Modeling the Implications Green Retrofitting River Conservation was Validated using (SEM) Analysis

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ABSTRACT

According to the 2015 United Nations Framework Convention on Climate Change (UNFCCC), reducing CO2 in the atmosphere is essential to reduce related environmental problems, considering the increasing demand for air due to climate change. Carbon capture and sequestration is an attractive method for reducing carbon dioxide (CO2) emissions from the atmosphere. However, in some places, agricultural landscapes face problems due to air resources. Trees play a very important role in the fight against climate change. They pollute the air, stop landslides, absorb CO2 and some air pollutants, and absorb phosphate and nitrate runoff. Ten main elements, ordered from least to most important, were identified using research techniques that combine SEM-PLS to process survey data and find the most influential components. River conservation verification in Envision has the greatest impact. According to this research, the following things influence the implementation of green retrofits on green rivers: energy savings; emission reduction; use of the latest energy; the existence of an environmentally friendly green river program; cost planning and design; project feasibility studies; material costs; and use of the latest technology. It is hoped that the results of this research will increase public awareness and concern regarding the implementation of environmentally friendly green rivers as an effort to make rivers greener and more natural, reduce operational costs, and provide comfort for the community.

Keywords: conservation; SEM-PLS; cost performance; cost efficiency; green retrofitting.

INTRODUCTION

Greenhouse gas (GHG) emissions, which also have an impact on global climate change (Habib & Al-Ghamdi, 2021), are the direct cause of global warming. The rising concentrations of greenhouse gases, particularly carbon dioxide (CO2), in the atmosphere are leading to a degradation in the climate's condition. The United Nations Climate Conference (UNFCCC, 2015) states that it is imperative to decrease atmospheric CO2 levels to mitigate associated environmental challenges. Biodiversity suffers from high CO2 levels. The main strategy for reducing CO2 levels in urban environments is to alter land use, as both urban forests and original or old urban vegetation (Sarkar et al., 2023) successfully contribute to urban sustainability.

The use of environmentally friendly river conditions has seen several advancements, including the introduction of several criteria that address what constitutes environmentally friendly river conditions. Criteria that can serve as a guide during the implementation process are necessary when adopting an ecologically friendly condition. Another way to think of Green River is as an environmentally friendly river application in spatial planning. This method can provide technical support in regional infrastructure planning (Lee et al., 2021), River landscaping is environmentally benign, meaning that rivers do not damage the ecosystem and do not affect the natural cycle of materials in the environment. The extent of the environmental harm caused varies depending on how Green River and the convention are implemented.

The feasibility study delineated above aims to validate the system's principle (Maries et al., 2020) and Effective Project Management (Syafrimaini & Husin, 2021) Envision understands that achieving sustainability necessitates a thorough renovation of the current infrastructure, substituting outdated components with new ones. To ascertain the viability of expenditures aimed at enhancing sustainable performance, an economic study has been conducted (Nahwani & Husin, 2021)

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Adopting novel and cutting-edge strategies, techniques, and technologies that raise the bar for performance in one or more sustainability-related areas leads to improvements. Three areas of innovation are recognized and praised by Envision; these categories are not exclusive of one another.

RESEARCH METHODS

Materials

Software selection

This study seeks to investigate the implementation of ecologically sustainable solutions, such as the utilization of Environmental Site Design (ESD) or green infrastructure, in both public and private sector projects focused on Green rivers, addressing a previously identified research gap (Sutikno et al., 2022). The primary outcomes of this investigation encompass (a) identification of the key factors linked to green rivers (private/public) by means of semi-structured interviews following an extensive literature review, and (b) examination of the relationship between delay factors and response criteria, as well as their interconnection with other factors, in order to construct a Structural Equation Model (SEM) (Santana & Maués, 2022). The findings suggest the implementation of a risk response mechanism to mitigate excessive expenses or minimize costs related to the design idea.

