildings; green building features and initiatives (GBFIs); wellbeing; productivity; performance

Green buildings are an increasingly topical area for researchers, as their prominence has increased rapidly in developed markets in the last two decades (Steinemann, Wargocki, & Rismanchi, 2017). There are a number of green building rating tools (GBRTs) used around the world that predominantly focus on energy and water consumption. This is argued to be the case because these utilities can be directly linked to the financial performance of the building, which in turn provides an incentive to owners and tenants to monitor consumption, as net income impacts the value of office buildings. Therefore, the main focus for attaining green certification for office buildings is arguably savings in

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Table 1. GBRTs points weighting comparison.

CATEGORY	BREEAM	LEED	CASBEE	Green Star SA (GSSA)
Electricity/Energy	16%	32%	25%	25%
Water	7%	9%	30%	12%
Building Materials	15%	13%	10%	14%
TOTAL	**38%**	**54%**	**65%**	**51%**
Health and Wellbeing/IEQ	14%	14%	10%	20%

utilities (e.g., electricity, water, and waste removal) and building materials as shown in Table 1. This growth in the green building movement (and the use of the associated GBRTs) provides positive incentives for real estate to produce assets of higher quality while also reducing costs (such as utility costs) to building occupants. Most of the research on green buildings focuses on "hard" commercial issues, such as green building premiums in relation to payback periods regarding the installation of green building features and initiatives (GBFIs). Although a reduction in operating costs is beneficial to both commercial property owners and their tenants, the implementation of GBFIs that address indoor environmental quality (IEQ) have the potential to realize a comparatively greater financial impact on the organization because they have a direct impact on the employees through improved wellbeing and possibly also increased productivity. Therefore, this has shifted the motivation for incorporating GBFIs into office buildings. Clements-Croome (2005), citing numerous sources, state that operating costs are only a fraction (1% to 5%) of staffing costs, and therefore a marginal increase (of between 3% to 10%) in productivity through a focus on IEQ should offset operating costs significantly, thus having a marked impact on payback periods. However, existing theory does not yet draw the theories from various disciplines together in a way that provides an integrated model to show how improved IEQ leads to improved organizational outcomes. Given the strong possible economic drivers for green building, there is a distinct need to review the literature in order to develop a speculative model that elaborates on these connections.

Different built environment stakeholders have seen the benefits of green buildings, resulting in an exponential growth in green buildings across the different real estate sectors. One of the selling points made by the World Green Building Council (WGBC) of building green offices is the assertion that enhanced IEQ results in improved organizational performance (Alker, Malanca, Pottage, & O'Brien, 2014). However, the focus on occupant wellbeing is not as heavily prioritized in the rating tools, probably because it is more difficult to monetize and therefore is a harder selling point to commercial property investors. Table 1 provides a summary of four prominent GBRTs (BREEAM, LEED, CASBEE, and Green Star South Africa [GSSA]), which indicates the heavy weighting attributed to water, electricity, and building materials. Over half the points for LEED (54%), CASBEE (65%), and GSSA (51%) are attributed to the three categories that influence initial building costs and operating costs. However, it should be noted that GSSA attributes 20% of the points to IEQ, which indicates that the Green Building Council of South Africa (GBCSA) acknowledges that office buildings primarily exist, in principle, to allow occupants to operate at optimum efficiency levels. In addition to the four mainstream GBRTs listed in Table 1, there is another tool that cannot be directly compared to these other GBRTs because it only looks at the indoor components; WELL intentionally focuses on a list of categories that underpin health and wellbeing including IEQ (e.g. air, thermal

comfort, sound, and mind) amongst other factors such as nutrition, exercise, and community connections. While WELL is certified by the Green Business Certification body, it is not specifically a GBRT.

As shown in Table 1, occupant health and wellbeing/IEQ can be found in most GBRTs. This aspect focuses on the quality of the user experience within a building. IEQ is in part underpinned by the overall design of the building, its implementation, and the management of sound quality, lighting, heating, ventilation, and air-conditioning. As already mentioned, energy, water, and building material usage is relatively easy to measure (Rashid, Spreckelmeyer, & Angrisano, 2012) and the long-term utility savings are well established. However the impact on office building occupants is more difficult to measure because the occupants are affected not only by the building, but also by other occupants in the building (e.g. managers or colleagues) as well as other situations that they have outside of the building (e.g., at home, in the traffic, their general health). Currently the most common form of measuring health and wellbeing is by conducting post occupancy evaluations (POE) because these can be used as diagnostic tools for isolating building related problems (Cooper, 2001; Prieser, 1995; Tagliaro & Ciaramella, 2016).

The purpose of this research is to show the development of a new theoretical model that links GBFIs to occupant wellbeing, individual productivity, and organizational performance in an office building. This is done by synthesizing and then extending on existing theory in a transdisciplinary manner. As will be shown in later sections of this paper, the existing theory only provides limited insight into individual productivity (sometimes also referred to as work performance) in relation to one of the physical office environment features, the comfort levels these evoke, and the work engagement that results. The implementation of GBFIs can potentially influence individual productivity within an office building, which may impact organizational performance (i.e., the tenant's profitability). This is underpinned by the notion that gains from improvements in organizational performance outweigh the savings from utility costs due to the implementation of GBFIs (Loftness et al., 2002). If individual building occupants are satisfied with their environment, then the organization would be less likely to vacate the premises. A decrease in building vacancies would increase the building's net operating income (NOI) and de-risk the building from the owner's perspective, thus resulting in a reduction in capitalization and discount rates. This would culminate in a greater value for the building, as commercial buildings are valued based on the NOI and a residual value which requires the application of a capitalization rate, and also a discount rate, depending on the valuation method. No researchers have attempted to test a theoretical model that encapsulates both individual productivity and organizational performance in a feedback loop that justifies the implementation of GBFIs, where a by-product is enhanced office building value.

Therefore, there is firstly a need for a consolidated review of the literature that addresses and identifies the main gaps in the existing body of knowledge that links IEQ to individual productivity levels. There are different approaches and preliminary models for determining to what degree a link exists and also conjecture amongst researchers regarding the manner in which productivity is measured. Secondly, the literature review will be followed by the development of a new theoretical model that will aid in graphically depicting the current linkages in the literature as well as how these linkages flow into how individual productivity and organizational performance are potentially

Table 2. Summary examples of previous work – Experimental laboratory studies.

