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Value for Money-at-Risk Analysis Model for Green Batching Plant Benefit based National Ready Mix Co Association (NRMCA) Method

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ABSTRACT

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: readymix concrete; green; value for money; at risk analysis model; SEM-PLS.

INTRODUCTION

Construction industry assumes a significant part in the economy of any country. One of the fundamental factors influencing the construction industry development is the concrete batch plants furthermore it is primarily connected with the productivity. Productivity is the overwhelming view point in the construction industry as it supports cost investment funds furthermore powerful usage of resources. It is the most significant concern in both developed and underdeveloped nations. It's noticed that construction is a vital area of the public economy for nations from one side of the planet to the other, as traditionally it takes up a major piece in the country's total employment and its critical commitment to a country's income in general. Likewise, productivity is one of the significant viewpoints for concrete batch plants, which helps its survival and development. Hence, working on the productivity of concrete batch plants is of basic significance considering its critical commitment to the project's income. (Ibrahim et al., 2022)

The concept of Green Construction is basically a strategy in the construction implementation process that prioritizes environmentally friendly construction through work methods, use of materials, use of construction equipment, management, supervision, etc. Basically, the green construction concept is an implementation stage which is a continuation process of an environmentally friendly design concept. The green construction concept aims to: Reducing Material Waste (Waste Materials), Reducing Pollution During Construction, Energy Efficiency, Air Use Efficiency (Thoengsal, 2024). This definition places contractors to play a proactive role in caring for the environment, and always increasing efficiency in the construction process during the construction period and minimizing leftover construction materials. (Fitriani et al., n.d.)

Some preliminary results of an on-going PhD research are presented. The overall aim of the research is to develop a risk management model specifically for PPP construction projects. Several milestones have been achieved in the study, including the investigation of critical success factors of PPP construction projects, and assessment of approaches to risk management. Primary data have been collected through a detailed and structured questionnaire survey, and are currently being analysed. The paper thus reports on the two aspects of the analysis, which have been completed: measures that enhance the achievement of VFM in PPP projects, and risk allocation between the project parties. (Li et al., 2001b)

According to data (Maximize Market Research, 2023), market growth for the concrete industry will increase 9.18% in 2021-2029, while in Indonesia, the Indonesian Construction Market Outlook (IMCO) 2023 predicts that total construction projects (building and civil projects, excluding oil and gas) in 2023 will increase by 5.78% compared to last year. This means that the need for materials such as concrete, sand, cement, stone and other project materials is also increasing.

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

The concrete industry throughout the world has an important role in the economy and development of a country, concrete is an important material for building construction in the world. The concrete industry has a negative impact on the environment during the production process, these impacts include waste, air dust, noise, uncontrolled use of natural resources including water and energy.

Indonesia agreed to reduce emissions by 29% under Business as Usual (BAU) and 41% if there is cooperation with other countries by 2030 at the 2015 Climate Summit (KTT) in Paris. One of the actions taken to support the commitment the Indonesian government is the growth of green industry. The environmental impact of concrete manufacturing can be reduced by conserving the use of raw materials, saving energy consumption, and following Best Management Practices (BMP) related to ready-mix concrete production (Kashwani et al., 2014).

One proposed solution to overcome these effects is the establishment of a "green" concept of industrial development, which prioritizes environmental factors in manufacturing processes and operations. (Susanti et al., 2017). Several other problems that arise in implementing the green concept have been identified, including the expensive cost of green investment compared to conventional buildings, poor understanding of the green concept, lack of availability of environmentally friendly products on the market, and the absence of financial and non-financial support from the government. (J. Pahnael et al., 2020). Changing the suitability of the old condition into a green concept. One of the problems that arise in the application of the green concept, such as the application of energy saving systems, lighting, conservation and water recycling, causes an increase in green construction costs by 10.77% (Kim et al., 2014).

