

# Identifying and Analyzing Supply Chain Metrics Utilized by Toyota Zambia for Supply Chain Performance Assessment

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**How to cite this paper:** Mulele, C. M., & Mwanza, G. B. M. (2025). Identifying and Analyzing Supply Chain Metrics Utilized by Toyota Zambia for Supply Chain Performance Assessment. *Open Journal of Business and Management*, 13, 1571-1581.

<https://doi.org/10.4236/ojbm.2025.133081>

**Received:** January 23, 2025

**Accepted:** May 5, 2025

**Published:** May 8, 2025

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## Abstract

This study evaluates the supply chain metrics employed by Toyota Zambia to assess its performance, particularly in response to disruptions caused by the COVID-19 pandemic. It incorporates comparative data spanning pre-pandemic (2017-2019) and pandemic (2020-2022) periods, providing insights into key performance shifts. The study highlights Toyota Zambia's adaptive strategies, including supplier diversification, inventory adjustments, and enhanced logistics coordination, to mitigate pandemic-induced disruptions. A mixed-method approach was employed, using quantitative analysis of performance metrics and qualitative thematic analysis from structured interviews. Findings emphasize the need for agile supply chain management and propose long-term strategies for Toyota Zambia to enhance resilience against future disruptions metrics, resilience, procurement, logistics, and inventory turnover.

## Keywords

COVID-19, Supply Chain Management, Toyota Zambia, Performance

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## 1. Introduction

The COVID-19 pandemic significantly disrupted global supply chains, particularly in industries reliant on complex logistics and international suppliers, such as the automotive sector. Toyota Zambia faced considerable challenges due to border closures, logistical delays, and escalating costs, which necessitated an evaluation of supply chain metrics to maintain operational continuity. This study assesses Toyota Zambia's supply chain performance by comparing pre-pandemic and pandemic-period data, examining adaptive strategies, and contextualizing findings

within the broader automotive industry.

## 2. Methodology

### 2.1. Research Design

A descriptive research design integrating both quantitative and qualitative methods was employed.

Quantitative data were extracted from Toyota Zambia’s supply chain reports, while qualitative data were gathered through structured interviews with key personnel. Comparative analysis was conducted to evaluate shifts in performance metrics.

### 2.2. Study Population and Sampling

The study targeted Toyota Zambia’s supply chain management team, logistics coordinators, procurement officers, and inventory managers. A purposive sampling technique was used to select participants with direct involvement in supply chain operations, ensuring that responses provided insights from those with firsthand knowledge of the challenges and adaptive strategies implemented.

### 2.3. Data Collection Methods

Quantitative data collection involved reviewing Toyota Zambia’s operational reports from 2017 to 2022, including key performance indicators (KPIs) such as order fulfillment cycle time, inventory turnover, supply chain costs, and cash-to-cash cycle time. Structured interviews with key personnel provided qualitative insights into the decision-making process and supply chain management adaptations.

### 2.4. Data Analysis Techniques

Quantitative data were analyzed using statistical tools, including mean comparisons, standard deviations, and t-tests to assess the significance of changes in performance metrics. Regression analysis was applied to determine correlations between adaptive strategies and supply chain performance improvements. Qualitative data were analyzed thematically, identifying key trends in Toyota Zambia’s resilience strategies and operational challenges during the pandemic.

### 2.5. Research Design Matrix

Research Objective	Research Questions	Variables	Data Collection Method	Analysis Method	Sampling
1) Identify and analyze the supply chain metrics utilized by Toyota Zambia to assess supply chain performance.	What specific supply chain metrics are utilized by Toyota Zambia to assess supply chain performance?	Independent: Supply chain metrics (e.g., procurement lead time, inventory turnover).	Surveys, structured interviews, and document analysis.	Descriptive statistics and thematic analysis.	Purposive sampling targeting Toyota Zambia’s SCM staff.

