Critical Success Factors for SCM Centralization Amidst Digital Infrastructure Fragmentation: A Case Study of PT ADHI KARYA (Persero) Tbk

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Abstract

The transition to centralized procurement is a strategic necessity for construction companies to achieve efficiency and transparency. However, this implementation is often hampered by fragmented application ecosystems (siloed systems). This study aims to identify internal Critical Success Factors (CSFs) as bridging variables in the transition to centralized Supply Chain Management (SCM) at PT ADHI KARYA (Persero) Tbk. Using an explanatory quantitative approach, data were collected from 95 operational and managerial respondents. The Exploratory Factor Analysis (EFA) method was used to extract factor dimensions, followed by Multiple Linear Regression analysis to measure variable determination. The study revealed three crucial internal latent factors, namely Data Consolidation Agility (X1), Transitional SOP Clarity (X2), and Top Management Intervention (X3). Simultaneously, these three factors have a determination of 65.4% towards implementation effectiveness ($p < 0.001$). The Data Consolidation Agility variable (X1) was identified as the most dominant determinant with a regression coefficient of 0.382, confirming that staff capability in bridging the manual to digital data gap is an absolute prerequisite for success amidst siloed systems. This finding contributes theoretically regarding the importance of strengthening internal pillars before pursuing system integration, as well as providing a managerial blueprint for PT ADHI KARYA (Persero) Tbk in achieving procurement efficiency.

1. Introduction

The construction services industry ecosystem currently operates under the pressures of hypercompetition, volatile strategic material prices, and escalating demands for operational efficiency. In this complex managerial landscape, the reliability of Supply Chain Management (SCM) has shifted from a mere support function to an

absolute determinant of corporate competitiveness. To improve procurement performance and mitigate ongoing construction project risks, identifying critical success factors has become an essential analytical tool [1]. To secure economies of scale and minimize budget deviations, large corporations are beginning to implement a paradigm shift from decentralized autonomy to a centralized procurement model. Theoretically, the implementation of centralized SCM is specifically designed to improve project management efficiency, align procurement processes, and strengthen corporate internal controls.

This operational transformation toward centralization relies heavily on the adoption of information systems and procurement digitalization. Empirically, the effectiveness of e-Procurement systems is highly dependent on technological infrastructure and the readiness to adapt to organizational bureaucracy [2]. Furthermore, electronic procurement has been proven to significantly accelerate performance and transparency for companies when their digital ecosystem is well integrated [3]. However, the structural shift towards centralization currently being accelerated by PT ADHI KARYA (Persero) Tbk is actually clashing with the immature state of its digital infrastructure. Field procurement operations remain trapped in a fragmented and siloed application ecosystem, where data flows and approvals between process stages are not automatically interconnected. This internal disruption creates a sharp operational gap between the Head Office's strategic ambitions and its technical execution capabilities.

The most critical impact of this unpreparedness for digital system integration is directly felt in the process of consolidating procurement data reporting and analysis. The integration of analytical procurement technology often fails to reach its full potential due to the fragmented structure of raw data in the field. At PT ADHI KARYA (Persero) Tbk, this complication is particularly evident when the SCM Department at Head Office attempts to compile reports on the implementation achievements and efficiency of e-Procurement. The urgent need to measure the comparative efficiency of e-Procurement methods versus conventional procurement, as well as efforts to monitor the internal allocation of Strategic Materials (MATGIS), becomes extremely complicated. The SCM department is forced to semi-manually extract and convert raw procurement data into a structured format (spreadsheet) before processing it. Consequently, creating executive reporting dashboards, which require visual precision, requires a massive administrative burden, triggers change fatigue, and is highly susceptible to data consolidation bias.