Value-for-money (VfM) is a public agency criterion used to select a set of possible procurement options for infrastructure provision. In recent years, one option that has gained wide acceptance among public decision makers is the public–private partnership (PPP), especially under the build–operate–transfer (BOT) contract. (Wibowo, 2022)

In the proposed model, the public sector is expected, in conjunction with the private sector to identify potential risks, which will arise throughout the life of a PPP project. The private sector evaluates its ability to deal with these risks, using the two dimensions of severity and frequency to measure the risk impact. The private sector also prices the risks in its tender, which is submitted to the public sector client. If the cost of the risks is acceptable to the public sector, a contract will be easily awarded. If however, the private sector's charge is considered to be excessive, the public sector would go into negotiation with the private sector. The negotiations would consider whether the public sector should either accept the high risk cost, share the risks with the public sector, or retain the risk in the public sector. (Li et al., 2001a)

Through the relationship between the application of the green batching plant concept and the value for money at risk analysis model, it can be developed and used to obtain an increase in the cost performance of green batching plants in the concrete industry. The aim of the research in this case 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, with a relationship structure model using Structural Equation Modeling – Partial Least Square (SEM-PLS) and developing the application of the green batching plant concept to improve the cost performance of green batching plants based on the Value for money at risk analysis model in the concrete industry

RESEARCH METHODS

To achieve the research objectives that have been set, the next step is for the researcher to create a research flow diagram for each step to obtain statistical analysis and steps to apply the research in case studies. On research (Vu-ngoc et al., 2018) only half of systematic reviews include flow diagrams, researchers need to create flow diagrams to assist readers in gaining thorough knowledge of research review procedures. The concepts in statistical analysis research and case studies can be seen in figures 3 and 4

