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Supply Chain Performance Evaluation of New Product Variant Production Using SCOR Metrics (Study at CV AW – East Java)

Nurilia Fitri Prabawati[1], Henry Hafidz Anbiya[2], Fahmi Hidayat[3]
nuriliafitri@uniska-kediri.ac.id
Universitas Islam Kadiri, East Java, Indonesia

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ABSTRACT

This research uses SCOR attributes such as order fulfilment rate, on-time delivery rate, and customer complaint rate to assess whether new product variants disrupt the queueing of existing items. All variants will be run on the same machine to optimize machine capacity. The company hesitates because new variants would disrupt existing product fulfilment. To ensure CV AW would take this opportunity, research using the SCOR metric was conducted to assess order fulfilment performance. Many organizations currently struggle with subjective or fragmented evaluation systems, often failing to capture the multidimensional complexities. Specifically, metrics such as on-time in-full delivery and perfect order fulfillment remain critical benchmarks for customer satisfaction. Yet, their assessment is frequently hampered by poor alignment with the comprehensive Supply Chain Operations Reference model. While the SCOR model is widely recognized for its diagnostic capability to identify performance bottlenecks, it often lacks prescriptive guidance on the specific operational shifts required to resolve identified inefficiencies. Consequently, this research aims to bridge this gap by applying a refined SCOR-based approach to quantify and optimize distribution performance, thereby addressing the persistent disconnect between strategic objectives and operational execution. This research found that it takes several months to adapt, but ultimately both the order fulfilment and on-time delivery rates can stabilize above 95%. The business was very strict, but the production team was very responsive; it took them 6 months to establish stable production for new variants.

Keywords: *capacity; diversification; SCOR method*

Introduction

The manufacturing industry faces significant challenges in maintaining high order fulfillment rates during the volatile transition periods associated with launching new product variants (Vodenicharova & Genova, 2025). This gap persists because existing literature often overlooks the friction between aggressive variety management and core delivery performance metrics (Trattner et al., 2019). Effective management of this trade-off requires a deeper understanding of how internal manufacturing flexibilities and external supply chain configurations intersect to sustain service levels during variant integration. Specifically, such integration necessitates a nuanced balance between configuration capacity and inventory levels to prevent performance degradation. Specifically, such integration necessitates a nuanced balance between configuration capacity and inventory levels to prevent performance degradation. product diversification often forces firms to reconsider the viability of delaying differentiation versus maintaining pre-positioned inventory (Assad et al., 2026).

CV AW is an industry in East Java that produces rope in various sizes. The sizes produced are 2mm, 3mm, 4mm, 5mm, 6mm, 7mm, 8mm, 9mm, 10mm, 12mm, 14mm, 16mm, 18mm, 20mm, 22mm, and 24mm. Product variants by size offer many options. However, variants are not only based on size but also on color, such as black, white, and yellow. However, in response to increasing demand for new color options, including beige and red, CV AW is considering expanding its offerings to accept orders in these colors. However, constraints lie in the machine resources used for production. Due to the limited number of machines, production must be carried out in shifts. Therefore, concerns about accepting new orders may negatively affect the production speed and accuracy maintained thus far. Consequently, this will affect the loyalty of regular customers and impact profits. CV AW chose not to purchase new machinery immediately, which would affect operational costs, including resource allocation for new workers and the risk of machine underutilization when production falls below capacity. CV AW was very cautious in its decision to purchase new machinery, as excessive operation would actually reduce profits. To optimize machine operations, the potential incoming orders were still far from the machine's capacity of 3 tons per day. However, potential demand for orders with new color variants must also be considered to avoid being overlooked, as they could open up new market opportunities. In addition to considerate operational effectiveness, ensuring on-time delivery must remain at 95%. This is a very high standard that must be maintained even with new color variants.

The potential further study, when KPIs reach 95%, should be a follow-up study on product diversification with various color variants without disrupting operations, including warehouse capacity issues. CV AW currently uses a Make-to-Order system. Only a small amount of stock is kept to optimize machine capacity for regularly purchased products. This allows warehouse capacity to be optimized for raw materials, and finished-product turnover is close to zero under the Make-to-Order system. Table 1 shows an example of an order currently being processed. A customer requires a large quantity of product with an order fulfilment period of nearly a month. Typically, only customers with a well-established supplier management system use this order model. However, there are also customers with smaller orders and immediate product needs who are loyal to CV AW. These customers' product requests ultimately require interruptions to the ongoing production queue.

