

## Green construction performance - A study on stakeholders' perceptions

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### ABSTRACT

This study is conducted to explore stakeholders' understanding of the performance of green-certified factories in the South of Vietnam. The study, based on the LEED Rating system, employs a qualitative approach to address objectives and in-depth interviews with 43 respondents including employees, managers, and buyers of green factories to collect data. The categories taken from LEED such as Water Efficiency, Indoor environmental quality, Energy & atmosphere, Resources & materials, Sustainable sites are used as the main analytical basis. To tackle the research objective, the study aims (1) to explore stakeholders' awareness of green factories' performance, and (2) to propose recommendations to enhance the effectiveness of green factories. The research findings show that, in general, stakeholders are satisfied with the performance of green factories. Nevertheless, there are some differences in the awareness of stakeholders working in small and large size green factories in a comparison with LEED. Finally, some suggestions are proposed to enhance the performance of green factories.

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### 1. Introduction

The construction industry today is one of the vital industries that has a profound impact on the economy of any nation. This sector contributes significantly to the growth of nations where governments make efforts to develop infrastructure related to commercial areas, transport, health, and education sector. Currently, the rapid urbanization and industrialization with the increase of construction development affect the global environment, especially in developing countries like Vietnam. Related issues of energy usage, materials resources consumption, waste of production and greenhouse gas release, etc. become the concerns of many countries. To respond to such an important concern, since 1993, green construction has been developed worldwide as an effective solution to resolve the problem (Kriss, 2014).

The first green building in Vietnam was completed in 2007. So far, over 10 years, the number of green buildings completion in Vietnam now reaches nearly 150 though (Nguyen, 2018). In recent years, green building has become one of the most encouraging measures in the environmental improvement policy of the government in Vietnam. The increasing number of green buildings in the country means that more people, as well as institutions, know and choose green buildings for their construction. Currently, in Vietnam, green buildings are not only included in normal buildings but also in factories, schools, and apartments, etc. Even though, the concept of green building is already widely known in the construction sector currently, it is still a new phrase

among involved stakeholders. Many people have never heard of green buildings, many others are using it but even do not know thoroughly about it. For investors and users, even if are aware of green construction, many of them still do not properly understand the benefits that this construction trend brings. Therefore, to evaluate and enhance the performance of green buildings, it is necessary to find out how it is understood by different stakeholders, whether they know how the green buildings operate and create benefits for them, and later on, for the environment.

The purpose of this present study is to explore the awareness of stakeholders of green building on the performance of these buildings. Therefore, the study aims (1) to explore stakeholders' awareness on performances of green buildings following the instruction of LEED, and (2) to propose recommendations to enhance the performance of green buildings.

## **2. Literature review**

### ***Green Building Terminology and Benefits of green factories***

The US Green Building Council first introduced the concept of green building (green construction) in 2007 (US Green Building Council, 2013). Accordingly, green building is a construction designed, built, and operated throughout its life cycle following criteria:

- Efficiently use energy, water, and other resources;
- Protect occupant health and improving employee productivity;
- Reduce waste, pollution and environmental degradation;
- Bring long term economic benefits.

The World Green Building Council defines green building as: "A green building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life." (World Green Building Council, n.d.).

According to the Vietnam Green Building Council (VGBC), green building refers to works that achieve high efficiency in the use of energy and material, minimize adverse impacts on the environment and design to minimize the negative impacts of the built environment on human health and the natural environment through:

- Use energy, water, and other resources effectively;
- Reduce emissions, pollution and negative impacts on the environment;
- Protect user health and improve labor productivity;
- Minimize waste, pollution, and environmental damage (Vietnam Green Building Council, n.d.).

Nguyen (2018) explained that whatever the definition, a green building ensures to limit harms to the natural environment, save energy, use energy efficiently, and reduce the amount of greenhouse emissions. This is the insight of "green" words in the green building concept, which is the meaning of life, ecology, and environmental friendliness.