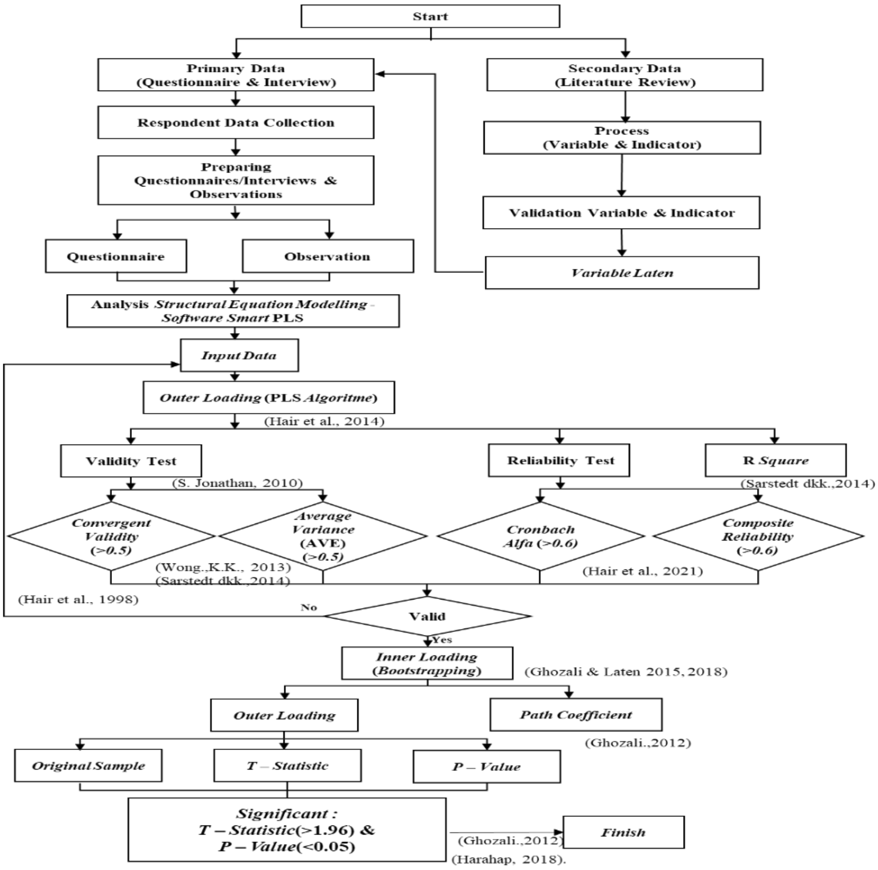

Figure 2. Diagram of Simulation Stages of Research Model with SEM-PLS

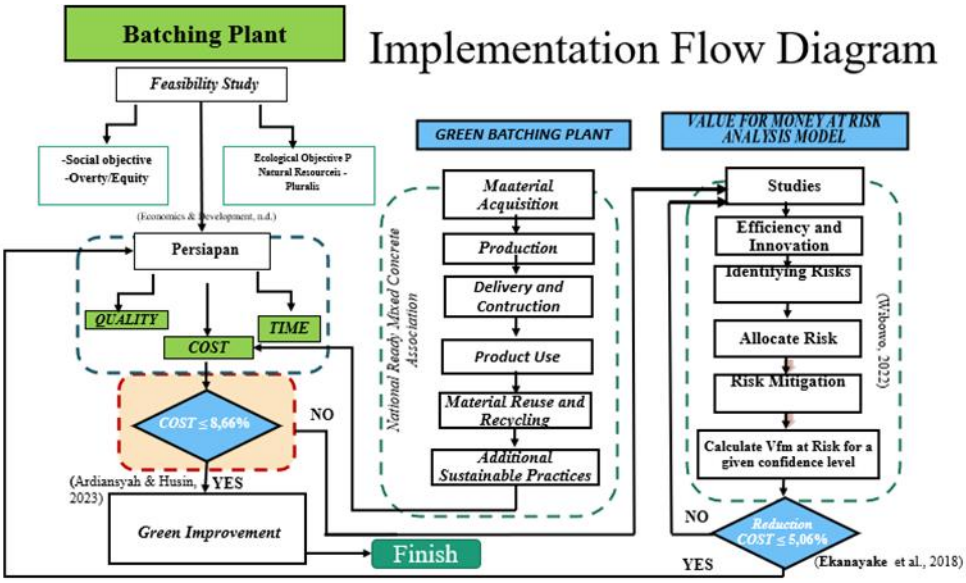

Figure 3. Flowchart of Implementing the Green Batching Plant Concept with the Value

For Money at Risk Analysis model in the Concrete Industry to Improve Green Batching Plant Cost Performance.

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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 significant level of 5% so that a minimum sample of 113 respondents is obtained. This study 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, distribution of questionnaires, validation of questionnaire results and data input process and model simulation in SEM-PLS. Table 4 shows a list of key success factors obtained from literature studies and expert validation. Data analysis to determine and analyze the factors that have the most influence on increasing the cost performance of green batching plants based on the value for money at risk analysis model applied to the concrete industry, the factors and sub-factors of the variables tested using SEM-PLS are shown in the following table:

Table 1. Key Success Factor

			Performance Assessment Parameters	Poin
			Assessment Green Batching Plant	**100**
1	**Material Acquisition**			
		a.	Recycled Aggregate	4
		b.	Optimized Portland Cement Use	6
		c.	Materials Transportation Analysis	4
		d.	Sustainable Purchasing Plan	2
	Sub Total			**16**
2	**Production**			
		a.	Process Dust Emissions Control	3
		b.	Fugitive Dust Emissions Suppression	3
		c.	Reduction of Fresh Water Use in Plant Operations Pabrik	4
		d.	Reduction of Fresh Water Use in Batching	3
		e.	Process Water Collection and Treatment	3
		f.	Stormwater Management	4
		g.	Proper Storage of Chemical and Petroleum Products	2
		h.	Secondary Containment of Chemical and Petroleum Products yang benar	2
		i	Employee Training Plan and Emergency Response Procedures	2
		j.	Reduced Carbon Footprint	6
		k.	Reduced Primary Energy Consumption	6
		l.	Renewable Electricity Use	4
		m.	Noise control	2
		n.	Employee Transportation	2
		o.	Biodiversity	3
3	**Delivery and Construction**			
		a	Fuel Efficiency Improvement	4
		b.	Fleet Emissions Reduction	5
		c.	Driver Training	2

	Performance Assessment Parameters		Poin
	Assessment Green Batching Plant		**100**
	d.	Green Building Products	2
	Sub Total		**13**
4	**Product Use**		
	a.	Green Building Education for Staff	3
	b.	Green Building Education for Specifiers	2
	c.	Sustainability Advocacy	1
	Sub Total		**6**
5	**Material Reuse and Recycling and Additional Sustainable Practices**		
	a.	Excess Concrete Reduction	3
	b.	Diversion of Returned Concrete from Disposal	3
	c.	Other Recycling Initiatives	2
	d.	Additional Sustainable Practices	5
	Sub Total		**13**