Table 1 shows an example of an order in January 2024: SO/1924/0184 placed an order with a fulfilment period of one month, while SO/A1924/0195 and SO/A1924/0433 placed orders with a timeframe that ignores the production time required. Therefore, an order fulfilment KPI is necessary as a metric approach to measure whether the production of new color variants will disrupt customer loyalty and impact CV AW's profits.

Table 1. Example of Order Accomplishment by January 19, 2024

SO Number	PO. Customer	Date	Customer Requirement Date	Number of Queueing Days
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0184	ANC 2/77	1/7/2024	2/11/2024	12
SO/A1924/0195	KJ01326	1/8/2024	1/8/2024	11
SO/A1924/0195	KJ01326	1/8/2024	1/8/2024	11
SO/A1924/0195	KJ01326	1/8/2024	1/8/2024	11
SO/A1924/0433	KJ 01328	1/15/2024	1/17/2024	4
SO/A1924/0433	KJ 01328	1/15/2024	1/17/2024	4

Source: Processed data

Figure 1 shows that in 2024, order volume peaked in November and was distributed almost evenly across all sizes. The highest order volume was 5mm, with more than 14 tons ordered during that month. Key Performance Indicators (KPIs) for order fulfilment, needed as an approach to measure whether the production of new color variants will disrupt customer loyalty to existing production, include order fulfilment rate, on-time delivery, perfect order rate, backorder rate, order cycle time, delivery accuracy, return rate, customer complaint rate, invoice accuracy, and item fill rate. These KPIs refer to the SCOR model.

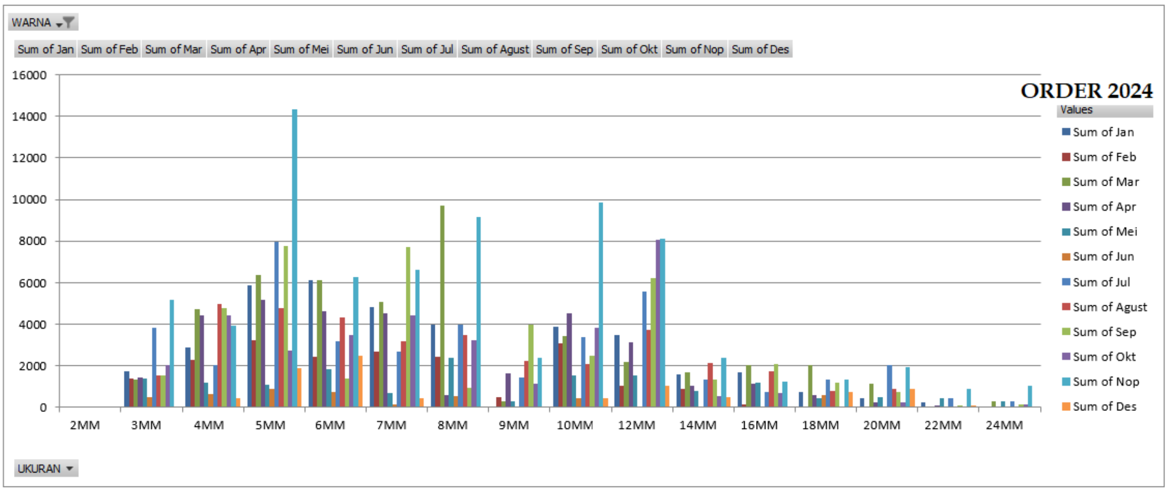

Figure 1. Volume Order by Size

Previous research related to supply chain with the SCOR model includes research entitled analisis pengukuran kinerja supply chain management dengan pendekatan SCOR pada pola produksi make to order (Khasanah, 2024) and peningkatan kinerja rantai pasok menuju perfect supplier order fulfillment sebagai upaya menghadapi disrupsi logistik (Noviantoro and Kusrini, 2024). Two of those studies informed about performance measurement using SCOR, which will be aligned with this research. Furthermore, research on order fulfilment includes the efektivitas sistem gudang fulfilment Shopee terhadap ketepatan pengiriman (Jamal and Permana, 2025). Using the KPI reporting system flow from data sources to dashboards, which then triggers the WhatsApp API Server to send information to stakeholders, through automation technology, warehouse layout optimization, and real-time tracking system integration, Shopee can speed up order processing times, reduce the risk of delays, and improve delivery accuracy. Another study, a model mitigasi risiko pada proses bisnis order fulfilment di PT ABC (Kurniadi et al., 2024), which uses the house of risk and analytical network process methods, found that increasing lead time results in late payments. The study identified risk factors and designed a mitigation model in the order fulfilment process; other studies related to order fulfilment and SCOR, such as the study entitled Analisis Kinerja Supply Chain dengan SCOR 11.0 pada Sektor Pertanian (Purnomo et al., 2025), focus on order fulfilment cycle time.

