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Development of Information Systems on the Integration of EDGE Certification, BIM and WBS Implementation in Operational and Maintenance Work of Flats in DKI Jakarta Province to Increase Effectiveness and Efficiency of Time and Cost

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Abstract

The construction of flats is one of the efforts of the DKI Jakarta Government to provide decent housing as mandated in Law No. 20 of 2011 and to address the housing backlog in DKI Jakarta Province. Limited land availability means that house construction must be carried out vertically with complexity in its operation and maintenance. This study aims to improve the effectiveness and efficiency of time and costs in the operational and maintenance work of flats in DKI Jakarta Province through the development of an information system for the application of EDGE Certification, BIM, and WBS integration. The methodology used is a questionnaire and interviews involving many experts, namely EDGE Experts and BIM Experts, and related respondents. The results of the study prove that the Development of an Information System for the Integration of the Application of EDGE Certification, BIM, and WBS in the Operational and Maintenance Work of Flats in DKI Jakarta Province can improve the effectiveness and efficiency of time and costs with a linear equation Y = 1.208 + 0.089 X1 + 0.322 X2 + 0.499 X3 – 0.161 X4.

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1 Introduction

The construction of flats is one of the steps taken by the DKI Jakarta Provincial Government to provide decent housing and overcome the housing backlog problem in DKI Jakarta Province. According to the Housing and Settlement Area Development and Development Plan (RP3KP), the DKI Jakarta Provincial Government still has to plan the construction of 402,287 flats (RP3KP Document of the Public Housing and Settlement Area Service of DKI Jakarta Province). The issuance of Law of the Republic of Indonesia Number 2 of 2024 concerning the Special Region of Jakarta Province where the City of Jakarta is no longer the capital city so that it changes into the Special Region of Jakarta, positioned as the Center of the National Economy and Global City. With the changing position and function of the city, Jakarta also pays attention to the issue of global warming for environmental preservation that supports sustainable development and increases investment and the economy (Law of the Republic of Indonesia No. 2 of 2024)

Due to land limitations, the construction of tower-shaped flats (above 8 floors) is a special challenge, especially in terms of operations and maintenance. The DKI Jakarta Provincial Government has set a fairly large subsidy in the management of flats, both in the form of rental fee subsidies, water usage fees, and electricity usage with a fairly large value. However, there are still residents, most of whom are from Low-Income Communities (MBR), who are in arrears on rent, water, and electricity fees, thus adding to the burden on the DKI Jakarta Provincial Budget. Lack of awareness of the importance of saving water and electricity, coupled with the behavior of residents who are still not ready to prevent negative impacts on the environment. After analysis, the amount of water usage in flats in February 2024 was 127.34 liters/person/day above the standard for clean water usage according to SNI 03-7065-2005 of 100 liters/person/day. Likewise, electricity usage in February 2024 of 150.87 kWh per unit is still above the per capita usage value in 2023 according to the Ministry of Energy and Mineral Resources of the Republic of Indonesia, which is 107 kWh.

For these problems, the author proposes a solution in the form of developing an information system for the integration of the application of EDGE Certification, BIM, and WBS in Flats in DKI Jakarta Province in operational and maintenance work to increase the effectiveness and efficiency of time and costs. Cozza et al. (2021), stated that the assessment of building work through energy certification is important to track the increase in energy efficiency of building supplies. Therefore, the author proposes the implementation of green building with the EDGE Certification approach with an assessment of 3 (three) indicators, namely energy, water, and materials which are simpler and easier to implement. EDGE can calculate the magnitude of effectiveness and efficiency in the three indicators, carried out through an online application so it is quite practical (Lee & Akin, 2011; de Souza et al., 2021). In addition, the need for the use of BIM in the operational stage of flats, so that the calculation of effectiveness and efficiency is more accurate. Zao & Gao (2022), proposed a BIM-based energy-efficient design method for green buildings, and the results of the study showed that the method has good feasibility and effectiveness. Green building designs or approaches need to be modeled in BIM to be documented and facilitate monitoring efforts. BIM is an information-based platform that is rich in large volumes of required asset data, then integrated with a WBS-based Date Base Management System (DBMS) can achieve effective integrated building asset management (Al-Kasasbeh et al., 2021). Analyzing the influence of EDGE relationships *Certification*, BIM, WBS, and Information Systems in improving the effectiveness and efficiency of time and costs in operational and maintenance work on flats in DKI Jakarta Province.