Evaluation of Measurement Model *(Outer Loading – PLS algoritm)*

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

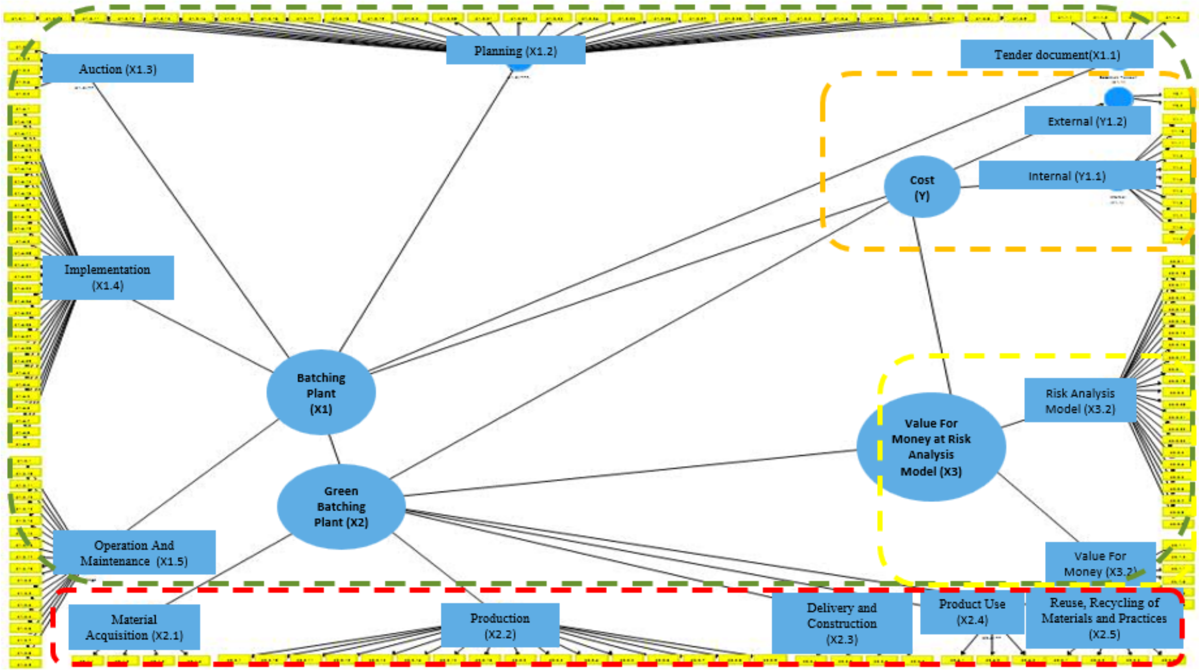

Figure 4. Structural Model and Path Model of the Relationship between Latent Variables

Outer Loading

Factor loading will be a major concern in modeling and measuring both reflectively and formatively (Hair et al., 2014).