Author(s)	Outcome	Critique
Veitch and Newsham (1997)	Tests if changes in light quality and energy efficiency affect task performance, mood, health satisfaction, and comfort. Inconclusive results regarding light quality and task performance.	All these studies are cross-sectional in nature. A longitudinal study design in an actual work context may be a better approach. Longitudinal designs would help determine whether any benefits are temporary or long-lasting (i.e., if performance benefits are only short-term this would only have a minimal effect on organizational performance). Laboratory conditions are often difficult to replicate in real world contexts, especially organizational contexts where there are both financial and social incentives to perform.
Wyon (2004), Park and Yoon (2011)	The impact of indoor air quality (IAQ) on behavior and productivity. The research involved removing indoor air pollutants and increasing the supply of clean air. Poor IAQ can reduce performance of office workers.	
Zhang et al. (2010)	Simulated a range of winter and summer conditions (18 °C to 30 °C) in an office environment. The participants were given three different tests to assess their productivity. Results indicate that changes in temperature do not significantly impact the performance of the subjects.	
Park and Yoon (2011)	Experiments on ventilation rates and work performance in experimental offices over an eight-hour period. Results indicate that increased ventilation rates lead to a perception of improved air quality, resulting in a marginal, non-significant increase in work performance. Temperature changes do not significantly impact performance. The researchers acknowledge that variations in improved work performance are dependent on the type of tasks that are used in the laboratory setting.	
MacNaughton et al. (2015)	Increased ventilation rates result in a marginal non-significant increase in performance, where similar controlled experiments were conducted that involved cognitive functioning scores with exposure to carbon dioxide, adequate ventilation, and volatile organic compounds (VOCs).	
Tanabe et al. (2015)	Laboratory experiments in a climate chamber that included five different scenarios that involved changes in temperature, omission of certain clothing, and inclusion/exclusion of certain portable cooling devices (e.g., fans). Weak correlation between temperature and individual performance.	

impacted by different components of IEQ. A product of this paper is the formulation of this new theoretical model, which is underpinned by the following research question: What proportion of impact do GBFIs have on individual productivity and organizational performance within an office building?

Table 3. Summary examples of previous work – Field studies.

Author(s)	Outcome	Critique
Wyon (2004)	Conducted two eight-week field studies in call centers in Northern Europe. Decrease in performance due to poor IAQ was actually larger in a field study when compared to the laboratory/ simulated environment. Poor indoor air quality results in a decrease in performance.	Generally, field studies tend to find stronger relationships between IEQ factors and productivity, however the results tend to be more varied than laboratory studies, i.e., there appears to be an element of inconsistency amongst the results depending on the focus of the research study, which is stipulated in the Outcome column.
Biron et al. (2006)	Physical quality of work environment can lead to absenteeism/ presenteeism, which impacts organizational performance.	
Roulet et al. (2006)	Studies in 64 office buildings in Europe indicate that there is a strong correlation between perceived comfort and buildings not containing sick building syndrome symptoms.	
Akimoto et al. (2010)	Examines the link between thermal comfort and productivity. The research considers controlled changes in temperature in an office building and how this contributes to symptoms of fatigue and productivity. Results indicate that although there were observed increases in discomfort (i.e., symptoms of fatigue) the changes in temperature have a marginal impact on productivity.	
Fisk et al. (2011)	The research focuses on the benefits and costs of improved IEQ in U.S. offices. The study examines increasing ventilation rates and reducing environmental factors that contribute to dampness and mold. Although it was estimated that these types of environmental interventions reduced SBS and absenteeism, thus improving productivity, the authors are unable to accurately quantify the benefits of improved IEQ on productivity.	
Tanabe et al. (2015)	Evidence linking IEQ and productivity is inconsistent.	
Chadburn et al. (2017)	Offices with good ventilation and temperature control result in higher productivity levels. This formed part of a trial study in an office in London, where analyses of the findings indicate that personal productivity is dependent on both the physical and behavioral environments.	

Previous Work (Existing Models)

The impact of the environment on wellbeing and work efficiency has been researched for many years prior to the emergence of the green building movement (e.g., Fanger,

Table 4. Summary examples of previous work – Linking GBFIs to organizational outcomes.

Author(s)	Outcome	Critique
Harter et al. (2003)	Workspace quality can enhance engagement that contributes to productivity, which contributes to organizational outcomes.	Psychological well-being contributes to productivity. However, this is very difficult to gauge at an individual level within an office environment.
Kampschroer et al. (2007)	A balanced scorecard strategy matrix was applied in order to test the links between goals, desired behaviors, workplace strategy, and outcome measures. Attempts to create a link between physical space, behavioral change, and organizational outcomes. A linear approach was applied where data were collected three years before and two years after a business moved from a modular office design to a more open plan office design containing an organic layout. Results indicate an increase in behavioral interaction and organizational performance.	It is acknowledged that non-environmental factors also contribute to organizational performance.
Vischer (2008)	Develops a workplace comfort model comprising physical comfort, functional comfort, and psychological comfort. The different types of comfort are underpinned by workspace quality attributes such as noise, lighting, air quality, thermal comfort, furniture layout, and ergonomics. These environmental factors influence the following behavioral factors: employee satisfaction, employees' perceptions of the work environment with regards to territory, ownership and belonging, and individual productivity. The comfort model's IEQ factors influence employee satisfaction and individual productivity.	One weakness of Vischer's (2008) model is that it does not consider non-IEQ factors that also influence IEQ, e.g., personal problems, financial troubles, physical and mental health issues unrelated to the building.
Flamholtz (2009)	Organizational outcomes are underpinned by corporate culture, management systems, operational systems, resources, products, and changing markets. Different corporate cultures have either policies or subtle prompts that mention environmental awareness, which may include IEQ. The implementation of IEQ features within an office could improve workspace quality and could potentially impact organizational outcomes.	IEQ is not a prominent factor within corporate policies, as it is easier to link management systems and other traditional business measures to organizational performance than features of the physical working environment.
Feige et al. (2013)	Tests a model that attempts to establish a linear relationship between the building features, comfort, work engagement, and financial gain to the company (i.e.,	More research is required to support the assertion of multiple green building councils that improved IEQ results in increased individual

(*continued*)

Table 4. Continued.

Author(s)	Outcome	Critique
	tenant). There is a relationship between building features and comfort. They only manage to partially confirm that there is a relationship between comfort and work engagement. No link is found between engagement and financial gain (outcomes).	productivity and organizational performance.
MacNaughton et al. (2016)	Focus on IEQ in terms of environmental and functional comfort. Office workers were transferred from a conventional building to a green certified building with significantly lower CO_2 levels. Building occupants reported improved IEQ and therefore reduced physical symptoms. It is established that both the physical elements and the psychological perceptions play a role in influencing stated comfort levels.	Perceptions regarding tangible comfort influence psychological comfort, which is difficult to gauge.