This bottleneck situation creates an extreme urgency to identify internal Critical Success Factors (CSFs) capable of bridging the gap between current SCM operations. Successful adoption and implementation of e-Procurement in the construction industry requires mapping critical factors that can bridge the gap between technological capacity and the reality of business execution. Given the lengthy time required for IT integration, aligning internal business processes through transitional Standard Operating Procedures (SOPs) and decisive intervention from top management are crucial for optimizing supply chain performance.

Although the literature on procurement centralization in the construction sector has been growing, a research gap underlies the urgency of this study. Much of the previous literature, such as the comprehensive study by Indriani, Purnomo, and Lestiani [4] that validated the effectiveness of the centralized procurement model at PT Wika Gedung, still focuses on organizations whose digital transparency ecosystems are assumed to be well-integrated. The study used the variables PROVE (Procurement-Oriented Values S Engagement), D-TRACE (Digital Transparency and Centralization Efficiency), and VENSTRAC (Vendor Transparency S Relationship Acceleration), with indicators focused on mature external vendor collaboration and digital transparency. Data were measured through top-level managerial perceptions, with a respondent population that included external vendors and project management.

Unlike those studies, this research presents novelty by limiting its focus to the "internal bridging" variable, which is crucial for companies with siloed digital systems. The proposed variables are Data Consolidation Agility (X1), Transitional SOP Clarity (X2),

1.1 Literature Review

1.1.1. Introduction to Literature

A literature review plays a fundamental role in building a conceptual framework for this research by synthesizing existing scholarly discourse and identifying empirical gaps that require further investigation [5]. In the context of supply chain management transformation, particularly during the procurement centralization phase in the State-Owned Enterprise (SOE) construction sector, this review focuses on theoretical synthesis that shapes the organization's internal adaptation strategies. The literature is structured into several essential themes, including the characteristics of construction procurement reporting, the evolution of centralized procurement implementation amidst digital infrastructure disruption, and a mapping of empirical studies highlighting the urgency of Critical Success Factors (Critical Success Factors) as administrative bridging variables in the transitional era.

1.1.2 Definition and Concept of Procurement in the Construction Industry

Supply Chain Management (SCM) in the construction industry is defined as the orchestration of goods and services procurement, characterized by its unique project-based and geographically decentralized nature [6]. Within this ecosystem, strategic material management (MATGIS) accounts for the largest portion of the total Implementation Budget Plan (RAP). Construction procurement processes often face structural complexity in operational reporting. Therefore, the successful transfer of tacit knowledge regarding the dynamics of material realization in the field into a central reporting system is a key determinant that directly dictates the accuracy of project efficiency evaluations [6]. Without precise data consolidation, executives lose visibility into procurement efficiency ratios.

1.1.3. Centralized Procurement: Concept and Implementation

To address the inefficiencies and administrative redundancies inherent in decentralized procurement models, construction corporations are undertaking a strategic paradigm shift toward a centralized procurement model. The concept of centralization is characterized by the concentration of strategic authority at Headquarters, which empirically aims to secure economies of scale and improve cost control efficiency [5]. The key to the success of this centralized reporting and oversight is the availability of an integrated e-Procurement system [7].

However, the implementation of centralized procurement often faces disruption when organizations are still in the technological transition phase, where the various applications used for various approval stages are not yet interconnected (siloed systems). This fragmentation of digital infrastructure results in the e-Procurement process losing its function as a Single Source of Truth (SSOT), triggering a buildup of manual consolidation workloads, and reducing the effectiveness of data analytics [8]. To address these internal operational bottlenecks, organizations absolutely need intervention through Critical Success Factors (CSFs). CSFs in this transitional implementation phase rest purely on the alignment of internal business processes, the decisiveness of managerial interventions, and the agility of operational consolidation to ensure reporting continuity amidst system integration limitations [9], [10].

