Journal of Mechanical Engineering and Applied Technology, 2 (2) 2024, 51-58

IMPLEMENTATION OF VALUE FOR MONEY AT RISK ANALYSIS MODEL FOR GREEN BATCHING PLANT COST PERFORMANCE BASED ON NRMCA ASSESSMENT

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Abstract.

The current green concept trend in Indonesia is contributing to the advancement of sustainability across all industries, including the construction materials sector. The concrete business is crucial because it provides the fundamental components for concrete, which is a critical role it performs in the building process. Throughout the production process, ready-mix concrete has a very negative effect on the environment. Planning and constructing a green concept will be 10-20% more expensive than conventional development. Researchers will use the value for money (VfM)-at-risk analysis model technique to cost-effectively apply the concept of the green concrete industry to statistical analysis and case studies. To improve cost performance, this research updates the knowledge on the green concept for concrete industrial objects and searches for factors that affect its application using partial least square (SEM-PLS) analysis and green concept modeling based on the value for monet at risk analysis model. "10 factors that influence the performance of green costs in the concrete industry" were identified by the research, and they include the following: the risk analysis model, the planning stage, internal costs, production, value for money, the bidding stage, the implementation stage, product use, the operation stage, and maintenance. The application of the VfM-at-risk analysis model was able to increase the green cost performance by 8.66% with a return of 9 years and 2 months by gaining benefits as an environmentally friendly and sustainable concrete industry.

Keywords: *Green batching plant; Green concrete; SEM-PLS; Value for Money-at-Risk*

1. Introduction

Every nation's economy depends heavily on the building sector. Concrete batching plants are one of the key elements driving the growth of the construction sector, as construction has historically accounted for the majority of all jobs and made a significant contribution to the total gross domestic product of a nation (Ibrahim et al., 2022). The Green Construction concept is essentially an implementation strategy for construction that gives environmental friendly construction priority in terms of work methods, material use, equipment use, management, supervision, etc. Reducing material waste, reducing pollution during building, increasing energy efficiency, and reducing air use efficiency are the goals of the green construction concept (Thoengsal, 2024). This definition puts contractors in a position to minimize wasteful use of building materials, constantly improve the efficiency of the construction process during the construction period, and play a proactive role in safeguarding the environment (Fitriani et al., nd). The main objective of this study is to create a risk management model specific to public-private partnerships (PPP) construction projects assessing various risk management. strategies. Primary data was gathered using a thorough, organized questionnaire survey, as well as techniques that enhance the distribution of risks among project participants and the attainment of VFM in PPP projects (Li et al., 2001b).

The concrete industry will grow by 9.18% between 2021 and 2029, according to data (Maximize Market Research, 2023). In Indonesia, on the other hand, the Indonesia Construction Market Outlook (IMCO) 2023 projects that the total number of construction projects (building and civil projects, excluding oil and gas) will increase by 5.78% in 2023 over the previous year. This indicates that there is a growing requirement for various project materials, including concrete, sand, cement, and stone.

Ready-Mix Concrete Market				
Base Year	2021	**Forecast Period**	2022-2029	
Historical Data	**CAGR**	**Market Size in 2021**	**Market Size in 2029**	
2017 to 2021	**9.18%**	**US$ 491.53 Bn**	**US$ 992.42 Bn**	
Segments Covered				
by Production • Onsite • Offsite			**by Application** • Industrial utilities • Infrastructure • Commercial • Residential	
Regions Covered				
North America • United States • Canada • Mexico	**Europe** • UK • France • Germany • Italy • Spain • Sweden • Austria • Rest of Europe	**Asia Pacific** • China • S Korea • Japan • India • Australia • Indonesia • Malaysia • Vietnam • Taiwan • Bangladesh • Pakistan • Rest of APAC	**Middle East and Africa** • South Africa • GCC • Egypt • Nigeria • Rest of ME&A	**South America** • Brazil • Argentina • Rest of South America

Figure 1 Estimated Construction Material Needs

Indonesia agreed to reduce emissions by 32% based on Business As Usual (BAU) and 43% if there is cooperation with other countries by 2030 at the 2015 Climate Change Summit in Paris. The government of Indonesia is dedicated to promoting the green industry. Making concrete is one of the things that has an impact on the environment. It will support the government's promise if raw material usage, energy consumption, and adherence to Best Management Practices (BMP) for the manufacturing of concrete are reduced (Kashwani et al., 2014).

