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The Effect of Supply Chain Integration on the Effectiveness of Batik Product Development Design at the Tuban Center

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Abstract: This study aims to determine whether there is a significant influence between supply chain integration and the effectiveness of batik product design development in the Batik Center of Tuban. This research is grounded in the importance of interconnectedness among supply chain actors to enhance the quality and competitiveness of sustainable local product designs. A quantitative approach was employed using an ex post facto design, meaning data were collected after the events had occurred without any experimental manipulation. The sample consisted of the entire population, totaling 60 batik industry participants. Data analysis was conducted with the assistance of SPSS version 22. The statistical results indicate that supply chain integration significantly affects the effectiveness of design development. The stronger the integration—such as in information sharing, production process synchronization, and collaboration between suppliers and producers—the more optimal the product design outcomes. These findings highlight the vital role of strategic collaboration across the entire supply chain in enhancing the competitiveness of batik products.

Keywords: Supply Chain Integration, Design Effectiveness, Batik Product Development.

INTRODUCTION

In the dynamics of modern industries that continue to evolve, companies are faced with the challenge of not only creating innovative products, but also managing their production processes efficiently and integrally (Damayanti, 2025; Fathoni & Muqorrobin, 2024). One of the strategic approaches that is getting more attention is supply *chain integration*. This concept emphasizes the importance of coordination and synergy between various elements in the production process, ranging from raw material suppliers, manufacturing, distribution, to end consumers. By integrating all of these elements, companies can increase competitiveness, speed up production times, and adapt products to changing market needs (Putra, 2024).

Supply chain integration is not only relevant for large-scale companies, but also for the small and medium industry (SME) sector, especially those engaged in culture-based creative industries. In the context of the batik industry, for example, the challenge of maintaining production continuity, maintaining product quality, and consistently innovating designs requires strong coordination along the supply chain (Ilham et al., 2025). Attractive batik designs that are in line with market trends will be difficult to realize without a smooth material

supply system, adaptive production, and efficient distribution. Therefore, supply chain integration plays an important role in ensuring that batik product designs can be realized effectively and on time.

More specifically, the design of batik product development is a complex and multidimensional process. It includes an exploration of aesthetic values, culture, local philosophies, as well as global market considerations. Design is not only a visual matter, but also related to function, selling value, and the ability to be mass-produced (Oktarendah et al., 2024). In practice, designs that have been created by a creative team or designer often have to undergo adjustments due to limitations in raw materials, production capabilities, or incompatibility between the design idea and the reality of production. This indicates that the success of the design cannot be separated from the readiness of all components in the supply chain to support its implementation (Wibowo et al., 2024).

In Indonesia, as a country with extraordinary cultural wealth, the batik industry has become one of the national creative economy icons. The government has provided various supports for the development of batik as an intangible cultural heritage recognized by UNESCO. However, behind this potential, the batik industry in various regions still faces various structural problems. One of them is the lack of optimal supply chain management which causes a lack of integration between design designers, material suppliers, craftsmen, and sellers. Many batik industry players still work separately and lack coordination, thus hindering the process of developing sustainable and efficient product designs (Muhammad Iqbal Maulana et al., 2024).

This problem is reinforced by various reports and studies that show that production delays, inconsistency in material quality, and lack of communication between design and production units are the main obstacles in product development in the batik sector (Rianto et al., 2024). In this context, the supply chain integration approach is important to be applied so that the entire batik production process from design conceptualization to finished products can run synchronously and adaptively (Darmawan, 2024).

Theoretically, the concept of supply chain integration has been comprehensively discussed stating that supply chain integration consists of three main dimensions, namely internal integration, supplier integration, and customer integration. These three dimensions are interrelated and affect the overall performance of the organization. Internal integration emphasizes cross-functional coordination within the company itself; Supplier integration includes collaborative relationships with suppliers; Meanwhile, customer integration is related to communication and actively fulfilling customer needs. The application of these three dimensions allows organizations to be more responsive to market dynamics, accelerate innovation, and increase production effectiveness, including in the aspect of product design (Ricardiansyah et al., 2024).