1.1.4. Previous Studies and Research GAP

An empirical study of the determinants of successful procurement centralization in the public construction sector has been comprehensively explored by Indriani, Purnomo, and Lestiani [4] in a case study of PT Wika Gedung. Through Exploratory Factor Analysis (EFA) modeling, the study validated the effectiveness of centralization driven by three main pillars: PROVE (Procurement-Oriented Values S Engagement), D-TRACE (Digital Transparency and Centralization Efficiency), and VENSTRAC (Vendor Transparency S Relationship Acceleration). The Wika Gedung model assumes that the company's digital transparency ecosystem is well-integrated, thus placing external vendor collaboration (VENSTRAC) as one of the key drivers.

The research gap underlying the urgency of this study lies in the limited literature on managerial dynamics when corporations (such as PT ADHI KARYA (Persero) Tbk) are forced to centralize under the pressure of a digital infrastructure that is still fragmented (siloed systems). Because the internal digital ecosystem is not yet complete, external (vendor) optimization cannot be prioritized for bridging. The novelty of this research is the repositioning of CSFs variables, focusing exclusively on "internal bridging." The indicators studied emphasize the adaptability of semi-manual data consolidation, the flexibility of transitional Standard Operating Procedures (SOPs), and the executive's policy authority in orchestrating the bureaucratic confusion of applications.

1.1.5. Conclusion of Literature Review

The synthesis of the literature review confirms that a shift towards procurement centralization is a strategic imperative for construction companies to achieve transparency and efficiency. However, the success of this model is not automatically achieved through changes in bureaucratic structures, but rather relies heavily on the organization's internal capabilities in bridging the digital infrastructure gap (siloed systems). By analyzing the literature on internal operational CSFs and gaps in previous studies, this study has a solid conceptual foundation for identifying and reducing bridging indicators at PT ADHI KARYA (Persero) Tbk using the Exploratory Factor Analysis (EFA) method. Furthermore, the results of the reduction of these latent factors (Data Consolidation, Transitional SOPs, and Management Interventions) will be quantitatively tested for their impact on the effectiveness of SCM centralization through Multiple Linear Regression analysis modeling. These findings are anticipated to produce a strategic blueprint for saving internal transitions for project-based organizations.

2. Research Methods

2.1 Research Design and Approach

This research was designed using a quantitative exploratory explanatory research approach. This approach was chosen to explore, extract, and test the causal relationships between latent variables that construct the Critical Success Factors (CSFs) of internal operations amidst the fragmentation of the digital ecosystem at PT ADHI KARYA (Persero) Tbk. Statistical data processing was executed in a structured manner assisted by JASP software, integrating the Exploratory Factor Analysis (EFA) method to reduce transitional indicators, which was followed by Multiple Linear Regression modeling to measure the determination of these factors on the effectiveness of centralized reporting and operations.

2.2 Research Stages

This empirical investigation process is carried out through a series of systematic standard operating procedures. Referring to the research stage flowchart, as follows:

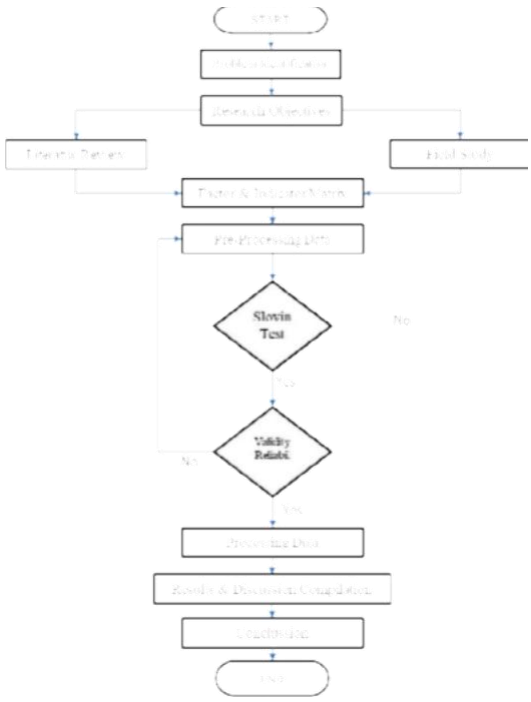

Figure 1. Research Stage Flowchart

2.3 Population and Sample

The target population in this study is the structural and operational stakeholders within PT ADHI KARYA (Persero) Tbk who are directly impacted by the centralization transition (specifically the SCM Department and the Operations/Project Department). The sampling technique used purposive sampling. The minimum sample size was evaluated using the Slovin Test and the EFA indicator adequacy ratio to ensure statistically strong representation (a moderate target of between 80 and 100 respondents).