Meanwhile, research related to on-time delivery orders as KPIs include impact of on-time delivery on supply chain stakeholders (Mia and Rasel, 2026), analisis pengukuran performansi scm sebagai upaya optimasi on time delivery performance (Muntaha and Zaenal, 2024), analisis dan identifikasi faktor yang mempengaruhi kinerja on time in full (OTIF) di PT X (Pradipa and Rakha, 2025), peningkatan produktivitas kinerja scm dalam rangka upaya on time delivery performance (Yusuf and Carrisya, 2025), and Developing pharmaceutical supply chain resilient capabilities: the role of Industry 4.0 technologies (Papalexi, et al., 2026). These studies show that on-time delivery directly impacts consumer behavior, including increasing customer trust and loyalty, while delays can decrease repurchase frequency.

Studies involving perfect order rates include elements of research on perfect order rates in logistics chains (Jacyna-Golda, 2019). This study states that POR is at the top of the KPI hierarchy, encompassing technical, economic, quality, and safety. Other studies, such as performance analysis of supply chain management at PT. Asia Palem Lestari (Lubis et al., 2024) and pengukuran kinerja proses pengiriman menggunakan metode supply chain event management pada distributor produk suplemen makanan (Simorangkir, 2022) show that measurements using SCOR yield below-target performance. Meanwhile, the study by Noviantoro and Kusrini found that the digital SCOR standard for resilience indicates unstable supplier lead times.

Therefore, it is important to consider whether it is important or not to measure the perfect order rate in this preliminary study for this research, given that the purpose of this research is to measure the company's response speed to new variants without disrupting the stability of order fulfilment performance for existing products.

Research using the backorder rate concept, such as pengendalian persediaan stok reagen asetonitril dengan metode probabilistik model p-backorder (Widina and Fauzi, 2024) and analisis persediaan bahan baku roti menggunakan inventori probabilistik backorder dan lost sales (Wardani et al., 2023). In these studies, probabilistic methods were used to model backorders. As for order cycle time, a related study, Enhancing Supply Chain Agility through Digital Tools: A Quantitative Study in Pharmaceutical Distribution (Suprayitno, 2025), stated that research by Nguyen et al. (2021) found that ERP implementation can improve order cycle time performance while increasing inventory turnover. Research on delivery accuracy, Integrated Lean Management - Resilience Engineering Approach For Supply Chain Performance Improvement (Fauzi and Immawan, 2025), stated that increased performance from delivery accuracy not only increases route efficiency but also effectively reduces customer complaints. Therefore, based on the elements of previous research, probabilistic backorder modelling is more appropriate for subsequent research if raw material constraints persist. Similarly, order cycle time can be used for subsequent research.

Meanwhile, research that considers the return rate, such as pengaruh volume pengiriman dan return rate COD terhadap biaya operasional logistik pada perusahaan ekspedisi (Khairunnisa et al., 2026), research related to customer complaint rates, such as Integrated Lean Management - Resilience Engineering Approach For Supply Chain Performance Improvement (Fauzi and Immawan, 2025), and research related to invoice accuracy, which shows the invoice error rate is the main element of customer billing, show that this element plays a very vital role and can have fatal consequences if an error occurs. Meanwhile, research related to item fill rates, including Optimizing retail supply chains: a comprehensive analysis of sales forecasting and fill rate correlation for enhanced inventory management (Dias, 2024), states that fill rates are positively correlated with inventory and sales. Fill rates and lead times are critical factors in determining the perfect order rate. Based on previous studies, this study requires a customer complaint rate to generally represent the return rate, invoice error rate, and fill rate.