1970; Wohlwill, 1966). In one example, Campion and Berger (1990) define four job design approaches—motivational, mechanistic, biological, and perceptual/motor—that could lead to effective organizational outcomes. The relevant design approach to consider for this paper is the biological approach which is derived from ergonomics. Simply put, this approach seeks to understand interventions that minimize the physical strain on an employee by reducing strength and endurance requirements, while simultaneously reducing environmental conditions that could hinder work efficiency. The argument is that this should reduce employee discomfort, fatigue, and illness. However, because office workers are now mostly working in knowledge-based jobs, the focus on physical attributes of physical strain and exposure to harsh environmental conditions such as sunlight exposure, extreme cold or heat, or windy conditions are less of a concern since in a physical office the built environment moderates many of these harsh environmental effects. More recently, work design models also include aspects such as ergonomics (i.e. the physical layout, the environmental conditions, and work-equipment design) which have an impact on wellbeing and productivity outcomes (Humphrey, Nahrgang, & Morgeson, 2007). Knight and Haslam (2010), for example, find that workspace quality and a better quality physical working environment impact mental performance and thus individual productivity in a knowledge-work environment.

A variety of literature is reviewed that covers GBFIs, workspace quality, individual productivity, and organizational performance in green buildings, with a specific focus on organizational outcomes and the integration of GBFIs and productivity in office buildings. This requires a great deal of cross-disciplinary reviewing of literature involving the fields of organizational psychology, the sustainable built environment, indoor air quality, occupational health, and ergonomics (amongst other disciplines) thus requiring an understanding of various non-uniform terminology and different research methods. Previous research generally fits one of the following three types: a) experimental laboratory type studies, where there is an attempt to link one or more IEQ features to

productivity or performance; b) field studies that try to link one or more IEQ features to health and/or productivity and/or performance; and c) exploratory studies that try to find relationships between IEQ features and organizational outcomes. Tables 2–4 summarize each of the aforementioned types. Following from a review of the findings of these types of studies we give a number of observations and critiques, which are also summarized in these tables, that refer to the challenges associated with how multiple building and non-building related variables impact individual productivity and organizational performance.

Experimental Laboratory Studies

Table 2 focuses on experimental laboratory studies that explore possible organizational performance benefits. This research focuses on a variety of IEQ factors, such as light quality (Veitch & Newsham, 1997), indoor air quality (Park & Yoon, 2011; Wyon, 2004), temperature (Park & Yoon, 2011; Tanabe, Haneda, & Nishihara, 2015; Zhang et al., 2010), and ventilation rates (MacNaughton et al., 2015)—all in relation to some measure of performance. Our general critique is that these types of cross-sectional studies limit what we can say about the long-term effects of environmental conditions and that longitudinal studies may be a better approach to determine whether there are any lasting effects that have an impact on organizational performance.

Although many of the studies listed in Table 2 focus on different IEQ factors, there seems to be a common trend relating to poor to moderate results linking IEQ to performance. In studies involving light quality (Veitch & Newsham, 1997), the results are inconclusive. Park and Yoon (2011) and Wyon (2004) conclude that poor indoor air quality can reduce performance of office workers, while Zhang et al. (2010) find that changes in temperature do not significantly impact the performance of the research participants. Park and Yoon (2011) research on ventilation rates find that increased venitlation leads to the perception of improved air quality. This results in a marginal but non-significant increase in work performance. MacNaughton et al. (2015) have similar findings to that of Park and Yoon (2011). Tanabe et al. (2015) conduct scenario testing and find a weak correlation between temperature and individual performance. The aforementioned studies, although based only on IEQ attributes, are often loosely used by green building councils (including the World Green Building Council) to justify that green buildings result in improved individual productivity and organizational performance (Green Building Council Australia, 2015; Green Building Council of South Africa [GBCSA], 2015; Milne, 2012; United Kingdom Green Building Council [UKGBC], 2015; United States Green Building Council [USGBC], 2015; World Green Building Council [WGBC)], 2015). However, this view is sometimes contested (as discussed further on in this study).

Field Studies Linking GBFIs to Health and/or Performance

A summary of examples of field study-based research is given in Table 3. This research focuses on a variety of factors, which include indoor air quality (Wyon, 2004), comfort (Roulet et al., 2006), temperature (Akimoto, Tanabe, Yanai, & Sasaki, 2010), improved indoor environmental quality (IEQ)/physical quality of work environment (Biron, Brun,

Ivers, & Cooper, 2006; Fisk, Black, & Brunner, 2011; Tanabe et al., 2015), ventilation, and temperature (Chadburn, Smith, & Milan, 2017). Most of these studies attempt to find a link between one of the aforementioned factors and individual productivity or organizational behavior. The research cited in this section highlights examples of field studies within the context of IEQ and health/performance. It is not intended to be a comprehensive analysis of research in this area. The overarching critique is that field studies tend to find stronger relationships between IEQ factors and productivity and performance, however the results are often more varied than laboratory studies. Some researchers find strong correlations between building factors and perceived comfort, while other researchers struggle to establish significant relationships between IEQ and productivity, as the results are often found to be inconsistent, possibly due to the influence of non-physical factors (e.g., the psychosocial or behavioral environment).

There are obvious limitations with field work studies, as illustrated in Table 3. Issues such as motivation, work supervision, office layout, interaction with work colleagues, different time pressures, and the appropriateness of the work tasks may be some of the factors which differ between laboratory-type studies and field studies. Generally, Wyon (2004) find that the decrease in performance due to poor IEQ is larger in a field study when compared to the laboratory/simulated environment. There are a wide range of findings linking IEQ and the internal/external building design to health, wellbeing, and individual productivity (Akimoto et al., 2010; Alker et al., 2014; Chadburn et al., 2017; Dimoff, Kelloway, & MacLellan, 2014; Fisk et al., 2011; Heerwagen & Zagreus, 2005; Laughton & Thatcher, 2018; MacNaughton et al., 2015; Roulet et al., 2006). Roulet et al. (2006) find that there is a strong correlation between IEQ, thermal, acoustic, and lighting comfort. They also find that there is a correlation between perceived comfort and those buildings that do not exhibit sick building syndrome (SBS) (Roulet et al., 2006). Research conducted by Akimoto et al. (2010) examines the link between thermal comfort and productivity. Their results indicate that although there are observed increases in discomfort (i.e., symptoms of fatigue) the change in productivity is marginal. The benefits and costs of improved IEQ are investigated by Fisk et al. (2011). Their study focuses on increasing ventilation rates and reducing environmental factors that contribute to dampness and mold. Fisk et al. (2011) are unable to accurately and independently quantify the benefits of improved IEQ on productivity. Chadburn et al. (2017) find that quiet workspaces with good ventilation and temperature control tend to result in higher productivity levels within an office environment. The results indicate that personal productivity is dependent on both the physical and behavioral environments.

