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Optimizing Agile Project Management in the Construction Supply Chain in Digitalization Era

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Abstract

Purpose: The primary aim of this study is to evaluate the effectiveness of Agile Project Management (APM) in enhancing Supply Chain Management (SCM) performance within construction projects, specifically focusing on the unique challenges these projects face. **Research design, data and methodology:** The research question addresses how Agile Project Management (APM) can enhance efficiency, success rates, and stakeholder involvement in the Cargo Transshipment construction project. Data was collected through observations, structured interviews, and document reviews related to supply chain management activities within the project. The analysis utilized the Conforto framework and Likert scale measurements. **Results:** The research findings provide evidence that the implementation of Advanced Project Management (APM) brings about a substantial improvement in Supply Chain Management (SCM) and operational control within construction settings. This improvement leads to better adaptability and more favorable project outcomes in terms of meeting deadlines, ensuring quality, and managing costs effectively. **Conclusions:** The study concludes that Agile Project Management provides a robust framework for enhancing SCM in construction projects, suggesting a valuable shift towards more agile, efficient, and effective management practices in the construction industry. Future research should explore the scalability of APM in diverse construction settings to fully ascertain its broader applicability and benefits.

Keywords: Adaptability, Agile Project Management, Construction Project, Effectiveness, Supply Chain.

JEL Classification Code: M11, M15, O14, O22

1. Introduction

Agile methodology, developed for software development, is now widely used in project management. Consider costs and benefits when making information system business strategies, information technology management, and future portfolio recommendations (Bintang Janaputra et al., 2021). Agile is a response to software development challenges and has proven useful for project management software (Werder et al., 2021). The academic world uses an agile project management approach based on the 12 principles of the Agile Manifesto for success (Aránega et al., 2023; Singh et al., 2023). Management should be associated with the organization's processes as per its specific flexibility, capacity, and adaptation (Hidalgo, 2019). Our study aims to enhance project management

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processes in companies and enable the successful completion of complex projects. APM has shown success in non-software development like manufacturing and public sector organizations (Žužek et al., 2020).

Project management software and agile methodologies can increase the effectiveness of construction projects by providing greater flexibility and ease of control over project schedules and costs (Jethva & Skibniewski, 2022). Previous research has explored effective research methods for analyzing the impact and implications of agile methods. Agile methodologies can also be applied in the design of buildings and structures, highlighting potential opportunities for agile project management in construction (Waszkiewicz, 2022).

In Industry 4.0 projects, it is unclear how project management affects implementation success and project sustainability (Vrchota et al., 2021). Agile methods are not commonly used in construction despite research and trials. Agile Operational Research can help prevent project problems (Vidoni et al., 2021). Agile methods have not been effective in providing adequate project supervision and control. Weaknesses in conventional project supervision cause difficulty in synchronizing construction project implementation. Dynamic capabilities in APM can lead to better communication, efficiency, autonomy, and motivation. Enhanced reconfiguring capabilities can help overcome challenges in implementing agile methods and improving departmental integration, flexibility, and project performance (Ferreira & Nobre, 2022). Bridging the gap between academics and practitioners is vital to maximize innovation and avoid redundancy and closing the gap between academics and practitioners is crucial to avoid redundancy and maximize innovation (Agarwal et al., 2021). The research focuses on using APM in converting a cargo ship into a coal-loading and unloading terminal ship, with a production capacity of around 6.5 MTPA. The project involves various parties and is planned to be completed in 12 months. The implementation of SCM construction is based on technical planning and is controlled by the Inspection and Testing Plan (ITP).

In construction projects, optimizing Agile project management can potentially lead to enhanced product and service quality, as well as the achievement of project targets. This relationship between variables is the focus of the study. Agile project management promotes collaboration among stakeholders and enhances flexibility in product development (Zasa et al., 2020). Agile project management emphasizes flexibility, collaboration, and adaptability to promote innovation. The same approach can be applied to supply chain management through iterative and incremental problem-solving (Ivanov & Dolgui, 2021). This study has objectives (1). Evaluate the level of agility or agility of APM practices compared to conventional standard PM; (2). Evaluate APM efficiency factors in the implementation of SCM, towards meeting targets within budget, on time, and quality requirements; (3). Evaluate stakeholder success factors against organizational satisfaction, team satisfaction, and customer satisfaction. Based on the study results, optimizing APM in construction projects can decisively drive technical business actors to implement it. This research supports the use of agile methodologies in the industrial world, potentially increasing SCM and project management's flexibility, effectiveness, transparency, and accountability.