Table 2. Outer Loading

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Indicator	Convergen Validity	Valid > 0.5	Indicator	Convergen Validity	Valid > 0.5
X1.1.1	0.862	Accepted	**X1.5.4**	0.692	Accepted
X1.1.2	0.915	Accepted	**X1.5.5**	0.806	Accepted
X1.1.3	0.917	Accepted	**X1.5.6**	0.765	Accepted
X1.1.4	0.876	Accepted	**X1.5.7**	0.843	Accepted
X1.2.1	0.820	Accepted	**X1.5.8**	0.760	Accepted
X1.2.10	0.834	Accepted	**X1.5.9**	0.892	Accepted
X1.2.11	0.882	Accepted	**X2.1.1**	0.924	Accepted
X1.2.12	0.839	Accepted	**X2.1.2**	0.850	Accepted
X1.2.13	0.786	Accepted	**X2.1.3**	0.915	Accepted
X1.2.14	0.898	Accepted	**X2.1.4**	0.858	Accepted
X1.2.15	0.884	Accepted	**X2.2.1**	0.918	Accepted
X1.2.16	0.816	Accepted	**X2.2.10**	0.814	Accepted
X1.2.17	0.860	Accepted	**X2.2.11**	0.782	Accepted
X1.2.18	0.833	Accepted	**X2.2.12**	0.857	Accepted
X1.2.19	0.852	Accepted	**X2.2.13**	0.833	Accepted
X1.2.2	0.699	Accepted	**X2.2.14**	0.928	Accepted
X1.2.20	0.888	Accepted	**X2.2.15**	0.889	Accepted
X1.2.21	0.841	Accepted	**X2.2.16**	0.932	Accepted
X1.2.22	0.842	Accepted	**X2.2.2**	0.943	Accepted
X1.2.23	0.853	Accepted	**X2.2.3**	0.927	Accepted
X1.2.24	0.886	Accepted	**X2.2.4**	0.914	Accepted
X1.2.25	0.819	Accepted	**X2.2.5**	0.843	Accepted
X1.2.26	0.786	Accepted	**X2.2.6**	0.835	Accepted
X1.2.27	0.884	Accepted	**X2.2.7**	0.819	Accepted
X1.2.28	0.828	Accepted	**X2.2.8**	0.788	Accepted
X1.2.29	0.815	Accepted	**X2.2.9**	0.887	Accepted
X1.2.3	0.848	Accepted	**X2.3.1**	0.886	Accepted
X1.2.4	0.858	Accepted	**X2.3.2**	0.904	Accepted
X1.2.5	0.880	Accepted	**X2.3.3**	0.781	Accepted
X1.2.6	0.891	Accepted	**X2.3.4**	0.809	Accepted
X1.2.7	0.843	Accepted	**X2.4.1**	0.800	Accepted
X1.2.8	0.783	Accepted	**X2.4.2**	0.911	Accepted
X1.2.9	0.698	Accepted	**X2.4.3**	0.937	Accepted
X1.3.1	0.867	Accepted	**X2.5.1**	0.910	Accepted
X1.3.2	0.881	Accepted	**X2.5.2**	0.910	Accepted
X1.3.3	0.888	Accepted	**X2.5.3**	0.880	Accepted
X1.3.4	0.832	Accepted	**X2.5.4**	0.864	Accepted
X1.3.5	0.876	Accepted	**X3.1.1**	0.894	Accepted
X1.4.1	0.773	Accepted	**X3.1.2**	0.866	Accepted
X1.4.10	0.748	Accepted	**X3.1.3**	0.858	Accepted
X1.4.11	0.858	Accepted	**X3.1.4**	0.782	Accepted

