Factors influencing logistics and supply chain efficiency in residential construction projects

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Abstract

This research aimed to 1) Study the factors affecting the efficiency of logistics and supply chains in residential construction businesses 2) Investigate guidelines for selecting suppliers that would enhance logistics and supply chain efficiency in residential construction businesses. The sample consisted of 384 project owners and contractors involved in residential development projects in eastern Thailand, both registered and unregistered. Questionnaires were used for data collection, and statistical analysis included mean, standard deviation, and multiple regression analysis. The research findings revealed Supplier Selection Factors Overall and across all aspects, the level of agreement was high, ranked as follows Project management quality Responsibility for on-time completion Availability of materials/equipment Cost-effectiveness/cost savings. Logistics and Supply Chain Efficiency Overall and in all details, the level of agreement was high. The highest-rated aspect was effective coordination, collaboration, and work control. Hypothesis Testing Results Different types of business groups There were statistically significant difference in overall logistics and supply chain efficiency, including the ability to effectively manage the cost of lost or damaged goods and transportation costs. This indicates that the type of business influences logistics and supply chain efficiency differently. Supplier selection factors: Overall, including cost-effectiveness/cost savings, availability of materials/equipment, and responsibility for on-time completion, had a statistically significant effect on logistics and supply chain efficiency. The overall supplier selection factors showed a relatively high correlation with logistics and supply chain efficiency.

Keywords: Logistics and Supply Chain Efficiency / Construction Businesses / Housing Development Projects / Suppliers

1. Introduction

Most people who want to own a home but lack land, design knowledge, and access to construction services opt for housing projects, which provide a convenient solution. The growth of housing projects is closely linked to the construction contracting business, which takes on partial or full construction work for developers. Between 2024 and 2026, the construction industry is projected to grow by 3.0–4.0% annually, aligning with Thailand's logistics development plan (2023–2027). Private sector construction, including residential and commercial real estate, is also expected to recover gradually, growing by 3.0–3.5% annually. Small and medium-sized contractors (SMEs) have experienced stable revenue in 2023–2024, with expected improvements in 2025–2026 due to economic recovery and increased purchasing power (Cronbach, L.J., 1990).

Housing project developers rely on contractors and suppliers, making contract agreements crucial. These contracts must clearly outline responsibilities, payments, material specifications, and quality assurance, typically covering a 1–5 year warranty. Selecting reliable contractors involves evaluating factors such as reputation, expertise, financial stability, equipment readiness, service consistency, adherence to deadlines, licensing, and safety management. Given these considerations, this study aims to examine factors influencing logistics and supply chain efficiency in housing project construction. The findings will help improve contractor selection and logistics management, contributing to sustainable business operations (Rovinelli, R. J, 1976).

1.1 Research Objective

1) To study the factors affecting the logistics and supply chain efficiency of the housing project construction business.

2) To explore supplier selection strategies that enhance the logistics and supply chain efficiency of the housing project construction business.

2. Literature Review

Definition of Logistics

Attawit (2020). defines logistics as the operational process within the supply chain that focuses on efficiency and effectiveness in planning, execution, and control. This includes the movement, collection, and distribution of goods, services, and information from the origin to the destination in alignment with customer demands.

DHL (2023). defines logistics as a management and delivery system that includes planning to help businesses store and transport goods to end customers. Logistics encompasses procurement, inventory management, warehouse distribution, transportation, and risk management.

Logistics refers to the operational process within the supply chain (Supply Chain) that involves management and delivery systems, including planning, execution, and control. It covers the movement, collection, and distribution of goods, services, and information from the point of origin to the final destination efficiently.

In other words, logistics encompasses procurement, inventory management, warehouse distribution, transportation, and risk management. This involves transferring products and materials from one location to another, receiving raw materials from partners or suppliers, ensuring reliable transportation, and managing warehouse storage. The ultimate goal is to optimize investment efficiency through strategic planning and cost-effective operations.

The Importance of Logistics

Logistics management plays a crucial role in ensuring that transportation and logistics systems operate proactively and with maximum efficiency. To achieve this, it is essential to focus on planning resources across land, water, air, and information technology. This includes real-time data integration and the use of technology for tracking and managing goods, such as sensor-based tracking systems. These measures help optimize transportation efficiency, meet customer demands, and minimize overall logistics management costs as effectively as possible

(Rework Cable Co., Ltd., 2023). The importance of logistics can be further explained in the following key aspects (Nattawee, 2023).

