Methods for raising the efficiency of sustainable human behavior in the work environment (to achieve more sustainable buildings)

Dr. Mohamed Hassan Sayed Mostafa Elfalafly
Architectural Engineering Teacher - October Higher Institute of Engineering and Technology Sixth of October City
arch_moh_elfalafly@hotmail.com
Dr. Lobna Abdelaziz Ahmed Albrolosy
Architectural Engineering Teacher - October Higher Institute of Engineering and Technology Sixth of October City
lobnaen@hotmail.com

Abstract

Pro-environmental Behaviors play a main role in advancing the development of sustainable environmental buildings. Where workplaces all over the world are the main source of carbon emissions, changing behavior of resources' use in these environments has the ability to reduce carbon emissions. Within the framework of sustainability strategies, governments have developed a set of policies to encourage the adoption of sustainable technologies and practices to help achieve sustainable cities and urban communities. Many partners and organizations have implemented ways to promote environmentally friendly behaviors at workplaces, including a sustainable use of natural resources. It often represents a challenge, because many daily behaviors of employees are based on habits and routines that are very difficult to change. Due to lack of knowledge and awareness, lack of regulations and laws, and lack of incentives, whether material or moral. Hence, the research discusses the study and discussion of methods of raising sustainable behavior at work environment by presenting the concept of sustainable human behavior and the barriers that hinder sustainable behavior at work environment, and what are the factors affecting the application of sustainable behavior? where the role of human resources management and environmental knowledge to form sustainable employee behavior? The research also reviews how to change to sustainable behavior and the formation of pro-environment behavior through behavioral pro-environment interventions, by making sustainable behavior a sustainable habit, with the application of interactive visualizations system to allow people to monitor their consumption patterns of natural resources and then change their consumption of resources more efficiently, with a study of the role and how to market to environmentally friendly behaviors. To reach a strategy for implementing sustainable behavior in the work environment, reaching the main determinants (performance - time - motivation) of methods for raising the efficiency of sustainable behavior in order to achieve more sustainable buildings.

Keywords:

Environmental knowledge - changing human behavior - sustainable behavior efficiency - more sustainable buildings

الملخص

تلعب السلوكيات المؤيدة للبيئة دورًا رئيسيًا في دفع عجلة تطوير المبانى البيئية المستدامة. حيث أماكن العمل في جميع أنحاء العالم هي مصدر رئيسي لانبعاثات الكربون ، وتغيير السلوك لاستخدام الموارد في هذه البيئات لديها القدرة على الحد

من الانبعاثات الكربونية. وفى أطار استراتيجيات الاستدامة وضعت الحكومات مجموعة من السياسات لتشجيع أعتماد التقنيات والممارسات المستدامة للمساعدة فى تحقيق مدن ومجتمعات عمرانية مستدامة. فقد نفذت العديد من الشريكات والمنظمات طرق لتعزيز السلوكيات المؤيدة للبيئة فى مكان العمل بما فى ذلك الاستخدام المستدام للموارد الطبيعية ، وغالباً يمثل هذا تحدياً كبيراً ، حيث ان العديد من السلوكيات اليومية للموظفين تستند إلى عادات وممارسات يصعب تغييرها، وذلك بسبب نقص المعرفة والوعى ، ونقص اللوائح والقوانين ، والأفتقار إلى الحوافز سواء كانت مادية أو معنوية. ومن هنا يناقش البحث دراسة ومناقشة اساليب رفع السلوك المستدام فى بيئة العمل من خلال عرض لمفهوم السلوك المستدام للانسان والحواجز التى تعيق السلوك المستدام فى بيئة العمل ، وماهى العوامل المؤثرة فى تطبيق السلوك المستدام ، حيث دور ادارة الموارد البشرية والمعرفة البيئية لتكوين سلوك الموظف المستدام. كما يستعرض البحث كيفية التغيير الى السلوك المستدام وتكوين سلوك مؤيد للبيئة من خلال التدخلات السلوكية المؤيدة للبيئة، عن طريق جعل السلوك المستدام عادة مستدامة ، مع تطبيق نظام التصورات التفاعلية للسماح للأشخاص مراقبة أنماط استهلاكهم للموارد الطبيعية ومن ثم تغيير استهلاكهم للموارد بشكل أكثر كفاءة ، مع دراسة دور وكيفية التسويق إلى سلوكيات صديقة للبيئة. وذلك بهدف الوصول إلى استراتيجية تطبيق السلوك المستدام فى بيئة العمل ، وصولاً إلى المحددات الرئيسية (الأداء – الزمن – الحافز) لاساليب رفع كفاءة السلوك المستدام. لتحقيق مبانى أكثر استدامة.

الكلمات المفتاحية :
المعرفة البيئية- تغيير السلوك الأنسانى – كفاءة السلوك المستدام – مبانى أكثر استدامة

1- Introduction

Environmental sustainability has become essential in society and organizations. The occurrence of natural disasters, climate change, and depletion of natural resources have become a troublesome (Olawole et. al.2020). Such as excessive logging, burning of fossil fuels, and the release of carbon monoxide due to regulatory and human activities.

Hence, many organizations are inclined towards ensuring that their daily life behaviors are less harmful to the environment through implementing environmental management systems or sustainable initiatives. These initiatives include reducing carbon emissions, such as reducing electricity use and office materials, and recycling materials appropriately.

Environmental performance of employees is critical to the success of these sustainable initiatives in organizations (Olawole et.ah.2020). To develop the environmental performance of the organization, you must develop the environmental skills of the staff and their behavior in order to achieve sustainable human behavior at work environment to reach more sustainable buildings.

1-1 Problematic research:

Despite the momentum of the environmental movement, in green building regulations and standards such as (US LEED BREEAM ... and others) sustainable green building faces great doubts and challenges, which are environmentally unfriendly habits and require a behavior change. It has conducted a post-occupancy assessment of the UK's highest-rated website (EcoHomes). Post-Occupancy Assessment researched building's energy performance, water consumption, user comfort, and satisfaction. The results indicated that energy efficiency behaviors are responsible for 51%, 37%, and 11% of heat, electricity, and water consumption respectively (Yu, T. et. ah. 2018). So the research problem is that green buildings may consume more energy and natural resources than non-green buildings due to unsustainable user practices and behaviors.