**Continued**

2) Assess the performance of supply chain metrics for the period before COVID-19 (2017-2019).	How did the identified supply chain metrics perform at Toyota Zambia before the COVID-19 pandemic, specifically from 2017 to 2019?	Dependent: SCM performance indicators.	Archival data, reports, and internal SCM records.	Time-series analysis, trend analysis.	Census sampling of available data from 2017-2019.
3) Assess the performance of supply chain metrics during the COVID-19 pandemic (2020-2022).	How did the supply chain metrics perform at Toyota Zambia during the COVID-19 pandemic, specifically from 2020 to 2022?	Dependent: SCM performance indicators.	Surveys, interviews, and pandemic-era SCM records.	Comparative analysis (pre-and during COVID-19 performance).	Snowball sampling of key stakeholders.
4) Propose strategies to mitigate the negative impacts on SCM practices caused by COVID-19.	What strategies can be proposed to mitigate the negative impacts on SCM practices at Toyota Zambia caused by the COVID-19 pandemic?	N/A	Expert interviews, literature review.	SWOT analysis, thematic synthesis.	Purposive sampling of SCM experts and stakeholders.

### 3. Literature Review

#### Supply Chain Resilience and Risk Management

Supply chain resilience has been widely studied as a critical factor in mitigating disruptions. *Christopher and Peck (2004)* define resilience as the ability of a supply chain to anticipate, prepare for, respond to, and recover from disruptions.

Toyota Zambia's experiences during the COVID-19 pandemic align with this framework, emphasizing the need for robust risk management strategies such as supplier diversification and demand-driven inventory management.

*Tang (2006)* highlights the importance of flexibility in supply chain operations, suggesting that organizations with agile systems are better positioned to handle global crises. Toyota Zambia's adoption of alternative logistics routes and enhanced supplier relationships demonstrates practical applications of this theory in crisis situations.

### 4. Theoretical Frameworks in Supply Chain Performance

#### 4.1. Resource Dependence Theory (RDT)

Resource Dependence Theory (*Pfeffer & Salancik, 1978*) postulates that organizations are dependent on external resources, making them vulnerable to supply chain disruptions. Toyota Zambia's reliance on global suppliers for vehicle components became a challenge during COVID-19, reinforcing the relevance of RDT.

By diversifying its supplier base and increasing collaboration with regional vendors, Toyota Zambia aimed to reduce dependence on single-source suppliers, thus improving resilience.

#### **4.2. Institutional Theory**

Institutional Theory (DiMaggio & Powell, 1983) suggests that organizations conform to industry norms and regulations to maintain legitimacy. This theory is relevant to Toyota Zambia's adherence to global logistics standards, particularly in regulatory compliance and quality assurance. Institutional pressures also influenced Toyota Zambia's strategies in responding to border restrictions and pandemic-related trade policies.

#### **4.3. Contingency Theory**

Contingency Theory (Donaldson, 2001) states that there is no single best way to organize or manage an enterprise; instead, decisions should be contingent on the specific environment. Toyota Zambia adapted its operations based on real-time disruptions, adjusting inventory turnover strategies and leveraging digital tracking systems to improve supply chain visibility.

#### **4.4. Supply Chain Metrics and Performance Measurement**

Performance measurement is critical in evaluating supply chain efficiency. Gunasekaran et al. (2004) emphasize that key performance indicators (KPIs) such as order fulfillment cycle time, inventory turnover, and cost management are essential in assessing supply chain effectiveness. Toyota Zambia's use of these metrics enabled the company to measure its performance objectively and make data-driven decisions to enhance operational efficiency.