Logistics is a significant expense for businesses and has an impact on and is influenced by other activities within the economic system. Improving the efficiency of logistics processes directly contributes to enhancing the overall economic condition. Effective logistics management enhances the efficiency and productivity of the industrial sector and related industries throughout the value chain, adding value to industrial products. Logistics increases utility in terms of time and place by ensuring that goods required by customers for consumption or production are delivered to the desired location, at the right time, in the right condition, and at the expected cost.

Efficiency of Logistics Services

The efficiency of logistics services can be described as follows (Attawit, 2020). Logistics is a significant cost for businesses and affects or is affected by other economic activities. Improving logistics processes directly contributes to overall economic growth. Effective logistics management enhances efficiency and productivity in industrial production and related industries throughout the value chain, increasing the value of industrial goods. Logistics adds utility in terms of time and place by ensuring that goods required for consumption or production reach the desired location at the right time, in the right condition, and at the right cost.

Efficiency in Logistics Management

The efficiency of logistics management includes the following aspects (Attawit, 2020). Reducing logistics costs (Low Cost). Ensuring timely procurement and delivery of raw materials and goods (Time Deliver Rise). Enhancing logistics operations with flexibility and adaptability to market conditions. Supporting the needs of different departments within the company, especially production and marketing, making logistics a value-adding activity. Effectively responding to customer demands.

Benefits of Logistics Management

Logistics management offers various benefits for businesses and customers in multiple aspects (Alshurideh, M., 2022). Financial Benefits – Effective logistics management helps reduce costs related to transportation, storage, and product loss, positively impacting business profitability. Efficiency Benefits – Enhancing operational efficiency in production, transportation, and distribution, enabling businesses to meet customer demands effectively. Safety Benefits – Managing risks related to transportation and natural disasters, minimizing damage to products and business assets. Environmental Benefits – Reducing environmental impact, such as pollution and energy consumption. Customer Satisfaction Benefits – Ensuring timely and accurate delivery, increasing customer satisfaction and customer retention. Effective logistics management enables businesses to grow and remain competitive in the market.

Logistics and Risk Management in Production and Production Control

Production is a fundamental business function involving the transformation of raw materials into products, such as phones and computers, or services like public transportation and entertainment (Attawit, 2020). Production control ensures smooth operations by managing the flow of information and materials. Decision-making in one area of production affects other components. For instance, stockpiling raw materials prevents production delays but may extend delivery timelines or dissatisfy customers. Thus, production control must align with

organizational goals. Types of Production Control (Nattawee, 2023). Flow Control – Continuous production scheduling with a fixed sequence in the production line. Order Control – Used in intermittent production where orders dictate scheduling. Block Control – Group-specific production control, such as manufacturing different sizes and styles of garments. Batch Control – Used for mass production of consumer goods. Project Control – Special project-based production control requiring close supervision to meet planned objectives.

Logistics Costs

Logistics costs comprise the following components. Inventory Holding Costs. Financial Costs (Cost of Capital): Opportunity costs associated with holding inventory, including the value of raw materials, work-in-progress, finished goods, interest on capital, and holding periods. Other Costs from Holding Inventory: Includes insurance costs, losses from write-offs, and depreciation of goods due to obsolescence. Inspection and Maintenance Costs: Expenses related to counting, inspecting, and cleaning stored goods.

Warehouse Management Costs. Warehouse Asset Investment Costs: Depreciation of warehouse buildings, office spaces, and interest on loans for investment. Facility and Office Expenses: Insurance, property taxes, and related costs. Employee Costs: Salaries, overtime, and temporary workforce expenses. Warehouse Operations Costs: Expenses for handling equipment, pallets, packaging materials, fuel, and administrative documents. Warehouse Management Information System Costs: Costs associated with IT systems for inventory control (Nattawee, 2023).

Transportation Costs. Vehicle Investment and Equipment Costs: Depreciation and loan interest on transport vehicles. Vehicle Maintenance Costs: Repair and maintenance of trucks and related equipment. Fuel Costs: Expenses for diesel, gasoline, or alternative fuels. Driver and Staff Costs: Salaries and wages for transport personnel. Other Transport-Related Expenses: Toll fees, parking fees, and cross-docking costs for multimodal transport.