1-2 Research objective:
Developing a strategy to implement sustainable behavior. The methods of raising the efficiency of behavior and its relationship with its main determinants to achieve the efficiency of sustainable behavior in the work environment to achieve more sustainable buildings.

1-3 Research Hypothesis:
The use of the strategy of implementing sustainable human behavior in buildings ensures the efficient sustainability of sustainable green buildings.

1-4 Research methodology:
The research relied on the following methodology:

- **Theoretical approach:** Study the concepts related to human behavior. What are the barriers to sustainable behavior, and the role of employees in the environmental performance at workplace?
- **Analytical descriptive approach:** Analyzing the factors affecting the application of sustainable behavior in the work environment, the role of sustainable human resource management practices in the sustainability and performance of sustainable behavior through environmental knowledge to improve employee behavior was studied and analyzed.

Analyzing behavior change processes, what are the mechanisms for behavior change to sustainable? through how to convert the employee's behavior to be sustainable? With generation motivation through interactive visualizations and an understanding of how to market more sustainable behaviors and the impact of human behavior towards sustainable buildings.

- **Deductive approach:** Arrive at a strategy for implementing sustainable behavior in the work environment. Down to methods of raising the efficiency of sustainable behavior. To achieve more sustainable buildings.

2- The concept of sustainable human behavior.

Human behavior depends on human intentions. Intentions are the result of social norms and attitudes and how to control behavior to preserve the environment? In terms of personal ethical norms and standards and the environmental impact of behavior, in addition to other factors such as identity, personal standard (sense of commitment) and knowledge. As the behavior can become a matter of habit (such as reducing waste or recycling ... etc.) (Gardner, B. 2015).
Many of our behaviors and actions vary with time and place. Where different motives and barriers such as home and workplace. For example, energy savings at home may not happen at work. (Leygue et al. 2017) Indeed, the work environment is beneficial for environmental behavior. (For example, setting up a recycling scheme at work).
Where greater control over the behavior, such as recycling, turning off lights, or energy-saving behaviors (such as automatic lighting). (Whitmarsh et al. 2017). So the relationship between work behaviors and home behaviors may be a sequential relationship where adopting a behavior in one place may lead to the adoption of the same behavior in another place; it results in 'behavioral extension' where one behavior leads to the adoption of another (Nash et al. 2017).
Behavior depends on a person's evaluative feelings of what is useful or non-useful, in particular regarding objects, actions, or abstract concepts, as well as the individual's life experience. As a result, sustainable behavior can be observed by people's beliefs, feelings, and attitudes in their behavior. (Lorraine E. et al. 2018) and definitions will vary accordingly. For example, sustainable behavior is a set of beliefs, influences, and intentions about environmental activities (Jackson T 2004).

Another definition of sustainable behavior is a willingness to respond in a consistently favorable or unfavorable manner to environmental issues (Heyl et. ah. 2013). On the other hand, those sustainable behaviors assess the natural and constructed environments and factors that influence their quality. (McIntyre, A., & Milfont, T. L. 2016). So, we should clarify the situation and understand the behavioral barriers to sustainable behavior.

2-1 Sustainable behavioral attitude.

Sustainable behavior has three main dimensions: cognitive, emotional, and behavioral. As the cognitive dimension refers to the perception or human evaluation of behavior. The emotional dimension reflects the relationship between emotions and feelings that connect things, people, and actions.

And finally, the behavioral dimension where it only indicates the intention. That is, it is possible to conclude that attitudes from experiences determine human behavior, thus we find that all three dimensions of behavioral attitude formation are useful for categorizing behavioral responses. So all dimensions must correspond to each other to provide a road map for the formation of behavior and its change to sustainable behavior (Coşkun Ayşen, 2017).

2-2 Barriers to sustainable behavior.

The barriers that affect sustainable pro-environment behavior are divided into: external (economic, social, and cultural factors) and internal factors (motivation, values, attitudes, environmental knowledge, etc.) (Marcella Ucci 2010). The main barriers to sustainable behavior practices are lack of information, education, research, knowledge, awareness, experience, lack of motivation and support, and lack of interest; The lack of laws and regulations to follow sustainable behavior. (Yu, T. et. ah. 2018).

The lack of knowledge and awareness is a critical barrier to sustainable behavior practices (Samuel et. ah. 2019). However, awareness does not necessarily translate into the work of Coşkun Ayşen, 2017). The behavioral possibilities that influence the decision-making that leads to sustainable behavior to overcome these barriers are a set of behaviors that individuals try to comply with. It can influence behavior because individuals take their cues from what others do and use them as a benchmark for comparing their behaviors (Samuel et. ah. 2019). Hence, the individual can affect behavior change.

3- Factors affecting the application of sustainable behavior in the work environment.

Three main factors affect employee behavior to create a sustainable behavior in the work environment as follows:

3-1 Sustainable human resource management

Human resource management practices contribute to organizational performance by enhancing the ability, motivation, and opportunities of employees to perform sustainable behavior, which is consistent with the strategic objectives of the organization. It is common knowledge that employees avoid behaviors they lack knowledge of. Thus the role of sustainable human resource management practices is to enhance employees' environmental knowledge while encouraging them to use this knowledge to achieve organizational goals, so they can implement environmentally friendly behavior in the workplace. (Chan et. ah. 2014).

The definition of sustainable human resource management is human resource management practices that aim to promote environmentally friendly use, which will enhance the organization's environmental performance, employee awareness, and demonstrate the commitment to environmental management problems. (Tang et. ah. 2017). Whereas, human resource management contributes to sustainable organizational performance through recruitment and training programs for employees, developing employees with sustainable

values, and helping to improve environmental awareness, behaviors, skills, and knowledge of their employees (Jia et al.2018).