One of the proposed solutions to overcome this impact is the formation of a "green" industrial development concept, which prioritizes environmental factors (Susanti et al., 2017). The high cost of green investment in comparison to conventional buildings, the lack of market availability of environmentally friendly products, the limited comprehension of green concepts, and the absence of financial and financial assistance are some of the challenges associated with putting green concepts into practice. non-financial assistance from the state (J.Pahnael et al., 2020). One issue that comes up when putting green ideas into practice, including recycling, water conservation, energy-saving systems, and lighting, is that it drives up the cost of environmentally friendly construction by 10.77% (Kim et al., 2014).

Value-for-money (VfM) is a public body's criteria for selecting a set of procurement options for the provision of infrastructure. One option widely accepted among public decision-makers is public-private partnerships (PPPs), particularly based on build–operate–transfer (BOT) contracts (Wibowo, 2022). The private sector evaluates its ability to face risks. However, if the costs charged by the private sector are deemed excessive, the government will negotiate with the private sector. These negotiations will share risks with the public sector, or retain risks in the public sector (Li et al., 2001a).

Through the link between the application of the green batching plant concept and the value for money at risk analysis model. With a relationship structure model using Structural Equation Modeling - Partial Least Square (SEM-PLS), which can improve performance, the objective of this research is to analyze the factors that influence the increase in green

batching plant cost performance based on the Value for money at risk analysis model applied to the concrete industry. The cost of a green batching plant for the concrete industry.

2. Methods

To achieve the research objectives that have been set, researchers create research flow diagrams at each step to obtain statistical analysis and steps for implementing research in case studies. About research (Vu-ngoc et al., 2018). Concepts in statistical analysis research and case studies can be seen in Figures 3 and 4.