Logistics Management Costs. Information Management Expenses: Costs for communication tools, office supplies, and data systems. Personnel Costs: Salaries for logistics managers and supervisors. Customer Service Support Costs: Expenses related to order fulfillment and customer communication. Personnel Costs. Estimated monthly expenses for logistics employees at various levels. Wages, overtime, allowances, bonuses, pensions, and benefits (Cronbach, L.J., 1990).

Storage Costs. Capital Costs: Interest and depreciation of stored inventory. Insurance and Obsolescence Costs: Losses due to write-offs and aging stock. Packaging Material Costs: Costs for labels, stickers, and protective packaging. Facility Depreciation Costs: Depreciation and loan interest on warehouses. Facility Maintenance Costs: Insurance and property taxes on storage buildings. Warehouse Operations Costs: Expenses for handling equipment and administrative documents. Warehouse IT System Costs: Software and system costs for inventory management. Storage Rental Costs: Rental fees for storage facilities, or equivalent market rental rates if owned by the business (DHL, 2023).

Information Management Costs. IT Equipment and Maintenance Costs: Rental or purchase costs for IT infrastructure. Consumable Supplies: Printer paper, ink, storage media, and monthly estimated expenses. Communication Costs: Telephone and internet expenses.

Miscellaneous Costs. Administrative and office expenses, including rent and estimated monthly lease costs.

Logistics Constraints for Construction Contracting and Building System Works

Rapeeras, W. (2022). Construction contracting must consider several constraints, including completing projects within the specified timeline, maintaining standards and quality as per contractual agreements, keeping costs competitive, and ensuring the integrity of subcontractors. The risks and constraints in logistics for construction contracting and system installation projects include:

Project Delays and Revenue Disruptions. Revenue from construction projects is recognized based on project completion stages per Accounting Standard No. 15. Unlike service industries that recognize revenue upon service delivery, construction firms face income continuity risks if projects are delayed, affecting progress milestones and potentially missing new project bids.

Inaccurate Cost Estimation. Misestimating costs or poor cost control can result in actual expenses exceeding budgeted amounts, affecting profitability and reducing competitiveness in future bidding.

Material and Equipment Price Fluctuations. Fixed-price contracts require strict budget adherence. If material prices rise unexpectedly and suppliers do not offer price adjustments, the contractor bears the cost burden, reducing project profitability.

Labor Shortages. Insufficient labor affects project timelines, leading to late deliveries, penalty charges, and higher-than-expected costs. Proper workforce planning is crucial to meeting contractual deadlines.

Regulatory and Policy Changes. Government policies, such as minimum wage adjustments, building codes, and construction permits, can increase costs and delay project execution. Changes in real estate policies may also impact construction demand.

Cooper, M.C. (1997). Dependence on Skilled Engineers. Construction projects require experienced engineers and project managers. Losing key personnel can disrupt ongoing projects and affect future opportunities.

Project Delays Leading to Compensation Claims. Delays may arise from late site handovers, design changes, financial constraints, or unforeseen circumstances like natural disasters. Unresolved delays can result in legal disputes and reputational damage.

Unpaid Additional or Change Orders. Clients may request changes or additions without prior agreements on pricing. Contractors often proceed with modifications before settling financial terms, leading to payment collection risks.

Investment Risks in Subsidiaries. Financial support to subsidiaries through loans or guarantees exposes the parent company to liquidity risks if subsidiaries face financial difficulties.

Delayed or Non-Payment from Clients. Construction firms provide services before invoicing, creating cash flow risks if clients delay or fail to pay. Proper client financial assessments help mitigate bad debt risks.

Political Uncertainty Risks. Political instability, protests, or policy shifts impact investor confidence, delaying real estate and infrastructure projects. This intensifies bidding competition, lowers profit margins, and increases project costs due to unforeseen delays.

Research on Logistics and Supply Chain Efficiency

Taha, M.G. (2020). Logistics activities involve moving products and/or materials from one location to another, receiving raw materials from partners or suppliers, ensuring reliable transportation, and managing warehouse storage. It is an essential part of the supply chain management process, focusing on cost-effectiveness and strategic planning to maximize investment efficiency.

As widely understood, logistics management covers the entire process, from sourcing raw materials from suppliers to delivering finished products to customers. Key logistics activities that directly impact a business's ability to deliver goods and services include procurement, transportation, and warehouse management.