Human resource management is a must for; Improving employee motivation and commitment through environment-based strategies and incentives and effective performance, based on their environmental performance, enhancing employees' desire to learn more and find more ways to protect the environment (Ren et al. 2018). Employees must participate in decision-making through feedback and suggestions, as employees are reassured in their organizational confidence in supporting the environment and increasing their interest in the environment. Through employee engagement training programs (Olawole et.al.2020).

There are five sustainable human resource management practices, employee selection to perform sustainable behavior, sustainable behavior training, performance monitoring and evaluation, motivation and reward provision, and employee participation in decision-making (Ren et al., 2018).

3-2 Environmental knowledge.

Environmental knowledge is the awareness of human interactions with environmental issues and multiple relationships in ecosystems. (Burchett, 2015) This knowledge entails the skills needed to mitigate negative impacts on the ecosystem, resulting in pro-environmental practices.That is by encouraging environmental protection, education and training by setting environmental recruitment and selection policies, performance management, rewards and participation, as the environmental knowledge of employees increases, and employees' awareness of environmental protection in the workplace increases (Zhang et al, 2019 – Saeed et al, 2019).

3-3 Sustainable Employee Behavior.

The employee must be environmentally aware of sustainable practices as it is a competitive advantage for organizations. Organizations must encourage employees and adapt them to behavior consistent with sustainable organizational goals in the workplace. This consciously aims to eliminate the negative effects of their behavior with the environment, such as optimal use of paper, avoiding waste of electricity, and recycling materials in the workplace.

Where sustainable behavior is the behavior required for the performance of official duties of the employee, which is considered in the evaluation of the employee's performance. (Olawole et.al.2020). So there is a need to motivate employees to maintain and practice environmentally friendly behavior by creating awareness, training, motivation, and encouragement. (Shen. et al. 2016). Therefore, we find that sustainable human resources management positively affects sustainable behavior in the work environment by providing environmental knowledge to employees, so environmental knowledge mediates the relationship between sustainable human resource management and sustainable employee behavior, as in Figure (1).

Figure (1) illustrates the factors affecting the application of sustainable behavior in the work environment. Source: researcher

4- Change towards sustainable behavior.

Behavior is affected in the workplace by a wide range of individual cognitive and motivational factors (such as attitude, awareness, personal norms, social norms, public beliefs and values, and perceived responsibility) and external circumstances (such as opportunities, social esteem, and regulations). (Gabriela. et al. 2019).

Behavior change is a complex process, so decision-makers should consider behavior change's basic strategy for preserving the environment and the consequences affecting social issues. By achieving a cognitive change and increasing sympathy and motivation to change behavior, which depends on the degree of the individual's belief in certain behavior and depends on (the association with the behavior, beliefs, and values in the memory, the determination and volume of knowledge in the individual memory, the influence of society). With all these influences in mind, one can identify and follow sustainable behavior. (Coşkun Ayşen, 2017).

4-1 Behavior change processes.

The change in behavior may be happening, through three different processes (Coşkun Ayşen, 2017).

- **Compliance**: When an individual believes that changing behavior will provide rewards, then satisfaction is a result of social influence.
- **Identity**: When a person believes that adopting the induced behavior will enhance their behavior, self-identity, and the satisfaction derived from compatibility with others. The behavioral content is irrelevant because the main motivation is self-identification.
- **Assimilation**: When one believes that the induced behavior is in line with one's values, the contentment results from sustainable new behavior content.

Compliance, identification, and inner comprehension are three concepts that explain how to change the situation. Each of these processes can be distinguished by (the relative importance of the expected effect, the relative strength of the influencing factor, and the estimated strength of the induced response) It will define the behavior change process (Coşkun Ayşen, 2017).

4-2 Mechanisms for changing behavior.

4-2-1 Sustainable Habit: (Forming sustainable habits in the work environment).

Behaviors in the work environment often include the routine and habits associated with performing basic tasks as well as daily "auxiliary" activities. It may be a habit of sustainable

behaviors such as turning off lights and computer screens after work, conscious use of air conditioning or heating, and climbing stairs instead of using the elevator. It is the case in duplex printing of paper, where the habit is a pattern of behavior or the behavior that people get used to.

However, many of these daily repetitive employees are extremely difficult to regulate their behavior for ethical reasons, due to the difficulties in enforcing the compliance process. Moreover, even if sustainable behavior is required to be implemented voluntarily to the environment. It may only function in the short term If it is perceived as too much of a burden without a supportive environment or adequate recognition. (Gabriela. et al. 2019).

Creating a sustainable habit aims to change the behavior into continuous sustainable behavior (Wood W, Rünger 2016). It is a process that takes place through stimulation, whether materially or mentally, that automatically generates a push towards sustainable action, and this makes it a "form of automaticity in response" (Gardner, 2015). The formation of a sustainable habit requires three conditions (link to behavior - sufficient repetition of behavior - satisfactory outcome). As the behavior association refers to a specific, constant verb conjugation occurring. For example, turning off the light when leaving the room, or drinking coffee in a reusable cup. Sufficient repetition of the target behavior refers to continuously targeting a specific behavior until it becomes automatic. As the daily repetition of behavior for more than two months becomes a habit, the amount of time required for the habituation range is about 3 to 37 weeks, even if the behaviors are simple. A satisfactory result indicates that the act of sustainable behavior and its outcome is rewarding to the person in a way that is in line with that person's goals (Rayner, 2018).

While the concept of habit emphasizes a person's motivations to repeat a behavior, it does not refer to the mechanism by which the behavior begins (Gabriela. et al. 2019) .Thus the conditions for habit formation must incorporate to motivate employees to engage in a new sustainable behavior (Wesselink. et al. 2017) .As in Figure (2), where it aims to:

1-Stir motive and initiate targeted sustainable behavior.

2- Create a habit by:

- Determine the situation that links specific behavior to a specific situation.
- Adequate encouragement to repeat the behavior.
- Make pathological outcome prominent.