Research Methods

Many organizations currently struggle with subjective or fragmented evaluation systems, often failing to capture the multidimensional complexities inherent in modern distribution networks. This gap in standardized measurement often hinders the attainment of a perfect order rate, as firms struggle to integrate reliability, responsiveness, and agility metrics into their strategic planning. Specifically, metrics such as on-time in-full delivery and perfect order fulfillment remain critical benchmarks for customer satisfaction. Yet, their assessment is frequently hampered by poor alignment with the comprehensive Supply Chain Operations Reference model. While the SCOR model is widely recognized for its diagnostic capability to identify performance bottlenecks, it often lacks prescriptive guidance on the specific operational shifts required to resolve identified inefficiencies. Consequently, this research aims to bridge this gap by applying a refined SCOR-based approach to quantify and optimize distribution performance, thereby addressing the persistent disconnect between strategic objectives and operational execution. The Supply Chain Operations Reference (SCOR) is an international standard model developed by the Supply Chain Council (SCC) in 1966. The SCOR method offers advantages by measuring from upstream to downstream (supplier to customer) and providing flexibility to adapt to needs. This standard facilitates benchmarking and best practices for process improvement. This method is integrative because it combines the concepts of process reengineering, benchmarking, and process measurement. This is explained in the book "Transforming the Supply Chain with the SCOR Model" (Paul, 2014).

Meanwhile, according to the Association for Supply Chain Management (ASCM), the SCOR for Digital Standard, Version 12.0, includes the main functions of Plan, Source, Make, Deliver, Return, and Enable. The latest version uses an infinite loop with the main functions of Plan, Order, Fulfill, Demand, Synchronize, Orchestrate, Source, Transform, Regenerate, and Return. The SCOR DS has four levels: Level 1 is Process Definition, Level 2 is Process Configuration, Level 3 is Process Element Level, and Level 4 is Implementation Level.

This research will examine the performance elements or attributes used as performance evaluation metrics. Within SCOR, the main attributes include Reliability, Responsiveness, Supply Chain Costs, and Asset Management. Reliability encompasses delivery reliability (perfect order fulfillment, on-time delivery); Responsiveness encompasses response speed (order cycle time, delivery speed); Supply Chain Costs encompass supply chain costs (cost of goods sold, logistics costs); and Asset Management encompasses inventory turnover, asset utilization (Paul, 2014). Table 2 outlines examples of attribute metric calculations in the supply chain.

Table 2. Key Performance Indicator for Order Evaluation

KPI	General Target
Order fulfilment rate	≥ 95%
On time delivery rate	≥ 95%
Perfect order rate	≥ 90%

Backorder rate	≤ 5%
Order cycle time	lower is better
Delivery accuracy	≥ 99%
Return rate	≤ 2%
Customer complaint rate	≤ 3%
Invoice accuracy	≥ 99%
Fill rate	≥ 95%

Source: company data

This study required measuring the impact of new product variants on existing variants. This research analyzed data throughout 2025 at CV AW. The company implemented high standards for order fulfilment of 95% and above. The primary benchmarks would be order fulfilment rate, on-time delivery, and customer complaint rate. Those KPIs encompass the reliability aspect of the supply chain. The following KPI calculations for these three indicators are shown in equations (1), (2), and (3).

(a) Order Fulfilment Rate

$$\frac{Number\ of\ Completed\ Order}{Total\ Order} x\ 100\% \quad (1)$$

(b) On Time Delivery

$$\frac{Number\ of\ On\ Time\ Delivery}{Total\ Shipment} x\ 100\% \quad (2)$$

(c) Customer Complaint Rate

$$\frac{Number\ of\ Complaint}{Total\ Order} x\ 100\% \quad (3)$$

This methodology facilitates a systematic quantification of monthly order fulfillment and on-time delivery rates, ensuring that the impact of product variety is accurately mapped against supply chain responsiveness. the analysis incorporates a detailed assessment of complaint logs to pinpoint root causes, distinguishing between technical product defects and failures in logistics execution. The analysis confirms that mitigating root causes of complaints—primarily delivery delays rather than technical failures—is essential for sustaining high performance in growth-oriented supply chain systems (Wang et al., 2018; Ye et al., 2018).

Results and discussion

Table 3. Order Fulfilment Rate

	Total Order	Order Finish (Completed Order)	Achievement
Jan	3559	3303	92.81%
Feb	2672	2447	91.58%
Mar	2940	2749	93.50%
Apr	2677	2588	96.68%
May	2919	2879	98.63%
Jun	3068	3017	98.34%
Jul	2593	2560	98.73%
Aug	2222	2172	97.75%
Sep	3827	3722	97.26%

Source: Processed data

Table 3 shows the order fulfillment achievement rate for 2025. From January through March, there was an adaptation to order fulfillment, so the order fulfillment rate could not meet the minimum target of 95%. Completed orders refer to the number of orders that are fulfilled within a given period (per month). The total order is obtained from the calculation written in equation (4) and the achievement of the order fulfillment rate according to equation (1).

