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Optimizing Online Transportation Efficiency with a Value Chain Taguchi Method Approach

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ABSTRACT

This study explores how applying the Taguchi method as a robust design tool can strengthen value chain integration in Indonesia's ride-hailing services. A survey of 162 users was conducted, with responses examined through factor allocation, variance analysis, and a structured quality control cycle covering verification, validation, implementation, feedback, documentation, and reporting. The findings highlight several service quality drivers: timely response during peak demand, transparent pricing, convenient digital payments, and dependable customer support. The results reveal gaps between actual operations and customer expectations, underscoring the need for tighter alignment. By positioning the Taguchi method within a service-based value chain, this research introduces a novel contribution, demonstrating how quality design principles traditionally applied in manufacturing can enhance efficiency, resilience, and customer satisfaction in the competitive ride-hailing sector.

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INTRODUCTION

Enhancing online transportation performance involves integrating supply chain management with the Taguchi and value chain methods [1]. Combining value chain with Taguchi principles strengthens service quality, trust, and competitiveness [2]. Additionally, using supply chain financing alongside value chain and Taguchi approaches addresses financial, operational, and quality issues, improving overall performance and customer satisfaction [3].

Integrating the Taguchi method into the value chain strengthens quality control in online transportation services [4]. Combining Six Sigma with Taguchi further enhances sustainability and competitiveness [5]. This approach also boosts service reliability, operational agility, and overall customer satisfaction [6].

Applying the Taguchi method within the value chain improves competitiveness, service quality, and customer value in online transportation [7]. Adding e-services boosts coordination and operational efficiency [8]. Combined, these approaches enhance logistics, customer satisfaction, and overall supply chain performance [9].

Integrating AI with supply chain management strengthens value chain coordination, enhancing quality, efficiency, sustainability, and competitiveness in online transportation [10]. The Taguchi method reduces variability to improve operations and service quality [11], [12]. This study explores how robust design and Taguchi techniques support value chain integration in Indonesia's online transportation sector. This study uniquely integrates robust design using the Taguchi method with value chain strategies in Indonesia's online transportation sector. Unlike prior research that treated supply chain and quality separately, it examines their combined impact on ride-hailing efficiency. The results provide practical guidance for enhancing service quality and operational performance through unified value chain design.

Value Chain

Earlier applications of Porter's value chain were mostly generic and not tailored to Indonesia's ride-hailing sector. This study customizes the framework to address operational variability across the entire service process [13]. Stage-specific improvements, from booking to post-ride support, are implemented to enhance consistency and overall performance [14].

The adaptation standardizes driver-customer data in inbound logistics, improves allocation to stabilize wait times in operations, optimizes routes with real-time tracking in outbound logistics, applies targeted promotions and consistent pricing in sales and marketing, and structures after-sales support with monitored complaint handling [15], [16], [17], [18], [19]. The novelty lies in customizing the value chain for ride-hailing using measurable performance metrics, controlling variability through indicators like delays and errors, and integrating feedback across all stages for continuous improvement.

Taguchi Method

Although common in manufacturing, the Taguchi method is rarely applied to variable services like ride-hailing [20]. This study adapts it for Indonesia's online transport by customizing orthogonal arrays for factors such as wait time, pricing, and service reliability [21]. The method allows focused improvements with fewer experimental trials [22].

Service quality metrics are integrated with defect cost analysis to pinpoint operations causing the highest financial losses across drivers, partners, and logistics [23]. Robust design, supported by fleet redundancy, maintains performance during peak demand or disruptions [24], [25]. The approach innovates by applying Taguchi design to qualitative service data, combining quality and cost insights, using a hybrid robust-redundant model for resilience, and enabling real-time coordination through parameter optimization.

Value Chain and Taguchi Method Integration

Indonesia's online transportation sector faces challenges from variable service quality, inconsistent driver performance, and operational inefficiencies [26]. This study addresses these issues by integrating a value chain framework with a modified Taguchi method [27]. The approach enhances coordination across logistics, operations, marketing, and after-sales support [28].

The Taguchi method is adapted to improve driver allocation, route efficiency, and response times with fewer test cycles [29]. The model targets five key service dimensions: safety, comfort, response time, pricing, and accessibility [30]. Safety reduces operational risks, while comfort enhances ride quality and convenience [31].

Response time is improved via faster driver–passenger matching, with transparent and fair pricing [32], [33]. Service accessibility is expanded, while an integrated system monitors drivers, quality, payments, and support, adjusting operations during congestion, bad weather, or demand surges [34], [35]. The approach innovates by merging value chain integration with Taguchi optimization, applying orthogonal arrays to qualitative metrics, linking stages through feedback, and creating a measurable, adaptive, and resilient system.

RESEARCH METHOD

Data Collection

Participants were Indonesian residents aged 18 or older who had used Grab, Gojek, or Maxim at least three times in the past three months. The questionnaire assessed safety, comfort, response time, price, driver quality, service, payment, and customer support, with an introduction outlining the study, ensuring confidentiality, and screening eligibility. The collected data are structured using the adapted value chain, with each service factor divided into three hierarchical levels. Levels 1, 2, and 3 indicate increasing detail and specificity. Table 1 presents these values for clear and organized analysis.

Table 1. Factor and Factor Level Assignment Online Transportation Service

Factor	Level		
	Level 1	Level 2	Level 3
Security (A)	Basic Security	Advanced Security	-
Comfort (B)	Basic Comfort	Advanced Comfort	Premium Comfort
Response Time (C)	Basic Response Time	Adaptive Response Time	Proactive Response Time
Price (D)	Basic Cost Element	Competitive Differentiator	Value-Added Strategy
Quality of Driver (E)	Basic Quality	Functional Quality	Superior Quality
Service Availability (F)	Basic Availability	Improved Availability	Advanced Availability
Ease of Payment (G)	Basic Payment Ease	Moderate Payment Integration	Advanced Payment Flexibility
Customer Service (H)	Basic	Intermediate	Advanced

Source: Processed Data (2024)

Data Processing

Data processing involves organizing and structuring the collected information to enable analysis using the Taguchi method with an L18 orthogonal array. The procedure includes the following steps:

1. Data processing involves organizing collected data for analysis using the Taguchi method with the L18 orthogonal array.
2. Convert survey results into numerical values (1 for low, 2 for medium, 3 for high) and input them into the orthogonal array.
3. This research aims to enhance customer response in online transportation services by focusing on factors like satisfaction and response time. It emphasizes maximizing customer response value, considering the robustness and variability of components, with a higher signal-to-noise ratio being preferred for better outcomes. An "average value" is:

