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Assessing Green Building Implementation and Barriers in Campus Settings

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ABSTRACT

The establishment of a green campus relies on the adoption of green building, which involves reducing energy consumption, conserving water, managing waste effectively, and protecting natural resources. Numerous educational institutions in South Jakarta exceed 30 years of age. One such example is the Faculty of Engineering Building at Universitas Pancasila (Fakultas Teknik Universitas Pancasila/FTUP). FTUP has made an effort to implement green building practices to support the development of a green campus. The purpose of this research is to assess the implementation of green building at FTUP and to identify the barriers to its implementation. The assessment of green building implementation is carried out through a combination of interviews, observations, and archival analysis. Questionnaires were distributed to building managers and academic representatives at FTUP to identify the barriers to green building implementation. The data obtained was then analyzed using the RII (Relative Importance Index). The finding showed that the green building implementation at FTUP is low (32%), with the absence of a strategic plan as the main barrier. The results indicate that the identified barriers are not due to a lack of information or high costs.

1. INTRODUCTION

The spread of the green building concept is based on an increase in energy consumption of 0.3% per year and an estimated CO_2 emission increase of 0.1-0.3% until 2050 [1]. The green building concept is a building concept designed to reduce the use of energy and resources so as to minimize the negative impact on humans and the environment [2]. This green building concept differs from conventional buildings. Data indicates that the building sector's operational activities, accounting for 40% of total energy consumption, contribute to global warming [3]. Conventional buildings are the largest contributor to the total energy use. Therefore, the development of green retrofit is changing conventional buildings into green buildings, with the aim to reduce gas emissions and conserving resources [4].

Concern for the environment also spread to the university. The representation of a university's commitment to environmental sustainability is known as a green campus. The green campus movement is a form of commitment from universities around the world to prioritize sustainable development. The focus of green campus is environmental issues, innovation, research, and application in campus management [5]. Efforts made by campuses around the world to make their campuses greener by implementing resources and energy efficiency, water and waste management, and reducing the use of motor vehicles [6]. Universities will benefit economically by implementing green building [7].

To enhance the green campus, universities upgrade their infrastructure services to be more eco-friendly [8]. Converting an existing building into a green building poses significant challenges, especially for universities that have conventionally operated buildings and limited land. Thus, retrofitting is essential to convert these conventional buildings into more eco-friendly and sustainable green buildings [9].

Implementation of green building in existing structures is not easy [10]. The challenges begin with the absence of policies, regulations, and guidelines for green building implementation on campus [11]. There is a lack of knowledge and communication, which impacts building managers' awareness [8, 11]. Limited amount of research and publications results in a lack of innovation in green building implementation [8, 12]. A significant amount of funding is required to implement green building [8, 11]. Lack of managerial experience is a hindrance to the implementation of green building [13], and the absence of strategic plans and reports on the implementation of green building [12].

Numerous education institutes in South Jakarta have buildings that were constructed more than 30 years ago. These buildings have not yet implemented green building practices. One such building is Universitas Pancasila's Faculty of Engineering Building (Fakultas Teknik Universitas Pancasila/FTUP). Currently, the FTUP building is moving towards the implementation of green building practices in its operations. This study aims to assess the level of green implementation and to identify barriers to its implementation at FTUP. It is crucial to assess the level of green building implementation in existing structures and identify the barriers

to implementing green buildings. By identifying these barriers, it is hoped that policies related to green building can be developed and implemented, ensuring sustainability within the university.

2. LITERATURE REVIEW

2.1 Green building

Green building is a construction concept that emphasizes environmental factors, efficient resource utilization, and sustainability through its design, construction, operation, and demolition phases [14]. Other studies highlight that green building constitutes an eco-friendly approach, optimizing energy usage and enhancing overall environmental performance across each stage of the project life cycle, including design, construction, operation, and demolition [9]. The primary objective of green building is to mitigate or eliminate negative environmental impacts and ensure a positive effect throughout the project's entire lifecycle [14].

Green building is a key component in pursuing low carbon emission development. Its primary application involves the implementation of policies and programs aimed at enhancing energy and water efficiency, utilizing sustainable building materials, and promoting the adoption of low-carbon technologies [7]. Key indicators of the success of green building include improvements in human health through enhanced environmental quality, energy savings, and increased comfort and safety [7, 10].