2. Literature Review

2.1. Agile Project Management

Agile project management promotes collaboration among stakeholders to increase flexibility in product development. Agile methods have benefits, but may not be optimal for large-scale projects (Dybå & Dingsøyr, 2008). Research has explored agile project management adoption in various industries, including building construction and government software quality assurance (Chathuranga et al., 2023; Wadood et al., 2022). The Agile Manifesto, introduced in 2001, emphasizes developing high-quality software with agility by having self-organizing teams, involving customers, adapting to change, and having knowledgeable people (Ferreira & Nobre, 2022). Project management is a rational and normative activity that involves planning and evaluation based on causal relationships. Software project management requires quick and effective planning, evaluation, and implementation while ensuring success based on time, cost, and quality.

The study evaluated APM's impact on project success and benefits compared to traditional project management. Agile methods in software development prioritize individuals, customer satisfaction, and adaptability to changing scenarios (Almashhadani et al., 2023). Agile project management enables quick response to disruptions by adjusting the product development cycle, lead time, and customer services (Chowdhury et al., 2021). Agile project management benefits various industries (Lindskog, 2022). Agile approaches have benefits but can present challenges like project managers relinquishing some authority (Fernandes & O'Sullivan, 2023). The success of APM requires team and management support, and APM can be optimized for manufacturing (Noteboom et al., 2021).

Project Management (PM) is a structured approach to achieving goals using resources, schedules, and stakeholders that covers all phases of the project life cycle. Planning is critical in realizing goals, scope, resources, partners, and stakeholder engagement (Guertler & Sick,

2021). A strong communication component is required to enable this feedback loop (Lill & Wald, 2021). Agile methods deliver high-quality software faster, cheaper, and more flexibly than traditional approaches.

2.2. Supply Chain Management

Global Supply Chain Management streamlines processes, reduces costs and increases speed across borders. It converts raw materials into finished products and services, distributed worldwide. SCM involves stakeholders ranging from small-scale raw material producers to multinational corporations and governments. SCM presents challenges such as visibility, traceability, scalability, data flow management, trust, and costs (Asante et al., 2023). Supply chain volatility and uncertainty are inherent elements of supply chain management and can occur in any company (Kähkönen et al., 2023). Researchers in Supply Chain Management focus on gaining a competitive edge through the resource-based view theory. Their areas of study include logistics, sustainability, alliances, blockchain, SCRM, and network design for SMEs (El Baz & Ruel, 2021). A company's success in a competitive market depends largely on effective supply chain management (Yerpude et al., 2023). Now the research on the agile method is starting to gain momentum, as evidenced by the increasing number of special journals, conferences, conference paths, and workshops (Conboy, 2009). Two key factors for effective decision-making in SCM are forecasting and anomaly detection (Nguyen et al., 2021). Disruptive events in supply chain management can cause uncertainty and volatility.

Supply chain management ensures the efficient flow of goods and services from origin to consumption. Disruptions can increase production costs due to factors like shortages, transportation challenges, and fluctuating demand (Maryono & Ambarwati, 2021). SCM is the management of goods and services flow from origin to consumption (Ambarwati et al., 2022). Supply chain management contains proper risk management, procurement coordination, and efficient distribution. APM improves SCM implementation, making it more efficient.

3. Research Methods and Materials

This research explores the implementation of Agile in supply chain management for construction projects, using cargo transhipment construction projects as case studies. The goal is to investigate APM practices and enhance the literature on APM adoption by construction companies.