   $\mu = \frac{1}{n}\sum_{i=1}^{n} y_i$ (1)

   The signal-to-noise ratio is defined as follows:

   $S/N = -10\log_{10}\left|\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_i^2}\right|$ (2)

ANOVA Analysis

ANOVA is applied to determine the key factors influencing supply chain quality, using the mean values from all experiments:

$\bar{y} = \frac{\sum y}{n}$ (3)

The mean value of each level factor is expressed as follows:

$\bar{\bar{y}}_{jk} = \frac{\sum \bar{y}_{ijk}}{n_{ijk}}$ (4)

The total sum of squares is defined as follows:

$SS_{total} = \sum Y^2$ (5)

The total of squares attributable to the mean is expressed as follows:

$mean\ (S_m) = n\bar{y}^2$ (6)

The value of the sum of squares attributable to factors is expressed as follows:

$SS_m = (n_{A1} x \overline{A1}^2) + (n_{A2} x \overline{A2}^2) + \cdots + (n_{An} x \overline{An}^2) - S_m$ (7)

The total number of squares resulting from the error is expressed as follows:

$SS_e = SS_{TOT} - S_m - (SS_A + SS_B + \cdots + SS_n)$ (8)

The degrees of freedom are defined as follows:

$DF_A = number\ of\ level - 1$ (9)

$DF_e = number\ of\ row\ x\ (number\ of\ level - 1)$ (10)

$DF_{SSt} = DF_A + DF_B + \cdots + DF_n$ (11)

$DF_{SSm} = k - 1$ (12)

The mean of squares is defined as follows:

$MS_n = \frac{SS_n}{DF_n}$ (13)

F ratio is defined as follows:

$F_n = \frac{MS_n}{MS_n}$ (14)

Pure sum of squares is defined as follows:

$SS_{n\prime} = SS_n - (DF_n\ x\ MS_e)$ (15)

Percent Contribution is defined as follows:

$\rho n = \frac{SS_{n\prime}}{SS_T} \times 100\%$ (16)

Quality Control

Quality control ensures reliable and applicable study results through the following steps:

a. Verification of Data

   Cross-check respondent inputs with platform metrics and remove inconsistent entries.

b. Model Validation

   Test Taguchi-designed trials in real scenarios, such as response speed improvements.

c. Implementation and Feedback Loop

   Based on the S/N ratio and ANOVA outcomes, the enhancement of the application interface can be prioritized to improve user interaction and overall system usability. The analytical results from the S/N ratio and ANOVA further suggest optimizing payment processes to achieve faster and more seamless transaction performance

d. Documentation and Reporting
Gradually implement changes with ongoing evaluation to monitor improvements.

RESULT AND DISCUSSION

The study participants' demographic and usage details are summarized in Table 2. Information includes age, gender, ride-hailing frequency, and preferred service platform. This overview helps contextualize the results and evaluate how representative the sample is.

Table 2. Respondent Characteristics

Gender	%	Services	%	Age	%	Education Level	%	Occupation	%
Male	63	Gojek	36	15 – 25	58	Senior High School	22	Student	22
Female	37	Grab	51	26 – 35	27	Diploma 1	15	Unemployed	3
		Maxim	13	36 – 45	10	Diploma 3	20	Civil servants	15
				46 – 55	5	Bachelor degree	27	Private employee	60
						Master degree	16		

Source: Processed Data (2024)

Table 2 indicates that 32 of the 102 male respondents use more than one online transportation app. Among the 94 respondents aged 15–25, 44 have completed a college education. The majority of these young users are employed in the private sector.

Table 3. Validity and Reliability Test Result

Factors	Validity	Reliability
Security (A)	0,319 – 0,906	0,663 – 0,861
Comfort (B)	0,306 – 0,924	0,604 – 0,749
Response Time (C)	0,307 – 0,909	0,618 – 0,864
Price (D)	0,305 – 0,926	0,604 – 0,751
Quality of Driver (E)	0,308 – 0,920	0,625 – 0,793
Service Availability (F)	0,306 – 0,908	0,607 – 0,727
Ease of Payment (G)	0,308 – 0,930	0,606 – 0,791
Customer Service (H)	0,313 – 0,901	0,666 – 0,838

Source: Processed Data (2024)

Table 3 demonstrates the reliability of the collected data. All variables show Spearman correlation values exceeding 0.3, indicating significant relationships. Additionally, the Cronbach's alpha values are above 0.6, confirming internal consistency.

Gojek Platform

Table 4 summarizes respondents' feedback regarding their experiences with Gojek's online transportation services. It highlights users' perceptions of service quality, convenience, and overall satisfaction. The data reveals both the strengths and areas requiring improvement in Gojek's services. Findings from the S/N ratio and ANOVA indicate that enhancing the application interface could improve user engagement and system efficiency. Moreover, the results suggest that optimizing payment processes would contribute to faster and more reliable transaction performance.

Table 4. Gojek Platform Orthogonal Array Average Result

Exp. Num.	Factors								Replication			Ave.	SNR
	A	B	C	D	E	F	G	H	R1	R2	R3		
1	1	1	1	1	1	1	1	1	75	72	71	72,46	36,95
2	1	1	2	2	2	2	2	2	71	73	73	72,30	37,08
3	1	1	3	3	3	3	3	3	71	71	71	71,33	37,03
4	1	2	1	1	2	2	3	3	72	73	70	71,81	37,12
5	1	2	2	2	3	3	1	1	70	70	70	70,00	36,91
6	1	2	3	3	1	1	2	2	70	70	72	70,67	36,99
7	1	3	1	2	1	3	2	3	71	73	69	70,98	37,02
8	1	3	2	3	2	1	3	1	70	74	74	72,55	37,21
9	1	3	3	1	3	2	1	2	71	74	73	72,77	37,24
10	2	1	1	3	3	2	2	1	72	74	72	72,73	37,61
11	2	1	2	1	1	3	3	2	73	72	72	72,57	37,22
12	2	1	3	2	2	1	1	3	70	71	70	70,49	36,97
13	2	2	1	2	3	1	3	2	73	72	70	71,54	37,09
14	2	2	2	3	1	2	1	3	71	70	72	71,20	37,05
15	2	2	3	1	2	3	2	1	78	74	79	76,90	37,64
16	2	3	1	3	2	3	1	2	74	73	73	73,17	37,29
17	2	3	2	1	3	1	2	3	71	71	69	70,45	36,96
18	2	3	3	2	1	2	3	1	79	75	76	76,51	37,74

Source: Processed Data (2024)

Table 4 displays the signal-to-noise ratios derived from the third replication of 18 experiments involving Gojek users. These ratios measure the consistency and quality of service responses across trials. The results help identify which factors most strongly influence user satisfaction.