Green building assessments in Indonesia are conducted by the Green Building Council Indonesia (GBCI). GBCI is a non-profit organization established in 2009. The assessment covers various aspects, including site, energy, water, indoor air quality, waste management, pollution control, and overall building environmental management [15, 16]. The green building implementation ranking is divided into 4 levels: bronze (minimum points 35), silver (minimum points 47), gold (minimum points 58), and platinum (minimum points 74) [17]. This assessment is categorized into two types: one for new buildings and another for existing buildings. The evaluation for existing buildings applies to those that have been operational for at least one year after completion [17]. The incorporation of sustainable construction methods in preexisting structures typically revolves around operational management and building maintenance, with a specific emphasis on energy preservation and resource optimization [18].

Green Building in Indonesia is regulated by Public Works Ministerial Regulation number 21 of 2021 concerning green building performance assessment. According to this regulation, green buildings must adhere to Technical Standards: Building planning and design, Building construction implementation and supervision, Building utilization standards, and Building demolition standards [19]. According to the regulations, green building certification rankings are divided into three categories: primary, intermediate, and main ranking. The primary certificate is awarded to buildings that achieve 45-65% of the assessment criteria, the intermediate certificate for the achieved value of 65-80%, and the main certificate for the achieved value of 80-100% [19].

Upgrading existing buildings to green buildings can be achieved through the retrofitting process. Retrofitting is a strategy to enhance building performance, either in parts or the entire structure, with the goal of improving energy efficiency and environmental sustainability [20]. Campus buildings can serve as pioneers in retrofitting for sustainable development and energy reduction [21]. Factors to consider when converting existing buildings into green buildings include energy, water, and material aspects related to cost, environmental performance, and economic advantages [22].

2.2 Green campus

A green campus is an international initiative adopted by colleges around the world to give priority to sustainable development, by including social, economic, and environmental factors. Green campus initiatives focus on environmental issues, innovation, research, and their application to campus management [5].

The implementation of a green campus aligns with academic performance. Universities that adopt green concepts often experience positive impacts on academic rankings, with good environmental performance assessments reflecting positively on academic standings. This success is attributed to the support of top university management and the allocation of various resources, both material and non-material, toward sustainable practices [8].

The measurement of the level of green campus implementation in Indonesia is conducted through UI GreenMetric. Established by Universitas Indonesia in 2010, UI GreenMetric World University Ranking ranks green campuses based on environmental sustainability [23]. The UI GreenMetric assessment criteria encompass evaluating several aspects like the establishment and infrastructure, energy consumption and climate change impact, waste management, water usage, transportation systems, and educational initiatives [5, 23].

Green campus indicators applicable to universities include green buildings, emphasizing energy savings, water conservation, waste management, natural resources, and transportation [16]. For instance, in the energy and climate element of UI GreenMetric, green building is a significant indicator. Incorporating sustainable building practices is apparent in construction and renovation policies [23]. Campus designed with a green concept enhances the quality of life for its users, including lecturers, students, and staff [5].

2.3 Green building on campus

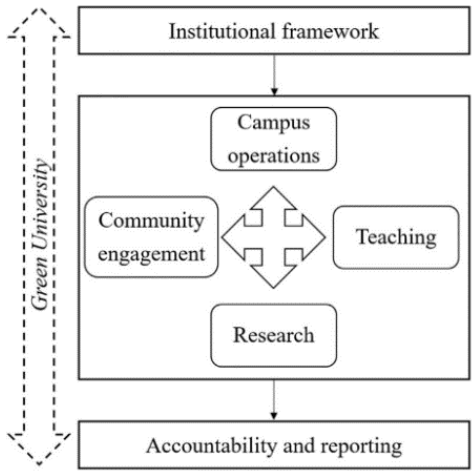

Figure 1. Dimension of sustainability in green campus [12]

The implementation of a green campus is shaped by dimensions that support sustainability. The dimensions of green building implementation on campus include institutional framework, campus operation, teaching, research, community engagement, and accountability and reporting [12], as illustrated in Figure 1.

The implementation of green building in universities can have an impact in three aspects: environmental, economic, and social aspects [10]. From an environmental perspective, green building implementation helps protect the campus's green areas, improve air and water quality, and reduce campus pollution and waste. Green building can economically reduce building operations costs through efficiency of energy, electricity and air usage, as well as increase worker productivity. The social benefit of implementing green building practices can enhance health and comfort, create a comfortable, green, and sustainable living environment, and improve the aesthetic quality of campus buildings [24]. Furthermore, implementing green building can enhance civitas academic awareness, influence positive practices in the community, and improve quality of life [10].