One type of confirmatory model analysis that examines the degree of variation between the covariance matrix in the sample data and the covariance matrix in the structural model is the structural equation model. Figure 1 displays the structural equation model's analysis steps. In this part, we use the structural equation model to study the phenomenon of cyber-violence. First, the observable variables and latent variables are identified in accordance with the issues with the questionnaire design, and the path diagram of the structure model is created. The structural model's confirmatory factor analysis is next performed to make sure the fitting

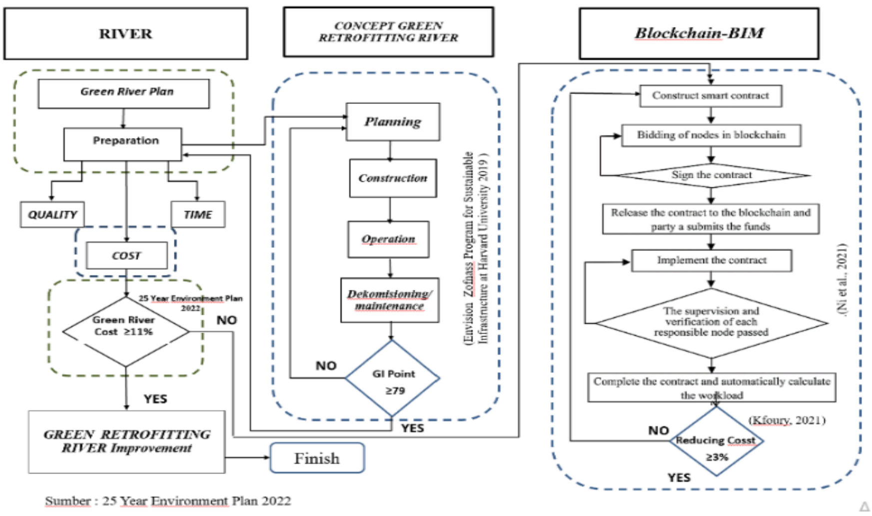

Figure 1. Research Flow Analysis

This study collects primary data through an audit or verification process to evaluate the suitability of existing buildings with green river requirements. The preliminary data reflects the degree of compliance with Harvard University's Envision(Shivakumar et al., 2014) Guidelines. At this stage, providing important evidence about the impact of validating the information model on developing an integrated delivery environment, data usage starts from secondary data available within the company, such as energy production and consumption data. In addition, secondary data in the form of project documents such as planning drawings, Bills of Quantity(Ye et al., 2020), and facility operational data will also be used.

In addition, we will conduct interviews to gain a deeper understanding. Using this tool, we aim to identify the main factors and sub-factors affecting our study's cost efficiency. SMART PLS is a widely used and well-known software for data analysis in scientific research.