Table 5. Gojek Platform Average Value Response

Level	Factors							
	A	B	C	D	E	F	G	H
Level 1	71,65	71,98	72,11	72,83	72,40	71,36	71,68	73,52
Level 2	72,84	72,02	71,51	71,97	72,87	72,89	72,34	72,17
Level 3	-	72,74	73,11	71,94	71,47	72,49	72,72	71,04
Gap	1,19	0,76	1,60	0,89	1,40	1,52	1,04	2,48
Rank	5	8	2	7	4	3	6	1

Source: Processed Data (2024)

Table 5 presents the mean response values for each service factor, calculated from three replications involving 18 Gojek users. These averages summarize user evaluations across multiple trials. The results provide a clear view of how each factor performs in practice.

Table 6. ANOVA of Gojek Platform Average

Label	SS	DF	MS	F ratio	SS'	Ratio % (r)	F table
A	19,039	2	9,519	3,696	13,888	5,400	3,175
B	6,521	2	3,260	1,266	1,369	0,532	3,175
C	23,519	2	11,759	4,566	18,367	7,142	3,175
D	9,136	2	4,568	1,774	3,985	1,549	3,175
E	18,250	2	9,125	3,543	13,098	5,093	3,175
F	22,540	2	11,270	4,376	17,389	6,761	3,175
G	9,888	2	4,944	1,919	4,737	1,842	3,175
H	55,574	2	27,787	10,788	50,423	19,605	3,175
Error	92,7	36	2,576	1,000	0,000	0,000	
SS_T	257,2	52	4,946		123,256	47,924	
SS_{MEAN}	281847,8	2					
SS_{TOT}	282105	54					

Source: Processed Data (2024)

Table 6 highlights the factors most valued by Gojek users, including security, response time, driver quality, service availability, and customer support. These aspects are prioritized based on user feedback and perceived importance. The data indicates which service areas have the greatest impact on customer satisfaction.

Table 7. ANOVA Gojek Platform Average After Pooled

Label	SS	DF	MS	F ratio	SS'	Ratio % (r)	F table
A	19,039	2	9,519	3,381	13,407	5,213	3,175
B	6,521	-	3,260	-	-	-	-
C	23,519	2	11,759	4,176	17,887	6,955	3,175
D	9,136	-	4,568	-	-	-	-
E	18,250	2	9,125	3,240	12,618	4,906	3,175
F	22,540	2	11,270	4,002	16,909	6,574	3,175
G	9,888	-	4,944	-	-	-	-
H	55,574	2	27,787	9,868	49,942	19,418	3,175
Error	92,7	-	2,576	-	-	-	-
Pooled	118,268	42	2,816	1	146,427	56,933	
SS_T	257,2	52	4,946		110,763	100,000	
SS_{MEAN}	281847,8	2					
SS_{TOT}	282105	54					

Source: Processed Data (2024)

Table 7 indicates that comfort, pricing, and payment convenience have little to no influence on Gojek users' overall experience.

Table 8. Gojek Platform SNR Value Response

Level	Factors							
	A	B	C	D	E	F	G	H
Level 1	37,06	37,14	37,18	37,19	37,16	37,03	37,07	37,34
Level 2	37,29	37,13	37,07	37,13	37,22	37,31	37,22	37,15
Level 3	-	37,24	37,27	37,20	37,14	37,18	37,24	37,02
Gap	0,23	0,11	0,20	0,05	0,08	0,28	0,17	0,32
Rank	3	6	4	8	7	2	5	1

Source: Processed Data (2024)

Table 8 presents the signal-to-noise ratios for each service factor, calculated from three tests involving 18 Gojek users. These ratios assess the consistency and reliability of user responses across the trials. The results help identify which factors most strongly affect service performance.

Table 9. ANOVA of Gojek Platform SNR

Label	SS	DF	MS	F ratio	SS'	Ratio % (r)	F table
A	0,235	2	0,117	17,367	0,221	20,487	3,592
B	0,047	2	0,023	3,442	0,033	3,057	3,592
C	0,121	2	0,060	8,943	0,107	9,943	3,592
D	0,017	2	0,008	1,220	0,003	0,276	3,592
E	0,018	2	0,009	1,298	0,004	0,373	3,592
F	0,230	2	0,115	17,021	0,217	20,055	3,592
G	0,099	2	0,050	7,329	0,086	7,923	3,592
H	0,308	2	0,154	22,766	0,294	27,246	3,592
Error	0,007	1	0,007	1,000	0,000	0,000	
SS_T	1,080	17	0,064		0,965	89,360	
SS_{MEAN}	24870,296	1					
SS_{TOT}	24871	18					

Source: Processed Data (2024)

Table 9 identifies the primary factors that impact Gojek users, including security, response time, service availability, payment convenience, and customer support. These elements are highlighted as the most critical for user satisfaction. The findings indicate where the service should focus to enhance overall user experience.

Table 10. ANOVA Gojek Platform SNR After Pooled

Label	SS	DF	MS	F ratio	SS'	Ratio % (r)	F table
A	0,235	2	0,117	9,408	0,210	19,429	3,592
B	0,047	-	0,023	-	-	-	-
C	0,121	2	0,060	4,845	0,096	8,884	3,592
D	0,017	-	0,008	-	-	-	-
E	0,018	-	0,009	-	-	-	-
F	0,230	2	0,115	9,221	0,205	18,996	3,592
G	0,099	2	0,050	3,970	0,074	6,864	3,592
H	0,308	2	0,154	12,333	0,283	26,187	3,592
Error	0,007	-	0,007	-	-	-	-
Pooled	0,087	7	0,012	1	0,286	26,505	
SS_T	1,080	17	0,064		0,868	100,000	
SS_{MEAN}	24870,3	1					
SS_{TOT}	24871	18					

Source: Processed Data (2024)

Table 10 indicates that comfort, pricing, and driver quality have minimal influence on Gojek users, according to the ANOVA signal-to-noise analysis. These factors were found to contribute little to overall user satisfaction. The results suggest that other service aspects play a more significant role in shaping user experience.