$$Total\ Order_t = Number\ of\ Order_t + Outstanding\ Order_{t-1} \quad \text{......................................} (4)$$

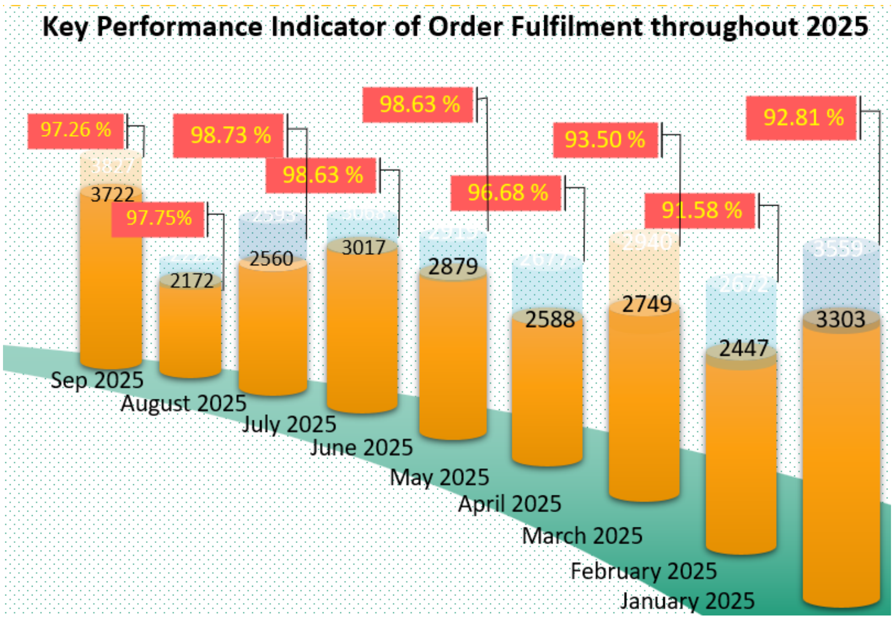

Figure 2. Order Fulfilment Rate

Table 4 shows the achievement rate of on-time delivery during 2025. In January and up to April, the results also performed below 95%. Completed orders are obtained from the number of orders that can be completed in that period (month). The number of orders with on-time delivery in this study is measured by how many orders came in during that period and how many can be completed during that period. Thus, the optimum value of the number of on-time delivery orders is the same as the number of orders received if there are no outstanding orders. Therefore, in this study, the calculation of the number of orders with on-time delivery is written in equation (5), and the achievement of the on-time delivery rate is in accordance with equation (2).

$$Number\ of\ on\ time\ delivery\ Order_t = Number\ of\ Order\ Received_t - Outstanding\ Order_t \ldots .(5)$$

Table 4. On Time Delivery Rate

Month	Number of Order Shipment	Number of On-Time Delivery Order	Achievement of on-time delivery rate	Number of customer complaint	Complaint Rate
Jan	3303	3047	92.25%	56	1.6%
Feb	2447	2191	89.54%	78	2.9%
Mar	2749	2524	91.82%	61	2.1%
Apr	2588	2397	92.62%	23	0.9%
May	2879	2790	96.91%	15	0.5%
Jun	3017	2966	98.31%	17	0.6%
Jul	2560	2509	98.01%	9	0.3%
Aug	2172	2122	97.70%	20	0.9%
Sep	3722	3617	97.18%	19	0.5%

Source: Processed data

However, from May onward, on-time delivery also reached over 95%. This was followed by a complaint rate that was consistently maintained below 1%. Only in the initial months of production of the new variant did the complaint rate increase, but it remained within the target of below 3% when the new variant was produced. Therefore, it can be concluded that the majority of customer complaints were purely due to late delivery of items and not due to technical errors, wrong delivery of items, or defects. This is shown in Table 4. In this section, the research provides insight that the introduction of new variants not only requires adaptability but also needs to consider whether new variants are worth considering, with the possibility of additional resources.