2.4 The barriers of implementation green building at university

The development of green building at universities faces numerous barriers. According to research by Richardson [25], there are four major barriers to implementing green building on campus: lack of internal leadership among stakeholders in decision-making, unmeasurable sustainability targets, and insufficient communication between designers and campus management. These challenges are exacerbated by financial limitations and a lack of organizational readiness to implement green building [26]. Another challenge in implementing green building is the lack of stakeholder awareness, incentives, support, financial considerations, and occupant satisfaction [11].

Other studies mention that the lack of references regarding research and innovation related to green building, the lack of specialized expertise in green construction, and the absence of standard procedures for green buildings are significant challenges [26]. One of the campuses that has successfully implemented green building is the large number of studies and the existence of a learning curriculum related to sustainability and green building [8].

3. RESEARCH METHOD

This research is divided into two stages: assessing green building implementation and identifying barriers to implementation. The first stage, the assessment of green building implementation using PUPR Regulation No. 21 of 2021 and GBCI Greenship Rating Tools Existing Building V1.1. Both are commonly used in Indonesia for certification purposes and assessing the implementation of green building practices. The variables used in this study are derived from the green building assessment parameters listed in PUPR Regulation No.21 of 2021. The indicators for each variable are based on the assessment criteria of green building implementation, as defined in PUPR Regulation No.21 of 2021 and GBCI Greenship Rating Tools Existing Building V1.1. The assessment aspects for existing buildings include the organization and governance of green buildings, the retrofit construction process, the maintenance of green building performance during utilization, and the role of occupants/users of green buildings [17, 19]. The detailed variables and indicators for green building assessment are shown in Table 1.

Table 1. Green building assessment variables for constructed buildings

No.	Variable X	Indicator	Poin
X1	Green building organization and governance	Environmental conservation policies and the development of SOPs for green building utilization	12
		Legal requirements	1
		Methods and performance of operation and maintenance	8
		Emergency response procedures	1
		Capacity development for building management	2
		Retrofitting planning for performance adjustment	29
X2	Retrofitting construction process	Green construction process for retrofitting	13
		Retrofitting implementation report	7
X3	Maintenance during the utilization of green building	Site management	1
		Energy usage efficiency	5
		Water usage efficiency	5
		Indoor air quality	3
		Waste management	2
		Wastewater management	1
X4	Role of occupants/Users of green building	Green Building Socialization	1
		Dissemination of green building performance information	1
		Survey of occupants' satisfaction with green building	1

Primary data for the assessment of the implementation of green building in the FTUP Building were obtained from interviews and observations. This research is purposive sampling. Interviewers' target respondents were SDGs managers, building managers, and construction work managers at the FTUP Building. Meanwhile, the secondary data needed includes existing green campus policy documents, regulations and procedures related to building management. The form of the question to assess the level of green building implementation is to use a nominal scale, categorizing responses as not implemented (0) and implemented (1).

The next stage is the identification of barriers to green building implementation. This stage is conducted using qualitative methods. The research employs a questionnaire carried out in two stages. The first stage involves content and construct validation by experts. The experts in this

questionnaire are certified green building professionals. The variables and indicators are derived from a literature review, resulting in 5 variables and 18 indicators hindering green building implementation at FTUP. These variables and indicators are detailed in Table 2.