Table 11. Parameter Setting Gojek Platform

Factors	Dimension	Indicators	Value
Security (A) Level 2 Advance Security	Sales and Marketing	Driver performance ratings are conducted on a regular basis, with the results based on a systematic analysis of user reviews.	TDPN 3 → 2,72
Response Time (C) Level 3 Proactive Response Time	Sales and Marketing	The mean response time during periods of peak demand is compared to that observed during periods of normal demand.	RPHD 1 → 1,94
Customer Service (H) Level 1 Basic	Services	The support team is readily accessible via a variety of communication channels, including telephone, email, and online chat.	EAS 1 → 2,67
Ease of Payment (G) Level 3 Advanced Payment Flexibility	Outbound Logistics	A plethora of payment methods is available for use in ride-hailing services.	VPM 5 → 1,83
Service Availability (F) Level 2 Improved Availability	Outbound Logistics	Vehicles are available even in remote areas	VARA 1 → 1,67
Quality of Driver (E) Level 2 Functional Quality	Inbound Logistics	Drivers are able to promptly and effectively address any issues that may arise during the course of their journey.	EC 3 → 1,22

Source: Processed Data (2024)

Table 11 highlights the main factors affecting Gojek's online transportation services, including robust security, fast response times, convenient payment options, enhanced service availability, reliable driver performance, and essential customer support. These elements are identified as critical to user satisfaction. The findings indicate which areas the service should prioritize for improvement.

Grab Platform

The analysis of Grab users' responses followed the same methodology used for Gojek participants. This approach guaranteed consistency and allowed for meaningful comparisons between the two platforms. Applying uniform methods enabled a clear evaluation of differences and similarities in user experiences.

Table 12. Parameter Setting Grab Platform

Factors	Dimension	Indicators	Value
Security (A) Level 2 Advanced Security	Sales and Marketing	Driver performance ratings are conducted on a regular basis, with the results based on a systematic analysis of user reviews.	TDPN 3 → 2,72
Customer Service (H) Level 3 Advanced	Sales and Marketing	The support team consistently exhibits polite and friendly communication.	CSCS 1 → 1,17
Response Time (C) Level 2 Adaptive Response Time	Outbound Logistics	The mean savings in travel time generated by the automatic routing algorithm are presented herewith.	OTP 1 → 1,39
Comfort (B) Level 2 Advanced Comfort	Outbound Logistics	The vehicle is equipped with a functional WiFi system that allows for reliable internet connectivity during the journey.	EIVS 1 → 1,39
Service Availability (F) Level 2 Improved Availability	Outbound Logistics	Vehicles are available even in remote areas	VARA 1 → 1,22
Quality of Driver (E) Level 1 Basic Quality	Services	Drivers adhere to the service standards set forth by the online transportation company.	CSCS1 → 1,17

Source: Processed Data (2024)

Table 12 presents the key factors influencing Grab's online transportation services, such as security, comfort, customer support, prompt service, availability, and core service quality. These aspects are critical for enhancing user satisfaction and indicate priority areas for improving overall performance.

Maxim Platform

Maxim users' responses were analyzed using the same procedure as for Gojek participants. This ensured methodological consistency and facilitated valid comparisons between the platforms. Using a uniform approach allowed for a clear assessment of user experience similarities and differences.

Table 13. Parameter Setting Maxim Platform

Factors	Dimension	Indicators	Value
Security (A) Level 2 Advanced Security		The application is equipped with an automated notification system that is triggered in the event that the vehicle deviates from the designated route	ASF 5 → 2,89
Service Availability (F) Level 2 Improved Availability	Outbound Logistics	The vehicles will always be available in remote areas when needed	VARA 5 → 1,56
Comfort (B) Level 2 Advanced Comfort		The vehicle is equipped with a functional WiFi system that allows for reliable internet connectivity during the journey	EIVS 1 → 1,33
Ease of Payment (G) Level 1 Basic Payment Ease	Operations	The process of making payments on online transportation applications is generally free of interruptions.	SP 3 → 1,67
Price (D) Level 3 Value-Added Strategy	Sales and Marketing	Ride-hailing services frequently provide discount programs that are pertinent to consumer requirements	DPO 1 → 1,61
Quality of Driver (E) Level 2 Functional Quality	Services	It is a universal practice among drivers to utilize seatbelts while operating a vehicle	DCR 1 → 1,22

Source: Processed Data (2024)

Tabel 13 highlights the main factors affecting Maxim's online transportation services, including enhanced security and comfort, increased service availability, basic payment convenience, value-added strategies, and functional service quality. These elements are identified as critical for ensuring user satisfaction. The findings suggest which areas the platform should prioritize to optimize overall service performance.

Robust Design

Table 14 demonstrates how robust design is applied within the online transportation supply chain, integrating value chain principles and Taguchi methods. This approach ensures consistent service performance despite variations in demand or external conditions. The implementation highlights the system's ability to optimize efficiency and maintain reliability across operations.

Table 14. Cross Case Analysis of Online Transportation Services Supply Chain

Value Chain Dimension	Gojek		Grab		Maxim	
	Factor & Level	Indicators	Factor & Level	Indicators	Factor & Level	Indicators
	Security (A) Level 2 → 1,19	TDPN 3 → 2,72	**Security (A) Level 2 → 6,63**	**TDPN 3 → 2,72**	Security (A) Level 2 → 3,39	TDPN 3 → 2,72
Sales and Marketing	Response Time (C) Level 3 → 1,60	RPHD 1 → 1,94	Easy of Payment (G) Level 1 → 1,74	DTS 5 → 1,72	Response Time (C) Level 3 → 2,21	RPHD 1 → 1,61
			Customer Service (H) Level 3 → 4,55	CSCS 1 → 1,17	**Price (D) Level 3 → 3,74**	**DPO 1 → 1,61**
Services	**Customer Service (H) Level 1 → 2,48**	**EAS 1 → 2,67**	**Quality of Driver (E) Level 1 → 6,06**	**DCR 5 → 1,22**	Quality of Driver (E) Level 2 → 4,12	DCR 1 → 1,22
Outbound Logistics	Comfort (B) Level 3 → 0,76	EIVS 1 → 1,39	**Comfort (B) Level 2 → 4,92**	**EIVS 1 → 1,39**	Comfort (B) Level 2 → 3,04	EIVS 1 → 1,33

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Value Chain Dimension	Gojek		Grab		Maxim	
	Factor & Level	Indicators	Factor & Level	Indicators	Factor & Level	Indicators
	Easy of Payment (G) Level 3 → 1,04	VPM 5 → 1,83	**Response Time (C) Level 2 → 5,57**	**OTP 1 → 1,39**	Customer Service (H) Level 3 → 1,23	FUAS 1 → 2,00
	Service Availability (F) Level 2 → 1,52	VARA 1 → 1,67	**Service Availability (F) Level 2 → 4,47**	**VARA 1 → 1,22**	Service Availability (F) Level 2 → 2,69	VARA 5 → 1,56
Inbound Logistics	Quality of Driver (E) Level 2 → 1,40	EC 3 → 1,22				
Operations	Price (D) Level 1 → 0,89	DP 1 → 1,33	Price (D) Level 2 → 1,75	DP 1 → 1,33	**Easy of Payment (G) Level 1 → 4,23**	**SP 3 → 1,67**

Source: Processed Data (2024)

Table 14, shows that the sales and marketing dimension notably impacts two factors: Security (A) and Price (D). The services dimension has a significant effect on Quality of Driver (E) and Customer Service (H). Outbound logistics influences three factors Comfort (B), Response Time (C), and Quality of Driver (E) while the operations dimension only affects Ease of Payment (G).