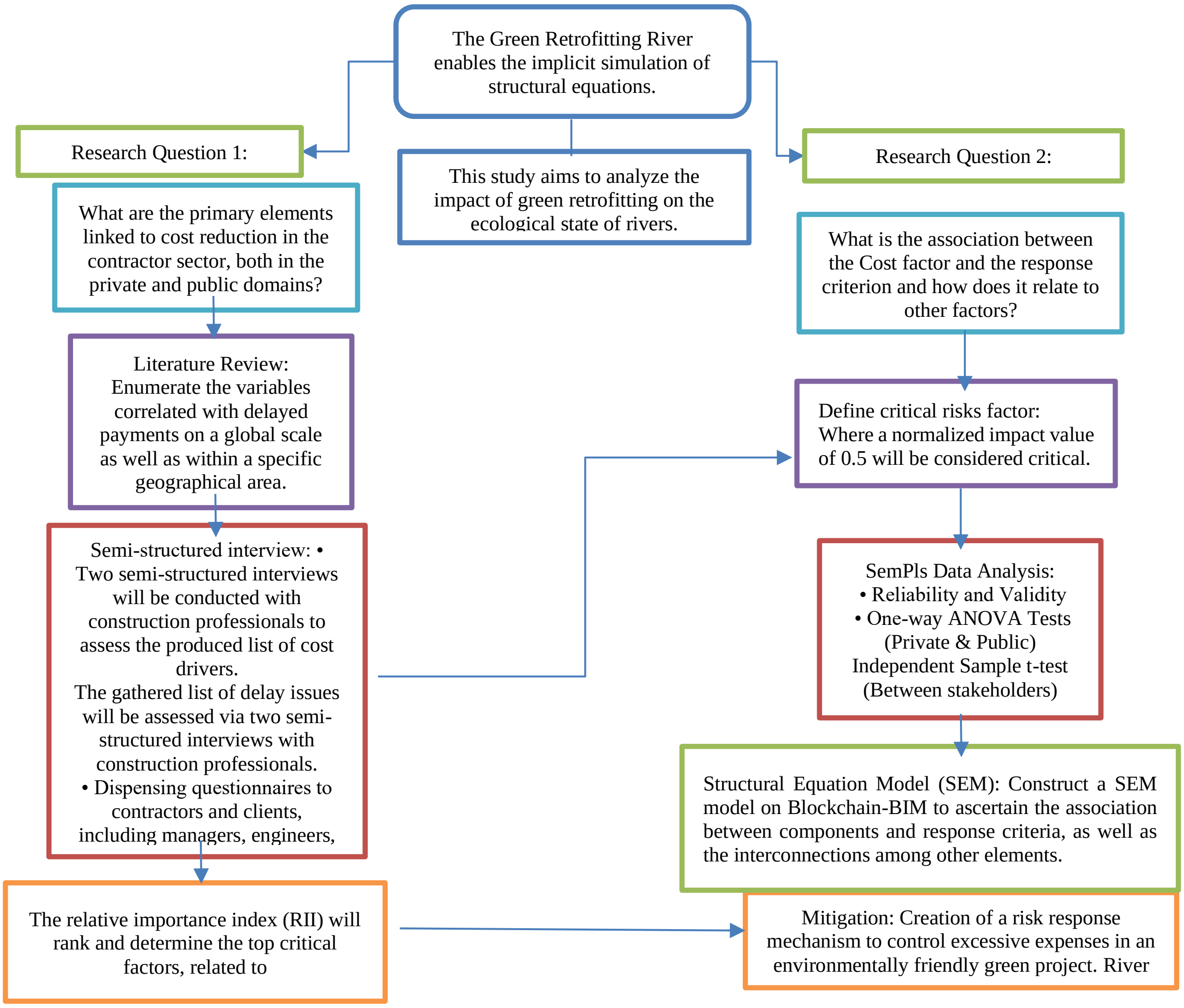

Figure 2. Workflow of the study

The data processing and analysis method using SEM-PLS can be seen in the flowchart in Figure 2. The result of this data processing is a model that shows the influence of the independent variable The PLS (Partial Least Squares) method employs a three-stage methodology, consisting of a principal component approach, a projection or regression approach, and a measurement approach. When conducting SEM-PLS analysis (Hossan et al., 2020), it is important to take into account various factors in order to determine the suitable sample size. These factors include missing values, data distribution, and the scale of measurement of the variables being analyzed. Additionally, it is crucial to test theoretical hypotheses regarding the relationship between the factors that are identified. Researchers must ensure that the data used fulfills the prerequisites for SEM-PLS modeling(Al-emran & Mezhuyev, 2018). Researchers must also take into account the existence of partial observations (missing values) in the data. Furthermore, it is advisable to employ a measurement scale that surpasses the nominal scale when quantifying endogenous latent variables in order to guarantee the model's proper identification.

Methods

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In this research, the data collection process was then carried out using research tools. The steps above are carried out before the conversation takes place. This research requires a comprehensive examination of the existing literature to gather various aspects relevant to the investigation. With the use of this instrument, our goal is to pinpoint the main elements and subfactors that influence cost efficiency. The aim of our research is to identify the main characteristics that have a major impact on the implementation of cost efficiency in retrofits. Green River's environmental friendliness was assessed using Blockchain-Building Information Modeling (BIM) technology, as shown in Table 1 for the Green Building variable (X1). Tables 2 and 3 represent factors X2, In the initial stages of research, the factors that provide impact are related to Rivers (X1), Green Retrofitting (X2), Blockchain-BIM (X3), and Variable Costs (Y).

Table 1. Assessing the performance of the use stage in retrofitting a specific region based on the Envision Harvard University of 2019.