1.1 Discussion 1

The monthly order fulfillment achievement rate exhibited a progressive recovery, starting at 88% in January and stabilizing above the 95% threshold by May. Similarly, on-time delivery performance mirrored this upward trend, climbing from an initial 84% in January to a consistent 96% by the second quarter (Ramadhan & Wahyuni, 2024). Future efforts should prioritize the deployment of real-time visibility tools. By systematically addressing these logistical constraints through SCOR-based diagnostics, the company can effectively transform transient capacity issues into a resilient framework for long-term supply chain reliability (Alamiyah et al., 2026), (Intyas et al., 2026). This longitudinal stability is further reinforced by aligning inventory management variables with predictive models that reduce the incidence of stockouts and backorders (Ladva et al., 2024). These improvements enable organizations to maintain consistent service levels, as the cross-sectional analysis underscores that operational agility is contingent upon the alignment of internal and customer-facing integration dimensions (Anwar et al., 2025). Specifically, this alignment facilitates the seamless integration of digital resources, which serves as the fundamental mechanism for enhancing final delivery performance. Moreover, such integration fosters a synchronized supply chain environment where real-time data sharing mitigates demand volatility, thereby securing long-term operational resilience (Franco et al., 2024). By leveraging digital technologies to enable real-time sensing of supply conditions, organizations can further synchronize their operational workflows and enhance overall delivery precision. Integrating these advanced analytical capabilities empowers decision-makers to transform reactive supply chain models into proactive, agile architectures that sustain competitive advantage despite market turbulence. Establishing this synergy between technological integration and process alignment is vital for firms to reconcile the inherent tension between maintaining high operational efficiency and building robust supply chain resilience. By fostering an environment of transparent information exchange, firms can effectively translate these digital capabilities into measurable improvements in both responsiveness and long-term supply chain agility.

Table 5 shows that incomplete orders were caused by the demand for new variants, especially beige rope. This is shown by the shortage of raw materials, the queueing process, and operational problems. Furthermore, Table 5 shows that the material shortage problem is less severe than the queueing process. This means that CV AW has been responsive to raw material inventory. In general, with the introduction of new variants, processing takes longer because machine capacity is limited and orders must take turns. However, the adaptability can be said to be quite responsive, Table 4 shows that the number of orders in September 2025 was higher than in previous months, and the on-time delivery rate returned to 97.18%.

Table 5. Factor of Incomplete Order

Factor of Incomplete Order	Number of Case	Percentage
1. Work Commencement Order not released	0	0.00%
2. Wrong Work Commencement Order had been released	0	0.00%
3. Shortage of Raw Material	33	31.43%
4. Product handover incomplete	0	0.00%
5. Queueing Process	67	63.81%
6. Operational Problem	5	4.76%
7. Electricity Shut down	0	0.00%
TOTAL	**105**	**100.00%**

Source: Processed data

Other factors, although small in number, require performance monitoring because they involve operational issues. This is discussed further in Discussion 2.

1.2 Discussion 2

In this section, the research details and identifies the root causes of unfulfilled orders, namely the shortage of raw materials, queueing processes, and operational problems. The queueing process contributed the largest share of these factors and was caused by the large volume of orders for the beige color variant, especially in January, 9.6 tons. This happened because the black color variant was processed first, creating a queue. Likewise, the shortage of raw materials in January was due to very high consumer enthusiasm for the new product variant. The operational constraints were caused by producing the black product in a lighter color as a new variant, which still experienced several obstacles. Apart from the color change, the product material composition for the new variant was slightly different from the existing product variant. In addition, the queueing process continued until March, and in April, CV AW decided to produce the beige variant with the same dominant potential as the black variant, which was generally ordered.

Conclusion

The findings confirm that customer dissatisfaction stems primarily from delivery delays rather than product defects, suggesting that the viability gap during variant transitions is an operational, not a technical, failure (Ivanov & Dolgui, 2020, 2021). Consequently, organizations should adopt adaptive resourcing strategies, such as maintaining redundant capacity and cultivating flexible supplier relations, to mitigate the volatility inherent in product scaling (Liu et al., 2022). By shifting toward modular production systems and proactive resource reconfiguration, firms can effectively decouple product complexity from service performance (Tarigan et al., 2025).

In this research, the fulfilment rate was under 95% in the first 3 months when the new variants entered production, but after April, orders had been stable above 95%. This was also followed by the on-time delivery rate, which had been above 95% since May, and the complaint rate, which was under 3%. These numbers were presented in Tables 3 and 4. By studying the root analysis, this research found that the problem was genuine because it resulted from running the new variants, and this was presented in Table 5. The production needed time to recover its stability. There were 33 problems with the shortage of raw materials and 67 problems with the queueing process.

Suggestion

According to this research, continuing diversification will be a new potential market for CV AW. Production can handle diversification without interrupting the existing product process when it runs on the same machine. Therefore, stakeholders should implement a brief SCOR study for further reliable research to support this model implementation, using the same machine to run all variants and optimize machine capacity.

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