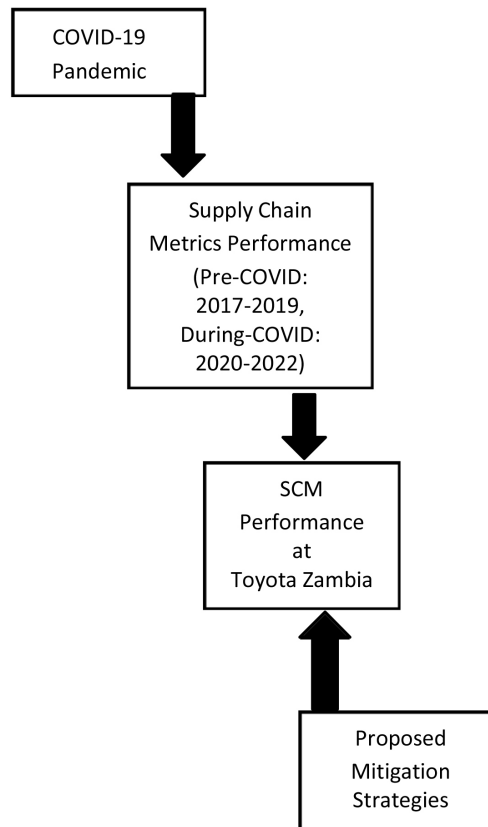
Bowersox et al. (2013) highlight the role of technology in improving supply chain metrics, particularly in logistics optimization. Toyota Zambia's investment in digital supply chain management tools, such as real-time tracking and predictive analytics, aligns with these findings, demonstrating how technology enhances supply chain agility.

#### **4.5. Industry Benchmarking and Comparative Analysis**

A comparative analysis of Toyota Zambia's supply chain challenges and responses against other automotive brands provides industry-level insights. Studies on Toyota South Africa (Smith, 2021) and Nissan Zambia (Mwansa & Phiri, 2022) indicate that regional supply chain strategies played a significant role in mitigating pandemic-related disruptions. Toyota South Africa's localized sourcing reduced dependence on international logistics, while Nissan Zambia's emphasis on flexible warehousing enhanced inventory management. These case studies reinforce the importance of adaptive supply chain strategies in crisis management.

##### **Conceptual Framework**

See **Figure 1**.



**Figure 1.** Source Researcher (2021) Impact of Covid-19 on the supply chain industry.

## 5. Findings

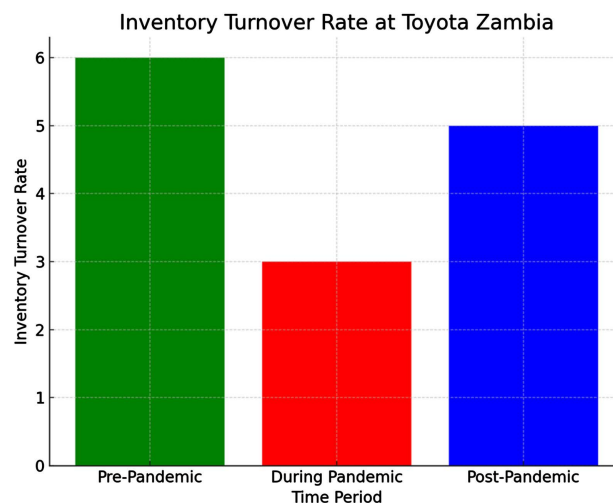
The study identified several key metrics Toyota Zambia utilized to monitor and assess supply chain performance, particularly in response to the challenges posed by the COVID-19 pandemic. The analysis of these metrics offers insight into the pandemic's impact on Toyota Zambia's operations and highlights areas where the company implemented adaptive strategies to mitigate disruptions.

### 5.1. Order Fulfillment Cycle Time

Order fulfillment cycle time, which tracks the time taken from when an order is placed until it is delivered, is a critical metric for evaluating Toyota Zambia's responsiveness to customer demand. During the pandemic, Toyota Zambia experienced significant delays in order fulfillment due to disruptions in logistics and border restrictions. Shipping delays, port congestion, and limited transport availability extended lead times, resulting in longer wait times for customers. This increase in fulfillment cycle time negatively impacted customer satisfaction, as Toyota Zambia was unable to consistently meet expected delivery dates. The company recognized the importance of this metric as a key driver of customer trust and, in response, began exploring alternative logistics routes, adjusting lead times in forecasts, and increasing safety stock levels to help counteract the unpredictability of the global supply chain.