No.	Criteria	Point	No.	Criteria	Point
1	Enhance the overall well-being and satisfaction of the community	1	27	Demonstrate proficient leadership skills and unwavering dedication	1
2	Promote and foster sustainable growth and development	1	28	Implement a comprehensive strategy for managing sustainability	1
3	Foster the growth of skills and capacities at the local level.	1	29	Promote synergy and cooperation among individuals to enhance collaborative efforts and foster effective teamwork.	1
4	Improve the well-being and security of the general population	1	30	Facilitate stakeholder engagement	1
5	Reduce the level of noise and vibration to a minimum.	1	31	Explore potential chances for by-product synergy.	1
6	Reduce the amount of artificial light that causes pollution	1	32	Enhance the integration of infrastructure	1
7	Enhance the overall well-being and satisfaction of the community	1	33	Develop a strategy for extended surveillance and upkeep	1
8	Promote and foster sustainable growth and development	1	34	Resolve contradictory regulations and policies	1
9	Foster the growth and proficiency of skills and competencies within the local community.	1	35	Conserve the essential functioning of floodplains.	1
10	mprove the well-being and security of the general population	1	36	Prevent inappropriate construction on steep inclines	2
11	Reduce the level of noise and vibration to a minimum	1	37	Conserve undeveloped land	1
12	Reduce the amount of light pollution	1	38	Oversee the control and treatment of rainwater runoff	1
13	Demonstrate proficient leadership skills and unwavering dedication	1	39	Minimize the negative effects of pesticides and fertilizers	2
14	Implement a comprehensive strategy for managing sustainability	1	40	Mitigate the pollution of both surface and groundwater	1
15	Promote the cultivation of cooperation and synergy among individuals	1	41	Conserve and protect the diversity of species	1
16	Facilitate stakeholder engagement	1	42	Manage and regulate the spread of invasive species	1
17	Explore potential for by-product synergy opportunities	1	43	Rehabilitate disrupted soil conditions	1
18	Enhance the integration of infrastructure	2	44	Preserve the hydrological functioning of wetland surfaces	1

No.	Criteria	Point	No.	Criteria	Point
19	Develop a comprehensive strategy for the ongoing surveillance and upkeep of the project.	1	45	Minimize the release of greenhouse gases	1
20	Resolve contradictory regulations and policies	1	46	Minimize the release of harmful gases into the atmosphere.	1
21	Prolong the duration of practical usefulness	1	47	Evaluate the risk posed by climate change.	1
22	Minimize the overall amount of energy used in the production and transportation of goods and materials.	2	48	Steer clear of pitfalls and susceptibility.	1
23	Promote and advocate for the implementation of sustainable procurement practices.	2	49	Get ready for the ability to adjust and thrive over an extended period of time.	1
24	Utilize reclaimed or repurposed materials.	2	50	Get ready for immediate dangers	2
25	Utilize locally sourced materials	1	51	Mitigate the impacts of heat islands	1
26	Redirect refuse away from disposal sites	1			

Table 2. Variables Blockchain-BIM

No.	Sub-factor	Source	No.	Sub-factor	Source
1	Specifications for the project	(Pedroza, 2019)	8	Transactions on the blockchain	(Pedroza, 2019)(Kfoury, 2021)
2	Reliable data	(Pedroza, 2019), (Baig & Wang, 2019)	9	Sources of data on the blockchain	(Pedroza, 2019)(Kfoury, 2021)
3	Occupation or job position in a specialized field	(Pedroza, 2019)	10	Bitcoin blockchain	(Pedroza, 2019)
4	Confidential data	(Pedroza, 2019), (Akbarieh et al., 2021)	11	Utilization of blockchain field of (BIM)	(Kfoury, 2021)(Sreckovic & Sibenik, 2021)
5	Specifications for the integration of blockchain technology with (BIM)	(Pedroza, 2019), (Li et al., 2022)	12	Adoption of blockchain technology in the field of (BIM)	(Kfoury, 2021)(Sreckovic & Sibenik, 2021)
6	Verification of Blockchain	(Pedroza, 2019)	13	Integration of BIM Level on Blockchain	(Pedroza, 2019)
7	Transparency in Blockchain Technology	(Pedroza, 2019), (Kfoury, 2021)			

Table 3. Cost Variables (Y)