Adaptation and Strategies of Construction Business Operators Amid the COVID-19 Pandemic in Phuket Province" The study found that the adaptation strategies of construction business operators in Phuket during the COVID-19 pandemic—specifically in terms of quality, technology, and differentiation—differ significantly based on personal factors. Moreover, the relationship between adaptation and business strategies during the pandemic indicates that the Speed Strategy is significantly associated with business adaptation in these aspects.

Enhancing the Sustainability of Supply Chain Efficiency in E-Commerce Logistics Providers in Thailand The study found that. Key service values include environmental responsibility (ENV), service convenience (CON), corporate image (IMM), social responsibility (SOC), employee service quality (STA), delivery efficiency (DEL), and highly effective information management (INF). Service values have both direct and indirect influences on the sustainable supply chain efficiency of e-commerce logistics providers, with indirect effects being mediated by service value perception. The findings can be applied to improve small Thai-owned logistics businesses, enabling them to compete sustainably. (Stock, J.R., 2001).

3. Methods

The study population consists of warehouse employees from cold storage businesses, with a total of 193 businesses (Priyanuch Satyapongphakdee, 2023). The sample includes warehouse employees from these cold storage businesses. Using the Krejcie and Morgan (1970, pp. 607-610) formula, the required sample size was calculated to be 129. To enhance the study, an additional 31 samples were included, resulting in a total sample size of 150. The researcher selected 1–2 employees per business and applied stratified random sampling, dividing the sample based on the population proportions described by Priyanuch Satyapongphakdee (2023). The sample distribution was categorized according to business size, ensuring proportional representation.

For statistical data analysis, the researcher employed both descriptive and inferential statistics. Descriptive statistics were used to analyze the personal factors of respondents through frequency and percentage, while cold storage warehouse management and the efficiency of inventory control in temperature-controlled warehouses were analyzed using mean and standard deviation. For inferential statistics, the study tested the hypothesis regarding the influence of cold storage warehouse management on inventory control efficiency in temperature-controlled

warehouses using Multiple Regression Analysis. The coefficient of determination (R^2) was applied to measure predictive accuracy, with a significance level set at 0.05. The Enter method was used to select independent variables for regression analysis and formulate a predictive model. Prior to hypothesis testing, the researcher examined the correlation among independent variables to prevent multicollinearity.

4. Results and Discussion

Table 4.2: Mean and Standard Deviation of Opinion Levels on Supplier Selection Factors (Overall)

(n = 384)

Supplier Selection Factors	$\overline{X}$	S.D.	Results	Rank
Project Management Quality	4.24	0.58	Much	1
Cost-Effectiveness / Cost Savings	4.20	0.52	Much	4
Availability of Raw Materials / Equipment	4.22	0.55	Much	3
Timeliness and Work Responsibility	4.23	0.59	Much	2
Include	**4.22**	**0.49**	**Much**	**-**

From Table 4.2, the overall opinions on supplier selection factors indicate that respondents rated their opinions at a high level, with an average score of 4.22. When considering individual aspects, all factors were rated at the highest level as follows. Rank 1 Project Management Quality – Average score of 4.24. Rank 2 Timeliness and Work Responsibility – Average score of 4.23. Rank 3 Availability of Raw Materials / Equipment – Average score of 4.22. Rank 4 Cost-Effectiveness / Cost Savings – Average score of 4.20

Table 4.9: Results of Multiple Regression Analysis Testing the Influence of Supplier Selection Factors on Logistics and Supply Chain Efficiency in Housing Development Construction Businesses. The analysis indicates that supplier selection factors have a direct positive influence on logistics and supply chain efficiency in the housing development construction sector.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Tolerance	VIF
	B	Std. Error	Beta				
Constant	.820	.138		5.945*	.000		
Project Management Quality (X_1)	.039	.040	.043	.963	.336	.439	2.277
Cost-Effectiveness / Cost Savings (X_2)	.099	.046	.098	2.149*	.032	.426	2.348

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Tolerance	VIF
	B	Std. Error	Beta				
Availability of Raw Materials / Equipment (X_3)	.310	.051	.323	6.132*	.000	.319	3.137
Timeliness and Work Responsibility (X_4)	.372	.049	.422	7.578*	.000	.286	3.498
R	0.815						
R Square	0.664						
Adjusted R Square	0.660						
Durbin-Watson	1.830		F-ratio	187.162	Sig (0.01)*		