Indicator	Convergen Validity	Valid > 0.5	Indicator	Convergen Validity	Valid > 0.5
X1.4.12	0.889	Accepted	**X3.1.5**	0.731	Accepted
X1.4.13	0.777	Accepted	**X3.1.6**	0.874	Accepted
X1.4.14	0.898	Accepted	**X3.2.1**	0.916	Accepted
X1.4.15	0.878	Accepted	**X3.2.10**	0.918	Accepted
X1.4.16	0.862	Accepted	**X3.2.11**	0.935	Accepted
X1.4.17	0.848	Accepted	**X3.2.12**	0.927	Accepted
X1.4.18	0.858	Accepted	**X3.2.13**	0.909	Accepted
X1.4.19	0.819	Accepted	**X3.2.14**	0.909	Accepted
X1.4.2	0.856	Accepted	**X3.2.15**	0.900	Accepted
X1.4.20	0.752	Accepted	**X3.2.16**	0.888	Accepted
X1.4.21	0.855	Accepted	**X3.2.17**	0.869	Accepted
X1.4.22	0.863	Accepted	**X3.2.18**	0.862	Accepted
X1.4.23	0.865	Accepted	**X3.2.19**	0.920	Accepted
X1.4.24	0.862	Accepted	**X3.2.2**	0.910	Accepted
X1.4.25	0.584	Accepted	**X3.2.20**	0.599	Accepted
X1.4.26	0.864	Accepted	**X3.2.21**	0.603	Accepted
X1.4.27	0.859	Accepted	**X3.2.22**	0.797	Accepted
X1.4.28	0.844	Accepted	**X3.2.23**	0.857	Accepted
X1.4.29	0.844	Accepted	**X3.2.3**	0.903	Accepted
X1.4.3	0.907	Accepted	**X3.2.4**	0.933	Accepted
X1.4.4	0.868	Accepted	**X3.2.5**	0.909	Accepted
X1.4.5	0.781	Accepted	**X3.2.6**	0.908	Accepted
X1.4.6	0.852	Accepted	**X3.2.7**	0.922	Accepted
X1.4.7	0.895	Accepted	**X3.2.8**	0.918	Accepted
X1.4.8	0.901	Accepted	**X3.2.9**	0.928	Accepted
X1.4.9	0.843	Accepted	**Y1.1**	0.890	Accepted
X1.5.1	0.792	Accepted	**Y1.10**	0.755	Accepted
X1.5.10	0.846	Accepted	**Y1.11**	0.855	Accepted
X1.5.11	0.741	Accepted	**Y1.2**	0.917	Accepted
X1.5.12	0.812	Accepted	**Y1.3**	0.924	Accepted
X1.5.13	0.742	Accepted	**Y1.4**	0.899	Accepted
X1.5.14	0.888	Accepted	**Y1.5**	0.822	Accepted
X1.5.15	0.714	Accepted	**Y1.6**	0.836	Accepted
X1.5.16	0.701	Accepted	**Y1.7**	0.900	Accepted
X1.5.17	0.700	Accepted	**Y1.8**	0.912	Accepted
X1.5.18	0.838	Accepted	**Y1.9**	0.892	Accepted
X1.5.2	0.825	Accepted	**Y2.1**	0.933	Accepted
X1.5.3	0.718	Accepted	**Y2.2**	0.859	Accepted

The convergent validity value for all indicators in the table obtained is > 0.5 so it can be concluded that all indicators can be accepted and maintained so that further processes can be carried out.

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Table 3. Test results AVE dan Composite Reability

Variable	Composite Reliability (>0.7)	*Cronbach 's Alpha* (>0.7)	Average Variance Extracted (AVE) (>0.5)
Planning Stage	0.986	0.985	0.718
Auction Stage	0.944	0.924	0.771
Implementation Stage	0.982	0.981	0.663
Operation and Maintenance Phase	0.965	0.962	0.606
Production	0.983	0.982	0.785
Delivery and Construction	0.979	0.971	0.920
Product Use	0.913	0.855	0.778
Reuse Recycling Materials and Practices	0.975	0.965	0.906
alue For Money	0.960	0.948	0.803
Risk Analysis Model	0.990	0.990	0.819
Tender document	0.881	0.821	0.651
External	0.851	0.649	0.740
Internal	0.970	0.966	0.750
Batching Plants	0.993	0.992	0.623
Green Batching Plant	0.992	0.991	0.798
Value For Money atRisk Analysis Model	0.992	0.991	0.812
Cost	0.973	0.970	0.737

The results of the AVE value show that the latent and median variables obtained a value > 0.5, thus indicating that the convergent variable is valid. The Composite Reability and Cronbach's alpha values were obtained > 0.7, so that the reliability of the instrument can be trusted and accepted.

Structural Model Evaluation (Inner Loading – Bootstrapping)

A major indicator of external structure that can explain endogenous construction is by looking at the coefficient of determination (R2). The coefficient of determination (R2) has a value between 0 and 1. Strong, medium and weak models, shown by R2 values of 0.75, 0.50 and 0.25. (Sarstedt et al., 2017). Chin classifies the R2 criteria as strong, moderate, and weak with values of 0.67, 0.33, and 0.19.(Ghozali & Laten 2015, 2018)**.**

Table 4. R2 value results

Variable	R Square
Risk analysis model	0.996
Planning stage	0.994
Internal	0.993
Cost	0.984
Production	0.980
Value for money	0.951
Auction stage	0.945
Implementation stage	0.934
Value for money at risk analysis model	0.928

Variable	**R Square**
Product Use	0.906
Operation and maintenance phase	0.903

The R-square value is a value that shows how much the independent variable can explain the variance of the dependent variable. It is known that the R-square result for Y = cost is 0.984, which is all latent variables and the median is able to explain the dependent variable or has an effect on cost of 98%.