Table 15. Robust Design of Online Transportation Services Supply Chain

Factors	Level		
	Level 1	Level 2	Level 3
Security (A)		Advance Security Trusted Driver – Partner Network	
Comfort (B)		Advanced Comfort Extra in – Vehicle Services	
Response Time (C)		Adaptive Response Time Optimization of Travel Paths	
Price (D)			Value – Added Strategy Discount and Promotion Offers
Quality Of Driver (E)	Basic Quality Driver Compliance with Rules		
Service Availability (F)		Improved Availability Vehicle Availability in Remote Areas	
Ease of Payment (G)	Basic Payment Ease Seamless Payment		
Customer Service (H)	Basic Customer Service Easy Access to Support		

Source: Processed Data (2024)

Table 15 indicates that three factors are classified at level 1: Quality of Driver (E), Ease of Payment, and Customer Service (H). Four factors fall under level 2: Security (A), Comfort (B), Response Time (C), and Service Availability (F). Meanwhile, level 3 includes one factors: Price (D).

Discussion

Table 15 shows that for Security (A) at level 2 under "trusted driver partner network," a Training and Incentive Program is recommended to address socioeconomic and infrastructure challenges and adapt to driver performance. Additionally, applying value chain analysis and the Taguchi Method strengthens platform stability, builds trust, maintains service quality, and improves overall system resilience in online transportation [36], [37], [38]. For Comfort (B) at level 2 under "extra in-vehicle services," enhancing technology and network infrastructure ensures consistent service by adapting to diverse socioeconomic and infrastructural conditions. Using value chain analysis and the Taguchi Method strengthens logistics, workforce skills, and flexible policies, supporting quality, resilience, and smooth operations, though leadership vision and resource gaps remain critical factors [39], [40], [41].

For Response Time (C) at level 2 under "optimization of travel paths," adaptive routing must consider socioeconomic and infrastructure constraints to ensure consistent and efficient service. Applying value chain analysis with the Taguchi method enhances efficiency, resilience, and sustainability by optimizing lead times, route clustering, replenishment, returns, and cross-border transit without compromising service reliability [42], [43], [44]. For Price (D) level 3, Adaptive Market and Compliance Planning tailors discounts and promotions to regional socioeconomic and infrastructure conditions to maintain efficiency and compliance. Using value chain analysis with the Taguchi method improves pricing, service efficiency, equity, and overall resilience in online transportation supply chains [45], [46], [47].

For Quality of Driver (E) level 1 under "driver compliance with rules", socioeconomic and infrastructure factors influence adaptive routing and contingency planning to ensure reliable, efficient, and resilient operations across regions. Additionally, applying value chain analysis with the Taguchi method enhances performance indirectly through logistics capability, advancing digital logistics maturity and reinforcing overall efficiency and resilience [48], [49], [50]. For Service Availability (F) level 2 under "vehicle availability in remote areas," socioeconomic gaps and poor infrastructure guide service allocation and route optimization to maintain reliable, efficient, and fair operations. Value chain analysis with the Taguchi method aligns digital technology, processes, and performance to drive sustainable, inclusive, and resilient robust design strategies [51], [52], [53].

For Ease of Payment (G) level 1, socioeconomic gaps and poor infrastructure reduce payment reliability, making robust connectivity and infrastructure upgrades critical for stable and efficient transactions. Applying value chain analysis with the Taguchi method improves efficiency, resilience, inclusivity, and adaptability, supporting collaboration and overall system performance [54], [55], [56]. For Customer Service (H) level 1, limited infrastructure and socioeconomic disparities restrict access to reliable internet and devices, limiting the impact of digital connectivity enhancements. Using value chain analysis with the Taguchi method optimizes transport networks, strengthens cross-chain resource sharing, and fosters a holistic, sustainable, and high-performing online transportation system [57], [58], [59], [60], [61].

Research Implication

Security (A) – Trusted Driver Partner Network

1. Training and incentives improve driver performance.
2. Value chain and Taguchi method boost platform stability.
3. Builds driver–passenger trust.
4. Enhances resilience during disruptions.

Comfort (B) – Extra In-Vehicle Services
1. Tech and network upgrades ensure consistent service.
2. Value chain and Taguchi method strengthen logistics and workforce.
3. Flexible policies improve efficiency.
4. Leadership and resources support sustained improvements.

Response Time (C) – Optimization of Travel Paths
1. Adaptive routing tackles infrastructure and socioeconomic limits.
2. Value chain and Taguchi method shorten lead times
3. Improves cross-border and clustered route efficiency.
4. Maintains service reliability in varied conditions.

Price (D) – Adaptive Market and Compliance Planning
1. Discounts and promotions adapt to regional conditions.
2. Value chain and Taguchi method optimize pricing and efficiency.
3. Supports fairness across diverse markets.
4. Strengthens resilience in the supply chain.

Quality of Driver (E) – Compliance with Rules
1. Adaptive routing ensures consistent service quality.
2. Contingency planning improves operational reliability.
3. Value chain and Taguchi method enhance logistics capability.
4. Advances digital logistics maturity.

Service Availability (F) – Remote Vehicle Access
1. Allocation strategies address infrastructure gaps.
2. Route optimization supports underserved areas.
3. Value chain and Taguchi method align digital tools with performance.
4. Promotes sustainable and inclusive service.

Ease of Payment (G) – Seamless Payment
1. Infrastructure upgrades improve payment reliability.
2. Value chain and Taguchi method boost adaptability.
3. Enhances transaction stability.
4. Strengthens collaboration across the system.

Customer Service (H) – Easy Access to Support
1. Addresses limited internet/device access.
2. Value chain and Taguchi method streamline networks.
3. Encourages cross-chain resource sharing.
4. Builds a holistic, sustainable service system.