While most studies tend to focus on IEQ, there are a smaller number of studies that look at other aspects of the built environment. For example, a study of an office environment prior to moving into a green certified building by Laughton and Thatcher (2018) establishes that different types of workspaces contribute to different types of physical stress in an office environment. They find that discomfort attributed to the neck, shoulders, and upper and lower back is high, regardless of the office layout. The types of organizational outcomes are frequently defined by the office layout which is often determined by the nature of the business. For example, open-plan layouts are found in marketing firms while cellular offices are typically found in legal practices. In addition, the quality of the physical working environment can have an impact on productivity, which

can potentially lead to absenteeism or more subtly, presenteeism (Biron et al., 2006), and thus impact organizational performance (Knight & Haslam, 2010). Despite the apparent consistencies described in this section, Tanabe et al. (2015) note that the evidence for a link between IEQ and employee productivity is frequently inconsistent. In general, while field studies do find significant relationships between workplace factors and individual and organizational outcomes, these results tend to be more varied than in a laboratory environment.

Studies Linking GBFIs to Organizational Outcomes

Table 4 provides a breakdown of research that attempts to find a link between GBFIs and organizational outcomes. There are a variety of findings that analyze corporate culture (Flamholtz, 2009), workplace quality (Harter, Schmidt, & Keyes, 2003), office design (Kampschroer, Heerwagen, & Powell, 2007), different types of comfort (Vischer, 2008), perception of the work environment (Vischer, 2008), and the link between comfort and work engagement and subsequently a connection to financial gain (Feige, Wallbaum, Janser, & Windlinger, 2013). The general comment is that non-environmental factors can also influence individual productivity. Only a partial link is established between comfort and work engagement and no link is found between work engagement and financial gain. These findings might suggest that there are possible mediating variables in these relationships.

One of the conclusions that can be drawn from Table 4 is that every organization is different and hence there is variation in the desired outcomes. These are underpinned by corporate culture, management systems, operational systems, resources, products, and changing markets (Flamholtz, 2009). Corporate culture of some organizations will have either policies or subtle prompts that mention environmental awareness, which may include IEQ (Flamholtz, 2009). Therefore, the implementation of IEQ features within an office could improve workspace quality and could potentially impact organizational outcomes. Workspace quality can contribute to worker productivity which contributes to organizational outcomes (Harter et al., 2003). Kampschroer et al. (2007) test the links between goals, desired behaviors, workplace strategy, and outcome measures. The same researchers also focus on organizational performance and thus there is an attempt to create a link between physical space, behavioral change, and organizational outcomes. Their results indicate an increase in behavioral interaction and organizational performance.

There is still some uncertainty in this area of research with regards to acknowledging how the environment specifically impacts individual productivity. An improvement in the physical environment could contribute to a change in behavior, however there would always be other non-environmental factors that influence productivity levels (Kampschroer et al., 2007). The defining feature of this set of studies is the presence of intervening variables that link IEQ to organizational outcomes. Vischer (2008) develop a model that arranges workplace comfort into a hierarchical framework, which comprises of three comfort categories. The different types of comfort are underpinned by workspace quality attributes. In Vischer's (2008) model, comfort is the link between satisfaction (i.e., with the built environment) and productivity (i.e., workplace behavior). It is

acknowledged that occupant environmental preferences do not relate to productivity levels. One of the shortcomings of the theoretical model of Vischer (2008) is that it only considers factors within the building that influence individual productivity, which is not entirely realistic as building occupants may experience external work-related stressors that can equally impact productivity (e.g., family troubles, financial difficulties, and physical and mental health issues unrelated to the building).

In the last decade there have been numerous researchers that have attempted to find a link between the internal built environment and building occupant comfort levels in conjunction with individual productivity and organizational performance (Akimoto et al., 2010; Dimoff et al., 2014; Kossek, Kalliath, & Kalliath, 2012; Tanabe et al., 2015). However, there is still a lack of widely accepted empirical tests or existing theoretical models. Further research is required to test current theoretical models by modifying and refining specific factors. Within the context of general comfort, IEQ plays a central role as there is a clear relationship between the user/occupant and their work environment (i.e., the built environment) as the building design has a direct influence on IEQ (Alker et al., 2014; Vischer, 2008). Feige et al. (2013) test a model that attempts to create a linear relationship between the building features, comfort, work engagement, and financial gain to the company. Their research confirms that there is a relationship between building features and comfort, however they only manage to partially confirm that there is a connection between comfort and work engagement. They find no connection between work engagement and financial gain. This suggests that further research is needed in order to investigate what intervening variables are present to support the assertion of multiple green building councils that improved IEQ results in increased individual productivity and organizational performance (Green Building Council Australia, 2015; Green Building Council of South Africa, 2015; Milne, 2012; UKGBC, 2015; USGBC, 2015; WGBC, 2015).

The Emergent Model

This section comprises four sub-sections. The first examines the limits of existing models and the second explores the creation of new pathways and the understanding/application of a new model. Next, the third represents how the new model addresses new pathways; and finally the fourth portrays the manner in which the new model delivers new analysis.

Limits of Existing Models

The existing research models manage to address certain elements that only partially establish a relationship between IEQ variables and individual productivity and organizational performance. There remains conjecture regarding the manner in which productivity is measured within a knowledge-based environment and how/if this can be attributed to IEQ. Measuring individual productivity within an office environment can at times be difficult, as noted by Viswesvaran and Ones (2000), as productivity is an abstract construct where one cannot always point to a physical deliverable that accurately resembles productivity and competence. It is even more difficult to do this in a way that is standardized across all employees, even in a single organization. This results