Path Coefficient and Interpretation

Path coefficient interpretation results are in accordance with the path coefficient table, results taken from the bootstrapping process, the results of path analysis or structural models have a very significant effect if the T statistic value is > 1.96 and the p value is < 0.05.(Ghozali & Laten 2015, 2018). In proving the hypothesis test using the relationship method on the cost of green batching plant can be seen in the analysis of indirect paths or using a specific median (Specific indirect effect). The results of the relationship between the application of the batching plant concept using the value for money at risk analysis model method have a significant effect on the performance of green costs in the concrete industry, Batchingplant □ Green NRMCA □ VFM □ RAM □ Cost is 6,501 (0.000) with a positive O value of 0.643, this indicates that the hypothesis is proven.

From the results of the analysis using SEM-PLS, it was found that the top 10 factors influencing the increase in green batching plant cost performance based on the Value for money at risk analysis model applied to the concrete industry are as follows:

Table 5. Hasil Faktor – faktor yang berpengaruh

No	**Sub Factors**		**Original Sample Value**	**Mean**	**T.Statistic > 1.96 (p < 0.05)**	**Against R Square**
1.	Risk Register	(X3.2.11)	0,939	0,940	62,854	0,984
2.	Basic price fluctuations	(Y2.1)	0,939	0,939	117,646	
3.	Land/Land Procurement	(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)	0,930	0,930	54,419	
10.	Risk Monitoring	(X1.4.3)	0,929	0,928	71,278	

Relationship between Green Concepts, Value for Money and Risk Analysis Model

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The results of the observations and independent assessment carried out obtained a Gold rating with a value of 73 (74%) with a planned green fee of 8.66% (IDR.3,263,688,229). The recapitulation of the independent assessment can be seen in the following table:

Table 6. Recapitulation of Self-Assessment in Research

Recapitulation Self Assesment – NRMCA					
Code	**Parameter**	**units**	**Standard Criteria NRMCA**	**Existing**	**Assesment**
	Material Acquisition	Points	16	6	12
	Production	Points	52	17	38
	Delivery and Construction	Points	13	2	7
	Product Use	Points	6	0	6
	Material Reuse and Recycling and Additional Sustainable Practices	Points	13	3	11
	Total	Points	100	28	74
	Percentage (by Point Maximal)		100%	28%	74%
	Total value		100	28	74

Table 7. Simulation Results Analysis Table

	The calculation results	**Rounding**
Maximum Cost	Rp3.205.811.650	Rp3.205.811.651
Minimum Fees	Rp1.158.987.399	Rp1.158.987.400
Average	2.182.399.525	2.182.399.526
Standard Deviation	526.885.614	526.885.615

Table 8. Frequency Distribution Analysis

No	**Cost**	**Frequency**	**PDF (%)**	**CDF (%)**	**Risk of Failure (%)**
1	1.158.987.399	1	0,11111%	0,11111%	9988889%
2	1.444.508.941	1	0,11111%	1000000%	9000000%
3	1.630.767.703	1	0,11111%	2000000%	8000000%
4	1.807.797.467	1	0,11111%	3000000%	7000000%
5	1.975.552.387	1	0,11111%	4000000%	6000000%
6	2.160.742.540	1	0,11111%	5000000%	5000000%
7	2.331.006.282	1	0,11111%	6000000%	4000000%
8	2.510.846.431	1	0,11111%	7000000%	3000000%
9	2.702.703.133	1	0,11111%	8000000%	2000000%
10	2.876.669.794	1	0,11111%	9000000%	1000000%
11	3.205.811.650	1	0,11111%	10000000%	0,00000%

Table 9. Green Costs Before and After Value for Money At Risk Analysis Model

Component	**Function**		**Cost Before value for money at rusk analysis model (IDR)**	**Cost After value for money at rusk analysis model**
	Verb	**Noun**		

				(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%**	

Using a "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.dkk, 2015) (A. Imron & Husin, 2022).