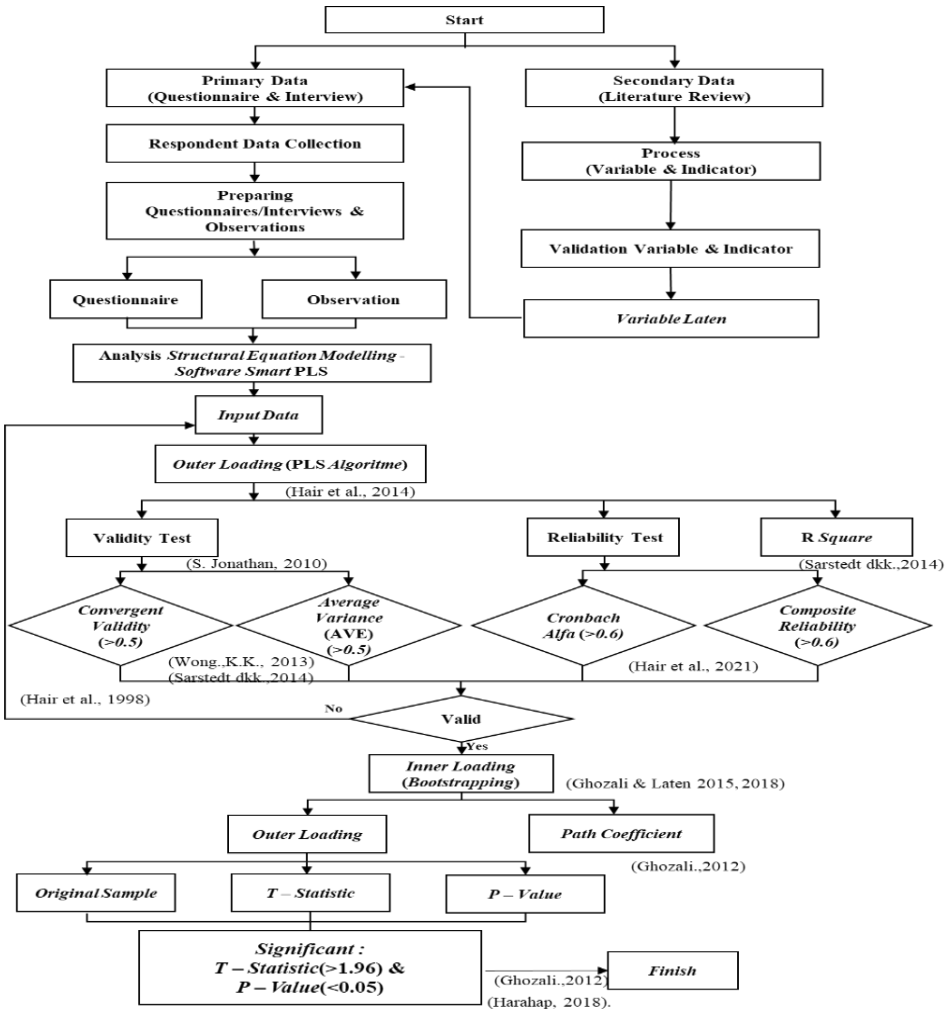

Figure 3 Diagram of Research Model Simulation Stages with SEM-PLS

This research model determines the minimum sample size taken to become respondents based on a path coefficient value of 0.25 and a statistical power test of 80% at a significance level of 5% so that a minimum sample of 113 respondents is obtained. This research consisted of 119 respondents = 82% of the total 145 respondents.

Primary data collection was carried out at the instrument validation stage, pilot survey, respondent data collection, questionnaire distribution, validation of questionnaire results and data input process, and model simulation in SEM-PLS. Data analysis to determine and analyze the factors that most influence the increase in green batching plant cost performance based on the value for money at risk analysis model applied to the concrete industry.

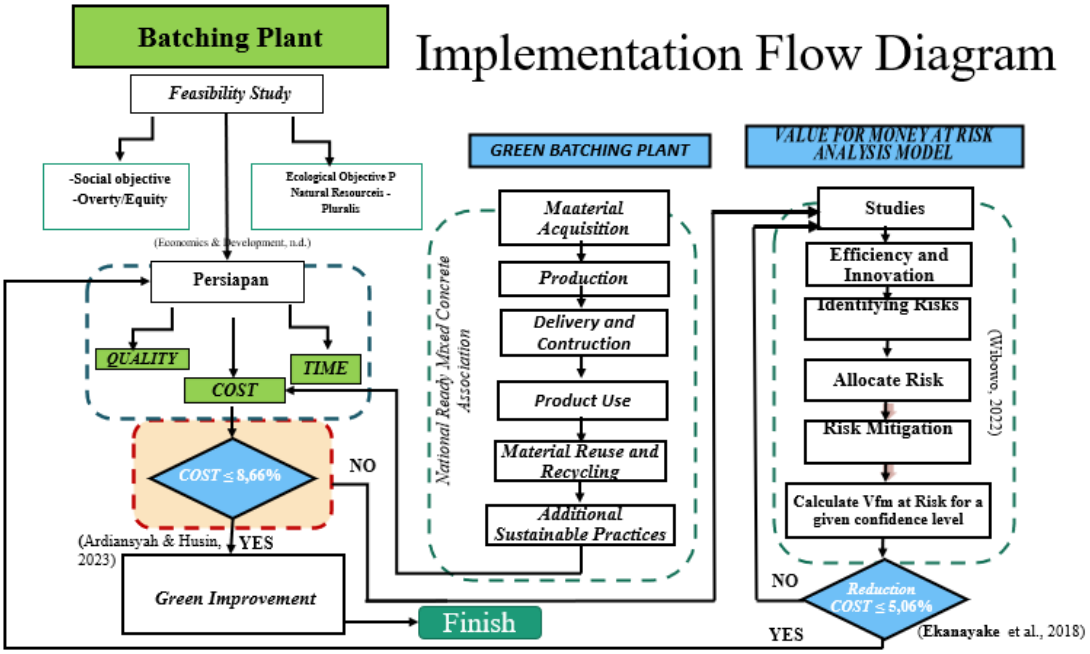

Figure 4 Flowchart for Implementing the Green Batching Plant Concept

3. Results and Discussion

3.1. Measurement Model Evaluation (Outer Loading – PLS algorithm)

The initial stage in analysis using SEM-PLS is to create a structural model. The structural model in this research is as follows:

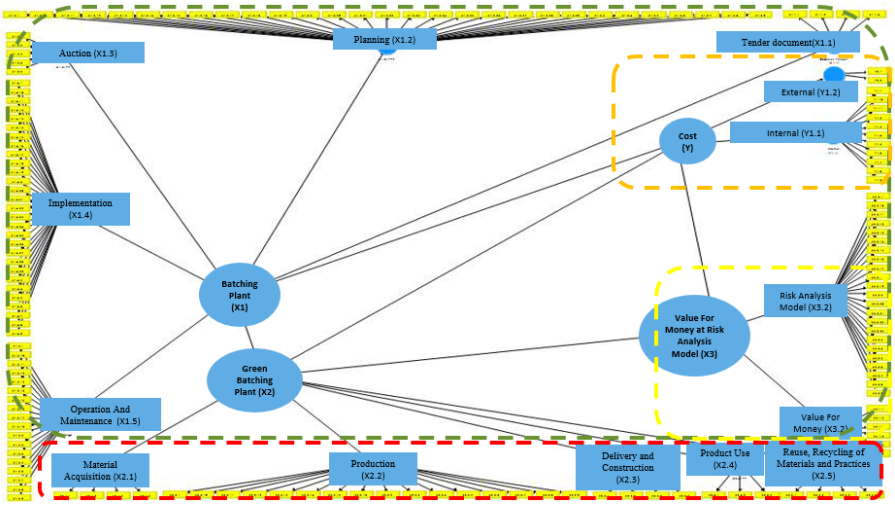

Figure 5 Structural Model and Path Model of Latent Variable Relationships

3.2. Structural Model Evaluation (Inner Loading – Bootstrapping)

The main indicator of external structure that can explain endogenous construction is to look at the coefficient of determination (R2). The coefficient of determination (R2) has a value between 0 and 1. Strong, medium, and weak models are indicated by R2 values of 0.75, 0.50, and 0.25. (Sarstedt et al., 2017). Chin classified the R2 criteria into strong, moderate, and weak with values of 0.67, 0.33, and 0.19 respectively (Ghozali & Laten 2015, 2018).

The R-square value indicates the extent to which the variance of the dependent variable can be explained by the independent variable. The R-square value for Y = cost is 0.984, indicating that all latent and median variables can account for 98% of the dependent variable's explanation or impact on cost. Path analysis or structural model results have a highly

significant impact if the T-statistic value > 1.96 and the p-value is < 0.05 (Ghozali & Laten 2015, 2018). Results of the relationship between applying the batching plant concept **Batchingplant→ Green NRMCA → VFM→ RAM →** Cost is with a positive 0 value of 0.984, this shows that the hypothesis is confirmed. From the results of the analysis using SEM-PLS, it was found that the top 10 factors that influence the increase in green batching plant cost performance based on the Value for money at risk analysis model applied to the concrete industry shown at Table 1.

Table 1 Results Influencing factors

No	Sub Factors	Original Sample Value	Mean	T.Statistik > 1,96 (p <0,05)	Against R Square
1.	Risk Register (X3.2.11)	0.939	0.94	62,854	0.984
2.	Basic price fluctuations (Y2.1)	0.939	0.939	117,646	
3.	Land/Land Acquisition (X2.2.16)	0.939	0.939	82,245	
4.	Risk Impact (X3.2.4)	0.938	0.939	63,460	
5.	Green Building Education For Specifiers (X2.4.2)	0.936	0.935	78,299	
6.	Risk Response (X3.2.12)	0.933	0.933	64,606	
7.	Reducing Air Use (X2.2.3)	0.931	0.932	93,263	
8.	Bargaining in Factory Operations (X2.2.14)	0.931	0.932	93,052	
9.	Employee Transportation (X3.2.11)	0.93	0.93	54,419	
10.	Risk Monitoring (X1.4.3)	0.929	0.928	71,278	

3.3. Relationship between Environmentally Friendly Concepts, Value for Money and Risk Analysis Models

The results of observations and independent assessments carried out obtained a Gold rating with a score of 74 (74%) with a planned green fee of 8.66% (Rp. 3,263,688,229). Recapitulation of the independent assessment of the national ready mix concrete association guidelines. From the results of the assessment carried out, it will be continued by carrying out a frequency distribution analysis of the risk of failure for the construction of a green batching plant following the risk in Table 2 and Table 3.

Table 2 Frequency Distribution Analysis

No	Cost	Frequency	PDF (%)	CDF (%)	Risk of Failure (%)
1	1,158,987,399	1	0.11%	0.11%	99.89%
2	1,444,508,941	1	0.11%	10.00%	90.00%
3	1,630,767,703	1	0.11%	20.00%	80.00%
4	1,807,797,467	1	0.11%	30.00%	70.00%
5	1,975,552,387	1	0.11%	40.00%	60.00%
7	2,160,742,540	1	0.11%	50.00%	50.00%
8	2,331,006,282	1	0.11%	60.00%	40.00%
9	2,510,846,431	1	0.11%	70.00%	30.00%
10	2,702,703,133	1	0.11%	80.00%	20.00%
11	2,876,669,794	1	0.11%	90.00%	10.00%
12	3,205,811,650	1	0.11%	100.00%	0