A number of previous studies have also shown that supply chain integration has a significant influence on the effectiveness of product development design (Lutpiah & Nafisal Hakim, 2025). Previous researchers have also stated that companies that have good supply chain integration tend to be faster in developing new products that suit market needs (Shamsudin et al., 2025). Similarly, the study confirms that information coordination between supply chain partners is one of the keys to success in product design and innovation development (Suhara et al., 2024). However, the majority of these studies are mostly conducted in large-scale manufacturing sectors such as automotive or electronics, while studies on cultural-based industries such as batik are still relatively limited.

Kalista (2022) argues that the success of product design in the creative industry depends not only on the creativity of designers, but also on effective coordination with production units and raw material suppliers. In her follow-up study, Kalista (2023) also highlighted that the failure to integrate information and resources between supply chain actors causes serious

obstacles to the innovation of culture-based products, such as batik. In addition, Kalista (2024) emphasizes the importance of a collaborative approach in design development so that local industry players can survive and develop amid market demand dynamics. The three findings reinforce the urgency of the need for comprehensive supply chain integration as a strategy to improve the effectiveness of batik product design, which is the object of study in this study.

Initial observations in the field show that the process of developing batik product designs in one of the traditional batik centers still faces various structural obstacles. Some craftsmen complained about the delay in raw materials coming from suppliers, while designers complained about the difficulty of realizing designs due to the limited technical capabilities of craftsmen. In addition, there is a communication gap between the marketing team and the production team, so that the designs that the market is interested in often cannot be produced with the appropriate quality. This shows that the complete integration of the supply chain has not been realized is one of the main causes of low effectiveness in the development of batik product designs.

From these conditions, it can be concluded that there is a research gap in the study of supply chain integration, especially in the context of the batik industry. Previous research has tended to focus more on aspects of logistics efficiency or increasing the profitability of large companies, and not much has highlighted how such integration impacts the success of product design, particularly in local creative economy sectors that have unique characteristics. There has been no study that specifically links supply chain integration with the effectiveness of the design of batik product development as a cultural product that is dynamic, creative, and has high aesthetic value.

Based on this description, this research has novelty in terms of focus and approach. First, this study examines the relationship between supply chain integration and product design effectiveness in the context of traditional creative industries, which is still rarely done. Second, the approach used is holistic, that is, it does not only highlight the design side or the logistics side separately, but integrates the two in one analytical framework. Third, this research has the potential to make a practical contribution to batik industry players in designing supply chain strategies that support creativity and efficiency at the same time.

Thus, this research not only fills the gap in the scientific literature related to supply chain integration in the cultural industry sector, but is also expected to be the basis for more structured and sustainable batik development policies or strategies in the future.

METHOD

In this study, a quantitative methodology was adopted to ensure the collection of comprehensive and appropriate data regarding the research investigation (Kusumastuti et al., 2020; Unaradjan, 2019). The researcher chose the population as a sample because the population in this study was only 60 employees of Batik Sentra Tuban. Based on the theory conveyed by Suharsimi Arikunto, if the population does not reach 100, all should be selected as samples (Arikunto, 2021). The use of questionnaires serves as the primary data collection method, allowing for the exploration of individuals' attitudes, beliefs, actions, and attributes. The decision to use the closed-ended questionnaire format was made deliberately, as it gave respondents predetermined choices, thus limiting the opportunity to provide additional comments. After data collection, the researcher applied multiple *regression analysis* to evaluate whether or not variable X had an influence on variable Y before conducting the analysis. The questionnaire was then distributed to the respondents to get direct answers. The data is then input into the SPSS statistical software to measure its validity and reliability. Furthermore, the classical assumption test such as the normality and linearity test carried out by the author by continuing with the analysis using *somers'D* to find out whether there is an influence of variable X on variable Y.