Energy Efficiency & Recycle Water

The energy efficient concept of using solar panels is designed in this case study to obtain environmentally friendly benefits. The concrete industry using solar PV system energy can reduce 17,165.05 Kg CO2e. If the system started in January (compared to January 2019), it could reduce the carbon footprint by about 9% per month. And around 205,980.6 Kg CO2e in a year. In other words, a solar system is designed to save production efficiency and be environmentally friendly. (Rasheed, 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 help 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 48V 70AH capacity batteries with 11 15KW inverters.

The concept of utilizing and using waste water requires special handling, to get more benefits and add environmentally friendly functions by reducing the use of clean water for the concrete industrial process. With a planned wastewater tamping capacity of 95 m3, it is hoped that the distribution of recycled water can save up to 50% of clean water usage every month. With energy efficiency and the use of industrial recycled water, the benefits of reducing production processes are obtained.(Dwaikata & Ali, 2018).

Table 10. Hasil NPV, IRR,Payback Period dan BCR

Criteria Investment	Value	Remark
NPV (IDR)	39.770.904.792	FEASIBLE PROJECT
IRR	37.23 %	FEASIBLE PROJECT

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Criteria Investment	Value				Remark
Payback Period	9	Year	3	Month	10 YEARS TARGET
Benefit Cost Ratio	1.33				FEASIBLE PROJECT

The results of the case study calculations for the Value For Money at Risk Analysis Model, obtained for the application of the green concept in industry, showed that the project could be implemented. The payback period level has a return value of 9 years 3 months in accordance with the target that has been set < 10 years.

RESULT AND DISCUSSION

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

1. 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, Auction Stage, Implementation Stage, Product Use, Operation and Maintenance Stage Research shows that there are 10 influencing factors, namely: this can also be obtained from path analysis which has a significant effect and not significant. Using SEM-PLS analysis has proven to be more effective in obtaining correlations to develop theories in research.
2. Flow diagram for implementing a green batching plant using the Value For-Money at Risk Analysis Model method has proven to be effective and can be implemented to obtain a solution for implementing the green batching plant concept to improve green cost performance.
3. Research results of green batching plant cost savings of 11.53% in the "Gold" Rating category with Green National Ready Mixed Concreate Association ver.1.1 parameters and return on capital spent on a green batching plant takes 9 years - 2 months, that the investment is profitable from investment and environmentally friendly side for the concrete industry in Indonesia, this investment is an additional function of the environmentally friendly and sustainable concrete industry.
4. The novelty of this research is the application of the green batching plant concept for the concrete industry in Indonesia with a value for money at risk analysis model, adding environmentally friendly functions to the concrete industry process.

CONCLUSION

Based on the analysis results, the hypothesis proposed is that an increase in the cost performance of green batching plants using the value for money at risk analysis model method in the concrete industry can be realized. Green batching plants, designed to reduce environmental impact, offer a variety of significant benefits to the concrete industry. By applying the value for money at risk analysis model method, it is hoped that cost optimization, increased efficiency and improved quality of environmentally friendly concrete products will be achieved. Value for money at risk analysis model, is a systematic approach to increasing the "value" of a product or system by examining the required functions and looking for ways to achieve them at lower costs without sacrificing quality. In the context of a green batching plant, it can be applied to identify components and processes that can be optimized, thereby reducing operational and maintenance costs, as well as reducing carbon emissions and waste. The research carried out an in-depth analysis of the entire concrete production process to identify areas that require improvement. For example, the use of alternative raw materials that are more environmentally friendly and efficient can be one of the main focuses. Second, evaluate the technology and equipment used in batching plants to find solutions that are more energy and cost efficient. New technologies such as wastewater treatment systems and the use of renewable energy can also be considered to increase efficiency. The advantages of implementing a green batching plant are not only limited to environmental and cost aspects. Increasing awareness of the importance of sustainability and proactive steps to reduce environmental impacts will increase the company's positive image. Apart from that, the application of green batching plants can open up new opportunities in the concrete industry. The resulting innovations can produce better and more sustainable performance. Overall, it is very possible to increase the cost performance of green batching plants using the value for money at risk analysis model in the concrete industry. The application of value engineering not only promises cost efficiencies and improved performance, but also offers significant environmental and social benefits. Thus, concrete industries that invest in these technologies and methods can expect sustainable and more profitable returns in the future.

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