2.4 Indicator Factor Matrix (Research Instrument)

To translate the concept of internal CSFs into measurable parameters, the research instrument was formulated into an Indicator Factor Matrix. The variables focused on administrative agility and managerial policies.

Table 1. Internal Transition Bridging Indicator Factor Matrix

Factors (CSFs)	Indicator	Measurement	Literature
Data Consolidation Agility	The reliability of the Central SCM team in s e m i - m a n u a l l y consolidating MATGIS procurement data from various different applications.	Likert Scale 1-5	[8] R. Handfield, S. Jeong, and T. Choi (2019).
Data Consolidation Agility	The ability to present efficiency on the executive dashboard precisely amidst system disruption.	Likert Scale 1-5	[7] A. Candela (2022).
Clarity of Transitional SOPs	Regulatory stringency to prevent duplication of document input between procurement applications.	Likert Scale 1-5	[5] Y. Wang, J. Liu, J. Zuo, and R. Rameezdeen (2019).
Clarity of Transitional SOPs	Availability of emergency work procedures (manual) if the main application system malfunctions.	Likert Scale 1-5	[10] P. Mikalef et al. (2022).
Top Management Intervention	The executive's firmness establishes one application as the Single Source of Truth during the transition period.	Likert Scale 1-5	[9] A. Afolabi et al. (2019).

2.5 Data Analysis Techniques

After the field data is validated, inferential testing is run through two sequential modeling stages:

- **Exploratory Factor Analysis (EFA):**
  Prior to factor extraction, the data suitability for analysis was evaluated using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity. A KMO value of at least 0.5 was required to ensure that the correlation between indicators was strong enough for factor analysis, while a Bartlett's Test with a significance of $p < 0.05$ was required to demonstrate that the correlation matrix was significantly different from the identity matrix. Factor extraction was then performed using Principal Component Analysis (PCA) with orthogonal rotation (Varimax) to reduce the indicators into independent CSF dimensions.

- **Multiple Linear Regression:**
  The latent factors extracted (Independent Variables: X1, X2, X3) were tested for their determination on the effectiveness of procurement centralization implementation (Dependent Variable: Y). The mathematical equation of this model is:

$$Y = \alpha + \beta 1\ X1 + \beta 2\ X2 + \beta 3\ X3 + \epsilon$$

The causality significance test was validated through a partial test (T-test) and a simultaneous test (F-test) to ensure that the internal siloed systems ecosystem bridging hypothesis can be empirically justified.

3. Result and Discussion

3.1 Respondent Characteristics Analysis and Data Feasibility Test

This study involved 95 respondents who were procurement practitioners and project managers at PT ADHI KARYA (Persero) Tbk. Respondents were dominated by SCM staff/managers (40%) and project logistics (36.8%), with the majority having a work period of over 3 years (73.7%). The instrument test showed a Cronbach's Alpha value of 0.875 (> 0.70), which confirmed the internal consistency of the instrument. The KMO value of 0.821 and the significance of Bartlett's Test < 0.001 confirmed that the data were suitable for further analysis using the Exploratory Factor Analysis (EFA) method.