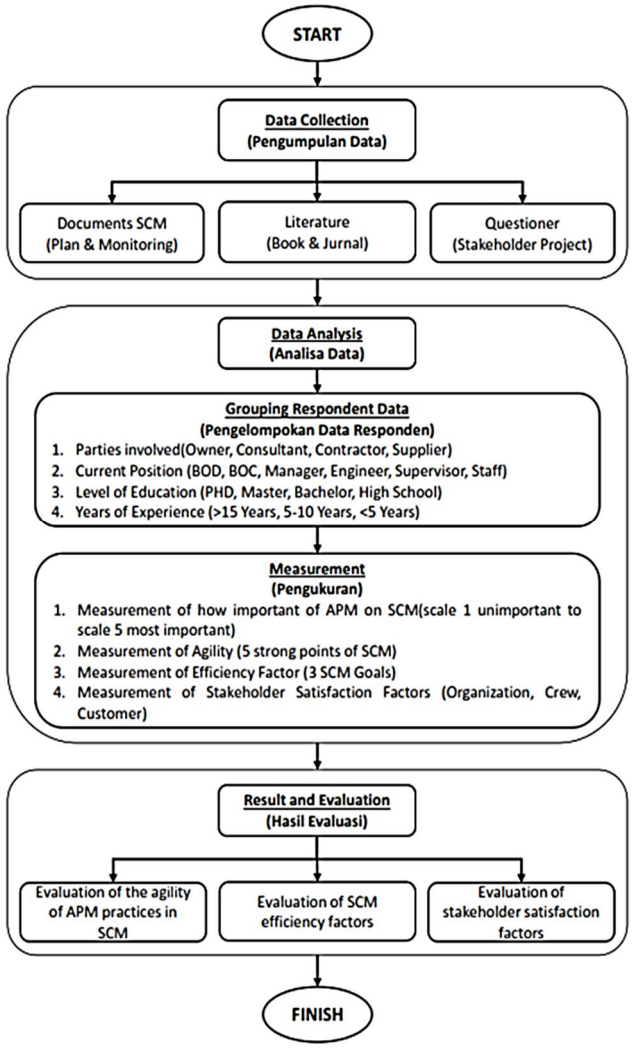

Figure 1: Research Method Process Diagram (Source: Authors)

The method process diagram illustrates the sequence of research implementation (Figure 1), starting from the data collection stage to the evaluation of measurement results. The implementation of research methods carried out includes:

1. Data Collection: Data will be collected through participatory observation:
   a. Collect SCM documents in the implementation of research object projects in the form of planning documents and monitoring documents.
   b. Collect and select literature in the form of books and previous scientific journals on APM and SCM. We have meticulously gathered literature from high-impact Q1 and Q2 journals by employing a meticulous keyword-based approach to establish associations. The selection of journals was based on

their substantial relevance to the effective implementation of the agile system.

c. In-depth interviews with key organization stakeholders, and analysis of related documents.

2. Data Analysis: The observation data was analyzed to measure 5 agility factors, efficiency factors, and stakeholder-satisfied factors, which consisted of:
   a. Grouping respondent data consisting of parties (companies) involved, the position of each respondent, education level, length of work experience, and the importance of APM.
   b. Measuring: APM Agility in SCM is measured using a Conforto questionnaire. Reviewing communication frequency & quality between team & customer, as well as the team's ability to adapt to its changes, as follows:
      (1) Customer and team integration: How often do the customer and project team interact to discuss project implementation?
      (2) Delivery frequency: How often does the team deliver to customers?
      (3) Customer validation: How do you agree that project progress reports are presented, discussed, and validated by the customer?
      (4) Decision time: "How long does it take for the team to analyze the problem, inform others, and make a decision?
      (5) How long will it take to finalize the project plan and share it with all stakeholders?
      (6) Measurement of efficiency factors for 3 project goals, cost, time, and quality.
      (7) Measurement of stakeholder satisfaction factors involves assessing the level of satisfaction within the organization, team, and among customers.

Evaluation Results consist of evaluation of the Level of Agility/Agility of APM, evaluation of efficiency levels; and evaluation of Success Factors/Stakeholder Satisfaction, regarding analysis measurement results.

4. Results and Discussion

SCM manages procurement, fabrication, transportation, storage, installation, inspection, and returns for defects/non-conformities. Global supply chains pose challenges for SCM, including visibility, traceability, scalability, data flow, trust, and costs (Asante et al., 2023). The SCM of this research project manages and controls the supply chain management of imported materials and local content. It includes estimated departure time, estimated time of arrival at the port, estimated customs process time, estimated time of arrival at the storage location, and time of arrival in the field. It also controls space dimension parameters such as production area, lifting and transport capacity, storage areas, and laydown areas in the field. Administrative obligations must be fulfilled at each stage, including compliance with applicable laws and regulations.