Table 3 Green Costs Before and After VfM-at-Risk Analysis Model

Function	*Cost Before Value for Money at Risk Analysis Model*	*Cost After Value for Money at Risk Analysis Model*

Component	*Verb*	*Noun*	(IDR)	(IDR)
Efisiensi Energy	*Lighting and Energy Operations*	*Sustainable and environmentally friendly*	2.738.790.449	2.131.888.578
Water Recycle	*Utilization and Savings*	*Sustainable and environmentally friendly*	434.017.780	392.385.780
Cover Loading Point	*Dust Reduction*	*Sustainable and environmentally friendly*	38.880.000	38.880.000
Sertification Green	*Assesment green Lable*	*Sustainable*	52.000.000	52.000.000
	Total (IDR)		3.263.688.229	2.876.669.794
	Total (Cost before-after) (IDR)		387.018.435	
	Percentage Saving base on Value For Money at Risk Analysis Model (%)		11,86%	

By using the "how-why" logic model, the function that will be obtained is to increase the development of projects that are discovered, categorized, developed, and selected (Berawi Et al., 2015; A. Imron & Husin, 2022).

The energy-saving concept of using solar panels is designed to obtain environmentally friendly benefits. The concrete industry that uses solar PV system energy is able to reduce carbon footprints. In other words, solar systems are designed to save production efficiency and are environmentally friendly (Rasyid, 2020). The installed power for the factory area is 555 KVA, with a voltage of 380V, with 3 phases, calculations assuming DOD (Depht of discharge) battery 80% and PSH 4.5 hours (Peak Sun Hours), with the assistance of SOFTWARE calculations for off-grid solar panel systems by the VE team, the minimum solar panel capacity required is 151.29 KWp. If you use the 550 wp Monocristalyne solar panel type, the total solar panel required is 275 pcs of solar panels < 434 maximum solar panels for the number of solar panels with an area rooftop batching plant, with a total of 165 pcs of 48V 70AH capacity batteries and 11pcs of 15KW inverters.

The concept of using wastewater requires very special handling, to get more benefits and add environmentally friendly functions by reducing the use of clean water for the concrete industrial process (Dwaikata & Ali, 2018). Results of NPV, IRR, Payback Period, and BCR are shown in Table 4 below.

Table 4 Results of NPV, IRR, Payback Period and BCR

Investment Criteria	Mark	conclusion
NPV (IDR)	39,770,904,792	A WORTHY PROJECT
IRR	37,23%	A WORTHY PROJECT
payback period	9 Years 3 Months	TARGET 10 YEARS
Benefit and Cost Ratio	1.33	A WORTHY PROJECT

The results of the Value For Money at Risk Analysis Model case study calculations obtained for the application of environmentally friendly concepts in the industry show that the project can be implemented. The payback period level has a return value of 9 years and 3 months in accordance with the target that has been set at < 10 years.

The research results show that the application of the green batching plant concept in the concrete industry using the value for money at risk analysis model using SEM-PLS has a significant effect on increasing the cost performance of green batching plants and it is obtained:

- Determine the factors that influence the implementation of green batching plants using the Value For Money at Risk Analysis Model method on green cost performance (by SEM PLS Tools); Risk Analysis Model, Planning Stage, Internal Costs, Costs, Production, Value For Money, Bidding Stage, Implementation Stage, Product Use, Operation and Maintenance Stage Research shows that there are 10 influencing factors.

- Flow chart for implementing a green batching plant using the Value For Money at Risk Analysis Model method has proven to be effective and can be applied to obtain a solution for implementing the green batching plant concept to increase green cost performance.

- Research results on green batching plant cost savings of 11.53% in the "Gold" Rating category with Green National Ready Mixed Concrete Association ver.1.1 parameters and return on capital spent on a green batching plant takes 9 years - 2 months. This investment is an additional function of the environmentally friendly and sustainable concrete industry.

- The novelty of this research is the application of the green batching plant concept to the concrete industry in Indonesia with a value-for-money at-risk analysis model, adding environmentally friendly functions to the concrete industry process.

4. Conclusions

Based on the analysis results, the hypothesis proposed is that increasing the cost performance of green batching plants using value for money at risk analysis model methods in the concrete industry can be realized, is environmentally friendly, and is more profitable in the future for the concrete industry.

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