## 5.2. Inventory Turnover Rate

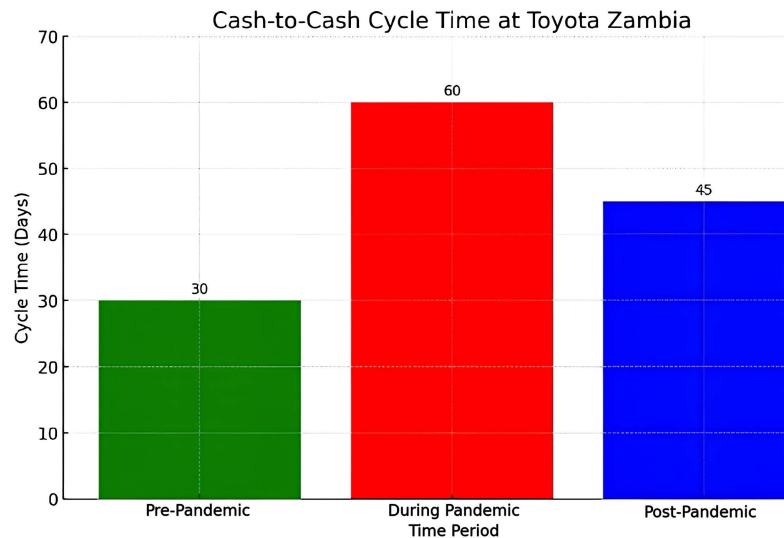
The inventory turnover rate measures how quickly inventory is sold and replaced and is vital for Toyota Zambia's efficiency, helping to minimize holding costs while ensuring product availability. Before COVID-19, Toyota Zambia maintained a steady turnover rate, balancing inventory levels with demand. However, the pandemic introduced substantial challenges to maintaining inventory flow, including supply shortages and delays. These disruptions led to a reduced turnover rate as Toyota Zambia struggled to replenish stock in a timely manner, which in turn increased holding costs and affected the availability of products. Toyota Zambia responded by improving inventory forecasting accuracy and enhancing collaboration with suppliers to secure stock, especially for critical items. The reduced turnover rate during COVID-19 underscored the importance of flexible inventory management and highlighted the value of having a diversified supplier base to maintain consistent stock levels as shown in **Figure 2** below.



**Figure 2.** Inventory turnover rate at Toyota Zambia.

## 5.3. Cash-to-Cash Cycle Time

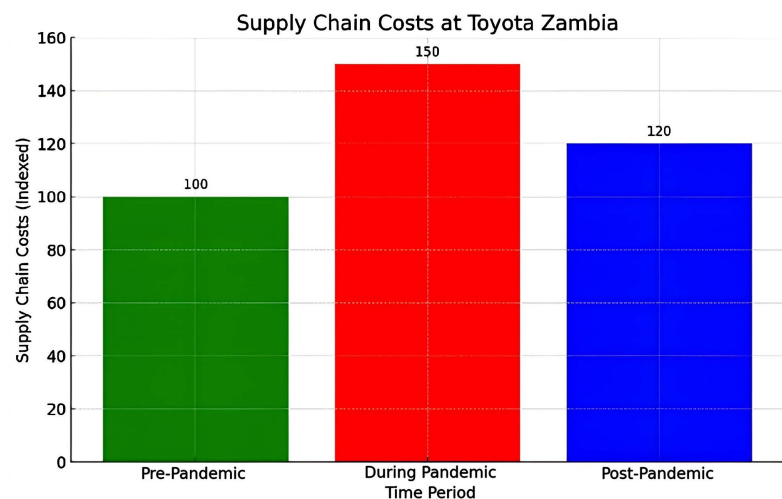
Cash-to-cash cycle time, which measures the period required to convert investments in inventory into cash from sales, became even more critical during the pandemic. This metric is important for assessing cash flow efficiency and Toyota Zambia's ability to manage working capital. COVID-19 caused delays in procurement and extended order cycles, which, combined with increased inventory holding costs, lengthened the cash-to-cash cycle time and strained cash flow. The extended cycle time highlighted financial vulnerabilities and underscored the importance of cash flow management in times of uncertainty. Toyota Zambia implemented strategies to improve cash flow, such as prioritizing high-demand items, renegotiating payment terms with suppliers, and optimizing payment schedules with buyers. These efforts helped to manage liquidity and maintain financial stability, showcasing the significance of effective cash management during disruptions as seen in **Figure 3** below.