3.2 Exploratory Factor Analysis (EFA)

The data reduction process using Principal Component Analysis (PCA) with Varimax rotation successfully grouped the indicators into three latent factors with a total cumulative variance of 71.2%. These three factors are defined as:

- Data Consolidation Agility (X1)
- Transitional SOP Clarity (X2)
- Top Management Intervention (X3)

3.3 Discussion of Research Results

The regression analysis results showed an adjusted R^2 value of 0.654, indicating that 65.4% of the effectiveness of SCM centralization was influenced by these three factors. The following is a detailed discussion of each variable:

- **Data Consolidation Agility (X1):**
  This variable was proven to be the most dominant determinant of the effectiveness of centralization with a regression coefficient of 0.382 ($p<0.001$). These results indicate that the ability of personnel to bridge data gaps between fragmented systems (siloed systems) is a key prerequisite. Data shows that staff who have high data handling capabilities are able to reduce bias in executive dashboard reporting, which directly increases the speed of management decision making.

- **Clarity of Transitional SOPs (X2):**
  This variable has a significant influence, with a regression coefficient of 0.315 ($p<0.001$). This finding indicates that clear bureaucracy during the transition period serves as an operational guideline (SOP) that minimizes duplication of document input between applications. The availability of well-established manual work procedures when the main application malfunctions has been proven to maintain operational continuity, thus maintaining the effectiveness of centralization even though the digital infrastructure is not yet fully integrated.

- **Top Management Intervention (X3):**
  This variable has a positive effect of 0.218 ($p=0.005$) on implementation effectiveness. Top management's firmness in establishing one application as the Single Source of Truth (SSOT) provides

legitimacy for staff to comply with the new workflow. The data demonstrates that consistent managerial intervention can orchestrate bureaucratic confusion resulting from the use of multiple applications, enabling the organization to move toward its MATGIS procurement efficiency target.

3.4 SCM Centralization Implementation Improvement Strategy Model

Simultaneously, hypothesis testing (H4) shows that these three factors significantly influence the effectiveness of centralization ($p<0.001$). This model emphasizes that in organizations with fragmented digital infrastructure, management should focus on strengthening the "internal pillars" (data consolidation and SOP governance) before pursuing comprehensive system integration.

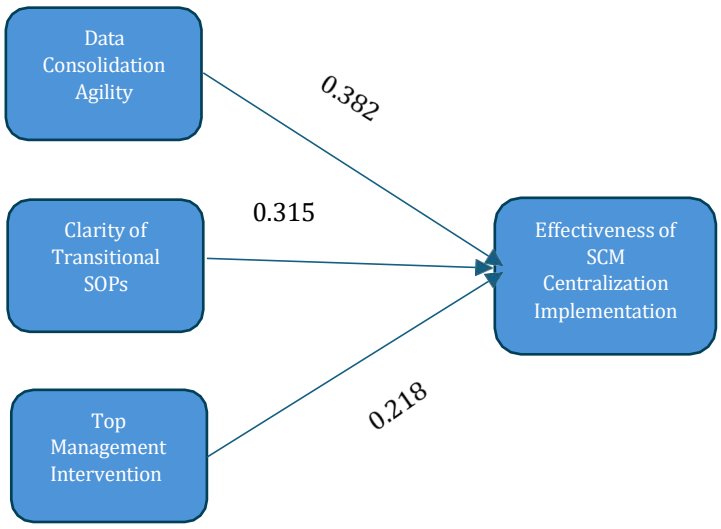

Figure 2. Strategy Model for Improving the Implementation of SCM Procurement Centralization

Based on the model above, the following hypothesis is proposed:

- H1: X1 has a significant effect on Y.
- H2: X2 has a significant effect on Y.
- H3: X3 has a significant effect on Y.
- H4: X1, X2, and X3 simultaneously have a significant effect on Y.