The object of the research is the project of building cargo transhipment with a dead weight of 80,000 tons at a shipyard in Indonesia. According to data from the Ministry of Industry of the Republic of Indonesia, there are about 250 shipbuilding companies in Indonesia with a production capacity of 1 million dead weight tonnage (DWT) per year for new buildings, and up to 12 million DWT per year for ship repairs. Shipyards in Indonesia have experience building various types of ships, ranging from passenger and cargo ships to special purpose ships with the largest graving dock facility (150,000 DWT). Especially for the construction of transhipment cargo ships with a capacity of more than 65,000 tons, there are only 2 shipyards that can carry out, namely shipyards in Batam and in Cilegon, which are samples for this research.

The research involved collecting data from SCM implementation documents, Scopus journal literature, and interviews with respondents. The literature included the latest research journals taken from Scopus with categories Q1 and Q2. A total of 107 journals were gathered for this research project. After careful consideration, 35 journals were chosen to serve as references for this study. The selection was based on their correlation with the variables, the analysis methods used, the framework employed, and their relevance to the specific topic under investigation. The primary source of reference is the research carried out by Zuzek and Conforto. In addition, we interviewed 60 stakeholders from the 19 involved companies, including high-level management, to obtain accurate data about their assessment during the use of APM, how the results were achieved, and their level of satisfaction. We carried out data analysis by grouping respondent data to understand SCM and APM practices. Data groups included the company involved and the respondent position. Respondents from each company were targeted to investigate the influence of organizational culture on their roles in the project (Jalali Sohi et al., 2021).

Table 1: Companies Involved

No.	Comp Initial	Comp Occupancy	Num. of Respondents	Nationality	Areas of Expertise / Core Business	Business Size
1	LMS	Consultant	5	Indonesia	Quality assurance, Inspection and shipping	±21 mother vessel cargos, >500 employees
2	STS	Consultant	4	China	Designer of Cargo Transhipment	Office in China & Singapore, >200 engineers
3	GPN	Consultant	1	Indonesia	Assessor and inspector classification of cargo ship	worldwide business with >3000 employees
4	ABC (SMI2)	Contractor, Shipyard Company	4	Indonesia	Shipbuilder and repair	400-hectare shipyard with 7 dry docks and 5 floating docks, >1000 employees
5	SSI	Contractor	2	Indonesia	EPC and Machinery Fabricator	±600 TPM, ±120 employees
6	BEST	Contractor	1	Indonesia	Steel Fabricator	±650TPM, ±350 employees
7	HCI	Contractor	16	Indonesia	EPC and Machinery Fabricator	3 Workshops, ±500 TPM, with >500 employees
8	GK	Contractor	1	Indonesia	Piping and Tank Fabricator	±1600 TPM, ±480 employees
9	MGH	Contractor	1	Indonesia	Piping and Tank Fabricator	300 TPM, ±100 employees
10	TSK	Contractor	5	Indonesia	Piping and Tank Fabricator	3 Workshops, ±1200 TPM, >1000 employees
11	SWS	Contractor	2	Indonesia	Mechanical and Electrical	±1000 TPM, ±350employees
12	KAA	Contractor	1	Indonesia	Mechanical and Electrical	±400 TPM, ±250 employees
13	CVAH	Contractor	1	Indonesia	Mechanical and Electrical	±250 TPM, ±150 employees
14	HKTS	Contractor	1	Indonesia	PLC and Communication Systems	±300 employees
15	BSA	Contractor	1	Indonesia	Eletrical & Instrument	±350 employees
16	DINS	Supplier	4	China	Material Handling Specialist	2000 TPM, ±600 employees
17	EI	Supplier	1	Indonesia	Importer Ship Machinery	1200 TPM, ±100 employees
18	KSP	Owner	1	Indonesia	Coal Trading	2 MTPA
19	SLS	Owner	8	Indonesia	Coal mining & coal trading	2,5 - 4,5 MTPA

The project involved 19 companies with different roles, including consultants, contractors, suppliers, and owners. There were 2 owner companies with 9 respondents, 2 supplier companies with 5 respondents, 12 contractor companies with 36 respondents, and 3 consultant companies with 10 respondents (Table 1). Additionally, the nationalities of the companies involved were 2 from China and 17 from Indonesia. The text also provides information about the core business expertise and business size of the companies.