In the world, there have been many research groups going into research and drawing conclusions about the perceptions, awareness, attitude of stakeholders around the green building in general. In the past 10 years, there were typically three studies conducted in Africa, one in West Asia and one in the United States. It is not difficult to recognize that, in these studies, a widely

diversified range of research subjects are aimed at. While The awareness and Perception of Office Property Users on Green Building in Lagos, Nigeria (Komolafe & Oyewole, 2018) conducted on people who use offices, the 2007 Consumer Survey (Jamison, 2008). Article conducted in the US examined the awareness of residents, i.e., the end-users, to see how they understand about green building. The research of Sichali and Banda in 2017 discovered the green building perspective of many objects including architect, quantity surveyor, clerk of works, project managers, engineer, foremen, bricklayer, businessman, contractor, planer, carpenters, electricians, etc. (Sichali & Banda, 2017). The other two remaining types of research in Africa (Omar et al., 2016) and (Nduka & Ogunsanmi, 2015) measured the perception of consultants and construction professionals. In the last ten year, the above-mentioned researches all covered LEED, a guideline for green building assessment, as a reliable tool for measuring study subjects about green building awareness. However, most of the studies did not mention factories, a type of construction that green buildings are also directed to, besides civil engineering. In Vietnam, in the period 2015-2018, there were about 40-50% of new LEED projects categorized in the industrial factory segment, which was quite a relatively stable group (Le, 2019). Therefore, research on perceptions of users, owners, and buyers revolving around green factories does not seem to be focused on research, especially in Vietnam.

Green buildings/green factories bring a lot of benefits. Firstly, Green factories help to increase energy efficiency and reduce harmful, thereby contributing to environmental protection. Secondly, green factories have an advantage of cost-saving in the operation process and increasing productivity. Thirdly, green factories bring a huge benefit to the community, such as improving public health, creating a healthy lifestyle and recreation.

### ***The Leadership in Energy and Environmental Design (LEED) Rating System***

LEED is one of the famous green building rating frameworks launched by the United State green building Council in 2013. This document is used to identify, implement, and measure the green building. Since its launch, LEED projects throughout the world have proved the benefits of using green design techniques that decrease the harms of buildings and decrease natural balance destruction.

By participating in LEED, parties together make a meaningful contribution to the green building industry. By tracking green construction, they contribute to a growing body of knowledge that will advance research in this rapidly evolving field. This will allow future projects to build on the successes of current designs and bring innovations to the market. There are nine main characteristics, which are called credits, these are (1) Integrative Process, (2) Location and Transportation, (3) Sustainable Sites, (4) Water Efficiency, (5) Energy and Atmosphere, (6) Materials and Resources, (7) Indoor Environmental Quality, (8) Innovation, (9) Regional Priority. (US Green Building Council, 2013)

(1) *Integrative Process* category is a list of requirements that need to be complied with by the parties to ensure that the project is high-performance, cost-effective. This is a credit goes beyond checklists and encourages integration during early design stages when clarifying the owner's aspirations and performance goals (US Green Building Council, 2013), not the operation stage. In general, this credit requires checking items of energy-related systems and water-related systems, which are more explicitly specified in other categories (Energy and Atmosphere, Water Efficiency), for the interactions among all building and site systems. Therefore, this credit is rejected.

(2) *Location and Transportation* is an outgrowth of the Sustainable Sites category (US Green Building Council, 2013), which formerly covered location-related topics. This category

considers the features of the transportation facilities around the building and assesses the integrity of these surrounding communities for user convenience. The criteria of its (Walking & bicycling distance and Total vehicle parking capacity) are partly mentioned in the Sustainable Sites category. Additionally, transport infrastructure features outside the factory were fixed before the construction started and could not be changed, so this credit is rejected.

(3) *Sustainable Sites* category rewards solutions about the environment surrounding the building, with relationships among buildings, ecosystems, and ecosystem services. In general, it focuses on restoring project site elements, integrating the site with local and regional ecosystems, and preserving the biodiversity that natural systems rely on (US Green Building Council, 2013).

(4) *Water Efficiency* category examines both outdoor and indoor use of water to recognize the use of non-potable and alternative sources of water. As a result, the credit encourages parties to take advantage of every opportunity to significantly reduce total water use (US Green Building Council, 2013).