* $p < 0.050$

From Table 4.9, the Multiple Linear Regression analysis indicates that supplier selection factors were refined by selecting independent variables with a statistical significance level (sig) of 0.05. These include. Cost-Effectiveness / Cost Savings (X2), Availability of Raw Materials / Equipment (X3), Timeliness and Work Responsibility (X4). However, Project Management Quality (X1) was excluded as it had a significance level above 0.05. The analysis also confirms no multicollinearity issues, as all Tolerance values exceed 0.1 and VIF values are below 10. Additionally, the Durbin-Watson value of 1.830, which falls within the acceptable range of 1.50 - 2.50, suggests no autocorrelation among independent variables. The coefficient of determination (R Square = 0.664 or 66.40%) indicates a moderately high positive correlation between supplier selection factors and logistics and supply chain efficiency in housing development construction businesses.

The F-test result (Sig. = 0.000, $p < 0.05$) confirms the statistical significance of the model. The Beta coefficients, ranked by influence, are Timeliness and Work Responsibility (X4) (Beta = 0.422), Availability of Raw Materials / Equipment (X3) (Beta = 0.323), Cost-Effectiveness / Cost Savings (X2) (Beta = 0.098). Multiple Linear Regression Equations:

Unstandardized Equation $\hat{Y}$ = .820* + 039 (X1) + .099 (X2)* + .310 (X3)* + .372 (X4)*

$\hat{Y}$ = Logistics and Supply Chain Efficiency in Housing Development Construction Businesses
X1 = Project Management Quality
X2 = Cost-Effectiveness / Cost Savings
X3 = Availability of Raw Materials / Equipment
X4 = Timeliness and Work Responsibility

Standardized $\hat{Y}$ = .043 (X1) + .098 (X2)* + .323 (X3)* +.422 (X4)*

$\hat{Y}$ = Logistics and Supply Chain Efficiency in Housing Development Construction Businesses
X1 = Project Management Quality
X2 = Cost-Effectiveness / Cost Savings
X3 = Availability of Raw Materials / Equipment
X4 = Timeliness and Work Responsibility

5. Conclusion

Most businesses in the housing project construction sector are subcontractors working on projects in the eastern region, accounting for 76.30%, while project owners constitute 23.70%. Regarding supplier selection factors, the overall opinions were rated at a high level. Among the key factors, project management quality ranked first, followed by responsibility for on-time project completion, availability of raw materials and equipment, and cost-effectiveness.

Project Management Quality – Overall, opinions were at a high level. The most crucial factor was adherence to project quality standards, followed by compliance with project specifications, the ability to source quality raw materials, sufficient labor supply, and finally, supplier performance evaluation from previous projects.

Cost-Effectiveness – Opinions were also at a high level. The most important factor was selecting suppliers based on past performance to ensure cost efficiency. Other key aspects included suppliers providing detailed Bill of Quantity (BOQ), optimizing material usage, meeting project material requirements on time, and offering materials at lower-than-market prices.

Availability of Raw Materials and Equipment – The most critical factor was suppliers' ability to source necessary tools and equipment for project modifications. Other significant factors included having reliable sourcing for high-quality equipment and raw materials, ensuring sufficient supply in required quantities, and delivering finished components as per project needs.

Responsibility for On-Time Completion – The highest-rated factor was ensuring workplace safety measures. Other important aspects included delivering materials on schedule and to the designated location, conducting quality inspections throughout the process, and willingness to allow retention money deductions as a performance guarantee.

Logistics and Supply Chain Efficiency Overall, logistics and supply chain efficiency were rated at a high level. The most important factors were effective coordination and work control, followed by cost-efficient material storage management, timely project completion, efficient logistics planning for raw materials, strategic operational planning, transport cost management, and minimizing losses.

Hypothesis Testing Results 1.Different business types showed statistically significant differences ($p < 0.05$) in overall logistics and supply chain efficiency, particularly in managing transport and loss-related costs. 2.Supplier selection factors related to cost-effectiveness, raw material availability, and responsibility for timely completion significantly impacted logistics

and supply chain efficiency ($p < 0.05$). However, project management quality did not have a statistically significant effect. The supplier selection factors had a strong positive correlation with logistics and supply chain efficiency, with an R^2 value of 0.664 (66.40%).

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