Table 2. Variables of barriers green building implementation

No.	Variable X	Indicator	Reference
X1	Policy	There are no policies, regulations and guidelines for implementing green buildings	[11]
		The vision and mission related to sustainability are not clearly defined, which affects the strategy for achieving it	[12]
		The vision and mission of sustainability are not socialized to all academic communities	[12]
X2	Knowledge Related to Green Building	Many stakeholders are not committed to implementing green building policies	[11]
		Lack of awareness and knowledge from facility management regarding green building	[11]
		Lack of awareness to implement sustainable Green Building policies	[11]
		Lack of communication from campus management to maintain the sustainability	[11, 12]
		Lack of training for green building management	[12]
X3	Research Related to Green Building	The number of research studies and publications related to green building is still very limited	[8, 12]
		There is no digitalization system to access research and publications related to green building	[12]
		The amount of project funding or internal research related to green building is still lacking	[12]
		There are very few innovations produced	[12]
X4	Financial	The initial cost of investment in green building construction is expensive	[8, 11]
		There are no funding resources from universities to implement green building	[12]
		There are no incentives from university leaders to faculties/departments that have implemented green building	[11]
X5	Organization	There is dissatisfaction from building users with the implementation of green building	[11]
		Lack of integration and communication between parties that play a role in the management of green building	[12]
		Lack of managerial experience in the implementation of green building	[13]
X6	Implementaion Green Building	There is no strategic plan for the implementation of green building	[12]
		There is no reporting on the implementation of green building	[12]
		Achieving a sufficiently high score to obtain a certified ranking	[8]

The Phase 2 questionnaire on barriers to green building implementation uses a Likert scale with an interval from 1 to 5, 1=very uninfluential, 2=uninfluential, 3=neutral, 4=influential, and 5=very influential. The variables and indicators for the barriers to green building implementation used in this phase are based on content and construct validation. The sampling method employed in this phase is purposive sampling, targeting individuals knowledgeable about green building and its implementation. The sample of this research includes representatives from the faculty and building management at FTUP. The research instruments are listed in Table 3.

Table 3. Research instrument

Variable and Indicator			How significant is the influence of these factor statements on the implementation of green building at FTUP?				
			1	2	3	4	5
X1		Policy					
	X1.1	There are no policies, regulations and guidelines for implementing Green Buildings					
	X1.2	The vision and mission related to sustainability are not clearly defined, which affects the strategy for achieving it					
	X1.3	The vision and mission of sustainability are not socialized to all academic communities					

The collected data is then tested for validity and reliability. Data analysis is conducted using Excel. After testing the data, it is analyzed to determine the top barriers to green building

implementation using the Relative Importance Index (RII). This method is used to analyze the variables that have greatest influence on object research. RII produces a ranking of the most important variables, based on the weighting of the values that have been filled in by respondents [27]. The RII calculation formula is RII=∑ W/ A×N, where W is the weight given to each factor by respondents (scale 1-5), A is the highest value (in this study, 5), and N is the number of respondents. The RII results range between 0 and 1. Barrier levels are categorized based on High (H) (0.8<RII≤1), Medium (M) (0.5<RII≤0.8), and Low (L) (0<RII≤0.5) [2].

4. RESULT AND DISCUSSION

4.1 Assessment of green building implementation

Based on the data collected through interviews with relevant parties, observations, and archive analysis, the implementation of green building at FTUP building was assessed. Data collection was conducted in June 2023. The assessment was conducted by evaluating each parameter of every indicator. If a parameter met the specified requirements, points were awarded. The results of the analysis are presented in Table 4.

Table 4. Assessment of green building implementation at FTUP

No.	Variable	Indicator	Reference Points	Implemented Points	Analysis
X1	Green building organization and governance	Environmental conservation policies and the development of SOPs for green building utilization	12	7	There are policies regulating the implementation of a green campus, including those related to reducing air pollution, saving energy and water, and managing waste
		Legal requirements	1	0	There are no certified experts in building maintenance competency
		Methods and performance of operation and maintenance	8	5	It already has SOPs for the maintenance and maintenance of building facilities and infrastructure. Periodic inspections are carried out for buildings (structural, architectural, mechanical, electrical, outdoor and household layouts)
		Emergency response procedures	1	0	Do not have an emergency response organizational structure, but already have an emergency response work instruction
		Capacity development for building management	2	1	There is maintenance manager training, but it is not carried out regularly
X2	Retrofitting construction process	Retrofitting planning for performance adjustment	29	11	Retrofitting that has been carried out is a ventilation system, natural lighting, and waste management. The applications that are still lacking are air conditioning, lighting systems, energy efficiency calculations, electrical systems, water efficiency and indoor air quality
		Green construction process for retrofitting	13	0	There are no policies for the construction process related to retrofitting
		Retrofitting implementation report	7	1	The only process that has been carried out is submitting a copy of the shop drawings
X3	Maintenance during the utilization of green building	Site management	1	1	Pest and weed control is carried out using environmentally friendly and non-toxic materials
		Energy usage efficiency	5	1	There is no efficiency check for energy usage, only regular maintenance for the elevators has been carried out
		Water usage efficiency	5	0	There is no efficiency check for water usage
		Indoor air quality	3	1	Warning signs prohibiting smoking have been installed in workspaces, study rooms, laboratories and the cafetaria
		Waste management	2	1	The existing waste management system only categorizes waste into organic, residual, and recyclable types. There is no calculation of the volume of waste produced
		Wastewater management	1	0	There is no wastewater treatment in place
X4	Role of occupants/Users of green building	Green building socialization	1	1	Introduction efforts have begun for new students. However, socialization has not yet been conducted regularly for faculty, staff, and students
		Dissemination of green building performance information	1	0	The performance of green building implementation is only reported for UI GreenMetric but is not disseminated widely
		Survey of occupants' satisfaction with green building	1	0	A survey of user satisfaction with green building performance has not been conducted