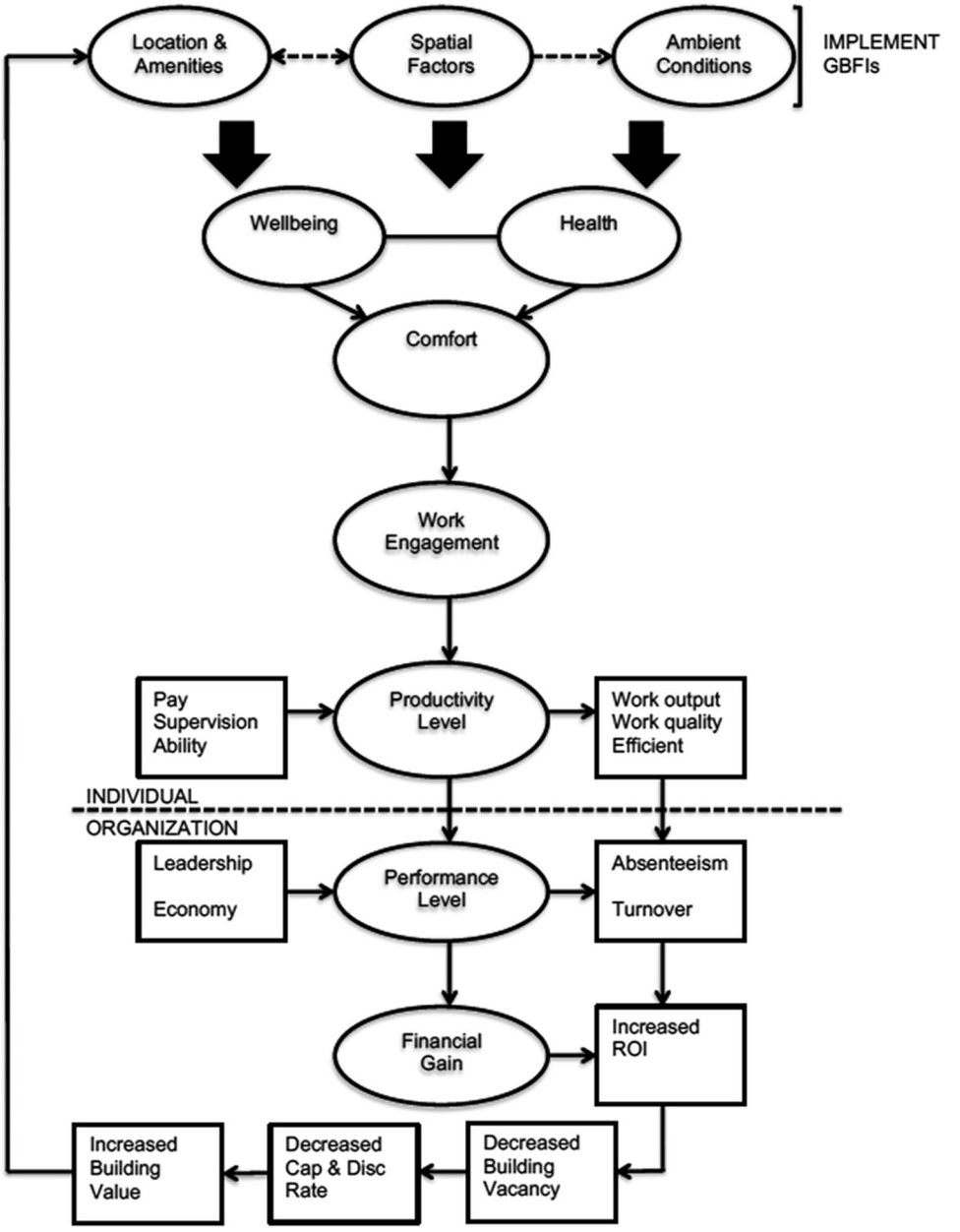

Figure 1. Emergent research model.

in individual productivity being measured by theoretical "widgets" produced or self- and supervisor-assessments; the latter occur more often in an office environment which can contain an element of bias from both parties (Haynes, 2008a; 2008b). Sullivan, Baird, and Donn (2013) and de Dear et al. (2013) both acknowledge that measuring productivity is difficult and that there are many different approaches to measuring productivity that makes comparisons between studies problematic. One approach is to ask respondents to self-rate their productivity, however often the questions in these types of surveys are

based on perceptions and self-assessment which can often be inflated due to self-reported biases. As a result, the notion of improved IEQ leading to an improvement in individual productivity is not always supported within the context of a knowledge-based environment because of the manner in which productivity is measured (Byrd & Rasheed, 2016; Mulville, Callaghan, & Isaac, 2016; Thatcher & Milner, 2014).

Another challenge is linking GBFIs to individual productivity, as there are also numerous non-building variables that can impact productivity (e.g., employee competency and ability, status of personal/professional relationships, the competencies of supervision and management, the support of colleagues, job satisfaction, motivation). Added to this are non-employee factors that can impact organizational performance, such as the status of the economy, the quality of the product or service, the quality of the marketing, the demand for the product or service, and mental and physical health factors not obviously related to the building (e.g., cardio-vascular disease, cancer, depression). As a result, it is likely that the influence of GBFIs on productivity (and therefore organizational performance) would only be a relatively small proportion of the overall organizational performance. However, there are some encouraging signs of established links. For example, Mayo (2016) establishes a connection between work engagement and organizational performance, where organizations with highly engaged employees yield lower staff turnover rates, higher customer loyalty, and higher levels of individual productivity, all of which lead to higher profitability for the company. However, it should be noted that while Mayo (2016) establishes a link between work engagement and organizational performance, no link is found between work engagement and the building features/qualities, as the role of the building is not incorporated into the research. Finding consistency within previous research is therefore extremely difficult. In this paper we present a model that attempts to integrate this disparate literature.

A theoretical framework developed by Haynes (2007) assesses the physical and behavioral environments in an office that are linked to occupant productivity. The physical environment is defined as the office layout and perceptions of physical comfort. Behavioral comfort is viewed as differing levels of interaction and distraction by office workers. According to Haynes' model, this results in the physical environment determining certain types of behavioral environments that allow for either collaborative or individual engagements. This impacts productivity in different ways, as the behavioral environment, Haynes argues, is a larger contributor to productivity than the physical environment. Haynes concludes that there are different physical components that are compared with different ways of working, such as individual processes, group processes, concentrated study, and transactional knowledge. Haynes' research model is empirically tested and it is concluded that the behavioral environment has the largest impact on office productivity. This is underpinned by interactions and distractions, which have both positive and negative impacts respectively on productivity (Haynes, 2007). The emergent research model (Figure 1) differs from Haynes's position, while acknowledging wellbeing (i.e., the behavioral environment), by having a more overt focus on the physical environment and its link to productivity by emphasizing the different pathways through which the physical environment has an impact on performance and productivity. These include direct pathways (i.e., physical impediments to work) and indirect pathways (i.e., distractions from work).

Vischer's (2007) research adds to the work of Haynes (2007). Vischer suggests that environmental comfort comprises physical comfort (which links the building user to the actual work environment), functional comfort (which defines the ability of the building occupants to operate efficiently within their work environment), and psychological comfort (which is an abstract construct that is underpinned by human relationships with colleagues or superiors), in addition to the influence of both personal and professional stress factors. Other contributing factors to psychological comfort are the quantity and quality of personal space that each building occupant is allocated to perform their work. This links back to functional comfort where the top three functional comfort dimensions are workstation comfort, thermal comfort, and air quality comfort according to Vischer. As stated earlier, Vischer also assesses some organizational outcomes (i.e., individual productivity), but fails to find a significant relationship between comfort and these organizational outcomes. Vischer (2008) also suggested that environmental satisfaction and functional comfort result in an enhanced user experience but this does not manifest in measurable organizational outcomes. This model implies that while there may be a relationship between sustainable building practices (GBFIs) and individual productivity, in order to incorporate GBFIs into this area of research, a more comprehensive understanding of individual comfort and the possible intervening variables (i.e., mediators) that connect comfort with organizational outcomes is required (Vischer, 2008). The emergent model (Figure 1) aims to integrate comfort, which is underpinned by wellbeing and health, in order to find a connection to work engagement (i.e., as the primary mediating variable) which impacts productivity levels. The new model will hopefully aid in establishing a link from individual productivity to organizational performance in order to address the concerns of Vischer (2008) regarding the link between comfort and organizational outcomes (performance). While the link between work engagement and productivity is well-established in the organizational psychology literature, research conducted by Feige et al. (2013) fails to establish a relationship between work engagement and financial gain, even though comfort predicts work engagement.