CONCLUSION

Security (A) falls under level 2 (advanced security), with the main influencing factor being manpower, for which training and incentive programs are recommended. Comfort (B) is categorized at level 2 (advanced comfort), where the environment is the key factor, and improvements in technology and network infrastructure are advised. Response Time (C) is also at level 2 (adaptive response time), driven mainly by environmental factors, with adaptive routing and contingency planning suggested. Price (D) is placed at level 3 (value-added strategy), influenced by environmental conditions, and the recommended approach is adaptive routing combined with contingency measures. Quality of Driver (E) is classified at level 1 (basic quality), primarily influenced by environmental factors, with adaptive routing and contingency planning suggested. Service Availability (F) is positioned at level 2 (improved availability), shaped mainly by method-related factors, with service allocation in remote areas and route optimization recommended. Ease of

Payment (G) falls under level 1 (basic payment ease), influenced by environmental conditions, where resilient connectivity and payment infrastructure upgrades are advised. Customer Service (H) is at level 1 (basic customer service), also driven by environmental factors, with strategies focused on enhancing digital connectivity and infrastructure. This study has several limitations. First, it only examines selected service factors and levels, which may not represent the full spectrum of online transportation performance. Second, the analysis covers only four supply chain dimensions Sales & Marketing, Service, Outbound Logistics, and Operations potentially neglecting others like Inbound Logistics or IT infrastructure. Third, the focus on specific platforms and regions limits the generalizability of findings. Fourth, the study does not fully account for interactions among service factors or external influences such as regulatory changes, competition, or socioeconomic differences. Fifth, the quantitative data may not capture qualitative aspects of user experience, such as trust, safety, or comfort. Future studies can expand on these areas by including additional supply chain dimensions, such as technology adoption and resource management, for a more comprehensive view. They could also explore interrelationships among service factors to uncover synergistic or conflicting effects on efficiency, resilience, and customer satisfaction. Broader research across different regions, cities, or platforms would improve generalizability and provide comparative insights. Investigating the impact of emerging technologies, like AI, IoT, and digital payments, could highlight opportunities for performance optimization. Finally, assessing external factors, including regulations, socioeconomic conditions, and market dynamics, would support better strategic and operational planning.

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REFERENCES

[1] R. B. Erlangga and H. C. Wahyuni, "Application of Quality Control using Six Sigma and Taguchi Method on UMKM Kerupuk Tahu Bangil in Pandemic Period (Case Study: UD. Sanusi)," *Procedia Eng. Life Sci.*, vol. 3, no. December, 2023, doi: 10.21070/pels.v3i0.1331.

[2] S. M. Uddin, "Operational Strategies and Management of Kfc: an Enquiry," *EPRA Int. J. Res. Dev.*, vol. 5, no. 4, pp. 172–179, 2020.

[3] D. F. Adhim and N. B. Mulyono, "Supply Chain Financing System Factors, Solutions, and Benefits: A Systematic Literature Review," *Oper. Supply Chain Manag.*, vol. 16, no. 2, pp. 242–253, 2023, doi: 10.31387/oscm0530386.

[4] M. K. C. S. Wijewickrama, N. Chileshe, R. Rameezdeen, and J. J. Ochoa, "Information-centric influence strategies for quality assurance in reverse logistics supply chains: external stakeholders' perspective," *Benchmarking*, vol. 29, no. 6, pp. 1857–1888, 2022, doi: 10.1108/BIJ-05-2021-0276.

[5] N. Y. Abidalreda and S. A. Jawad, "Using some of quality techniques in Supply chain management to improve the production processes," *Int. J. Supply Chain Manag.*, vol. 8, no. 4, pp. 772–787, 2019.

[6] D. R. S. Dewi and Y. B. Hermanto, "Achieving Supply Chain Agility Through Product–Service Systems Offering," *J. Ind. Eng. Manag.*, vol. 17, no. 2, pp. 611–629, 2024, doi: 10.3926/jiem.7521.

[7] U. A. A. Anwar, A. Rahayu, and L. A. Wibowo, "Operation Process Integration Using Supplier Selection, Supply Chain Agility and Logistic Management to Optimize Corporate Performance Based on Enterprise Resource Strategic," in *Proceedings of the 7th Global Conference on Business, Management, and Entrepreneurship (GCBME 2022)*, Atlantis Press International BV, 2024, pp. 1570–1584. doi: 10.2991/978-94-6463-234-7_165.

[8] D. Dzemydienė, A. Burinskienė, and K. Čižiūnienė, "An Approach of Integration of Contextual Data in E-Service System for Management of Multimodal Cargo Transportation," *Sustainability*, vol. 16, no. 18, p. 7893, 2024, doi: 10.3390/su16187893.

[9] D. Asamoah, D. Nuertey, B. Agyei-Owusu, and J. Akyeh, "The effect of supply chain responsiveness on customer development," *Int. J. Logist. Manag.*, vol. 32, no. 4, pp. 1190–1213, 2021, doi: 10.1108/IJLM-03-2020-0133.

[10] R. Toorajipour, V. Sohrabpour, A. Nazarpour, P. Oghazi, and M. Fischl, "Artificial intelligence in supply chain management: A systematic literature review," *J. Bus. Res.*, vol. 122, no. September 2020, pp. 502–517, 2021, doi: 10.1016/j.jbusres.2020.09.009.

[11] I. Diez-Martinez and A. Peiro-Signes, "Transitioning towards sustainability: The 'what', 'why' and 'how' of the integration of sustainable practices into business models," *Tec Empres.*, vol. 16, no. 1, pp. 44–86, 2022, doi: 10.18845/te.v16i1.6013.

[12] Z. Zhu, "The Relationship Between Supply Chain Management and Customer Relationship Management," *Proc. 2022 7th Int. Conf. Financ. Innov. Econ. Dev. (ICFIED 2022)*, vol. 648, no. Icfied, pp. 3028–3033, 2022, doi: 10.2991/aebmr.k.220307.494.

[13] T. N. Duening, R. A. Hisrich, and M. A. Lechter, *Technology Entrepreneurship Taking Innovation to the Marketplace*. Elsevier Science, 2020.

[14] E. R. Crandall and W. R. Crandall, *How Management Programs Can Improve Performance: Selecting and Implementing the Best Program for Your Organization*. Information Age Publishing, Inc., 2015.

[15] M. Helmold, *Virtual and Innovative Quality Management Across the Value Chain Industry Insights, Case Studies and Best Practices*. Springer Nature Switzerland AG, 2023. doi: https://doi.org/10.1007/978-3-031-30098-9.

[16] X. Xu and T.-M. Choi, "Supply chain operations with online platforms under the cap-and-trade regulation: Impacts of using blockchain technology," *Transp. Res. Part E Logist. Transp. Rev.*, vol. 155, no. 11, 2021, doi: https://doi.org/10.1016/j.tre.2021.102491.