(5) *Energy and Atmosphere* category focuses on addressing energy use reduction, energy-efficient design strategies, and renewable energy resources, the recent problems of unsustainable nonrenewable energy sources. Strategies like passive heating and cooling, natural ventilation are some measures to reduce a building's energy use (US Green Building Council, 2013).

(6) *Materials and Resources* category aims at minimizing the energy used and impacts of extraction, processing, transport, maintenance, and disposal of building materials.

(7) *Indoor Environmental Quality* category addresses the design strategies and environmental factors including air quality, lighting quality, acoustic design, controlled over people's surroundings that affect the way they learn and work (US Green Building Council, 2013).

(8) *Innovation* category is to recognize projects for innovative building features and sustainable building practices and strategies (US Green Building Council, 2013). In fact, during the rating process of a green building, this credit is determined as the extra-score rewarding which buildings that performance that greatly exceeds what is required in an existing LEED. This credit was not credited to the scorecards of the two factories in this study, so it was rejected.

(9) *Regional Priority* is a criterion built on each different area's characteristics. Because some environmental issues are location-specific, USGBC has worked with local experts to identify RP credits for every location - and every rating system - within local or national boundaries (US Green Building Council, 2013). Different LEED project types may be associated with different environmental consent, so each rating system has its Regional Priority credits. Hence, this category is rejected as it cannot use as a standard factor.

LEED is worldwide accepted by practitioners and scholars (Komolafe & Oyewole, 2018), (Jamison, 2008), (Sichali & Banda, 2017), (Omar et al., 2016) & (Nduka & Ogunsanmi, 2015). Therefore, LEED is also chosen as a guideline for this research. Among 9 dimensions in LEED, some are measured in the design stage (Integrative process, Innovation), or the direction or policy of the local authorities (Regional priority, Location, and Transportation). Therefore, these are not included in the framework for collecting data in this research. Finally, there are five dimensions in the LEED applied as the guideline for this study (Figure 1).



**Figure 1.** Adjusted LEED rating tool

### 3. Methodology

To explore the awareness of stakeholders on the performance of green factories, a qualitative approach is employed. In particular, in-depth interviews and focus groups are the main techniques to collect data. Based on 5 chosen dimensions of LEED rating tool, interview questions are proposed to investigate interviewees' opinions of conditions and performance of their (green) factories. In detail, interviewees are asked about their thinking, as well as whether they are satisfied with each of the construction solutions applied in factories. All questions are adjusted in words to be compatible with the situation of each participant. This section aims to obtain the way how participants understand about green building practices and the extent of the importance of green building in construction. Depending on participants, characteristics are added or rejected accordingly. For instance, the technical factors will not be included in questions for workers.

This research conducted interviews in two certified green factories, which have been in operation for about a year at the time the research conducted. They are two garment factories located in the South of Vietnam. Interviewees from these two factories include factory managers, buyers, and employees as the three key stakeholders. Factory managers could be either directors or managers working in the factories. Buyers are enterprises taking the partnership with the two factories by using the factory's infrastructure. Employees are workers and officers currently working for these two factories.

Participants in the interview include workers and employees working at the factory; plant manager - the person most responsible for running the plant, the middle manager; and representative of the factories' buyer. Of the 43 participants, 25 are workers in two factories (accounting for one-third of total participants), 12 are employees, who carried out administrative tasks at the factory. Of the remaining 6 interviewees, 4 are members of the management of two factories, and 2 are buyers' representatives.

#### *A summary of the two sampled factories*

Factory A has a partnership with two buyers, Nike and Uniqlo, and is rewarded LEED certification in the 1st quarter of 2018. Factory A currently has 2 buildings, each building has 3 floors, used as sewing workshops in a large area of 43,205.75m<sup>2</sup> in Tien Giang province (Figure 2).



**Figure 2.** Factory A simulation model

Factory B is one of the 1st manufacturing factories received green building certification. It is manufacturing sportswears for Decathlon to export. It has an area of 22,300 m<sup>2</sup>. The factory includes sewing lines, cutting area, semi-finished goods area, components warehouse, office area, canteen, and green area in DongNai province. (Figure 3).