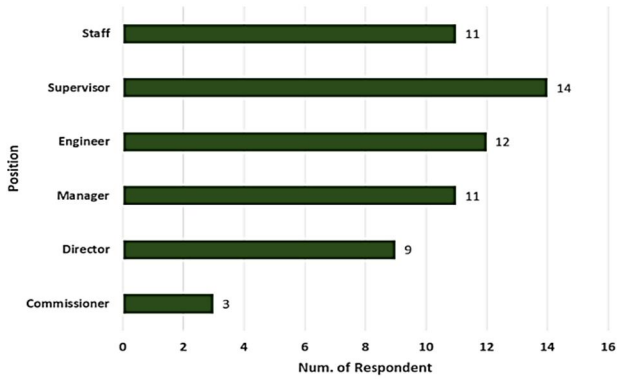

Figure 2: Respondent's Position in the Company (Source: Authors).

The survey includes 60 participants from 19 companies, comprising 3 Commissioners, 9 Directors, 11 Managers, 12 Engineers, 14 Supervisors, and 11 Staff (Figure 2). Careful selection ensures balance and representation, and accurate reflection of supply chain management implementation across different positions.

Table 2: Respondent's Education Level

No	Party	Level of Education			
		PHD	Master	Bachelor	High School
1	Owner	2	3	4	
2	Consultant	2	5	3	
3	Contractor	4	9	19	4
4	Supplier		1	3	1
Total		**8**	**18**	**29**	**5**
Percentage		**13%**	**30%**	**48%**	**8%**

Survey respondents' education levels reveal insights into supply chain management implementation (Table 2). The questionnaire answers may indicate SCM's urgency and expected goals. The survey includes 8 doctoral (13%), 18 master's (30%), 29 bachelor's (48%), and 5 high school respondents (8%). The composition of all levels of

education is fulfilled so that the survey results can be representative data.

Table 3: Respondent's Length of Work Experience

No	Party	Years Of Experience		
		>15 Years	5-15 Years	<5 Years
1	Owner	5	3	1
2	Consultant	4	3	3
3	Contractor	9	16	11
4	Supplier	4	1	
Total		**22**	**23**	**15**
Percentage		**37%**	**38%**	**25%**

Out of the respondents, 22 individuals (37%) had over 15 years of work experience, 23 individuals (38%) had 5 to 15 years of work experience, and 15 individuals (25%) had less than 5 years of work experience (Table 3). The respondent's work experience can explain supply chain management changes over time and evaluate agile project management's effectiveness.

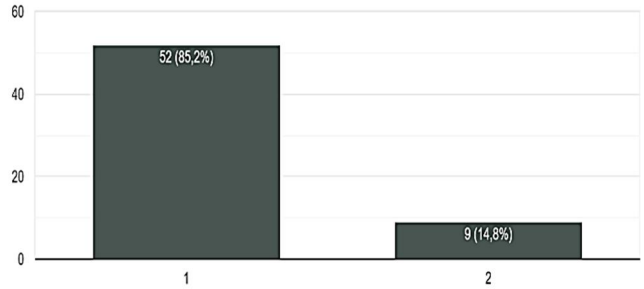

Figure 3: Measuring How Important APM Practices Are in SCM (Source: Authors).

The majority of respondents (85.2%) emphasized the significance of agility, while a small percentage (14.8%) expressed that APM is not important (Figure 3). Agility is crucial for companies involved in supply chain management to improve performance, competitiveness, and sustainability. An agile supply chain management system is required for success in the digital era.

The next data analysis activity is measuring respondent data which has been grouped into 5 measurement agility factors. To assess the extent of agility, five factors are taken into consideration, namely, the level of collaboration between customers and teams, how often the deliveries are made, the degree of customer validation, the time taken to make decisions, and the frequency of updates to the project plan.