Literature Review
Maintenance Work

Maintenance work includes cleaning, tidying, inspection, testing, repair and/or replacement of building materials or equipment, and other similar activities based on building operation and maintenance guidelines (Preventive Maintenance) which are divided into 6 groups of work, namely architectural, structural, mechanical, electrical, exterior layout, and housekeeping (Regulation of the Minister of Public Works Number 24/PRT/M/2008). Building maintenance and care includes requirements related to building safety, building health, building comfort, and building convenience (Park & Cai, 2017; Ding et al., 2019).

Operational Work

According to the Big Indonesian Dictionary (KBBI), the meaning of the word operational is (in nature) operational. Another meaning of Operational is a series of activities and processes carried out to run a business or organization.

EDGE Certification

Excellence in Design for Greater Efficiencies (EDGE) is an innovation from the International Finance Corporation (IFC) in the form of an environmentally friendly building platform that includes global environmentally friendly building standards, software applications, and certification programs covering energy, water, and materials (http://edgebuilding.com). EDGE enables the discovery of technical solutions at an early design stage to reduce operational costs and environmental impact. Based on user information input and a selection of environmentally friendly actions, EDGE provides projections of operational savings and carbon emission reductions. Households still have great potential for energy savings. The most frequently used electrical appliances in households and with significant potential for savings are air conditioners (AC) and refrigerators (Santosi & Salim, 2017).

Building Information Model (BIM)

BIM transforms construction methods from conventional and less efficient to more integrated and collaborative processes. In Indonesia, the implementation of BIM is required based on the Regulation of the Minister of Public Works and Public Housing Number 22/PRT/M/2018 concerning Guidelines for the Construction of State Buildings.BIM is an effective tool to ensure sustainable development principles throughout the life cycle of buildings including structures and road infrastructure (Bilov et al., 2023). After long-term operations, BIM provides opportunities to accelerate and save resources in capital improvement planning and reconstruction.

Work Breakdown Structure (WBS)

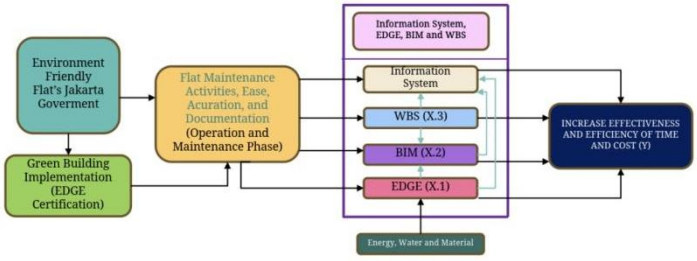
According to PMBOK 6th edition, WBS (Work Breakdown Structure) is a hierarchical breakdown of the overall scope of work that must be performed by the project team to achieve the project objectives and produce the required results. WBS organizes and defines the overall scope of the project and represents the work specified in the currently agreed-upon project scope statement (Volk et al., 2014; Gorla et al., 2010).

Information Systems

According to the Big Indonesian Dictionary, a system is a set of elements that are regularly interrelated to form a totality. While information is **information, notification, news, or news about something.** An information system consists of several main components that work together to collect, store, process, and present data into information, namely hardware, software, databases, networks, procedures, and people (Widarti et al., 2024). The new system advances the performance process and also reduces errors like manual systems. The new system also provides an opportunity for companies to increase efficiency in their processes. The new system will increase customer satisfaction (Attanatwong, 2000).

2 Materials and Methods

Based on the operational research model and research methodology used, in this study there are 4 independent variables, namely X.1. EDGE Certification, X.2 BIM, X.3 WBS, and X.4 Information Systems, and 1 dependent variable (Y), namely Increasing the Effectiveness and Efficiency of Time and Cost.