3.5 Hypothesis Test Results and Discussion

Based on the results of the t-test (partial) and F-test (simultaneous), the following results were obtained:

Table 2. Summary of Hypothesis Tests

Hypothesis	Variables	Coefficient (β)	t-count	Significance	Decision
H1	X1 → Y	0.382	5.210	< 0.001	Accepted
H2	X2 → Y	0.315	4.150	< 0.001	Accepted
H3	X3 → Y	0.218	3.020	0.005	Accepted
H4	X1, X2, X3 → Y	-	72.34	< 0.001	Accepted

Discussion:

All hypotheses (H1, H2, H3, and H4) are accepted, which shows that these three internal factors are absolute determinants for the effectiveness of centralization in siloed systems.

- **Dominance of Data Consolidation Agility (X1):**
  With the highest regression coefficient (β = 0.382), this variable proves that the company's primary problem is an "internal data integration crisis." Staff ability to process data semi-manually with a high degree of precision is essential for successful executive reporting. Without this competency, procurement efficiency will not be achieved even if the organizational structure has been changed.
- **The Role of Transitional SOP Clarity (X2):**
  This variable serves as a supporting variable that provides operational legitimacy. With a coefficient of 0.315, transitional SOPs act as a safety net, ensuring standardized workflows amid malfunctions or disconnections between procurement applications.
- **The Role of Top Management Intervention (X3):** R^2
  Management intervention, with a coefficient of 0.218, provides workflow certainty for all work units. Executive assertiveness in establishing a Single Source of Truth (SSOT) serves as an instrument to minimize operational ambiguity that often occurs during the digital transition.

This model has an Adjusted $\boldsymbol{R^2}$ value of 0.654, which confirms that this model is very strong in explaining the success of centralization at PT ADHI KARYA (Persero) Tbk. This finding provides an empirical basis that management focus should be directed at improving internal data and transitional bureaucracy as the main prerequisites before the company achieves complete digital system integration.

4. Conclusion

4.1 Conclusion

Based on the results of empirical data analysis of 95 respondents at PT ADHI KARYA (Persero) Tbk, this study answers the research question regarding the factors that determine the effectiveness of the SCM centralization transition. The research conclusions are as follows:

- Determination of Critical Success Factors: This study successfully identified three internal critical success factors that determine the effectiveness of the SCM centralization transition: Data Consolidation Agility (X_1), Clarity of Transitional SOPs (X_2), and Top Management Intervention (X_3). These three factors simultaneously contributed 65.4% to the effectiveness of centralization implementation at PT ADHI KARYA (Persero) Tbk.
- Dominant Determining Factors: Data Consolidation Agility (X_1) was identified as the most dominant factor with a regression coefficient of 0.382. This confirms that in conditions of fragmented digital infrastructure (siloed systems), personnel's ability to perform semi-manual data bridging is key to a successful transition, far more crucial than other factors.
- Model Validity: All identified factors were shown to significantly influence the effectiveness of centralization ($p<0.001$). Thus, this study validates that an effective centralization transition in construction companies cannot be achieved solely through technology integration but must be supported by strengthening internal pillars such as data agility, adaptive SOPs, and decisive leadership.

4.2 Suggestion

Based on the findings above, strategic recommendations are proposed for the management of PT ADHI KARYA (Persero) Tbk as follows:

- Optimizing HR Capacity (Data Agility): Considering the dominance of the Data Consolidation Agility variable (X_1), companies are advised to allocate 15-20% of the 2026 HR development budget for intensive training in integrated data processing, in order to increase the precision of executive reporting which is currently still semi-manual.

- Standardization of Transitional SOPs: Companies need to determine a Service Level Agreement (SLA) for document approval times through transitional SOPs with a maximum target of 2x24 hours. This is important to ensure cross-application workflow compliance during a period of incomplete system integration.

- Strengthening the Role of Top Management: Top management is expected to be more consistent in determining one procurement application as a Single Source of Truth (SSOT) with 100% compliance. This clarity is needed to minimize data ambiguity and speed up the operational consolidation process.

- Further Research: To complement these findings, further research is recommended to explore behavioral determinants, such as change fatigue and organizational resistance, which are often latent obstacles in digital transformation in project-based organizations.

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