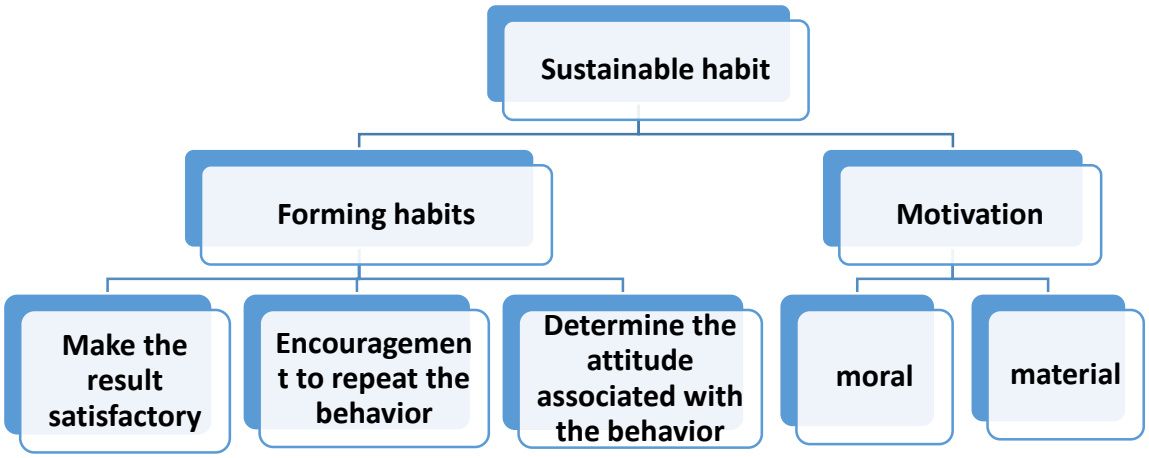

Figure (2) Forming a sustainable habit in the work environment. Source: Researcher

4-2-2 Behavior change through interactive data visualizations

Interactive visualizations allow users to view some aspects of their environmental resource consumption data, such as their water and energy, and interact with the visualization presented

in some form. By monitoring their consumption patterns and supporting the necessary factors that help people change their behavior. By giving users some kinds of comments and data, to make their use of resources less. For behavior change to occur, three factors must coincide: (1) people must be motivated in principle, (2) there must be a timely stimulus factor reminding them to do the right thing, and (3) they must be capable to act immediately.

That is the aspect of interaction that, if designed effectively, provides users with the control and ability to investigate the behavior and patterns of resource use ,thus motivate and help them to change their primary behavior .Interactive data visualizations that provide timely feedback on the use of environmental resources make users interested in continually monitoring their use and preservation of these resources. (Thomas. et al. 2019). For examples of these interactive visualizations Figure (3) show an example of using scale visualization in the USEM mobile application to show current energy use (top). Also, the USEM interface mobile application includes some distinctive displays of energy-consuming devices. It allows users to track the share of individual devices on total accumulated energy consumption, based on this information, make informed decisions about which devices should turn off to reduce energy consumption (Reinhart. et al. 2014).

Figure (3). An example of a metric visualization used in a USEM mobile app to display current and power consumption data (top). Source: Reinhart. et al. 2014.

In general, the assumption regarding the utility of the gauges on the dashboard is correct for driving the car, so the indicator shows the current driving style, for example, economical or not. It is likely to have a positive effect on drivers' behavior. (Thomas. et al. 2019) Figure (4) shows a portion of Toyota's dashboard. The "ECO" indicator turns off automatically when acceleration exceeds a certain limit, to inform drivers that their driving style is less economical. This type of "ECO" indicator can provide responsible drivers who have control over their driving and who wish to adopt a more economical driving behavior.

Fig (4). Example of a car dashboard with the "ECO" indicator, indicating whether the driving mode is economical or not.

Figure (5) shows an interactive display device for the key holder. It is placed near the entrance door, as part of motivation methods to change behavior (Rist. et al. 2012). The aim is to provide users with information about their energy-consuming devices when they leave their homes to enable them to take action and stop that action, and turn off those devices that are no longer needed immediately.

Figure (5). An interactive key holder tool used as part of behavioral change motivation techniques, to inform people about their energy-consuming devices to enable them to act. Source: Rist. et al. 2012.

4-2-3 Sustainable Marketing for Behavior Change

Behavior change strategy is a media strategy that exploits social norms. That has been used in some projects for energy use, where the results of energy consumption reports of companies and organizations compared, prompting some companies to reduce their energy use to be in line with their peers (Goldstein. et al. 2008). The motivational factors for informational strategies are (perception, knowledge, and understanding), as some of these strategies can be effective if the goal is relatively environmentally friendly behavior and is very inexpensive (in terms of money, effort, time, or social rejection) (Davis and Challenger, 2009). These strategies may not lead to permanent changes in behavior. Behavior change campaigns are not significantly different from marketing campaigns. As the principles of social marketing for sustainable behavior depend on (1) Defining the target behavior; (2) Examine the barriers and drivers of those behaviors (including segmentation of the target audience, if appropriate); (3) Marketing strategy development; (4) Experience; (5) Measurement and Evaluation (Marcella, 2010) as in Figure (6).

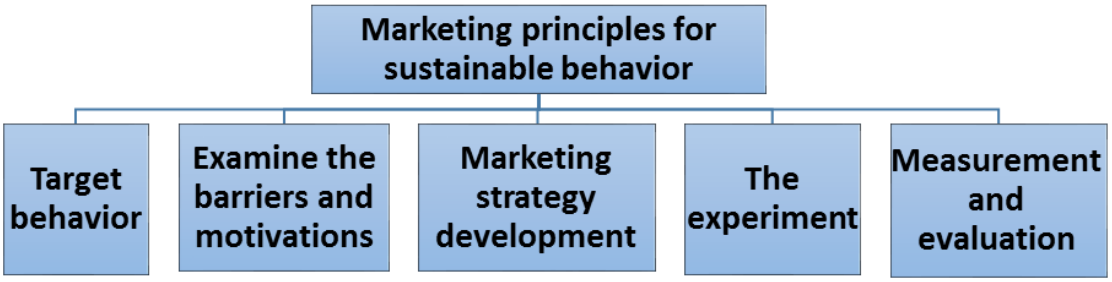

Figure (6) Marketing strategy for sustainable behavior. Source: researcher.