Creating New Pathways for Understanding and Using a New Model

The new model (Figure 1) represents a consolidated group of pathways that attempts to show the paths between the implementation of GBFIs through comfort and work engagement, to individual productivity and ultimately organizational performance that results in increased building value. This culminates in a feedback loop, justifying the initial implementation of GBFIs. The model defines a distinction between the individual and the organization by defining productivity as outputs at the individual level, while performance is defined as outputs at the organizational level. The proposed model creates a new paradigm by consolidating different areas of research into a holistic framework, providing a theoretical model to guide empirical research, which uses new (and existing) pathways.

There are various studies that attempt to analyze linear relationships between several IEQ variables (lighting, ventilation, acoustics, general environment) and job satisfaction (De Been & Beijer, 2014; Newsham et al., 2009; Schwede, Davies, & Purdey, 2008; Tanabe et al., 2015; Vischer, 2007). However, there is a lack of robust modelling that

demonstrates the link between ambient environmental office conditions and organizational effectiveness outcomes. This research aims to expand on the work of Becker and Pearce (2003), Byrd and Rasheed (2016), Feige et al. (2013), Haynes (2007), Newsham et al. (2009), Thatcher and Milner (2014), and Vischer (2007) by developing a more comprehensive model that proposes the relationships between GBFIs and their influence on individual productivity and organizational performance. Previous research also links GBFIs to increased building value (Nurick, Le Jeune, Dawber, Flowers, & Wilkinson, 2015), but this focuses on operating cost savings, i.e., the link to occupants (both people and organizations) is not considered. Previous theoretical frameworks that include green building literature and work analysis models with a specific focus on the built environment are therefore considered first.

How the New Model Addresses New Pathways

This sub-section comprises three components that delve into how the new model addresses new pathways. The first component provides a narrative on linking GBFIs to wellbeing, health, and comfort. Graphically, this is represented in the top third of the new model. The second component speaks to the links between comfort and work engagement, which is shown in the next phase of the new model. The last component discusses linking work engagement to productivity, performance, and financial gain. This is illustrated in the bottom third of the new model.

Linking GBFIs to Wellbeing, Health, and Comfort

Figure 1 shows that the model we propose emerges from the literature and that it would need to be empirically tested. Following Alker et al. (2014), Figure 1 shows that the GBFIs implemented would consist of ambient conditions, spatial factors, location, and amenities. Ambient conditions are underpinned by IEQ, ventilation, thermal comfort, lighting (natural and artificial), and noise/acoustics and these factors have been the most vigorously researched. These contributing factors often include some of the following items: volatile organic compounds, particulates, aroma, fresh air ventilation, moisture levels, indoor air temperature, humidity levels, light quality, glare, and background noise and auditory distractions (such as loud noises or people talking). The underlying contributing factors can affect individual productivity in a number of ways, as poor ambient conditions that either physically disrupt the work directly (i.e., a direct path to productivity) or that force office workers to "escape" the environment through distractions (i.e., an indirect path through intermediary responses such as health, wellbeing, and/or comfort). For example, the quality of lighting and glare off computer screens also reduces the ability to work efficiently. This essentially hinders concentration levels, which has a direct impact on organizational performance or an indirect impact through impacts on health, wellbeing, and/or comfort.

Spatial factors are underpinned by interior layout/design, biophilia, external views, location, and access to office amenities. These contributing factors include some of the following items: the incorporation of ergonomic design layouts, break-away and social interaction spaces, connection to nature via internal vegetation and views, and appropriate design in terms of corporate culture. These contributing factors can impact individual

productivity indirectly as they influence comfort levels of office workers, which may have an effect on concentration, thus impacting organizational performance. The physical layout of the office can also impact productivity directly. For example, being located close to "noisy zones" such as the coffee machine or a busy thoroughfare can impair concentration and impact productivity directly through the inability to perform (e.g., adequately listen to a telephone call). Additionally, being located far from office resources such as printers or being far away from other close work colleagues can reduce work efficiency.

Location and amenities include ease of access to retail centers, medical facilities, schools, gyms, parking, and public transport nodes. Direct effects might mean that office workers may spend less time at their work stations in order to make allowances to access these amenities. Conversely some buildings and commercial precincts provide amenities, which results in a less absent work force, thus having a positive impact on organizational performance. Indirect effects might mean that access to these amenities means that office workers spend less time feeling stressed about how they will access these services.

A theoretical model developed by Seppänen and Fisk (2006) highlights a link between environmental controls (IEQ) with regards to operational and maintenance costs/benefits, which includes a decrease in health costs, increase in number of working days, increase in output quality (individual productivity), increase in staff retention, and a decrease in maintenance costs (organizational performance). In theory their conclusion was that the implementation of GBFIs that enhance IEQ have a direct positive financial impact on the organization, without the need for any intermediary variables (although both health and productivity are arguably intermediary variables). This is supported by Doggart (2006) who finds that a well-designed commercial building from a user comfort perspective can result in aiding an organization's financial performance. Doggart (2006) finds that overhead costs per person could be reduced from 3% to 15% in a relatively short period of time, thus confirming that good building design is good for business.

As already noted, while it is possible that there are direct effects of these factors on individual productivity, previous models also suggest that many of the effects on individual work productivity are likely to be indirect and mediated or moderated by other individual and organizational factors. First, we argue that these three factors directly determine the levels of comfort, wellbeing, and health of employees experiencing these conditions. This starts with comfort, which is defined using Vischer's (2007) three pillars of environmental, psychological, and functional comfort. For example, environmental comfort is assessed by Gou, Lau, and Chen (2012) through the implementation of a POE in a three-star green-certified office building in China. Their research finds that although the vast majority of respondents are satisfied with the thermal environment there is still some discomfort experienced by office workers that were exposed to uncomfortably cold air in both summer and winter. An example such as this shows that a badly designed office environment can be uncomfortable whereas a carefully designed office environment can support employee comfort.