The implementation of green building in the FTUP building, based on the assessment conducted, is at 32%. Only 30 out of 93 total indicators of green building indicators were met. This indicates that the level of green building implementation in FTUP buildings is low. According to the green building assessment criteria in PUPR Regulation No. 21 of 2021, the FTUP building has not received a primary-level certificate (achievement value of 45-65%).

In the green building organization and governance, the indicators that have been met include the presence of policies related to green building. The policy that applies at FTUP is related to green campus and reducing air pollution in the campus environment. Policies related to the implementation of green campus, issued by the Vice Chancellor II of Universitas Pancasila in 2019, include reducing and managing plastic waste, saving water, saving electricity, and monitoring and reporting the green campus program. Policies related to reducing air pollution in the campus environment contain appeals to limit motorized vehicles entering the campus, restrictions on private vehicle parking, and socialization of the use of public transportation. This policy was established by the Rector of Universitas Pancasila in 2019.

To realize green building at the FTUP building, retrofitting modifications need to be implemented. The retrofitting parameters for applying green building practices include planning for energy and water efficiency, indoor air quality, and waste management. The retrofitting construction process must also consider construction method, optimization of equipment uses, and the implementation of construction waste management. The successful implementation of green building at FTUP can be achieved with the involvement of building occupants/users. Currently, the retrofitting process at FTUP has only included documentation related to shop drawings.

In the process of building retrofitting planning, the steps taken include improvements to the building envelope (ventilation system, air conditioning, and lighting), indoor air quality (smoking ban and control of refrigerant use), and waste management. The FTUP building applies a ventilation system and natural lighting to the lobby, hallway, and toilet areas. Air conditioning and artificial lighting systems are used in workspaces, classrooms and laboratories. Regarding indoor air quality indicators, smoking is prohibited throughout the entire FTUP building, including in the garden and canteen areas. In waste management, waste is managed by using the 3R principles (Reduce, Reuse, Recycle), with waste segregation available for organic, non-organic, and hazardous waste. At Pancasila University, a Temporary Waste Shelter (TWS) has also been provided. Efforts to save energy have also been made, although there is no written policy, but there have been appeals through stickers attached to strategic places, including for saving electricity and water.

The implementation of green building in the FTUP aims to support the campus movement. The implementation of green campus at the university is supported by regulations and is translated into operational activities and educational procedures [5]. The success of green campus implementation is supported by management as well as material dan non-material resources directed towards sustainable practices [8]. Therefore, a special organizational structure is needed that manages green buildings, to monitor and control, and disseminate information related to the implementation of green buildings [19].

4.2 Barriers to green building implementation

Data to determine the barriers to green building implementation in the FTUP were collected through questionnaires. The questionnaires were distributed to representatives of the faculty and FTUP building managers. The total number of respondents was 13, consisting of 10 lecturers and 3 building managers. Data collection was conducted on 18-25 October 2023.