No	Sub-factor	Source	No	Sub-factor	Source
1	Material costs	(Albtoush et al., 2020)(Salam, 2019)	4	Corporate Social Responsibility Costs	(Salam, 2019)
2	Labor costs	(Albtoush et al., 2020)(Salam, 2019)	5	Fluctuations in Cost of Production	(Salam, 2019)
3	Equipment costs	(Albtoush et al., 2020)(Salam, 2019)	6	Environmental costs	(Salam, 2019)

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RESULT AND DISCUSSION

Research questionnaires were distributed to 109 participants, which meets the minimum requirement of 86 respondents for statistical analysis. The respondent data consists of the information collected from the participants:

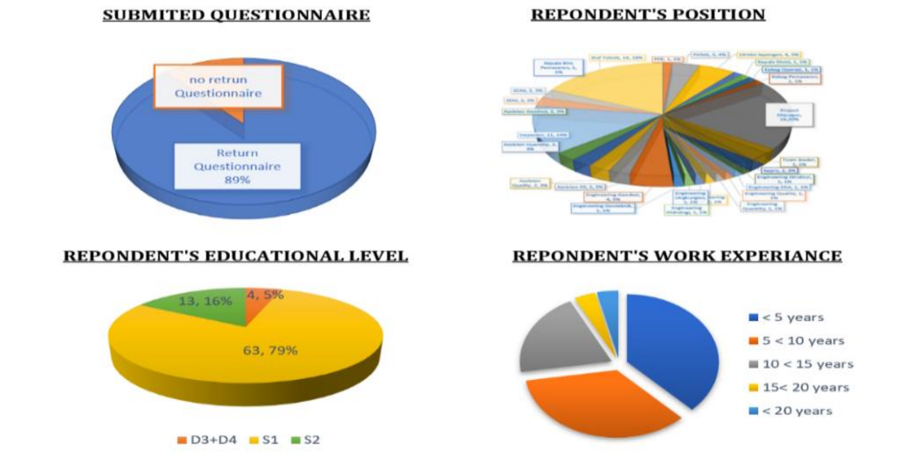

Figure 3. Respondent Data

The research questionnaire was distributed to 109 participants, which met the minimum requirement of 86 respondents for statistical analysis. In the respondent data, Figure 3 below consists of information collected from participants: Based on the data collected, 89% of respondents returned, 11% did not, as shown in Figure. Respondents are included in the age group < 5 years, 37% are included in the age group 5 < 10 years, 35% are included in the age group 10 < 15 years 20%, age 15 < 20 years 4%, and age < 20 years 4%, as seen in the picture. In addition, 38% of respondents had experience < 5 years, 5 < 10 years 35%, 10 < 15 years 20%, 15 < 20 years 4% and more than < 20 years 4%. Most respondents (79%) have a bachelor's degree, while the rest have a combination of Diploma, Bachelor's Degree, and Master's degree as their highest level of education. Most of the sample worked full time and belonged to small to medium-sized companies with 4-13 employees.
To ensure that the data population is accurately targeted, determining the population is not solely based on the population size but also involves validation from experts. This is done to ensure that the targeted population(Gong et al., 2015) aligns with the research objectives. After data collection, the gathered data is examined and grouped based on variables such as education, job position, and project experience. This is crucial to appropriately direct the questionnaire(Wang et al., 2015) to relevant respondents, thereby obtaining valid data.

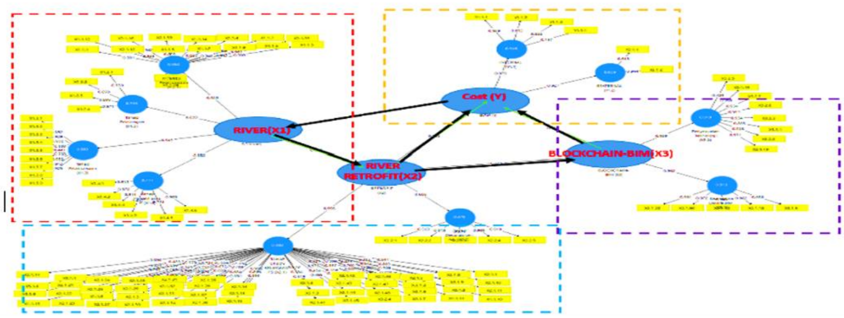

Figure 4. Structural Model and Path Model of Relationships between Latent Variables Source: Processed SEM-PLS Results, 2023