	Variabel	
RQ 1	X1	EDGE Certification
RQ 2	X3	WBS
RQ 3	X1	EDGE Certification
RQ 4	X1	EDGE Certification
	X2	BIM
	X3	WBS
RQ 5	X1	EDGE Certification
	X2	BIM
	X3	WBS
	X4	Sistem Informasi
RQ 6	X1	EDGE Certification
	X2	BIM
	X3	WBS
	X4	Sistem Informasi
	Y	Increase Effectiveness and Efficiency Time and Cost

Figure 1. Operational Model (left) and Variable Research Questions

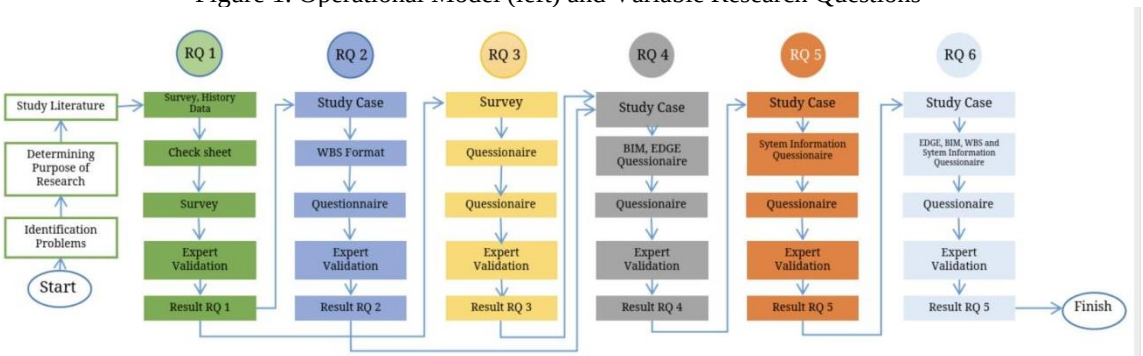


Figure 2. Research process

3 Results and Discussions

Existing Condition of Buildings and Operational and Maintenance Work of Flats in DKI Jakarta Province that Have Not Been EDGE Certified

In answering RQ 1, a field review was conducted at Tambora Flats as the object of study including the flat building including residential units and interviews with the management. From the input results on the EDGE application, it is known that Tambora Flats from the energy assessment of 0.11% still has not reached the minimum efficiency value, while from the water side of 40.64% and material of 86%, it has met the efficiency value. However, the EDGE assessment is only based on the design assessment, often different in realization. In Tambora Flats, the water efficiency assessment has met more than 20% but the actual water usage exceeds the standard. One of the reasons is because the number of occupants exceeds the provisions. There are 44 residential units with more than 4 occupants.

In the management of flats, it is known that there is no SOP for the Maintenance or Care of Flats. Currently, maintenance and care of flats is usually carried out periodically, including Daily Maintenance, Monthly Maintenance, and Years Maintenance. The tasks and authority of operational work are under the auspices of the Head of the Facilities and Infrastructure Implementation Unit who is assisted by technicians who are divided into 4 shifts, namely morning, afternoon, evening, night, and off. Daily operational scheduling has been recorded but has not been fully implemented, while maintenance work, especially repairs to residential bathrooms, is still based on complaints from residents (Madureira et al., 2017; Aziz et al., 2012).

Based on the results of the collection through questionnaires to 5 apartment management experts and data analysis, it is known that of the 37 (thirty-seven) energy assessment components, 10 (ten) components can be improved, while of the 18 (eighteen) water assessment components, 12 (twelve) components can be improved and of the 11 (eleven) material assessment components, 5 (five) components can be improved to increase cost-effectiveness and efficiency.