Table 5. RII analysis ranking and influence level of the barriers to green building implementation

Variable	Likert Scale					RII Component			RII Index	Rank	Level
	1	2	3	4	5	W	A	N	Value		
X1.1	2	1	0	1	9	53	5	13	0.82	6	High
X1.2	0	1	2	3	7	55	5	13	0.85	3	High
X1.3	1	1	2	3	6	51	5	13	0.78	10	Medium
X1.4	1	2	1	4	5	49	5	13	0.75	14	Medium
X1.5	1	0	3	3	6	52	5	13	0.80	8	Medium
X2.1	1	0	3	0	9	55	5	13	0.85	4	High
X2.2	0	1	1	4	7	56	5	13	0.86	2	High
X2.3	1	1	1	3	7	53	5	13	0.82	7	High
X2.4	2	2	1	2	6	47	5	13	0.72	19	Medium
X2.5	2	2	3	2	4	43	5	13	0.66	25	Medium
X3.1	0	4	2	5	2	44	5	13	0.68	23	Medium
X3.2	1	1	3	4	4	48	5	13	0.74	16	Medium
X3.4	1	1	2	6	3	48	5	13	0.74	17	Medium
X3.5	1	3	1	6	2	44	5	13	0.68	24	Medium
X4.1	3	0	3	2	5	45	5	13	0.69	22	Medium
X4.2	1	2	2	0	8	51	5	13	0.78	11	Medium
X4.4	2	0	4	3	4	46	5	13	0.71	21	Medium
X5.1	0	2	2	4	5	51	5	13	0.78	12	Medium
X5.2	2	0	2	1	8	52	5	13	0.80	9	Medium
X5.3	1	0	2	3	7	54	5	13	0.83	5	High
X6.1	0	1	1	2	9	58	5	13	0.89	1	High
X6.2	2	1	1	1	8	51	5	13	0.78	13	Medium
X6.3	1	2	3	1	6	48	5	13	0.74	18	Medium

The collected data was then subjected to validity and reliability tests. Out of a total of variables and 25 barrier indicators, after conducting the validity and reliability tests, one indicator was found to be invalid, namely, indicator X4.3 (There are no incentives from university leaders to faculties/departments that have implemented Green Building). Meanwhile, the unreliable indicator was X3.3 (The amount of project funding or internal research related to Green Building is still lacking). Both indicators were removed from the list.

After the data were tested for validity and reliability, the next step was to analyze the ranking and influence level of the barriers to green building implementation in the FTUP. The analysis is initiated with the entry of the data collected from the respondents. In the column Likert Scale, the number of responses corresponding to the scale selected by each respondent is entered. Subsequently, the total factor scores from all respondents are calculated and entered into W column of the RII component. From the RII analysis conducted on 23 indicators, 7 indicators were found to have the highest rankings and fell into the high-level category. The results can be seen in Table 5.

The highest-ranking indicators of barriers to green building implementation include:

X6.1: There is no strategic plan for the implementation of green building

X2.2: Lack of awareness to implement sustainable green building policies

X1.2: The vision and mission related to sustainability are not clearly defined, which affects the strategy for achieving it

X2.1: Lack of awareness and knowledge from facility management regarding green building

X5.3: Lack of managerial experience in the implementation of green building

X1.1: There are no policies, regulations and guidelines for implementing green buildings

X2.3: Lack of communication from campus management to maintain sustainability

The lack of a strategic plan for implementing green building is the highest-ranking barrier. This aligns with the assessment results of the green implementation at FTUP, which indicate that there is already a policy towards a green campus, including green building. There is a need for a strategic development plan towards a sustainable campus.

In general, this strategic plan is a stage to achieve the green university target. For campuses that still have conventional buildings, developing a strategy is necessary to convert these buildings into green buildings. Since converting existing buildings into green buildings requires significant cost, leadership is developing green solutions so that green buildings can be implemented gradually [12]. The preparation of the retrofitting strategy is adjusted to the changing needs and requirements towards a green campus. In the development of the retrofit process activities, it involves multidisciplinary collaboration and a learning process [28].

This strategic plan is closely related to the university's vision and mission [12]. According to the results of the analysis using RII, an undefined vision and mission will affect the strategy for achieving the implementation of green buildings. The implementation of a green campus in higher education begins with the preparation of a strategic plan, which is then translated into a vision, mission, targets, programs, policies and sustainable campus activities [29]. The vision, mission and policies in the implementation of green buildings are included in the institutional framework [12].

Knowledge in the implementation of green buildings plays a crucial role. Several countries around the world, such as China, Poland, Japan and UK, leverage knowledge and information to enhance the performance of green buildings. These countries make policies related to knowledge and dissemination of information related to green building, so that people can increase their awareness [4].