RESULTS AND DISCUSSION

The findings of the research in Tuban on the development of central batik products, the researcher used the Likert scale, using the help of SPSS.22, and provided a questionnaire containing statement questions to the respondents to be answered, as a test of the validity and reliability of the data. Each statement provides five alternative options with the following categories:

Table 1. Questionnaire Scoring Scale

Statement items	Score weight				
	ST	S	N	T	TS
Positif	5	4	3	2	1
Remarks : strongly agree, agree, neutral, strongly disagree, disagree					

Validity and Reliability Tests

After the questionnaire grid as above, the researcher first conducted a data validity and reliability test for each variable which will be further researched, the following is a table of the results of the validity and reliability test of the variables of supply chain integration variables and the effectiveness of the design of the development of batik centrara products. The data can be confirmed to be valid if the calculation value is greater than the alpha value of 0.05 and can be said to be reliable if the value of Cronbach's alpha if the item deleted is greater than the critical value of 0.06 (Sugiono, 2019). The following are the results of the validity and reliability test of individual behavior variables.

Table 2. Validity and Reliability Test of Supply Chain Integration Variable X

No Question	Corrected Item-Total Correlation	Alpha	Note	Cronbach's Alpha If Item Deleted	Critical Value	Note
1	0.528	0,05	Valid	0.728	0,06	Reliable
2	0.219	0,05	Valid	0.765	0,06	Reliable
3	0.611	0,05	Valid	0.712	0,06	Reliable
4	0.798	0,05	Valid	0.675	0,06	Reliable
5	0.102	0,05	Valid	0.787	0,06	Reliable
6	0.437	0,05	Valid	0.740	0,06	Reliable
7	0.730	0,05	Valid	0.714	0,06	Reliable
8	0.646	0,05	Valid	0.705	0,06	Reliable
9	0.233	0,05	Valid	0.765	0,06	Reliable
10	0.029	0,05	Valid	0.788	0,06	Reliable

The results of the validity and reliability test data instrument above can be found that all items are suitable to be used at the analysis stage to determine whether there is an influence of the supply chain integration variable on the effectiveness of batik product development design. To find out whether there is an influence by using the help of *SPSS 22*. Before conducting an analysis test to determine whether there is an influence or not, first test the validity and reliability of the variables of the effectiveness of the design effectiveness of the development of batik sentara products as follows:

Table 3. Validity and Reliability Test of Variable Y
Effectiveness of Batik Sentra Product Development Design

No Question	Corrected Item-Total Correlation	Alpha	Note	Cronbach's Alpha If Item Deleted	Critical Value	Note
1	0.361	0,05	Valid	0.661	0,06	Reliable
2	0.584	0,05	Valid	0.616	0,06	Reliable
3	0.414	0,05	Valid	0.649	0,06	Reliable
4	0.311	0,05	Valid	0.670	0,06	Reliable
5	0.086	0,05	Valid	0.701	0,06	Reliable
6	0.527	0,05	Valid	0.634	0,06	Reliable
7	0.541	0,05	Valid	0.628	0,06	Reliable
8	0.232	0,05	Valid	0.683	0,06	Reliable
9	0.399	0,05	Valid	0.654	0,06	Reliable
10	0.013	0,05	Valid	0.713	0,06	Reliable

The results of the validity and reliability test data instrument above can be found that the entire item is suitable to be used at the analysis stage to find out whether there is an influence of the variable effectiveness of the design effectiveness of batik product development. To find out whether there is an influence by using the help of *SPSS 22*. Before the analysis test is carried out to find out whether there is an effect or not. After all variables already have valid and realistic data, the next step before multiple regression analysis is carried out, the normality and reliability test of the data is first carried out as follows :

Table 4. One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		60
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	2.48435545
Most Extreme Differences	Absolute	.102
	Positive	.088
	Negative	-.102
Test Statistic		.102
Asymp. Sig. (2-tailed)		.197[c]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

Based on the results of the normality test using the Kolmogorov-Smirnov One-Sample on non-standardized residual values, a significance value of 0.197 was obtained. Because this value is greater than 0.05, it can be concluded that the residual data is normally distributed (Sugiyono, 2018). This suggests that one of the classic assumptions of regression, namely residual normality, has been met. Thus, the regression analysis carried out is feasible to continue because there is no violation of the assumption of normality. Next, a linearity test was carried out as follows:

Table 5. ANOVA

	Sum of Squares	df	Mean Square	F	Sig.