Table 1
EDGE assessment components that can be improved in flats

No.	Faktor Penilaian Sertifikat EDGE yang dapat dilakukan *Improvement* untuk Efektitas dan Efisiensi Waktu dan Biaya	
A. Energi (X.1.1)		
1	EEM02	Atap Pemantul Cahaya
2	EEM03	Dinding Eksterior Pemantul Cahaya
3	EEM05*	Insulasi Atap
4	EEM07	Atap Hijau
5	EEM08*	Insulasi untuk Dinding Luar
6	EEM22	Penerangan Hemat untuk Area Dalam Ruangan
7	EEM23	Penerangan Hemat untuk Luar Ruangan
8	EEM24	Kontrol Penerangan
9	EEM29	Lemari Es dan Mesin Cuci yang Efisien
10	EEM33	Energi Terbarukan di Lokasi

No.	Faktor Penilaian Sertifikat EDGE yang dapat dilakukan *Improvement* untuk Efektitas dan Efisiensi Waktu dan Biaya	
B. Air (X.1.2)		
1	WEM01*	Shower Hemat Air
2	WEM02*	Keran Hemat Air untuk KM Pribadi/Semua
3	WEM03	Keran Hemat Air untuk Toilet Umum
4	WEM04*	WC yang Efisien untuk Toilet Pribadi
5	WEM05	WC yang Efisien untuk Toilet Umum
6	WEM08*	Keran Hemat Air untuk Westafel Dapur
7	WEM11	Mesin Cuci Hemat Air
8	WEM13	Sistem Irigasi Taman Hemat Air
9	WEM14	Sistem Penampungan Air Hujan
10	WEM15*	Sistem Pengolah dan Daur Ulang Air Limbah
11	WEM17	Meteran Cerdas untuk Air
12	WEM18	Tindakan Penghematan Air Tambahan

C. Material (X.1.3)		
1	MEM03*	Pelapis Lantai
2	MEM04	Konstruksi Atap
3	MEM09	Insulasi Atap
4	MEM10	Insulasi Dinding
5	MEM11	Insulasi Lantai

WBS Operational and Maintenance Work of Flats in DKI Jakarta Province

The preparation of the WBS for Operational and Maintenance Work of Flats refers to literature studies and related regulations, then a questionnaire is distributed for validation to 3 experts from housing planning, housing maintenance of the DKI Jakarta Provincial Public Housing and Settlement Area Service and flat managers at WBS Levels 1 to 6. The results are validation of each work package, operational and maintenance categories along with their respective activities accepted if more than 2 experts agree.

WBS Level 1	Pekerjaan Operasional dan Pemeliharaan																									
WBS Level 2 Rumpun Pekerjaan	WBS Level 3 Jenis Pekerjaan	Apakah Jenis Pekerjaan ini termasuk WBS Level 3 Pekerjaan Operasional dan Pemeliharaan Rumah Susun?				WBS Level 4 Paket Pekerjaan	Kode EDGE Certification	Apakah Jenis Pekerjaan ini termasuk WBS Level 4 Pekerjaan Operasional dan Pemeliharaan Rumah Susun?				WBS Level 5 Aktivitas Operasional	Apakah Aktivitas Operasional WBS Level 5 Rumah Susun sudah sesuai?				Berapa Jumlah Tenaga Operasional yang Dibutuhkan?				WBS Level 6 Aktivitas Pemeliharaan	Waktu Pelaksanaan	Berapa Jumlah Tenaga Pemeliharaan yang Dibutuhkan?			
		P1	P2	P3	Jumlah			P1	P2	P3	Jumlah		P1	P2	P3	Jumlah	P1	P2	P3	Hasil			P1	P2	P3	Hasil
Struktur (X.3.1)	Referensi: - Peraturan Menteri Pekerjaan Umum Nomor : 24/PRT/M/2008 - Muhammad Naufal (2020)																									
	Tie Beam dan Sloof (X.3.1.2)	1	1	0	2	Tie Beam Beton Bertulang (X.3.1.2.1)	---	0	0	0	0	Tidak dapat dilakukan operasional	0	0	0	0	---	---	---	---	**Pemeriksaan**: Pengamatan visual terhadap keretakan beton	Tahunan	---	---	---	---
																					Pemeliharaan: ---	---	---	---	---	---
																					Perawatan: • Ketuk beton yang ada di sekeliling retakan menggunakan palut untuk memastikan tidak ada beton lagi yang terkelupas • Bersihkan permukaan hasil pahatan • Lakukan *grouting* pada bagian retak • Lakukan pengecatan kembali dengan cat emulsi atau cat yang tahan air dan asam pada permukaannya	2 Tahunan	---	---	---	---
						Tie Beam Baja (X.3.1.2.2)	---	0	0	0	0	Tidak dapat dilakukan operasional	0	0	0	0	---	---	---	---	**Pemeriksaan**: Pengamatan visual pada sambungan baja dan batang baja	Tahunan	---	---	---	---

Figure 3. Data Collection Process, Analysis and Expert Validation RQ 2

After a series of analyses, the WBS for Operational and Maintenance Work of Flats in DKI Jakarta Province as a whole was obtained as well as identification of WBS components based on EDGE Certification.