[17] E. Madina, "Marketing Logistics as a Leading Factor in Improving the Competitiveness of Enterprises," *Eur. J. Res. Dev. Sustain.*, vol. 2, no. 4, pp. 34–35, 2021.

[18] J. Basalamah, M. H. Syahnur, M. Ashoer, and A. F. Bahari, "Consumer Behavior in Online Transportation Services : A Systematic review of Business Strategies," *Ilomata Int. J. Manag.*, vol. 1, no. 3, pp. 134–144, 2020.

[19] B. Bentalha and A. Hmioui, "Digital Service Supply Chain Management : Current Realities and Prospective Visions Lecture Notes in Intelligent Transportation and Infrastructure," in *The Proceedings of the 4th International Conference on Smart City Applications*, 2020, pp. 808–822. doi: 10.1007/978-3-030-37629-1.

[20] A. Gola, Ed., *Design and Management of Manufacturing Systems*. MDPI AG, 2021.

[21] A. Mitra, *Fundamentals of Quality Control and Improvement*. Wiley, 2021.

[22] K. Siregar, A. Ishak, F. Ariani, and R. Spencer, "Quality Assessment Using Quality Loss Function Method in PT . QRS Quality Assessment Using Quality Loss Function Method in PT . QRS," in *IOP Conference Series: Materials Science and Engineering*, IOP Publishing Ltd, 2020, pp. 1–6. doi: 10.1088/1757-899X/1003/1/012104.

[23] T. Eifler, F. Campean, S. Husung, and B. Schleich, "Perspective on Robust Design - An Overview of Challenges and Research Areas Across Industry Fields," in *Proceedings of the international Conference on Engineering Design (ICED23)*, Cambridge University Press, 2023, pp. 2885–2894. doi: 10.1017/pds.2023.289.

[24] P. Chebotayev, D. Urazayev, I. Pospelova, A. Karassenko, D. Zykov, and A. Shelupanov, "Analysis of the level of SNR in the PLC channel based on the results of mathematical and physical modelling Analysis of the level of SNR in the PLC channel based on the results of mathematical and physical modelling," in *IOP Conf. Series: Journal of Physics: Conf. Series 1145 (2019) 012013*, IOP Publishing Ltd, 2019, pp. 1–8. doi: 10.1088/1742-6596/1145/1/012013.

[25] H. Cui, L. Gong, Y. Yan, Z. Mo, X. Xiang, and X. Liu, "ScienceDirect An integrated approach for selecting design parameters in smart product-service system conceptual design," in *30th CIRP Design Conference*, Elsevier B.V., 2023, pp. 278–283. doi: 10.1016/j.procir.2023.01.003.

[26] J. A. Garza-Reyes, V. Kumar, J. L. Martinez-Covarrubias, and M. K. Lim, *Managing Innovation and Operations in the 21st Century*. Taylor & Francis, 2017.

[27] D. Gardiner and H. Reefke, *Operations Management for Business Excellence: Building Sustainable Supply Chains*. Routledge, 2020.

[28] J. A. Okechukwu and H. Hubs, "Supply Chain Drivers: Effect on Service Delivery," *Eur. J. Mark. Manag. Sci.*, vol. 5, no. 06, pp. 84–93, 2023.

[29] A. L. Setyabudhi, H. L. Napitupulu, R. Ginting, and M. T. Sembiring, "Streamlining logistics : Innovating cross-docking distribution systems for operational excellence," *J. Infrastructure, Policy Dev.*, vol. 8, no. 12, pp. 1–21, 2024.

[30] S. F. Alkhatib and R. A. Momani, "Supply Chain Resilience and Operational Performance: The Role of Digital Technologies in Jordanian Manufacturing Firms," *Adm. Sci.*, vol. 13, no. 2, 2023, doi: 10.3390/admsci13020040.

[31] H. M. Alzoubi, M. T. Alshurideh, B. Al Kurdi, and M. In, "Do perceived service value , Quality , price fairness and service recovery shape customer satisfaction and delight ? A practical study in the service telecommunication context," *Uncertain Supply Chain Manag.*, no. February, 2020, doi: 10.5267/j.uscm.2020.2.005.

[32] M. Shaiq, S. Khurram, S. Shaikh, and Z. Zaman, "Quality management as driver of vertical integration in service chain: A study of 3rd party logistics industry," *Oper. Supply Chain Manag.*, vol. 13, no. 3, pp. 244–255, 2020, doi: 10.31387/OSCM0420266.

[33] Y. Shen and B. Panichakarn, "Sustainability of agricultural trade supply chains status, opportunities, and future directions," *Uncertain Supply Chain Manag.*, vol. 11, no. 4, pp. 1769–1782, 2023, doi: 10.5267/j.uscm.2023.6.014.

[34] P. B. Sangode, "Supply Chain Risk Model for Cement Industry Based on Interpretive Structural Model Driven by FMEA," *J. Ind. Eng. Manag.*, vol. 16, no. 3, pp. 473–492, 2023, doi: 10.3926/jiem.5643.

[35] M. S. Shakur, M. Lubaba, B. Debnath, A. B. M. M. Bari, and M. A. Rahman, "Exploring the Challenges of Industry 4 . 0 Adoption in the Emerging Economy," *Logforum*, vol. 8, no. 27, pp. 1–28, 2024.

[36] P. Bossong, A. Reinhardt, and R. Elbert, "Adoption drivers and barriers of digital freight transport platforms—An intermodal case study," *Electron. Mark.*, vol. 35, no. 1, 2025, doi: 10.1007/s12525-025-00780-0.

[37] T. D. Mastos *et al.*, "Introducing an application of an industry 4.0 solution for circular supply chain management," *J. Clean. Prod.*, vol. 300, 2021, doi: 10.1016/j.jclepro.2021.126886.

[38] F. G. Yazıcılar Sola and D. Güzel, "The Role of Supply Chain Transparency and Supplier Trust in the Impact of Blockchain Technology Adoption on New Product Development †," *Sustain.*, vol. 17, no. 11, pp. 1–31, 2025, doi: 10.3390/su17115171.

[39] A. Mishrif, A. Antimiani, and A. Khan, "Examining the Contribution of Logistics and Supply Chain in Boosting Oman's Trade Network," *Economies*, vol. 12, no. 3, pp. 1–25, 2024, doi: 10.3390/economies12030070.

[40] M. Drljaca and V. Sesar, "Supply chain transportation management," *Transp. Res. Procedia*, vol. 74, no. 2022, pp. 338–345, 2023, doi: 10.1016/j.trpro.2023.11.153.