**Figure 3.** Factory B simulation model

#### **4. Stakeholders' opinion of factories' performance followed lead**

##### **4.1. Water efficiency**

In terms of ease of use, all interviewed workers and officers of Factory A and Factory B answered that the factories' water equipments are very modern and easy to use.

*"... Sanitary appliances are of course easy to use, no broken or low quality" (O A.2)*

Relating to consumed water, not only the owner but also managers in Factory A confirmed that the factory reduced a significant amount of water consumption thanks to sanitary equipment. Both factories carry out re-use systems of wastewater, rainwater collection systems as a main solution to help save water. Harvesting rainwater can reduce the use of drinking water for landscape irrigation. The managers of both factories said that recycling and reusing wastewater through water harvesting and recycling systems had greatly contributed to saving large amounts of monthly-consumed water.

*"In fact, those solutions, especially the water treatment system, helped save a lot water, in the first month only using pure water, we had to pay 70 million for a water consumption billing; when we started reusing water the following months, it was dropped down about 14 to 15 million. So it saves water successfully" (Manager A.1)*

More importantly, both factories received good feedbacks from interviewees on water quality, whether drinking water or using non-potable water.

*“Both drinking water and hand sanitizer are clean. I feel very assured when using water at the factory” (O B.3).*

Currently, no buyers put strict demands on the level of the factory’s water consumption. Nike stated that the supplier minimizes freshwater withdrawals and discharges wastewater in compliance with relevant local laws, regulations, and Nike standards. Supplier strives to be a good water steward by understanding and managing its water risk and promoting the continuous reduction and efficient use in its operations. Both Factory A and Factory B are aiming at this goal. As mentioned above, all facilities such as water harvesting system, wastewater recycling system, using water-absorbing grass brick, etc. To reduce the use of potable water effectively. On the other hand, brands are particularly concerned with how factories discharge of wastewater into the environment, they both have strict guideline regulations on discharge conditions, which currently both two factories still have not discharged any production wastewater.

In general, both factories have almost the same investment items in terms of water use category, which is the same in the understanding between workers and employees, even factory owners and buyers as well.

#### **4.2. Indoor environmental quality**

This dimension includes Lighting, Thermal comfort, Workshop’s air ventilation, Office’s viewing, Acoustic performance, Restroom atmosphere, and Canteen atmosphere. With this dimension, the requirement from buyers are clearly stated:

*“All of the suppliers need to provide a safe workplace setting and takes necessary steps to prevent accidents and injury arising out of, linked with or occurring in the course of work or as a result of the operation of supplier’s facilities” (Nike Global, 2017).*

In general, all sub-dimensions are serving well. Stakeholders’ opinions of these are also positive. For example, regarding to Lighting, workers and officers at both factories are satisfied. Both factories have tried to reduce the pollution light as much as possible, even though they are applied to different systems. Factory A is using LED light as the main light source, meanwhile, Factory B is employing the flexibility between artificial light and sunlight use. One of the workers in Factory B said:

*“Because of taking natural light through the roof and through windows directly, artificial light is almost no need” (W B.7).*

According to a manager at Factory B: *“Normally, the lights are turned on from 8 am, turned off at 9 am to save the electricity. In general, when the sun shines, we turn it off. There are the sun optic sheets absorbing sunlight, which are more useful for the factory than normal roofs” (M B.1).*

Or a manager at Factory A said: *“In general, here we use LED light so we don’t need to worry about the lack of light, not even too bright” (M A.1).*

Similarly, other sub-dimensions are serving well and getting good feedbacks from respondents. However, there are some slight differences between the two factories relating to the used systems, such as light systems, thermal comfort, etc. For example, Factory B plays music in the workshop every day, which shows that in addition to the sound of sewing machines, workers could listen to music regularly and the noise from the sewing machine was not too loudly. While the workshops at Factory A said that there is much noise from sewing machines and it even makes people difficult to communicate. Or, there are feedbacks about the open space design of the canteen at Factory B make rain and strong wind easily affect the inside atmosphere.