4-3 The impact of human behavior towards sustainable buildings.

Sustainable buildings may actually consume more energy than unsustainable buildings due to user practices and behaviors. Newsham et al. conducted an analysis of building energy use for 100 LEED-certified commercial and institutional buildings, using a dataset provided by the New Buildings Institute and the US Green Building Council. On average, LEED buildings used 18-39% less energy than their conventional counterparts. However, 28-35% of LEED buildings used more energy than their traditional counterparts. The studies pointed out that different working hours, loads and users' behaviors were the main factors that caused LEED buildings to not perform well.

Also, Xiaohuan et al. collected data mainly from a sustainable building users' survey in China. The survey was conducted in the areas of Shenzhen, Shanghai and Guangzhou, where sustainable buildings have been constructed, supported by governments, and approved by developers. LEED and GBL are currently the most popular rating systems in China. GBL is similar to LEED in that it uses checklist scoring of sustainable buildings in five categories: sustainable site, energy and atmosphere, water efficiency, materials and resources, and indoor environmental quality. Seven sustainable buildings and their users were involved in this survey (Table 1). Among the seven sustainable buildings, there are four GBL buildings and three LEED buildings. They are the first-generation sustainable buildings in China, representing cutting-edge sustainable design and technologies.

Table 1. Surveyed green buildings and participants. Sours: (Xiaohuan et al.2017).

No.	Location	Rating System	Year Built or Certified	Number of Participants	Main Green Features
1	Shenzhen	GBL	2009	82	Green roofs, atrium, water cooling system, photovoltaic panels, indoor plants, operable windows.
2	Shenzhen	GBL	2009	75	Atrium, independent temperature-humidity control air conditioning system, intelligent blinds.
3	Shanghai	LEED	2010	55	Wetland ecological system, photovoltaic panels, heat pumps, silicon cooling system, indoor greenery, electrical fans, operable windows.

4	Shanghai	GBL	2007	42	Green roofs, grey water recycling, solar hot water, ground cooling system, indoor greenery, electrical fans, operable windows.
5	Guangzhou	GBL	2009	60	A courtyard, pervious pavement, grey water recycling, photovoltaic panels, heat pumps, operable windows.
6	Shenzhen	LEED	2008	50	Green roofs, grey water recycling, rain water harvesting, photovoltaic panels, task lights, movable louvers.
7	Shanghai	LEED	2010	48	Water-saving appliances, Energy Star labeled office appliances, certified low VOC (Volatile organic compounds) materials, indoor greenery.

The used survey was a standard questionnaire. For energy and resource use behaviors, respondents were required to indicate their habits in their sustainable office buildings, including "switch off electricity", "take shorter shower", "use half flush", "reuse paper", "use stairs instead of lifts", "use public transport instead of private", "use recycle bins", and "reuse paper" on a Likert-scale: never, seldom, sometimes, often, or always.

Figure (7) shows participants' practices with respect to the eight behavioral items. Participants had excellent habits in terms of switching off lights and their computer when not in use. These are the two saving behaviors that are most commonly found in office building energy use studies. They also demonstrated the good habits of using stairs instead of elevators, and using public instead of private transportation. These two behaviors, which are not only related to energy saving but also to health and physical well-being, are increasingly encouraged in workplace settings. Reusing paper and using recycled bins were the third type of resource saving behaviors frequently practiced by participants. Office reusing and recycling have been investigated in other studies which found that prior experience was shown to be an excellent predictor of office-based conservation behavior. The least practiced resource saving habits were using half flush and taking short showers. Although little research has been conducted on these two behaviors, water savings contribute to a significant portion of the credits and performance of sustainable buildings.

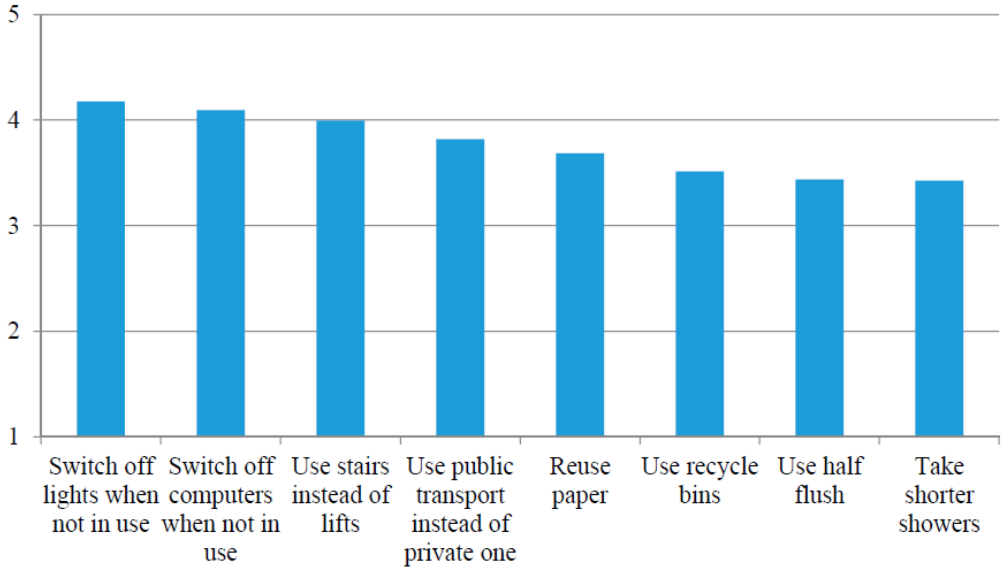

Figure (7). Energy and resource saving behaviors in sustainable buildings. The response values ranged from 1, which meant "never", to 5, which meant "always". Sours: (Xiaohuan et al.2017).

These studies also suggested that the gap arises not because sustainable building design, tools, techniques or technologies are 'wrong', but because of what happens in reality; buildings do not use energy, but people do. A sustainable building becomes greenwash if it relies on technological solutions, such as solar panels and thermal insulation, while maintaining intensive energy use habits. Good use behaviors can significantly reduce energy consumption.