[41] M. Cichosz, C. M. Wallenburg, and A. M. Knemeyer, "Digital transformation at logistics service providers: barriers, success factors and leading practices," *Int. J. Logist. Manag.*, vol. 31, no. 2, pp. 209–238, 2020, doi: 10.1108/IJLM-08-2019-0229.

[42] V. Pasupuleti, B. Thuraka, C. S. Kodete, and S. Malisetty, "Enhancing Supply Chain Agility and Sustainability through Machine Learning: Optimization Techniques for Logistics and Inventory Management," *Logistics*, vol. 8, no. 3, 2024, doi: 10.3390/logistics8030073.

[43] V. Fani, I. Bucci, R. Bandinelli, and E. R. da Silva, "Sustainable reverse logistics network design using simulation: Insights from the fashion industry," *Clean. Logist. Supply Chain*, vol. 14, no. April 2024, p. 100201, 2025, doi: 10.1016/j.clscn.2024.100201.

[44] A. Abudureheman and A. Nilupaer, "Optimization model design of cross-border e-commerce transportation path under the background of prevention and control of COVID-19 pneumonia," *Soft Comput.*, vol. 25, no. 18, pp. 12007–12015, 2021, doi: 10.1007/s00500-021-05685-6.

[45] M. Nouri-Harzvili and S.-M. Hosseini-Motlagh, "Dynamic discount pricing in online retail systems: Effects of post-discount dynamic forces," *Expert Syst. Appl.*, vol. 232, p. 120864, Dec. 2023, doi: 10.1016/j.eswa.2023.120864.

[46] P. Rungskunroch, S. Triwanapong, V. Wattanajitsiri, and P. Maneerat, "Assessing the viability of enhancing logistics and supply chain operations: a case study of the Eastern Economic Corridor," *Urban, Plan. Transp. Res.*, vol. 12, no. 1, 2024, doi: 10.1080/21650020.2024.2379352.

[47] M. M. Shourkaei, K. M. Taylor, and B. Dyck, "Examining sustainable supply chain management via a social-symbolic work lens: Lessons from Patagonia," *Bus. Strateg. Environ.*, vol. 33, no. 2, pp. 1477–1496, 2024, doi: 10.1002/bse.3552.

[48] M. Wang, L. C. Wood, and B. Wang, "Transportation capacity shortage influence on logistics performance: evidence from the driver shortage," *Heliyon*, vol. 8, no. 5, p. e09423, 2022, doi: 10.1016/j.heliyon.2022.e09423.

[49] P. Golinska-Dawson, K. Werner-Lewandowska, K. Kolinska, and A. Kolinski, "Impact of Market Drivers on the Digital Maturity of Logistics Processes in a Supply Chain," *Sustain.*, vol. 15, no. 4, pp. 1–19, 2023, doi: 10.3390/su15043120.

[50] R. G. Richey, S. Chowdhury, B. Davis-Sramek, M. Giannakis, and Y. K. Dwivedi, "Artificial intelligence in logistics and supply chain management: A primer and roadmap for research," *J. Bus. Logist.*, vol. 44, no. 4, pp. 532–549, 2023, doi: 10.1111/jbl.12364.

[51] M. Perano, A. Cammarano, V. Varriale, C. Del Regno, F. Michelino, and M. Caputo, *Embracing supply chain digitalization and unphysicalization to enhance supply chain performance: a conceptual framework*, vol. 53, no. 5–6. 2023. doi: 10.1108/IJPDLM-06-2022-0201.

[52] J. Fan, S. Mehmood, I. Hussain, S. Nazir, and A. Basit, “Transport infrastructure environmental performance: the role of stakeholders, technological integration, government policies and lean supply chain management,” *Front. Environ. Sci.*, vol. 11, no. December, pp. 1–17, 2023, doi: 10.3389/fenvs.2023.1322466.

[53] D. Parmaksız, M. A. Ülkü, and H. Weigand, “Investigating Rural Logistics and Transportation through the Lens of Quadruple Bottom Line Sustainability,” *Logistics*, vol. 8, no. 3, 2024, doi: 10.3390/logistics8030081.

[54] A. L. Kilay, B. H. Simamora, and D. P. Putra, “The Influence of E-Payment and E-Commerce Services on Supply Chain Performance: Implications of Open Innovation and Solutions for the Digitalization of Micro, Small, and Medium Enterprises (MSMEs) in Indonesia,” *J. Open Innov. Technol. Mark. Complex.*, vol. 8, no. 3, 2022, doi: 10.3390/joitmc8030119.

[55] F. F. Rad *et al.*, “Industry 4.0 and supply chain performance: A systematic literature review of the benefits, challenges, and critical success factors of 11 core technologies,” *Ind. Mark. Manag.*, vol. 105, no. August 2020, pp. 268–293, 2022, doi: 10.1016/j.indmarman.2022.06.009.

[56] M. C. Schmidt, J. W. Veile, J. M. Müller, and K. I. Voigt, “Industry 4.0 implementation in the supply chain: a review on the evolution of buyer-supplier relationships,” *Int. J. Prod. Res.*, vol. 61, no. 17, pp. 6063–6080, 2023, doi: 10.1080/00207543.2022.2120923.

[57] M. Wang, P. Childerhouse, and A. Abareshi, “Global logistics and supply chain integration in the digital era: a focus on China’s Belt and Road Initiative,” *J. Int. Logist. Trade*, vol. 22, no. 2, pp. 58–79, 2024, doi: 10.1108/JILT-03-2023-0018.

[58] V. Eriksson, A. Dubois, and K. Hulthén, “Transport in supply networks,” *Int. J. Logist. Manag.*, vol. 33, no. 5, pp. 85–106, 2022, doi: 10.1108/IJLM-06-2021-0350.

[59] A. Stroumpoulis, E. Kopanaki, and P. T. Chountalas, “Enhancing Sustainable Supply Chain Management through Digital Transformation: A Comparative Case Study Analysis,” *Sustain.*, vol. 16, no. 16, 2024, doi: 10.3390/su16166778.

[60] R. Anissa, “Supply Chain Management Sustainability Through the Performance Improvement of Mts-Mto Production System Typology,” *J. Manaj. Ind. Dan Logistik*, vol. 1, no. 1, p. 58, 2017, doi: 10.30988/jmil.v1i1.8.

[61] M. A. Regiyanti, E. W. Abryandoko, R. Stighfarrinata, and P. Pramu, “Supply Chain Optimization of Industrial Machinery Projects Based on Artificial Neural Networks for Multi-Product Demand Forecasting,” *J. Manaj. Ind. dan Logistik Vol.*, vol. 9, no. 2, pp. 99–117, 2025.

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