The results of this research were then validated by green building experts in the Group Discussion Forum. According to experts, the facilities at FTUP have been able to carry out green building measurements. For the physical condition of the building, measurements can be made using EDGE green building certification. As for the barriers to green building implementation, financial issues are not considered a significant obstacle. In fact, the cost incurred for the implementation of green buildings is determined by how many green building elements will be implemented. The elements of green building that will be implemented can be adjusted to the financial situation of the campus [11]. The initial costs of implementing green buildings are offset by the benefits gained, such as cost reductions due to efficiency and resource savings.

It is also said that the main factor in converting existing buildings that are not yet green buildings into green building is changing the mindset of the people or occupants, not just the building themselves. Raising awareness among building users to implement green building practices is supported by knowledge competence. Therefore, policy decisions should focus on enhancing the awareness of occupants and building managers. Thus, the initial phase of green building implementation involves improving human awareness, enhancing policies, and upgrading building maintenance procedures. This aligns with research conducted by Hopkins (2016), which suggest that solutions for green building implementation on campus include developing a sustainability plan and green building master plan, increasing awareness and knowledge about green buildings among all stakeholders, retrofitting infrastructure, obtaining certification to increase the campus's market value [11].

In previous research on barriers to the implementation of green building, with students as respondents, the results revealed include a lack of knowledge about the principles and benefits of green building by students, insufficient promotion by the government to universities, limited knowledge among university management on the importance of green building implementation, and high-cost implementation [30]. In other studies on the barriers to green building implementation in universities in Indonesia are resistance to change, lack of information and knowledge related to green building implementation, no sanctions, no rewards, unclear regulations, lack of commitment, and lack of funds. From the previous research [29], it was found that the knowledge factor was the main barrier to the implementation of green building in universities. While at FTUP, the highest barrier to green building implementation is the absence of a strategic plan.

An important element for implementing a strategic plan for green building at FTUP is the commitment from both the faculty leadership and the entire academic community, which includes students, lecturers, staff, and building managers. The initial steps that can be taken include the development of green campus policies to support the implementation of green building, the drafting of regulations related to green building, and socializing these policies to all building users. The next step is to establish a team or unit responsible for green building

implementation, followed by creating a work program to support sustainability.

According to the assessment results, the implementation of energy and water conservation at FTUP is still very low. These two parameters should be the primary targets in an effort to implement green building practices. One of the weakness in FTUP's green building implementation is the absence of monthly energy and water consumption records, making performance tracking difficult. Retrofitting can be done to reduce energy and water usage in the FTUP building. The findings from this research on energy and water conservation can be applied to FTUP. The success of this implementation can serve as good example for other faculties at Universitas Pancasila as well as the wider community.

Green building is an essential component of a green campus, contributing to the creation of a sustainable campus environment. The implementation of green building whitin a green campus begins with design, followed by facilities management, and tjhe conservation of energy and water [31]. Universities play an important role in life in society. The university as a pilot in the application of sustainability in daily life. It can be said that universities are a small community in society, free from political influence, business interests, and other constraints. Therefore, through research and innovation, the implementation os sustainability can progress and be passed on the surrounding community for a better future [29].

5. CONCLUSION

According to the assessment of green building implementation, FTUP is classified as low performance, with a score of 32%. The green building implementation policy at FTUP currently follows the green campus implementation policy, which means not all green building criteria are fully implemented. Since FTUP is an existing conventional building, the development of green retrofitting policies is necessary. Successful green building implementation depends on the collective responsibility of the university community, supported by binding policies and regulations. Continuous monitoring, evaluation, and corrective actions are necessary to realize a green campus. Future research should include examination and simulation of energy usage as well as evaluations of comfort and safety levels for occupants.

The low level of green building implementation is attributed to various barriers. The highest-ranking barriers identified in this study include the lack of a strategic plan for implementing green buildings. This strategic plan needs to be well-developed and aligned with the green campus program. The strategic plan that can be done to improve the implementation of green building is the commitment of the leadership and the entire academic community. Such commitment will help raise awareness among individuals. The findings of this study differ from previous research, which highlighted the lack of information and knowledge, as well as high cost, as the primary barriers to green building implementation.

Although this research provides insights into the implementation of green building and its barriers in FTUP, there are several limitations to consider. These include the relatively small number of respondents, the short timeframe, and the possibility that it may not fully represent the views of all stakeholders. Further research with a larger sample size is necessary to obtain more comprehensive results.

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