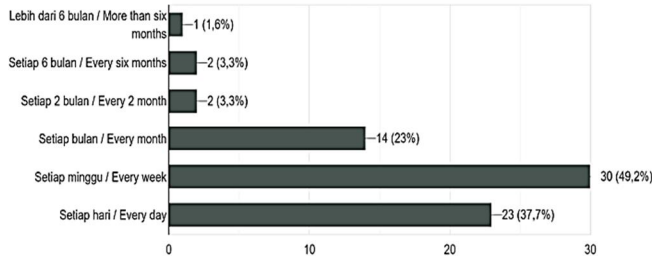

Figure 4: Customer and team integration: Frequency of communication between the project team and the custo mer (Source: Authors).

The frequency of communication from daily to weekly on a regular and flexible basis was the choice of the majority of respondents, namely 53 people out of 60 respondents (86.9%) (Figure 4). This illustrates that implementing APM allows for tighter and more flexible communication frequencies and coordination between team members and between teams and customers.

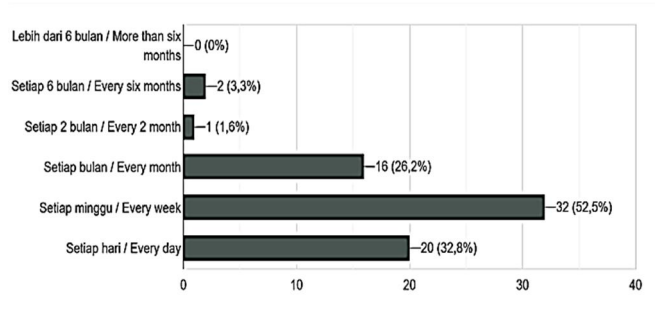

Figure 5: Delivery frequency: Frequency of team delivery of the team to the customer (Source: Authors).

There were 52 out of 60 respondents (85.3%) who stated that the process of delivering data and information to fellow team members and from the team to customers can be done daily to weekly (Figure 5). This shows that the implementation of APM allows agility, speed and flexibility in sending data/information.

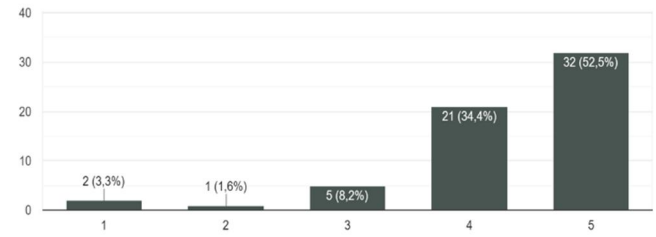

Figure 6: Customer validation: The project progress rep orts are presented, discussed, and validated by the cust omer (Source: Authors).

The vast majority of respondents, 53 out of 60 (86.9%), enthusiastically supported the idea of promptly conveying and validating project progress updates and constraints to customers (Figure 6). This commitment to proactive communication can empower swift corrective action and enable decisive decision-making.

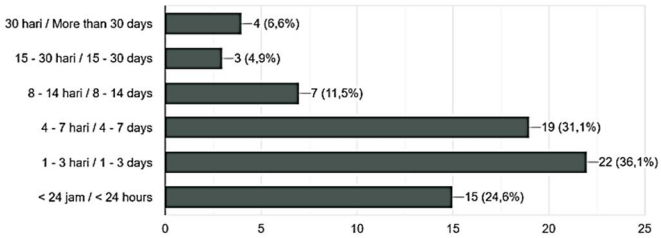

Figure 7: Decision time: Time to analyze the problem, and make a decision (Source: Authors).

The decision-making time between <24 hours to 7 days was the choice of respondents, 56 out of 60 respondents (91.8%), which is a flexible time in meeting project targets, which can be achieved with the help of APM (Figure 7).