Table 2
Results of WBS component analysis for operational and maintenance work of flats

No.	Building WBS Components (Initial)	WBS Components for Operational and Maintenance Work of Flats	WBS Components of Operational and Maintenance Work of EDGE-Based Flats
a	The structural work group has 9 types of work and 36 work packages.	The structural work group consists of 7 types of work and 15 work packages.	The structural work group consists of 2 types of work and 5 work packages.
b	Architectural work group, there are 45 types of work and 137 work packages.	The architectural workgroup contains 35 types of work and 75 work packages.	The architectural workgroup contains 12 types of work and 33 work packages.
c	The mechanical workgroup contains 40 types of work	The mechanical workgroup contains 26 types of work and 43	The mechanical work group consists of 4 types of work and 4 work packages.

No.	Building WBS Components (Initial)	WBS Components for Operational and Maintenance Work of Flats	WBS Components of Operational and Maintenance Work of EDGE-Based Flats
	and 80 work packages.	work packages.	
d	The electrical work group consists of 4 types of work and 42 work packages.	The electrical work group consists of 4 types of work and 30 work packages.	There are 2 types of electrical work and 3 work packages in the electrical work group,
e	The landscape work group consists of 12 types of work and 27 work packages.	The landscaping work group consists of 11 types of work and 19 work packages.	The landscaping work group contains 1 type of work and 2 work packages.
f	The housekeeping job group consists of 8 types of work and 20 work packages.	The housekeeping job group consists of 7 types of work and 12 work packages.	---

Building components that need to be maintained and operated based on EDGE certification

From the results of the RQ 1 answers, for components that can be improved to increase the effectiveness and efficiency of time and costs, a sorting of components that can be maintained only, operated only, maintained and operated or not both are carried out. Data collection through questionnaires to 5 respondents/experts from apartment managers.

Table 3
Categorization of assessment components

No.	Komponen Penilaian	Kategori
1	EEM02, EEM03, EEM05, EEM07, EEM 08. MEM03, MEM04, MEM 09.	Dapat dipelihara saja
2	WEM 13 dan WEM 18.	Dapat dioperasikan saja
3	EEM22, EEM23, EEM24, EEM33. WEM01, WEM02, WEM03, WEM04, WEM05, WEM08, WEM14, WEM15, WEM17.	Dapat dipelihara dan dioperasikan
4	EEM29, WEM11, MEM10.	Tidak dapat dipelihara dan dioperasikan

BIM Model Based on WBS and Building Components Based on EDGE Certification

There are 18 WBS building components based on EDGE Certification in the BIM model, then a questionnaire was distributed to 3 (three) experts with EDGE Expert competency and BIM experience in answering which components can be developed in operational work only, maintenance only, or both or neither.

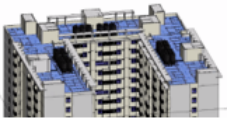
No.	Komponen Bangunan WBS berbasis EDGE *Certification*			Dalam Rangka Pengembangan Model BIM, maka Komponen Bangunan WBS berbasis EDGE *Certification* ini termasuk pekerjaan:						Hasil
				Pakar 1		Pakar 2		Pakar 3		
	WBS Level 3	WBS Level 4	Kode EDGE	Operasional	Pemeliharaan	Operasional	Pemeliharaan	Operasional	Pemeliharaan	
	WBS Level 2	Struktur (X.3.1)								
1	Plat Lantai (X.3.1.5) 	Plat Lantai Beton Konvensional (X.3.1.5.1)	- MEM01 - MEM02	✓			✓	✓		Operasional
2	Atap (X.3.1.8) 	Atap Plat Beton Konvensional (X.3.1.8.1)	- MEM04 - EEM03 - EEM04	✓			✓	✓		Operasional

Figure 4. BIM Model Analysis Process Based on WBS and Building Components Based on EDGE Certification

Based on the analysis results, it is known that 16 building components based on WBS and based on EDGE Certification can be developed in the BIM model of operational and maintenance work and 2 building components based on WBS and based on EDGE Certification can only be developed in operational work.