VAR00002 VAR00001	*Between Groups	(Combined)	202.567	12	16.881	2.956	.004
		Linearity	106.834	1	106.834	18.707	.000
		Deviation from Linearity	95.733	11	8.703	1.524	.155
	Within Groups		268.417	47	5.711		
	Total		470.983	59			

Based on the linearity test, it is known that the significance value of the linear relationship between variables X and Y is 0.000, which means that it is smaller than the significant limit of 0.05. Meanwhile, the significance value for deviation from linearity is 0.155, which is greater than 0.05 (Sugiono, 2019). These findings indicate that there is a real and linear relationship between the two variables, and no significant deviation from the linear relationship pattern was found. Therefore, the use of linear regression models in this study is considered appropriate and acceptable. Next, the Somer's D test is carried out to find out whether there is an influence of variable x on variable Y as follows:

Directional Measures

Table 6. Results of Somers' d Directional Measure Test

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.294	.093	-3.117	.002
		VAR00001 Dependent	-.296	.093	-3.117	.002
		VAR00002 Dependent	-.292	.092	-3.117	.002

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Based on the results of data analysis, it was found that variable X has a significant influence on variable Y. This is indicated by a significance value (Sig.) of 0.002, which is below the threshold of $\alpha = 0.05$. Thus, statistically it can be concluded that there is a real relationship between the two variables.

This study shows that supply chain integration has a significant influence on the effectiveness of batik product development design in the Tuban Center area. These findings were obtained from the analysis of the data using a quantitative approach through linear regression testing, where the significance value obtained showed a number well below the limit of $\alpha = 0.05$, which statistically indicates that an alternative hypothesis is accepted. Thus, supply chain integration can be said to be one of the important factors that clearly supports the success of the design and innovation process of batik products developed by industry players in the area.

Conceptually, supply chain integration refers to alignment and coordination between all entities in the supply chain, from raw material suppliers, producers, to distribution parties and end customers (Herbeth et al., 2025). An integrated supply chain allows for a smooth flow of information, goods, and funds, ultimately driving efficiencies and increased product value. In the context of the batik industry in the Tuban Center, this integration allows batik producers to get access to quality raw materials in a timely manner, speed up the production process, and respond to market needs more accurately. This is in line with the opinion that supply chain integration contributes greatly to product innovation because it is able to accelerate the flow of

information from the market to the manufacturer, which in turn encourages design adjustments that are more adaptive and relevant to consumer needs (Selvi Cahyani et al., 2024).

This research reinforces previous findings that MSME actors who apply the principle of supply chain integration, especially in terms of intensive communication with suppliers and customers, are able to produce more innovative and market-oriented product designs. This encourages competitiveness and expands export opportunities (Shamsudin et al., 2025). A similar phenomenon is also found at the Tuban Batik Center, where artisans who work closely with material suppliers, motif designers, and marketing consultants, produce batik designs that are more adaptive to market trends, as well as more efficient in terms of production time and cost.

From a managerial point of view, supply chain integration not only drives operational efficiency, but also provides flexibility in responding to changing market demands. When entities in the supply chain are effectively interconnected, the flow of information about consumer needs, fluctuations in raw material prices, and design developments can be immediately forwarded to all parts of the system (Nuraeni & Adman, 2024). This encourages a more responsive and risk-free product development process. In the context of batik design development, this flexibility makes it easier for artisans to create new motifs, adapt coloring techniques, and design more attractive product packaging according to the characteristics of the target market.