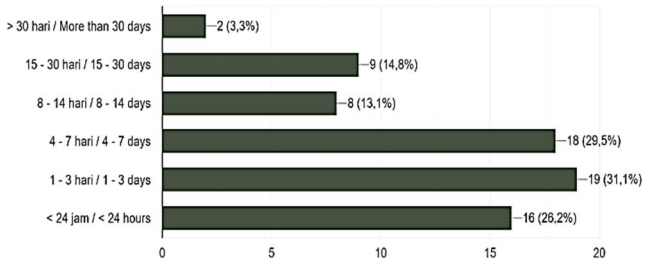

Figure 8: Time of Reporting The project team to stake holders (Source: Authors).

The deadline for delivering project work progress reports to customers is 24 hours, as chosen by 53 out of 60 respondents (86.8%) (Figure 8). The quicker and more stringent the deadline, the more it demonstrates a high level of agility.

Table 4: Measurement of Efficiency Factors

Likert Parameters: 1—Goal not achieved, 2—Goal partially achieved, 3—Goal fully achieved, 4—Goal exceeded, 5—Excellent.				
Respondents		**Objectives**		
		Budget Goals	**Time Goals**	**Scope (Quality) Goal**
Owner	1	3	3	4
	2	4	3	3
	3	3	3	4
	4	3	3	3
	5	4	3	3
	6	3	3	4
	7	4	3	4
	8	3	3	3
	9	4	3	4
Consultant	10	3	3	4
	11	3	3	4
	12	3	2	4
	13	3	2	3
	14	3	2	3
	15	3	2	3
	16	3	2	4
	17	3	3	3
	18	3	3	4
	19	3	3	4
Contractor	20	3	2	3
	21	3	2	3
	22	3	2	3
	23	3	2	3
	24	3	3	3
	25	3	3	3
	26	2	3	4
	27	2	3	4
	28	3	3	3
	29	3	3	3
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	46	3	3	3
	47	2	3	4
	48	2	3	4
	49	3	3	3
	50	3	3	3
	51	3	2	3
	52	2	2	4
	53	3	2	3
	54	2	2	4
	55	3	2	4
Supplier	56	4	2	3
	57	4	3	3
	58	3	2	3
	59	3	3	3
	60	4	3	3
Efficiency Factor (Average)		**3**	**3**	**3**

The respondents' assessments of efficiency in achieving cost, time, and quality objectives varied between partially achieving and exceeding goals (Table 4). To analyze this variation, an average number was calculated by summing the respondents' assessments. Overall, the findings indicate that, on average, all three project objectives were fully achieved.

Table 5: Measurement of Stakeholder Satisfied Factors

Likert Parameters: 1—Goal not achieved, 2—Goal partially achieved, 3—Goal fully achieved, 4—Goal exceeded, 5—Excellent.				
Respondents		**Objectives**		
		Organ. Satisfaction	**Team Satisfaction**	**Customer/ Partner Satisfaction**
Owner	1	4	3	2
	2	4	3	3
	3	4	3	3
	4	4	3	3
	5	4	3	2
	6	4	3	3
	7	4	3	3
	8	4	3	2
	9	4	3	3
Consultant	10	3	3	3
	11	3	3	3
	12	3	3	3
	13	3	3	3
	14	3	3	3
	15	3	3	3
	16	3	3	3
	17	3	3	3
	18	3	3	3
	19	3	3	3
Contractor	20	3	3	3
	21	3	3	3
	22	3	3	3
	23	3	4	3
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	52	3	3	3
	53	3	3	3
	54	3	4	3
	55	3	4	3
Supplier	56	3	3	3
	57	3	3	3
	58	3	3	3
	59	3	3	3
	60	3	3	3
Stakeholder satisfied factors (Average)		**3**	**3**	**3**

The average response of the respondents to the stakeholder satisfaction factor, which consists of organizational satisfaction, team satisfaction and customer/ partner satisfaction can be fully achieved (Table 5).

The integration of agile methods in supply chain management (SCM) implementation significantly enhances flexibility, accuracy, and effectiveness. Research indicates that the adoption of Agile Project Management (APM) in SCM has positive effects on companies, regardless of their adoption of APM or not. Both groups showcase similar enhancements in team and customer integration, delivery frequency, and customer validation. Therefore, all companies should strive to standardize their SCM systems to achieve their project management objectives.

5. Discussion

Agile project management is a popular approach due to its flexibility and customer-centricity. Agile practices integration with conventional project management techniques is a point of contention, especially in managing hybrid organizations (Zasa et al., 2020).