Table 4
BIM Models that can be developed in operational and maintenance work

No.	EDGE Certification based WBS Building Components			Building Components of EDGE Certification based BIM Model can be developed in the following work.
	WBS Level 3	WBS Level 4	EDGE Code	
	WBS Level 2	Structure (X.3.1)		
1	Floor Plate (X.3.1.5)	Conventional Concrete Floor Plates (X.3.1.5.1)	MEM01, MEM02	Operational
2	Roof (X.3.1.8)	Conventional Concrete Slab Roof (X.3.1.8.1)	MEM04, EEM03, EEM04	Operational
	WBS Level 2	Architecture (X.3.2)		
3	Floor (X.3.2.5)	Floor Hardener (X.3.2.5.1)	WEM03	Operation and Maintenance
4	Walls (X.3.2.7)	Exposed Concrete Walls (X.3.2.7.1)	EEM01, EEM03, MEM05, MEM06	Operation and Maintenance
5	Doors (X.3.2.11.1)	Aluminum Frame Glass Door (X.3.2.11.3)	EEM09, MEM07, MEM08	Operation and Maintenance
6	Window Door (X.3.2.12)	Aluminum Frame Glass Window Door (X.3.2.12.1)	EEM01, EEM09, MEM07, MEM08	Operation and Maintenance
7	Windows (X.3.2.13)	Aluminum Frame Glass Window (X.3.2.13.1)	EEM01, EEM09, MEM08	Operation and Maintenance
8	Toilet (X.3.2.16)	Sitting Toilet	WEM04, WEM05	Operation and Maintenance

No.	EDGE Certification based WBS Building Components			Building Components of EDGE Certification based BIM Model can be developed in the following work.
	WBS Level 3	WBS Level 4	EDGE Code	
		(X.3.2.16.1)		
9	Urinal (X.3.2.19)	Urinal (X.3.2.19.1)	WEM07	Operation and Maintenance
10	Tap (X.3.2.22)	Wall Tap (X.3.2.22.1)	WEM02, WEM03, WEM08	Operation and Maintenance
11	Shower (X.3.2.25)	Shower (X.3.2.25.1)	WEM01	Operation and Maintenance
12	Roof Insulation (X.3.2.31)	Aluminum Foil (X.3.2.31.1)	EEM05, MEM09	Operation and Maintenance
13	Roof Layer (X.3.2.32)	Waterproof Membrane Concrete Roof (X.3.2.32.1)	EEM03	Operation and Maintenance
14	Canopy (X.3.2.44)	ACP Canopy (X.3.2.44.1)	EEM04	Operation and Maintenance
	WBS Level 2	Mechanical (X.3.3)		
15	WTP (X.3.3.30) and STP (X.3.3.31)	WTP (X.3.3.30.1)	WEM15	Operation and Maintenance
16		STP (X.3.3.31.1)	WEM15	Operation and Maintenance
	WBS Level 2	Electrical (X.3.4)		
17	Electrical Load (X.3.4.3)	Lighting System LED Light (X.3.4.3.2)	EEM22, EEM23	Operation and Maintenance
18		Lighting Control System (Time Sensor) (X.3.4.3.7)	EEM24	Operation and Maintenance

Information System for Operational and Maintenance Work Based on BIM and EDGE Certification

From the results of the answers to RQ 1, 2, 3 and 4, the development of an operational and maintenance work information system for flats was carried out and an assessment of the information system that had been developed was carried out on 5 respondents who were flat managers (potential users). The assessment analysis used RII with Likert scale data 1-4.