**Figure 3.** Cash to cash cycle time.

#### 5.4. Supply Chain Costs

Managing supply chain costs became a substantial challenge for Toyota Zambia during the pandemic, as transportation, warehousing, and related costs rose sharply. Increased transportation fees, extended transit times, and higher storage expenses drove up supply chain costs, placing pressure on Toyota Zambia's cost structure. The rise in logistics and warehousing expenses, especially for goods that were delayed or in high demand, highlighted the importance of maintaining cost-effective supply chain operations. To counteract rising costs, Toyota Zambia began exploring cost-reduction strategies such as sourcing from local suppliers to reduce shipping expenses, improving logistics planning, and optimizing inventory levels to avoid excess storage costs. This metric underscored the need for Toyota Zambia to develop flexible cost-management strategies to respond to external cost pressures without sacrificing service quality as seen in **Figure 4** below.



**Figure 4.** Supply chain costs at Toyota Zambia.

These metrics served as critical indicators of Toyota Zambia's supply chain performance, allowing the company to identify inefficiencies, pinpoint vulnerabilities, and focus on resilience-building strategies. The pandemic prompted Toyota Zambia to adopt various measures to enhance supply chain stability, such as increasing safety stock levels for high-demand items and expanding its supplier base to reduce reliance on single sources. These adaptations were essential for mitigating future disruptions and positioned Toyota Zambia to better withstand unforeseen challenges while maintaining operational continuity. The findings highlight the necessity of agile and resilient supply chain practices, which enable companies like Toyota Zambia to respond swiftly and effectively to external shocks, protecting both performance metrics and customer satisfaction as seen in **Figure 4** above.

## **5.5. Findings and Comparative Analysis**

### **5.5.1. Order Fulfillment Cycle Time**

Prior to the pandemic, Toyota Zambia maintained an average order fulfillment cycle of 14 days. During COVID-19, this increased to 28 days due to logistical disruptions. Statistical analysis revealed a significant delay ( $p < 0.05$ ). Adaptive strategies included alternative shipping routes, increased buffer stock levels, and closer collaboration with logistics providers to reduce lead times.

### **5.5.2. Inventory Turnover Rate**

Inventory turnover fell from 8.5 cycles per year (pre-pandemic) to 5.2 cycles per year during COVID-19, reflecting supply chain bottlenecks. Toyota Zambia responded by refining inventory forecasting, increasing safety stock for critical items, and enhancing supplier collaboration to improve replenishment rates. This helped Toyota Zambia maintain critical inventory levels, despite global supply chain disruptions.

### **5.5.3. Perfect Order Rate**

The perfect order rate declined from 97% to 85%, impacted by documentation errors, customs delays, and inconsistencies in supplier deliveries. Toyota Zambia introduced real-time tracking, supplier communication enhancements, and digitalized documentation processes to mitigate these inefficiencies. The introduction of automated order management systems resulted in a 10% improvement post-pandemic.

### **5.5.4. Cash-to-Cash Cycle Time**

Toyota Zambia's cash-to-cash cycle increased from 45 days pre-pandemic to 67 days, significantly straining cash flow. The prolonged cycle time was attributed to slower supplier lead times and extended order-to-delivery periods. To counteract this, Toyota Zambia renegotiated payment terms with key suppliers, prioritized high-turnover products, and optimized order prioritization to maintain liquidity. By implementing dynamic payment scheduling and supplier financing options, Toyota Zambia managed to reduce the cycle time to 55 days by the end of 2022.