5- The application of sustainable behavior in the work environment.

The process of changing behavior to sustainable behavior in the work environment is based on coordination between sustainable human resources management and the employee to achieve high-quality sustainable behavior to rationalize resource consumption on time, to reach the goal (activating sustainable behavior within the work environment). Where the appropriate conditions exist for behavior change processes (compliance - identity - absorption). Through environmental knowledge and the formation of a sustainable habit through (linking to behavior - sufficient repetition of behavior - and the satisfactory outcome), whereby the redundancy in saving in non-productive actions from the economy in resources and reducing waste and controlling performance. However, it needs auxiliary factors for success (training - follow-up and performance evaluation - motivation/motivation - reward - and good marketing for sustainable behavior) and accordingly, the hypothesis is realized through applying the following strategy as shown in Figure (8) to achieve sustainable behavior and thus more sustainable buildings.

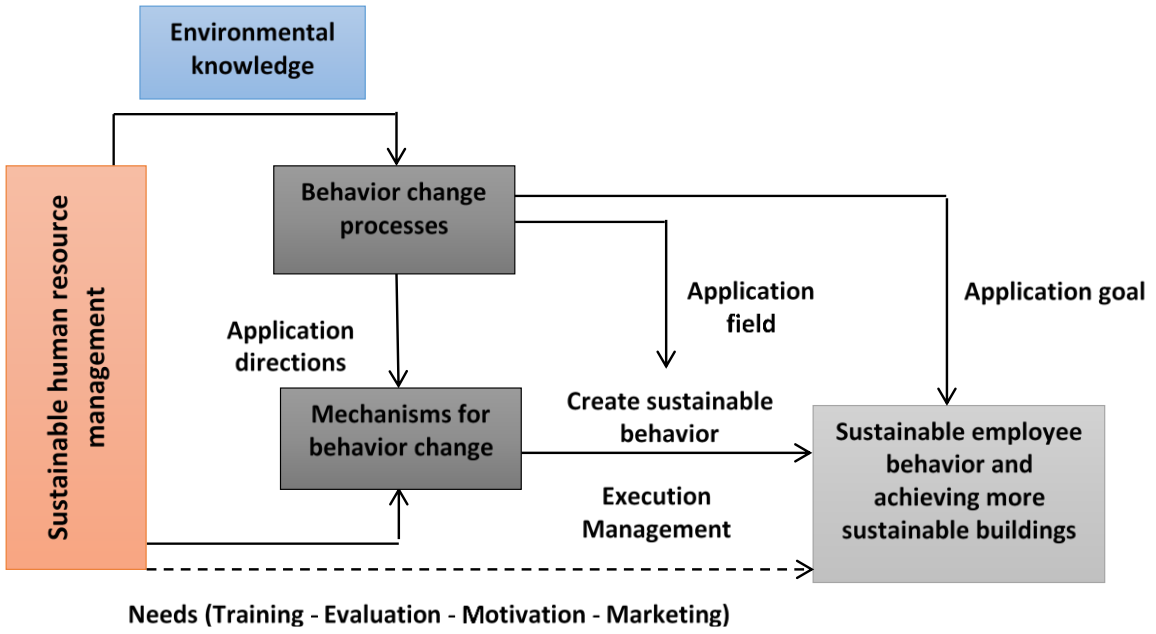

Figure (8). A strategy for implementing sustainable behavior and achieving more sustainable buildings. Source: researcher

6- The efficiency of sustainable behavior in the work environment (behavior efficiency triangle) (performance - time – motivation)

To achieve the efficiency of sustainable behavior in the work environment to make buildings more sustainable should be linked to the main determinants of the efficiency of behavior for a higher sustainable behavior through:

1- Determine the appropriate time to change behavior.

2- Determine the performance of the desired behavior.

3- Determine the appropriate incentive through monitoring and evaluation of performance.

A behavior's performance rates can be converted into resource consumption rates by:

1. The rate of application of behavior is a direct link between (performances – time).
2. The rate of evaluation of the application of behavior, which is a direct link between (motivation - time) and there is an indirect link between (performance - motivation) through time.
3. Resource consumption rate, which is a direct link between (performances – motivation)

In this way, duple relations can be combined through the relationship between performance, motivation, and time. And also inferring mathematical, graphical relationships that form the relationship between them. The performance components, their criteria, and the rates of correlation between them can be used to deduce a mathematical system that links performance, motivation, and time. So it is possible to calculate and measure the efficiency of sustainable behavior to achieve sustainable buildings. As in Figure (9).

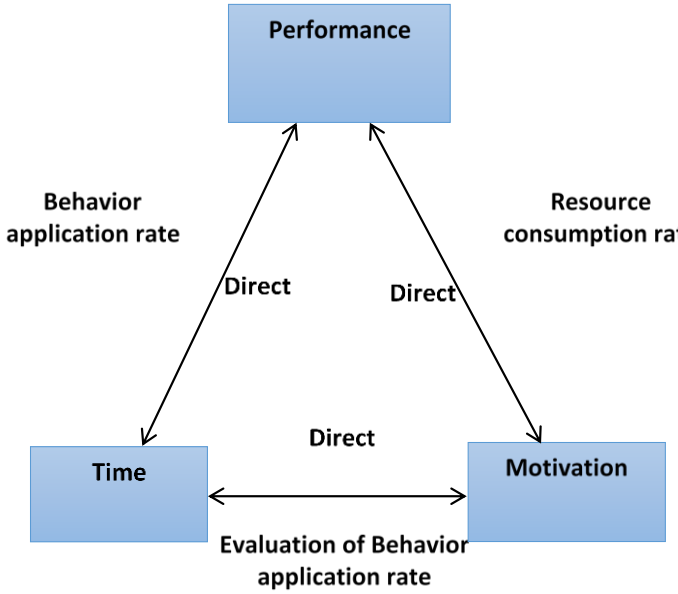

Figure (9). Illustrates the relationship between performance, time, and motivation that make up the efficiency of sustainable behavior. Source: researcher