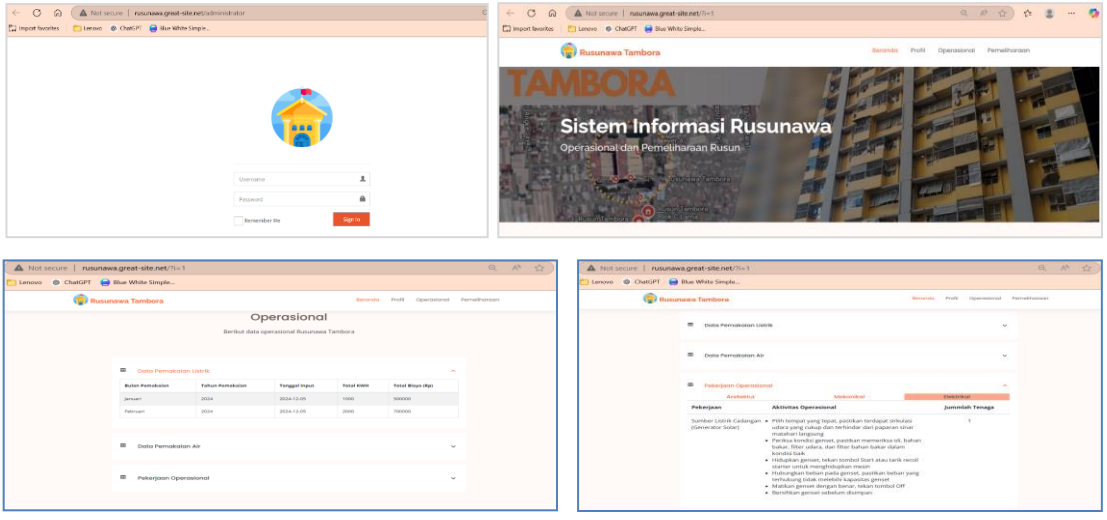


Figure 5. Display of information system development on the integration of EDGE Certification, BIM, and WBS implementation in operational and maintenance work of flats in DKI Jakarta Province

Table 5
Information system assessment on the integration of EDGE Certification, BIM, and WBS implementation in operational and maintenance work of flats in DKI Jakarta Province

No	Statement	Y	Results
1	**Hardware**		
	Because it is in the form of a website, accessing the information system for operational work and maintenance of flats does not require high-specification hardware.	0.7	Does not require high-specification hardware.
2	**Software**		
a	The information system of operational and maintenance work is simple enough to support the operation of the system.	0.75	Simple.
b	The information system has a quick response with complete features in meeting the needs of operational information and maintenance of flats.	0.7	Fast Response
c	The information system has an attractive design and color composition so that it supports its use in the operational and maintenance work of flats.	0.75	Attractive design
3	**Database**		
a	The data in the information system is organized and stored in a structured manner so that it is easy to access and manage.	0.75	Easy to access and manage.
b	The information system can provide clues/guidelines in the operational and maintenance work of the flat.	0.9	Very helpful in providing clues/guidelines
c	The information system can contain the chronology of the operation and maintenance of flats.	0.7	Contain the chronology of the operation and maintenance
d	The information system helps in scheduling operational work and maintenance of flats.	0.7	Helps in scheduling operations and maintenance
4	Network		
	The use of information systems is highly dependent on adequate networks.	1	Very highly dependent on adequate networks.
5	**Procedure**		
a	The data collection procedures, data processing process, and overall governance are easy to understand and implement.	0.7	Easy to understand
b	Navigation in the information system is easy to understand so it is easy to use.	0.75	Easy to understand so it is easy to use
6	**People**		
	The use of information systems does not require human/personal resources with special competencies.	0.7	Does not require human/personal resources with special competencies

The Influence of the Relationship between EDGE Certification, BIM, WBS and Information Systems in Increasing the Effectiveness and Efficiency of Time and Cost in Operational and Maintenance Work of Flats in DKI Jakarta Province

In answering RQ 6, questionnaires were distributed to 63 respondents involved in the operation and maintenance of flats, with 30 questions. After the data was collected, a series of tests were carried out where the results of the data adequacy test, the data was considered sufficient. In the normality test, it was found that the data was not normally distributed. The homogeneity test based on the origin of the respondents, level of education and work experience, obtained homogeneous data. The results of the reliability test produced a Cronbach's Alpha value of 0.95, greater

than 0.6 indicating that the research questionnaire was reliable. Then a correlation test was carried out and the relationship between variables was obtained.