This study evaluates the agility of APM practices, efficiency factors, and success factors/stakeholder satisfaction using the Conforto framework (Conforto et al.,

2016) and (Žužek et al., 2020) with Likert scales: 1—Goal not achieved, 2—Goal partially achieved, 3—Goal fully achieved, 4—Goal exceeded, 5—Excellent.

Table 6: Evaluation of APM Agility

Likert Parameters: <25%=1—Very Low, 25%-<85%=2—Low, 85%-100%=3—High, 101%-110%=4—Very High, >110%=5—Excellent.			
No.	**Description**	**%**	**Likert Score**
1	Customer and team integration	86.9%	3
2	Delivery frequency	85.3%	3
3	Customer validation	86.9%	3
4	Decision-making time	91.8%	3
5	Project plan update time	86.8%	3
	Average	**87.5%**	**3**

Based on the results of the measurement of 5 agility factors (Table 6), the evaluation of the respondents' comments with an average scale of 3 was obtained, which means that the level of agility and flexibility is high.

Table 7: Evaluation of SCM Efficiency Factors

Budget Goals	Time Goals	Scope (Quality) Goal
3	3	3
Goal fully achieved	Goal fully achieved	Goal fully achieved

The project management objectives of cost, time, and quality were evaluated, and each achieved an average rating of 3 (Table 7). This efficiency factor of 3 indicates that SCM can be implemented on time and within cost, meeting quality requirements. Agile software projects measure success in terms of cost, time, and customer satisfaction.

Table 8: Evaluation of Success Factors / Stakeholder Satisfaction

Organizational Satisfaction	Team Satisfaction	Customer/Partner Satisfaction
3	3	3
Goal fully achieved	Goal fully achieved	Goal fully achieved

Satisfaction is satisfactory, but defining project success and performance metrics can be unclear due to varying stakeholder expectations (Table 8). APM helps integrate interests towards project goals and regulations. Efficiency indicators evaluate project objectives and customer satisfaction (Vrchota et al., 2021). This research tests the effectiveness of using APM in SCM to implement ERP SCM in a project. Agile management can enhance supply chain operations by improving efficiency and agility. Agility performance is influenced by organizational, team, and project factors.

Agility performance is influenced by organizational, team, and project factors. Rapid project planning change and active customer involvement are key metrics for agility. Agile management can be integrated into supply chain management frameworks, highlighting the importance of agility as a performance indicator in SCM. This framework combines model-based and data-driven approaches to improve decision-making in supply chain risk management and integrates Industry 4.0 principles into a management framework. The study contributes to the theoretical foundations of supply chain uncertainty, structural dynamics, and risk analytics.

6. Conclusions

Agile Project Management (APM) has proven to be a benchmark for achieving success in Supply Chain Management (SCM). By working closely with the team, maintaining data entry discipline, ensuring quick access to information, making informed decisions, and updating steps with certainty, APM has resulted in higher levels of agility and efficiency. The latest data shows that SCM with APM practices can lead to successful project implementation and operations according to plan, meeting objectives on time, on quality, and within budget.

The application of APM is proven to optimize SCM performance in the field of construction projects, which means it can also increase the effectiveness and efficiency of SCM performance, which in turn can increase the level of customer satisfaction and stakeholders involved in the project. Research is limited to one construction project so it cannot justify the overall application of agile methods to other construction projects in general.

The study has some limitations, such as the measurement of 5 agility factors within a time limit, which may be open to debate. In this study, a time frame of less than 24 hours to 7 days for communication, delivery, validation, decision-making, and progress updates is categorized as achieving a high level of agility. Another limitation is that APM has not been implemented in ship construction projects in Indonesia in general, so the results obtained in this study can be used to assess the operations of other construction projects in terms of agility, efficiency, and stakeholder satisfaction.

It is necessary to prove the effectiveness and optimization of SCM performance by applying APM more widely in several construction projects simultaneously in a certain period in one study. With this research, we hope that it can trigger the emergence of further research that can answer these limitations and be able to answer the phenomenon of APM practice in SCM in a much more complete way, as well as its influence in a wider field.

Compliance with Ethical Standards

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