7- Conclusion:

- By studying the methods of raising the efficiency of sustainable behavior in the work environment to achieve the sustainability of the buildings, it was found that there is a link between the efficiency of behavior and the management of sustainable human resources in terms of training, follow-up, and evaluation, which gives control over the components of the efficiency of behavior (performance - motivation - time) and the possibility of programming them in the form of constants and variables.
- The application process of sustainable behavior is considered an important stage for the sustainability of buildings, through which it is possible to measure the efficiency of behavior, control the quality of behavior and manage it, and it can be controlled by a set of determinants (pre-application - during application - and after application) and by analysis and study, the application method is a determinant affecting the efficiency of behavior.
- The general determinants of the efficiency of sustainable behavior for application in the work environment vary between behavior change processes (compliance - identity - assimilation) and behavior change mechanisms (sustainable habit - interactive perceptions - marketing) and can be reduced to a set of determinants (performance - motivation - time). Among them there is a triangle of relationships to achieve the efficiency of sustainable behavior.
- Interactive visualizations aim to promote the sustainable use of natural resources. As such, it must be taken into consideration by designers' visualizations of resource control and management, where it is used mainly to increase users' awareness of their consumption, to motivate them to save resources.
- There are theoretical studies that affect the efficiency of behavior, varying between (economic - social-cultural) studies. They have a comprehensive vision of the followed behaviors. There is a set of discretionary criteria (motivation - values - attitudes - environmental knowledge) that have direct technical and economic impacts on the efficiency of behavior.
- The sustainable behavior efficiency measure is considered the basic measure for evaluating the sustainability of buildings, but relying on traditional behaviors within the buildings limits

the feasibility of the assessment, which was the reason for the search for a developed pattern that corresponds to sustainable buildings and updating the scale of sustainable behavior efficiency.

- The efficiency of sustainable behavior is the key to advancing the sustainable building movement.

As a result: The efficiency of behavior with its three main challenges (time - performance - motivation) is closely related to the efficiency of sustainable behavior, as in Figure (10), where:

✓ The efficiency of sustainable behavior is inversely proportional to time, where more time in understanding and applying sustainable behavior, the less efficient the sustainable behavior.

✓ The efficiency of sustainable behavior is directly proportional to performance, where the more efficient the performance, the more efficient the sustainable behavior.

✓ The efficiency of sustainable behavior is directly proportional to motivation, where the more motivation in applying sustainable behavior, the greater the efficiency of sustainable behavior .

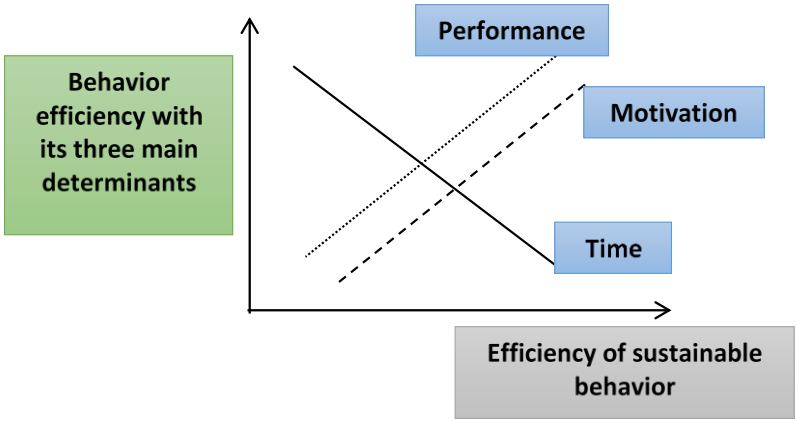

Figure (10). The relationship between the efficiency of behavior and the efficiency of sustainable behavior. Source: researcher

8- Recommendations and future studies:

Green rating systems for buildings such as (US LEED- BREEAM ... and others) are constantly evolving and changing. So it is necessary to follow these developments in order to know the new requirements and needs for the building to reach the highest levels of sustainability, thus enhancing the value of the building according to the standards that are measured. It requires the need for standards to evaluate and monitor the effect of the efficiency of human behavior on the sustainability of buildings. By developing a methodology for evaluating sustainable green buildings. According to the efficiency of sustainable human behavior, through green rating systems of buildings and application in buildings.

9- References:

1. Burchett, J.H., "Environmental literacy and its implications for effective public policy formation", Baker Scholar Projects, (2015) available at: https://trace.tennessee.edu/utk_bakerschol/27/

2. Chan, E.S.W., Hon, A.H.Y., Chan, W. and Okumus, F., "What drives employees' intentions to implement green practices in hotels? The role of knowledge, awareness, concern and ecological behavior", International Journal of Hospitality Management, (2014)Vol. 40, pp. 20-28.