These conditions were specified and committed between the factory and the buyer from the first stage of cooperation. According to the buyers, the two factories are still well-performing the above conditions.

#### **4.3. Energy and atmosphere**

This dimension belongs to green construction techniques, therefore, only factories' managers and buyers are approached to ask. The interviewees are aware of the aim to save energy. With Factory A, its buyers, Uniqlo and Nike, require factories to comply with the environmental conditions such as air emissions, hazardous waste, etc. The Factory director can clearly explain the solar power system to obtain green building certificate for the factory:

*"... we decided to do the investment (solar system) to save energy, to get LEED. If not, it was impossible to reach our goal ... it makes the factory cooler ... and, the price of electricity is now increasing, this brings economic benefits to us in the future ..."* (M A.2)

Factory B, in addition to applying green building solutions to reduce energy consumption in operation, together with its buyer, Decathlon, is participating in programs to reduce energy consumption. Furthermore, at the same time, Factory B is making a great effort in reducing CO<sub>2</sub> emissions into the environment. These doings are contributing to help factory employees realize and accompany the management board in saving and protecting the environment in the production industry. As stated by its buyer (Decathlon representative):

*"Decathlon focuses on the factory's commitment to reduce CO<sub>2</sub> emissions; we mainly focus on CO<sub>2</sub> reduction and renewable energy. CO<sub>2</sub> includes indirect and direct, electricity, fuel, coal, oil, and diesel. In general, the Decathlon global assesses which country has a lower CO<sub>2</sub> emission index to give priority of taking supplier, so it's an important point must be focused on"* (B B.1)"

#### **4.4. Materials and resources**

This dimension includes Waste management and Materials. Through interviews, both factories have built areas in which trash was classified according to standards and transported to trucks before being taken out afterward. A worker at Factory A said *"The bins are divided into recyclable and non-recyclable ones. Everyone follows it seriously. And the production waste is also carefully classified"* (W A .8), *"Rags, thread is collected and classified separately"* (W A.14).

Similarly, the factory manager of Factory B said: *"Trash is classified and managed following green standards and government's rules. There are two kinds of waste, another specialized company and domestic waste collect industrial waste from workers' eating, and drinking is taken outside by a truck. Industrial waste is classified into many types at the trash houses, these are paper boxes, packaging, thread, rags, and then is sold away. About hazardous waste, we have a company that collects chemicals and glass every 3 months"* (M B.1).

It is obvious that, in the early construction process and the operation phase, the factories have focused on installing separate waste classification and treatment systems, and conducting awareness-raising of employees on waste sorting problem. One problem both factories have is that they cannot guarantee that the waste can be categorized after they are taken away from the factories.

In terms of Materials, factories' owners are asked about the construction materials. Factory A's owner shared:

*"The factory was constructed by high-quality construction materials. For instance, we spent*

money to invest Blue Scope roof for the canteen. From the design stage, the consultants gave us a list of materials due to the standards and introduced a few suppliers, then, the factory made the decision basing on that. Such, about solar power, there were many suppliers and kind of prices, but with our strict requirement on annual consumption capacity, only TTC Company was the only one could respond to us. Choosing TTC provider was worthy decision to get a LEED certificate and prepared for the future of electricity rising price, and for 5 years to recover capital investment" (MA.1).

Or, Factory B's director said:

*"From the beginning, we decided to choose unburnt bricks to reduce intrusion into the factory; the facade of the factory is installed glass. Also, we worked together to pick cooling pads, sun optics, corrugated lining to reduce the heat coming inside the factory, sanitary equipment (restrooms sanitary, water metering), waste-water treatment area" (MB.1).*

It is possible to see the absolute consensus in waste sorting and waste treatment between factories (including management members and employees) with buyers.

#### **4.5. Sustainable sites**

This dimension includes Greenspace, Campus, Parking lot, and Smoking area. The green space in the factories were all praised as green, clean, and beautiful. Factory B is even equipped with a sports ground for workers. All interviewees in two factories are pleased with the greenness in factories: *"I really like the company's vegetable garden. The plants, trees in the company are very fresh, lush" (OB.2)*, and *"I did not know that there was a vegetable-planting campus. Yes, behind the workshop area there is a vegetable garden" (O.3)*, or *"The tree lines cover the glass door that makes the room much less dazzling" (OB.4)*.