Assessment of Measurement Models (Bootstrapping - Inner Loading) Check for statistical T coefficients to see if the study hypothesis is supported. When using the Calculate PLS Bootstrapping command, the output of SEM-PLS yields T Statistics, as illustrated in Figure 4. The 109 sub-factors that have been examined can be used to determine which factors are the most significant based on the tested questionnaire data. Testing the collinearity between the constructs and the model's predictive capacity is the first stage in assessing a structural model. Next, the effect size (f2), path coefficients, cross-validation redundancy (Q2), and coefficient of determination (R2) are used. If Q2 > 0, then the observation reconstruction has a high value.Q2 < 0 denotes that the model has no predictive relevance [23], and the model has predictive relevance. It is necessary to assess the path coefficient's estimated value in the structural model for path correlation in terms of the correlation's strength and significance (P value < 5% and T Statistic > 1.96).

Table 4. The Most Influential Main Factor

No	Factor	R Square
1	Feasibility Study Stage (X2.1)	0.992
2	Internal (Y1.1)	0.946
3	Technology Adjustment (X3.2)	0.919
4	Implementation Stages (X1.3)	0.893
5	Planning Stages (X1.2)	0.862
6	Exsternal (Y2.1)	0.859
7	BIM Reliability (X3.1)	0.813
8	Cost (Y)	0.810
9	Maintenance Stages (X1.4)	0.777
10	Auction Stage (X1.2)	0.738

The initial step is the computation of the SEM-PLS program as described by Deng et al. (2021). Convergent Validity analysis pertains to the extent to which a measure demonstrates a positive correlation with other measures that assess the same construct. The assessment methodologies utilized include composite reliability and Cronbach's alpha (Maydeu-Olivares et al., 2019). Reliability levels ranging from 0.6 to 0.7 are regarded as indicative of good reliability, as stated by Latief et al. (2023). The Cronbach's alpha coefficient is employed to assess the internal consistency of the scales, yielding reliability values for all variables. The study concludes that the total scale utilized has a value over 0.6, indicating satisfactory reliability. All indicators with outer loading values greater than 0.5, as shown by the outer loading validity value, demonstrate convergent validity, as evidenced by the Average Variance Extracted.

Table 5. Results of Construct Reliability Examination based on Convergent Validity

Main Factor	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
1.Cost (Y)	0.922	0.928	0.939	0.722
2.Blockhcain-BIM (X3)	0.963	0.967	0.968	0.705
3.External (Y1.2)	0.883	0.884	0.945	0.895
4.Green River Retrofit (X2)	0.982	0.984	0.983	0.528
5.Internal (Y1.1)	0.882	0.888	0.920	0.742
6.Reliability In BIM (X3.1)	0.944	0.948	0.960	0.831
7.Technology Adjustment (X3.2)	0.958	0.972	0.967	0.791
8.Feasibility Study Stage (X2.1)	0.983	0.986	0.984	0.564
9.Decomisioning Stage (X2.2)	0.824	0.894	0.878	0.603
10.Implementation Stage (X1.3)	0.937	0.956	0.950	0.689
11.Auction Stage(X1.2)	0.821	0.850	0.879	0.649
12.Maintenance Stage (X1.4)	0.895	0.933	0.922	0.674
13.Planning Stage(X.2.1)	0.989	0.990	0.990	0.857
14.River (X.1)	0.982	0.984	0.983	0.636

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Each construct in Table 2 has a Cronbach alpha value beyond 0.7, indicating that the necessary conditions have been satisfied. Therefore, it can be inferred that each construct is viable. For instance, a latent variable is deemed dependable if its Cronbach alpha coefficient is 0.992 for the Cost (Y) variable. The findings of SEM PLS data processing are presented in Figure 5, where the analysis includes Cronbach Alpha reliability and validity assessment.