Inappropriately designed LEED IEQ attributes such as IEQ, temperature, humidity, ventilation, lighting, acoustics, and ergonomic design all contribute to physical health and psychological wellbeing, be it clinical symptoms (asthma and respiratory allergies) and/or psychological symptoms (depression and stress), which impact productivity (Singh, Syal,

Grady, & Korkmaz, 2010). Empirical findings from longitudinal research conducted in the United States by Singh et al. (2010) involving two separate case studies where occupants moved from two conventional buildings into two different grades of green-certified buildings find that on average there is a reduction in both clinical and psychological symptoms, which results in a decrease in absenteeism. Furthermore, the perceived improvement in health and wellbeing contributes to a perceived positive impact on productivity by the office workers. Furthermore, there is a significant body of literature supported by empirical evidence (Fisk et al., 2011; Hedge, 2000; Kim & de Dear, 2012; Newsham et al., 2009; Rashid & Zimring, 2008; Seppänen, Fisk, & Lei, 2006; Wyon & Wargocki, 2013) that indicates that improved IEQ can contribute to both improved physical and mental wellbeing (see Thatcher & Milner, 2016 for a review of this literature). However, this relationship is not always consistent. Research by Gou, Prasad, and Lau (2013) involves a selection of conventional (non-green) and green certified buildings in order to determine the perceived levels of satisfaction and comfort by means of a building user survey (BUS). The findings indicate that workers located in a green building are not always more comfortable than workers located in a conventional building. This shows that although green buildings may be more resource efficient, not all green buildings provide superior comfort levels for office workers when compared to conventional buildings.

Linking Comfort, Health and Wellbeing to Work Engagement

Comfort, health, and wellbeing levels have, to a greater or lesser extent, impacted work engagement, which can be defined as a persistent and purposeful cognitive state where dedication is applied in order to achieve certain objectives (Schaufeli, Bakker, & Salanova, 2006). This is vital within an office environment as it underpins the levels of individual productivity and therefore has an impact on organizational performance. Theoretically, it makes sense that an employee who is more comfortable, healthy, and psychologically well would be more engaged in their work and more likely to spend time in their workplace working productively. According to a literature review conducted by Kossek et al. (2012), surveys conducted in the United States reveal that employers that take an interest in employees' personal lives and provide support where necessary have higher levels of engagement in the workplace. Conversely, lower levels of engagement are ultimately reflected as an expense to an organization, and it is estimated that low engagement resulted in annual costs of approximately $350 billion at the time (Kossek et al., 2012). The underlying components of comfort impacting work engagement are established by Gou, Lau, and Shen (2012) when analyzing LEED certified buildings. As an example, natural light can sometimes hinder environmental and functional comfort as direct sunlight increases internal temperatures and results in glare from computer screens. This impacts comfort levels which interferes with the employee's ability to engage with their work.

Similar to what we describe for the relationship between GBFIs and productivity, there may also be direct pathways between comfort and productivity. Research by MacNaughton et al. (2015) examines the interconnections between comfort and productivity. Their previous research specifically involves increasing ventilation rates (i.e., environmental comfort) to test for an increase in employee productivity. Their research finds that there is an increase in productivity with increased levels of environmental comfort, which they express as a monetary value in terms of costs per occupant. MacNaughton

et al. (2015) do not look at work engagement as a possible mediator so it is not possible to say whether the relationship with productivity is direct or mediated. Theoretically though, feeling uncomfortable can directly influence a person's productivity through being a distraction, regardless of how engaged they might feel with their work.

Linking Work Engagement to Productivity, Performance, and Financial Gain

Research conducted by Feige et al. (2013) only establishes that there is a link between comfort levels and work engagement, but does not find a link between productivity and work engagement. Feige et al. do propose that due to the link between comfort levels and work engagement, a comfortable working environment could positively influence staff retention and the attraction of high caliber staff. The link between work engagement and productivity is a key component of the new research model, as work engagement is the proposed intermediary between comfort and productivity despite Feige et al. not finding a significant relationship. In contrast, in other research Mayo (2016) find that there is a significant relationship between work engagement and organizational performance, but not between IEQ features and work engagement. It should be noted that Mayo's study attempts to link work engagement to the work environment (organizational culture) not IEQ, i.e., relationships with co-workers and access to resources in order to efficiently work (engage). Therefore, in Mayo's study, buildings are not considered to be a contributing factor that influenced work engagement.

Considering theoretical work, a literature review conducted by Bakker and Albrecht (2018) states that high work engagement results in dedication and a strong work ethic, which has a positive impact on individual productivity and potentially also on the organization's financial results (i.e. organizational performance). Earlier research by Bakker and Bal (2010) using teachers as research participants find that there is a positive relationship between work engagement and job performance (individual productivity). Furthermore, it is suggested by Bakker (2011) that there are four reasons that support the superior performance of engaged workers compared to non-engaged workers: a) engaged workers tend to experience positive emotions in the workplace, such as gratitude, joy and enthusiasm; b) engaged workers seem to experience better health; c) engaged workers tend to exhibit signs of pro-activity in the workplace (i.e. positive work behavior); and d) work engagement is contagious, thus setting a subtle workplace culture where engagement is considered the norm results in a positive reinforcing impact on organizational performance.

However, productivity, like work engagement, is influenced by many other factors such as equitable pay, motivation, supervision, and individual capability. The emergent model indicates that individual productivity levels contribute to organizational performance, although organizational performance is also influenced by senior leadership and the overall economy. Organizational performance might also partially be measured by using absenteeism and employee turnover as "proxy" measures. Ultimately, organizational performance is measured by financial gain in terms of return on investment. Satisfactory organizational performance can, as previously mentioned, be partially linked to occupant comfort (IEQ). From a commercial property valuation perspective this can impact vacancy assumptions, thus de-risking a commercial property resulting in lowering the capitalization rate and yielding a greater nominal value (Nurick et al., 2015). This results in a positive feedback loop, if organizational performance increases, that justifies

the initial implementation of GBFIs as a result of an increase in individual productivity and organizational performance. In other words, the capital expenditure of implementing GBFIs is offset by an increase in organizational performance, which is underpinned by individual productivity. Another justification for the implementation of GBFIs is that the reduction in operating costs that are attributed to water, electricity, and waste removal will also positively impact the building's value, as this will increase the net operating income (NOI). This is a benefit to not only commercial tenants leasing space as they would incur lower utility costs, but also organizations that are owner-occupiers that would accrue the added benefit of enhanced building value. This would therefore further strengthen the feedback loop from financial gain to the implementation of GBFIs, as shown in Figure 1. Thus, the emergent research model provides a consolidated framework for the different relationships derived from the literature. Furthermore, Figure 1 also shows where new relationships need to be empirically tested in order to provide further clarity where other researchers have struggled to establish definitive conclusions.