In addition, the results of this study also show that the relationship between supply chain integration and product design effectiveness is not only technical, but also contains social and cultural dimensions. The batik industry as a creative industry is highly dependent on the exchange of ideas, local aesthetic values, and an understanding of cultural characteristics (Kurniawan, 2025). When the product development process is supported by an integrated supply chain system that includes collaboration between artisans, academics, designers, and market players, the resulting innovations not only meet the functional aspects but also reflect strong cultural values. This is an added value in the marketing strategy of batik products to the domestic and international markets.

These findings are also supported by previous studies that concluded that cross-actor coordination in the supply chain greatly determines the speed and quality of product design developed, especially in responding to dynamic market tastes (Farid, 2025). Therefore, strengthening integration between actors in the supply chain is a strategic factor that cannot be ignored by creative industry players such as batik. On the other hand, the effectiveness of product development design is also influenced by the ability of industry players to manage collaboration. In the context of an integrated supply chain, collaboration is not only related to technical activities such as material procurement and distribution, but also involves creative aspects such as the exchange of design ideas, coloring techniques, and the exploration of innovations in batik motifs (Farid, 2025). When batik business actors in the Tuban Center are able to establish good partnerships with creative actors and suppliers, the development of product design becomes more structured and directed.

The results of this study provide important practical implications for the development of local government policies and MSME coaching institutions. The government can encourage the formation of an integrated supply chain ecosystem in the batik sector through strengthening cooperatives, forming industrial clusters, and supply chain management training. With this approach, the batik industry players at the Tuban Center not only focus on production, but also on collaborative strategies that encourage creativity and product design efficiency. This intervention is important considering that most batik business actors are MSMEs that have limitations in terms of access to technology, information, and market networks.

However, it is important to note that effective supply chain integration also requires adequate information infrastructure. This study found that some business actors still face

obstacles in terms of communication and real-time access to market data. Therefore, information technology support is needed to digitally connect all elements within the supply chain, such as through the use of simple Enterprise Resource Planning (ERP) systems or web-based collaborative platforms. Such support will further strengthen synergy among actors and accelerate the decision-making process in product design development.

However, it is important to note that effective supply chain integration also requires adequate information infrastructure. In this study, it was found that some business actors are still experiencing obstacles in terms of communication and access to market data in real time. Therefore, information technology support is needed that is able to connect all elements in the supply chain digitally, such as the use of a simple Enterprise Resource Planning (ERP) system or a web-based collaborative platform. This support will further strengthen the synergy between actors and accelerate the decision-making process in product design development.

In the final reflection, the results of these findings reinforce the importance of supply chain integration as a determining factor in the design and development of effective batik products. Not only does it have an impact on operational efficiency, but also on improving product quality and competitiveness. Therefore, strategic collaboration between supply chain actors in both production, creative, and distribution aspects needs to continue to be developed and facilitated systemically. In the future, further research can be directed to explore the role of digital technology in strengthening this integration and measure its impact longitudinally on the growth of the batik industry in other regions.

CONCLUSION

Based on the results of the analysis that has been carried out, it can be concluded that supply chain integration has a significant influence on the effectiveness of design in the development of Batik products at the Tuban Batik Center. These findings indicate that the better the integration in the supply chain—which includes coordination between suppliers, manufacturers, and distribution—the higher the effectiveness of the product design and innovation process produced. The integration of information and resources throughout the supply chain is able to accelerate responses to market needs, strengthen collaboration between batik industry players, and optimize sustainable design-based production processes.

These results also reinforce the theoretical view that good supply chain integration will increase flexibility and adaptability in the product development process, especially in creative industries such as batik which rely heavily on design innovation. The effectiveness of the design in question refers not only to time and cost efficiency, but also includes accuracy in capturing market trends, consumer preferences, and cultural values that want to be raised in each motif and design.

Thus, strengthening supply chain integration cannot be ignored in the strategy of increasing the competitiveness of local batik products. Synergistic collaboration between craftsmen, designers, distributors, and other stakeholders is a key factor in creating a responsive and high-value-added production system. Therefore, the results of this research make an important contribution both practically for batik business actors, and academically for the development of supply chain studies in the creative industry sector.

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