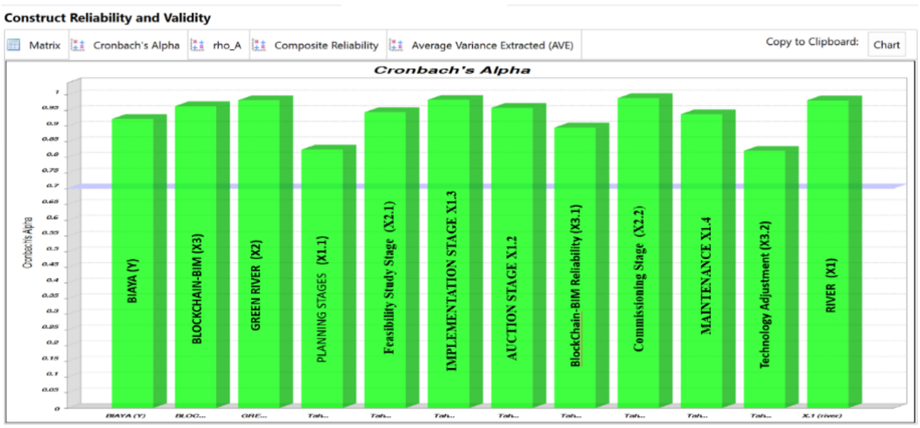

Figure 5. Outer loading validity Test-Cronbach

Subsequently, it is necessary to search for the T statistical coefficient and P value in order to evaluate the hypothesis. The bootstrapping command yields a T statistic value of > 1.96, indicating a meaningful association. Figure 6 displays the outcomes of the P-value examination for the loading factor and path coefficient.

Specific Indirect Effects

Mean, STDEV, T-Values, P-Values | Confidence Intervals | Confidence Intervals Bias Corrected | Samples | Copy to Clipboard:

	Origin...	Sampl...	Standa...	T Stati...	P Values
X.1 (river) -> GREEN RIVER RETROFIT (X2) -> Tahap Operasi (X2.1)	0.855	0.855	0.031	27.443	0.000
GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3) -> Tahap Operasi (X2.1.)	0.591	0.588	0.067	8.802	0.000
GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3) -> Tahap Operasi (X.2.1)	0.556	0.553	0.062	8.914	0.000
X.1 (river) -> GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3)	0.529	0.526	0.061	8.636	0.000
X.1 (river) -> GREEN RIVER RETROFIT (X2) -> Tahap Maintenance (X2.2)	0.522	0.528	0.050	10.370	0.000
X.1 (river) -> GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3) -> Tahap Operasi (X2.1.)	0.507	0.504	0.060	8.456	0.000
GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3) -> BIAYA (Y)	0.500	0.497	0.067	7.448	0.000
X.1 (river) -> GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3) -> Tahap Operasi (X.2.1)	0.477	0.475	0.056	8.506	0.000
X.1 (river) -> GREEN RIVER RETROFIT (X2) -> BLOCKCHAIN-BIM (X3) -> BIAYA (Y)	0.429	0.427	0.060	7.183	0.000

T – Statistic(>1.96) & P – Value(<0.05) → Significant

Figure 6. T Statistic and P Value Results

The ten influential factors are sorted into the greatest, where the most influential factor is Envision's validation, shown in Table 6 below.

Table 6. The Most Influential Sub Factor (Significant)

No	Sub Factor		Original Sample Value	Mean	T.Statistic > 1.96 (p < 0.05)	R Square
1	Pollutant emission	X2.1.50	0.972	0.973	131.169	0,992
2	Greenhouse gas emissions	X2.1.49	0.971	0.970	81.222	

3	Specification	X3.1.5	0.970	0.965	186.896
4	Blockchain data sources	X3.2.4	0.965	0.965	70.077
5	Project requirements	X3.1.1	0.964	0.966	157.585
6	Term Of Reference (TOR)	X1.1.7	0.963	0.964	102.194
7	Professional role	X3.1.3	0.962	0.962	73.75
8	Financing Planning (Budget)	X1.1.5	0.962	0.963	100.104
9	Maintenance Operation Plan	X1.4.1	0.961	0.961	59.123
10	Manage the heat island effect	X2.2.5	0.959	0.959	78.159