Once the new model is empirically tested, the emergence of new pathways/relationships may also become apparent. Specifically, these would be the differentiation between individual productivity, organizational performance (financial gain), and increased building value. There has been previous research linking GBFIs to increased building value by focusing directly on building related income and costs, which influence risk, and ultimately value, by means of the discounted cash flow (DCF) method (Fuerst & van der Wetering, 2015). This model intends to test if GBFIs can influence work engagement to a point where individual productivity and organizational performance can be directly included in valuation (DCF) variables, thus having a positive impact on value. Since the main focal points are people (productivity), the organization (performance), and the property owner (building value), the preceding contributing factors need to be well defined and based on previous research.

How the New Model Delivers New Analysis

The new research model will allow for researchers to isolate and analyze relationships between the indoor environment (GBFIs), building occupants, the organization, and building value. As a result, the model delivers a holistic representation of how the implementation of GBFIs within an office building can potentially result in positive externalities where the individuals, the organization, and the property owner simultaneously benefit. This is done by highlighting the linear relationships between each of the main components (as discussed previously), where each relationship has a positive knock-on effect on the next component, as illustrated in the model. Ultimately the new model, once empirically tested, can be used as a theoretical framework to establish to what level the implementation of GBFIs in an office building results in enhanced individual productivity and organizational performance.

Additional Factors to Consider

Chadburn et al. (2017) find that quiet workspaces with good ventilation and temperature control tend to result in higher productivity levels within an office environment. These

form part of a trial study in an office in London, where analysis of the findings indicated that personal productivity is dependent on both the physical and behavioral environments. This type of study suggests that the GBFIs each work cooperatively to produce positive organizational outcomes. However, there are frequently times when the GBFIs interact in ways that produce negative outcomes. Some of the more obvious interactions are between ventilation rates, temperature, and air quality (e.g., Fang, Wyon, Clausen, & Fanger, 2004). As mentioned in the introduction, one of the main drivers of green buildings is to reduce operating costs through more efficient energy systems. Clearly GBFIs interact in complex and sometimes unpredictable ways. One of the most common ways to reduce energy costs is the installation of energy efficient lighting systems and/or the redesign of space that makes use of more natural light. Often, the introduction of more natural light requires a redesign of the internal space. This might inadvertently have a negative effect on the ambient conditions as the management of natural light can result in indoor thermal challenges, especially for those workers located near large windows and glare. A re-configuration of an office environment into a more open-plan design can result in an increase in residual noise, which can be exacerbated if the external building façade is predominantly glass (i.e., sound waves reverberate well off glass), thus having a negative impact on individual productivity levels. In order to increase ambient comfort within a naturally lit office environment, interventions such as automated thermal controls and glare controls need to be implemented to avoid undermining productivity levels. Another example would be open-plan offices which, while good for allowing natural light to infiltrate the interior of an office space, often increase noise levels. Office environments containing knowledge workers tend to have typical internal designs that comprise of an open-plan layout in conjunction with shared or singular cellular offices for senior members of staff or staff with highly specialized work functions (Chadburn et al., 2017; De Croon, Sluiter, Kuijer, & Frings-Dresen, 2005). The use of natural lighting can reduce the need for low-quality artificial lighting, which in turn could result in the implementation of high-quality, energy efficient lighting that may reduce computer screen glare.

Newsham et al. (2013) state that improved IEQ in LEED certified buildings results in increased satisfaction with the thermal conditions, external views, general aesthetic appearance, less disturbance from heating ventilation and air-conditioning (HVAC) noise, and an improved workplace image. This leads to improved nighttime sleep patterns, mood, improved physical symptoms, and a reduced number of airborne contagions. In addition, improved IEQ results in enhanced building user experience, higher quality light levels, greater access to windows and natural light, better thermal conditions, and a general increase in air quality (Newsham et al., 2013). Tangible benefits of IEQ are relatively easy to measure, however one of the resultant but more challenging measurable effects is that of improved productivity as a result of the implementation of GBFIs (Kato, Too, & Rask, 2009). Thompson, Veitch, and Newsham (2014) identify that a relatively minor increase in individual productivity can improve organizational performance by a greater factor than the costs of implementing GBFIs. Finally, Thompson et al. (2014) note that the same measures are rarely used between studies, and thus there is a need for standardization to fully understand how the various components of IEQ impact individual productivity.

Way Forward

At this point, the model in Figure 1 is based on a literature review that has been conducted to inform the development of a new theoretical model. Where it exists, empirical data from previous studies is used to support the individual relationships. However, no empirical data has been collected to test the model as a whole. The next step for this research is to empirically test the model by carefully gathering data on GBFIs and comparing buildings with different GBFI qualities. To make equitable comparisons it would be necessary that tenants in different buildings have employees/occupants who are performing roughly similar work. These comparisons would need to look to incorporate a number of metrics, including that of individual productivity, organizational performance, and financial gain, and therefore like-for-like comparisons could be made. It would be necessary to gather three different sets of data. The first set of data would be information about the various GBFI qualities of the various buildings. This information would include determining the exact GBFIs contained in the subject building(s). The second phase would need to be an organization-wide survey of the occupants in each of these buildings assessing satisfaction with GBFIs, comfort, perceived health and wellbeing, work engagement, and some consistent measure of productivity. Length of time in a building is also important to understand as it is likely that the effects discussed in the model would take some time to manifest. This data would be extrapolated by conducting a POE similar in structure to previous research, although with motivations for standardized measures. This will allow for insight in occupant productivity in relation to GBFIs. The third phase would be to compare the organizational performance of the organizations in the different buildings. For example, if the organizations being compared were in the financial services industry, then organizational performance could be assessed by comparing a generic financial product (e.g., balance investment fund) in the form of comparing annualized returns over a prolonged period of time. This would allow for the fair ranking of different investment firms within the context of a single financial product, as they all operate within the same market and are privy to the same market information. Ultimately, the research model is based on relationships supported by empirical evidence from other studies. The difference is that the research model attempts to consolidate these relationships to illustrate the GBFI lifecycle from an organizational benefit perspective as opposed to previous green building research that focuses on the long-term financial benefits relating to utility savings.

Recommendations for Future Research

This research has the potential to develop into residual studies that incorporate green buildings, their impact on occupants, and the occupants' subsequent behavior. This may include a study on the length of time spent in the building or the foot traffic in a retail building containing GBFIs, i.e., assessing if consumers shop for longer (spend more) in retail building containing GBFIs. There is also a possibility that a similar study could be implemented in a light industrial building containing GBFIs, as this has become a more prevalent real estate asset class (superior financial returns) due to the successful emergence of e-commerce (European Public Real Estate Association, 2017).

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