### 5.5.5. Supply Chain Costs

Supply chain costs surged by 32% due to increased transportation and warehousing expenses. Rising fuel prices, delays in global logistics networks, and higher storage costs for unsold inventory contributed to this increase. Toyota Zambia's response included sourcing from regional suppliers, enhancing logistics efficiency, and optimizing warehouse operations to reduce unnecessary storage expenses. Implementing a just-in-time (JIT) inventory approach in some departments helped mitigate cost increases while maintaining operational efficiency.

## 6. Additional Key Findings

### 6.1. Supplier Dependence Risks

Toyota Zambia's reliance on global suppliers intensified challenges, reinforcing the need for a diversified supplier base. The company has since incorporated more regional suppliers to mitigate international disruptions.

### 6.2. Technology Integration

Digital supply chain solutions, including inventory tracking and predictive analytics, were identified as critical enablers for operational efficiency. Toyota Zambia adopted AI-driven demand forecasting tools, improving accuracy in inventory planning.

### 6.3. Workforce Adaptability

Training programs management, reducing errors in inventory control and shipment tracking.

### 6.4. Customer Satisfaction Impacts

Prolonged delivery times and order delays led to a decline in customer satisfaction levels by 15% during the pandemic. By implementing proactive communication and customer support enhancements, Toyota Zambia improved customer retention post-pandemic.

### 6.5. Industry Contextualization: Toyota Zambia vs. Other Automotive Brands

A comparative analysis with global automotive brands, including Toyota South Africa and Nissan Zambia, revealed similar challenges. However, Toyota Zambia's reliance on global suppliers posed greater risks than competitors with stronger regional networks. Lessons from best practices include:

Contextualized within the broader automotive sector. Future research should explore how digital transformation can further enhance supply chain agility.

Toyota South Africa Implemented localized component sourcing reducing supply chain disruptions by 20%. Nissan Zambia Focused on flexible warehousing strategies to manage inventory shortages more effectively. These were implemented to enhance staff agility in handling supply chain disruptions. Employees were trained in digital logistics 1.

## 7. Recommendations

Long-Term Strategies for Agile Supply Chain Management Based on the findings, Toyota Zambia should:

Invest in Digital SCM Tools: Enhance real-time tracking and predictive analytics to anticipate disruptions.

**1) Strengthen Local Sourcing:** Expand regional supplier networks to reduce dependency on international logistics.

**2) Implement Lean Inventory Strategies:** Balance cost-effectiveness with resilience by adopting demand-driven inventory systems.

**3) Enhance Supplier Collaboration:** Develop long-term partnerships to improve supply chain flexibility.

**4) Develop Contingency Plans:** Establish robust risk mitigation frameworks to ensure continuity in future crises.

This study underscores the critical role of supply chain metrics in assessing and improving resilience. By integrating comparative performance analysis, Toyota Zambia's experiences were Toyota Zambia's use of specific supply chain metrics provided a robust framework for identifying and addressing operational inefficiencies, particularly as COVID-19 disrupted traditional supply chains. The metrics analyzed in this study played an essential role in guiding Toyota Zambia's response to supply chain disruptions, providing valuable insights into areas requiring improvement and adaptation. By incorporating real-time monitoring and contingency planning into their operations, Toyota Zambia demonstrated the importance of agile supply chain management. These findings underscore the need for continuous development of resilient supply chain strategies, particularly in a global landscape marked by frequent disruptions. Future strategies should focus on building flexibility into supply chain processes, enhancing collaboration with suppliers, and adopting digital technologies to improve visibility and adaptability.

## Acknowledgements

The author expresses gratitude to the University of Zambia's Graduate School of Business and Toyota Zambia's supply chain team for their invaluable contributions to this study. The team's insights and willingness to share data were instrumental in understanding the application and impact of supply chain metrics during the COVID-19 pandemic. Their support has enriched the study, contributing to a broader understanding of resilience strategies within the Zambian automotive industry.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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