DISCUSSION

This research was conducted in Bekasi Regency, West Java Province, Indonesia (Fig. 7). This location was selected based on environmentally friendly green river management issues

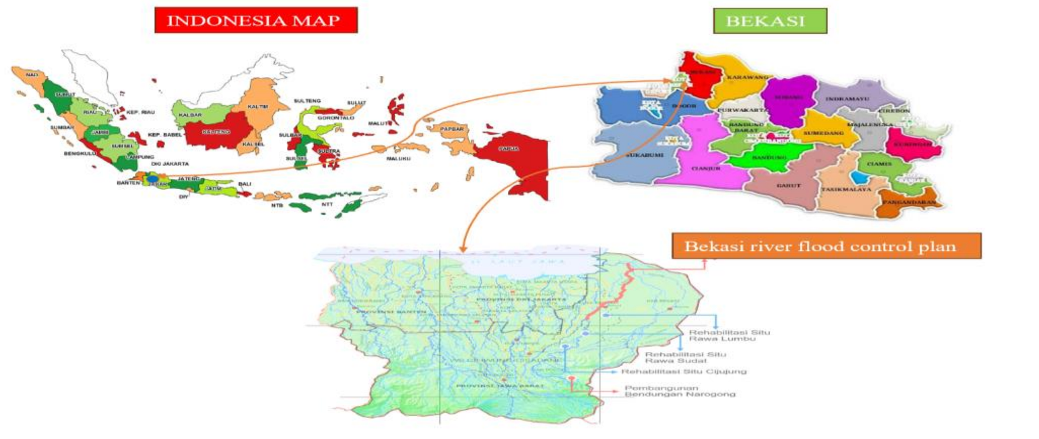

Figure 7. Geographic location of the study area in Bekasi Regency, Indonesia

This study collects primary data through an audit or verification process to evaluate the suitability of existing buildings with green river requirements. The primary data reflects compliance with Harvard University's Envision (Shivakumar et al., 2014) Guidelines. At this stage, providing important evidence about the impact of validating the information model on developing an integrated delivery environment(Chadee et al., 2023), data usage starts from secondary data available within the company, such as energy production and consumption data.

CONCLUSION

This study employs Structural Equation Modeling (SEM) to investigate the influence of climate change costs on the environmentally sustainable Green River conservation across the entire project life cycle. This particular component has been overlooked by earlier studies. This study is distinctive as it aids construction researchers and stakeholders in assessing the magnitude of the effects caused by factors that exert the most significant influence on River conservation. It is crucial to prioritize the use of environmentally friendly practices and promote green awareness throughout the whole lifecycle of the project, including design, building, and operations. Specifically, the operations phase is considered to be greatly influenced by the (SEM) of PLS, necessitating significant measures to be taken by stakeholders in order to increase awareness. Furthermore, this study is the initial endeavor to construct a quantified model for assessing the Factor impact of Harvard University's ENVISION method on awareness (SEM) throughout the entire project life cycle. This model will be valuable for policy makers in formulating a suitable framework for the adoption of Envision's eco-friendly green river concept. This paradigm will be beneficial for stakeholders, including client consultants

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and contractors, in implementing Envision in their projects. Additionally, the framework derived from this research can greatly facilitate the implementation of Envison in other poor nations with similar construction project practices. However, this study provides significant insights for managers and contributes empirical evidence to the development of environmentally sustainable green rivers. The consequences and contributions are outlined below: 1) Conceptual and Empirical Contributions, (a) the research adds conceptually by identifying and defining new factors, such as the impact of implementing green river on Envision use and awareness worldwide project life cycle, (b) the study's findings provide a substantial prediction tool (PLS-SEM) for the first time to address the influence of never-before-tested elements influencing the use and idea of Envision in Sustainability Infrastructure projects across the project life cycle. 2) Managerial Implications, (a) this provides a significant motivator for building enterprises to address climate change and global warming worldwide, (b) help clients, contractors, and consultants with assessments at every stage of the project's life cycle to enable wise decision-making when the project is being carried out, (c) Provide factual data that is relevant.3) Limitations and Future Research, (a) as a result, the government also contributes significantly to the nation's construction projects by raising the bar for laws and regulations about PLS-SEM.

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