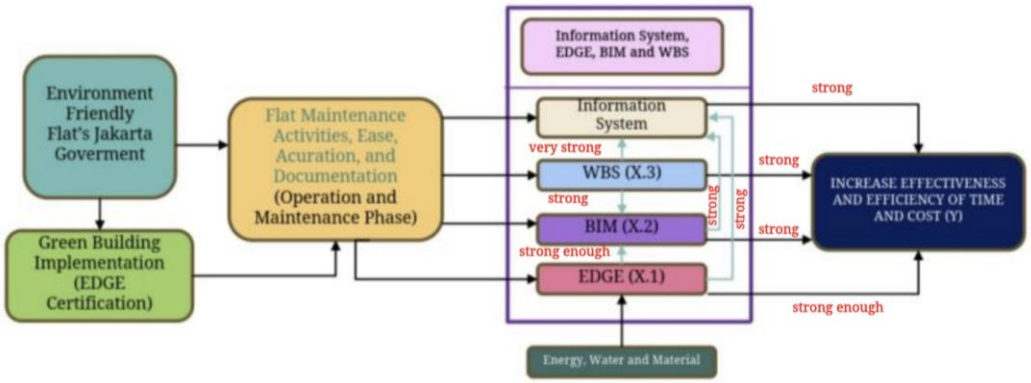


Figure 6. Influence of relationships between variables in research

The results of the factor analysis test stated that the maximum number of factors that can be formed is only 1. Then a multiple linear regression analysis was carried out to find the equation Y = 1.208 + 0.089 X1 + 0.322 X2 + 0.499 X3 – 0.161 X4. Based on these results, it can be concluded:

1) The constant value of 1.208 indicates that if all independent variables (X) have a value of zero, then the Effectiveness and Efficiency of Time and Cost has a value of 1.208;
2) The regression coefficients of 0.089, 0.322, 0.499, and -0.161 represent the influence of each independent variable (X1, X2, X3, X4) on the dependent variable (Y). These coefficients show the change in Y due to a one-unit change in each independent variable, assuming the other variables remain constant;
   - The coefficient of 0.089 X1 means that if X.1 increases by one unit, then Y will increase by 0.089, assuming X.2, X.3, and X.4 remain unchanged.
   - The coefficient of 0.322 X2 indicates that if X.2 increases by one unit, Y will increase by 0.322, assuming X.1, X.3, and X.4 remain constant.
   - The coefficient of 0.499 X3 indicates that if X.3 increases by one unit, Y will increase by 0.499, assuming X.1, X.2, and X.4 remain unchanged.
   - The coefficient of -0.161 X4 indicates that if X.4 increases by one unit, Y will decrease by 0.161, assuming X.1, X.2, and X.3 remain constant.
3) Each coefficient reflects the contribution or influence of each independent variable on the dependent variable (Y).

The negative value of the coefficient X.4 (Information System) is interpreted as the presence of other reduction factors, such as the relatively large implementation costs and the need for training in information system management as well as adaptation of reporting and monitoring with the information system.

4 Conclusion

The condition of flats in DKI Jakarta Province that have not been EDGE certified still do not meet the EDGE assessment / green building concept. Currently there is no SOP for maintenance or care work. The development of an information system on the integration of the application of EDGE Certification, BIM and WBS in operational and maintenance work of flats in DKI Jakarta Province can increase the effectiveness and efficiency of time and costs. However, in its implementation it needs to be supported by adequate resources.

Conflict of interest statement
The authors declared that they have no competing interest.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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In addition to operational and maintenance work, the use of information systems in the management of flats can also be integrated into maintenance work in order to optimize building utilization services. The development of information systems can also be improved by adding alarm connectivity or notifications according to the maintenance work schedule according to the guidelines that have been prepared.

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