3. Coşkun Ayşen, Understanding Green Attitudes, chapter 4, Driving Green Consumerism Through Strategic Sustainability Marketing, by IGI Global, (2017), U.S.A.
4. Davis , M . and Challenger , R . Climate change – Warming to the task . The Psychologist 22 (2) (2009),: 112 – 114.
5. Gabriela Michalek · Ines Thronicker · Özgür Yildiz3, · Reimund Schwarze, ," Habitually green: integrating the concept of habit into the design of pro-environmental interventions at the workplace", Nachhaltigkeits Management Forum, (2019) https://doi.org/10.1007/s00550-019-00487-9.
6. Gardner, B.. A review and analysis of the use of 'habit' in understanding, predicting and influencing health-related behavior. Health Psychol. (2015) Rev. 9, 277–295. doi: 10.1080/17437199.2013.876238
7. Goldstein , N . , Cialdini , R . and Griskevicius , V . A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. Journal of Consumer Research, (2008) 35 : 472 – 482 .
8. Heyl, M., Díaz, E. M., & Cifuentes, L.. Environmental attitudes and behaviors of college students:A case study conducted at a chilean university. Revista Latinoamericana de Psicología, (2013), 45(3),487. doi:10.14349/rlp. v45i3.1489
9. Jackson, T. Consuming Paradise? - Unsustainable consumption in cultural and social-psychological context. International Workshop on Driving Forces of and Barriers to Sustainable Consumption, (2004). 402.
10. Jia, J., Liu, H., Chin, T. and Hu, D., "The continuous mediating effects of GHRM on employees' green passion via transformational leadership and green creativity", Sustainability (Switzerland), (2018), Vol. 10 No. 9, pp. 1-18.
11. Leygue, C., Ferguson, E., and Spence, A.. Saving energy in the workplace: why, and for whom? J. Environ. Psychol. (2017), 53, 50–62. doi: 10.1016/j.jenvp.2017.06.006.
12. Lorraine E. Whitmarsh*, Paul Haggar and Merryn Thomas, , Waste Reduction Behaviors at Home, at Work, and on Holiday: What Influences Behavioral Consistency Across Contexts?, Front. Psychol. (2018), 9:2447. doi: 10.3389/fpsyg.2018.02447
13. Marcella Ucci, , Sustainable buildings, pro-environmental behavior and building occupants: A challenge or an opportunity?, Journal of Retail &#38 Leisure Property · August 2010 DOI: 10.1057/rlp.2010.11 · Source: OAI.
14. McIntyre, A., & Milfont, T. L.. Who Cares? Measuring Environmental Attitudes. In Research Methods for Environmental Psychology, John Wiley & Sons, Inc. (2016) , (pp. 93–114). doi: 10.1002/9781119162124.ch6
15. Nash, N., Whitmarsh, L., Capstick, S., Hargreaves, T., Poortinga, W., Thomas, G., et al. Climate-relevant behavioral spillover and the potential contribution of social practice theory. WIREs Clim. Change, (2017). 8:e481. doi: 10.1002/wcc.481
16. Newsham, G.R.; Mancini, S.; Birt, B.J. Do LEED-certified buildings save energy? Yes, but . . . . Energy Build.**2009**, 41, 897–905.
17. Olawole Fawehinmi , Mohd-Yusoff Yusliza, Zaleha Mohamad, Zikri Muhammad. ."Assessing the green behavior of academics The role of green human resource management and environmental knowledge" Article in International Journal of Manpower, (2020), DOI: 10.1108/IJM-07-2019-0347, https://www.researchgate.net/publication/338594916

18. Rayner J, Morgan D , An empirical study of 'green' workplace behaviors: ability, motivation and opportunity. Asia Pac J Hum Resource, (2018) , 56(1):56–78
19. Ren, S., Tang, G. and Jackson, S.E., "Green human resource management research in emergence: a review and future directions", Asia Pacific Journal of Management, (2018), Vol. 35 No. 3, pp. 769-803.
20. Reinhart, F.; Schlieper, K.; Kugler, M.; André, E.; Masoodian, M.; Rogers, B. Fostering Energy Awareness in Residential Homes Using Mobile Devices. In Proceedings of the 4th International Conference on Smart Grids, Green Communications and IT Energy-aware Technologies (ENERGY 2014), Chamonix, France, 20–24 April; pp. 35–43.
21. Rist, T.; Wendzel, S.; Masoodian, M.; André, E. Next-Generation Home Automation Systems. In Usability Day X; Intelligent Wohnen: Dornbirn, Austria, 1 June (2012); pp. 80–87.
22. Saeed, B.B., Afsar, B., Hafeez, S., Khan, I., Tahir, M. and Afridi, M.A., "Promoting employee's pro environmental behavior through green human resource management practices", Corporate Social Responsibility and Environmental Management, (2019),Vol. 26 No. 2, pp. 424-438.
23. Samuel Fiifi Hammond, Thayaparan Gajendran, Kim Maund and David A. Savage, RETHINKING THE CHALLENGES TO ATTAINING SUSTAINABLE CITIES AND COMMUNITIES: LESSONS FROM SOCIAL NORMS AND STATUS QUO BIAS, West Africa Built Environment Research (WABER) Conference 10th Anniversary Conference, Accra, Ghana, ,(2019), DOI: https://doi.org/10.33796/waberconference2019.64
24. Shen, J., Dumont, J. and Deng, X., "Employees' perceptions of green HRM and non-green employee work outcomes: the social identity and stakeholder perspectives", Group & Organization Management, (2016), Vol. 43 No. 4, pp. 594-622.
25. Tang, G., Chen, Y., Jiang, Y., Paille, P. and Jia, J., "Green human resource management practices: scale development and validity", Asia Pacific Journal of Human Resources, (2017), Vol. 56 No. 1, pp. 31-55.
26. Thomas Rist , Masood Masoodian," Promoting Sustainable Energy Consumption Behavior through Interactive Data Visualizations", J Multimodal Technologies and Interaction. (2019).
27. Wesselink R, Blok V, Ringersma J , Pro-environmental behavior in the workplace and the role of managers and organization. J Clean Prod, (2017) ,168:1679–1687.
28. Whitmarsh, L., Capstick, S., and Nash, N,. Who is reducing their material consumption and why? A cross-cultural analysis of dematerialization behaviours. Philos. Trans. A Math. Phys. Eng. Sci. (2017), 375:20160376. doi: 10.1098/rsta.2016.0376
29. Wood W, Rünger D, Psychology of habit. Annu Rev Psychol , (2016) , 67:289–314.
30. Xiaohuan Xie, Yi Lu, and Zhonghua Gou, Green Building Pro-Environment Behaviors: Are Green Users Also Green Buyers? Sustainability MDPI Journal, (2017).
31. Yu, T., Shi, Q., Zuo, J. & Chen, R., Critical factors for implementing sustainable construction practice in HOPSCA projects: A case study in China. Sustainable Cities and Society, (2018). 37, 93-103.
32. Zhang, Y., Luo, Y., Zhang, X. and Zhao, J., "How green human resource management can promote green employee behavior in China: a technology acceptance model perspective" Sustainability, (2019), Vol. 11 No. 5408, pp. 1-19.