Similarly, parking lots of both factories are spacious and clean. In terms of the Smoking area, Factory A has dedicated areas for people to smoke. The smoking areas were standardized-built, all workers said there is no difficulty or discomfort about the smoking-problem. and Factory B prohibits workers & staff from smoking completely.

In addition, both factories choose bicycles as a means of transport to travel around the factory. The purpose is to promote an environment in which bicycles, pedestrians can safely co-exist (Viettien, 2018). However, no respondents mentioned this issue in the interviews.

#### **5. Conclusion**

This study followed LEED, a global assessment used in green building evaluation, to explore the opinions of stakeholders about studied factories operating in the garment industry. Qualitative research method is employed, and in-depth interviews and focus group are used to collect data.

In general, the research findings show that workers and officers, who directly use factory resources, are satisfied with their current working conditions. Importantly, workers and officers at Factory B show a higher understanding of the factory conditions they use, they work and act together to accomplish the common goal of the factory. While at Factory A, it seems that employees merely go to the factory to work and not perceive how the green factory is important in operating.

On the owners' side, factories have different investment options depending on their conditions, however, both factories have certain common points in the implement solutions to achieve each item in LEED certification. Factory B, on a small scale, understanding of

stakeholders shows some quite high similarities in a green factory. Factory A, with a much larger scale, was built with major construction investments, indicated that the respondents had differences in the awareness of green factory conditions.

Eventually, managers and buyers had strong commitment and long-term agreements in how factories are operating. It is worth to mention that Factory B, besides taking the garment orders, has activities with the buyer towards a common goal, which does not appear at Factory A. At Factory A, Nike's conditions are more stringent than Uniqlo, which affects how the factory operates, indirectly affecting workers' working conditions.

### ***5.1. Managerial implementation***

From the research findings, there are three suggestions to help construction and consulting firms to improve the understanding of the subjects around green factory operations. These doings are significant to enhance the effectiveness of green factories' performance in practice.

Firstly, buyers' decisions are one of the most significant factors to design and construct factories. Therefore, construction companies, especially consultation ones, need to concern not only the requirements of the owners but also pays attention to the requirements that the buyers, as factory customers, care about. This would help adjust the consulting solutions to best suit the factory's conditions and satisfaction of stakeholders.

Secondly, it can be said that the consulting solutions are remarkably effective to build a good green project plan. However, after nearly a year of operation, the factories would have problems arising; therefore, finding solutions to overcome arising problems after the factory is in operation is an extremely necessary task. It helps to improve the performance and bring about the experience for the company for future consultation practice. Above all, contractors and consulting companies need to have a clear plan of regular visits to factories for interviews and surveys to identify stakeholder's opinions about the performance of the plant to record their thinking and find out existing and new hidden problems. Moreover, regular visits are also important in terms of spreading the knowledge about and the use of green construction.

Lastly, to consolidate the perception of stakeholders, especially factory workers, about the operation and benefits of "green" applications in the factory, communication activities should be enhanced to strengthen understandings of stakeholders. Construction companies can coordinate with the factory to organize events, programs to disseminate knowledge about sustainability-related issues such as water-saving, energy consumption, etc., which would contribute to spreading the factory's water-saving objective within not only the factory's employees but also their families.

### ***5.2. Limitation & further research***

This study is only conducted in two green factories operating in the field of garment outsourcing in South Vietnam. The limitations in the research scope, such as the number of factories surveyed, the geographic location of factories, and the field of outsourcing industry, time of operation can cause major deviations in the research results. The following studies should expand the scope and the scale of research according to areas of activities, agent locations, and sample size, etc. for factories.

Completely undertook by the qualitative research method, data is collected by interviews. It is difficult to avoid that the research findings would be subjective and has bias information. The following study should be conducted in parallel with qualitative research and quantitative research.

That is, in addition to taking the interviews, the author should perform and analyze quantitative data surveys to compare the results to obtain as the most accurate results as possible.

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