Evaluating Supply Chain Performance through Financial Metrics: A Study in a Manufacturing Industry

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Abstract – This empirical study is based on primary data emphasizing the importance of evaluating supply chain performance through financial metrics, each activity within the supply chain directly impacts both the top line and bottom line of a business. In today's challenging business environment, organizations must prioritize monitoring their financial performance to ensure enduring resilience. The economy of Bangladesh has encountered turbulence due to disruptions such as the aftermath of the COVID-19 pandemic and the ongoing global political unrest. These occurrences have significantly impacted the business landscape, resulting in uncertainties in both demand and supply, shifts in consumer purchasing patterns, and notable increases in the prices of essential commodities and raw materials, therefore, the overall cost of business has risen. This study investigates the consequences of various disruptions, both internal and external, on the economy, adversely affecting organizations. The ability of an organization to withstand such challenges depends on maintaining robust financial and operational performance. Given the persistent global upheaval, there is a compelling need for an innovative approach to enhance supply chain optimizations, overall operational efficiency, and meticulous budget control and variance analysis aligned with financial planning. This is crucial at a substantial level to ensure positive entries in the profit and loss account and maintain a healthy cash flow statement. This study is done based on twenty-four (24) manufacturing sectors of Bangladesh. To address these challenges, the study advocates an Integrated Supply Chain Performance Measurement (ISCPM) model. This model contributes to academia through a novel approach, demonstrating its effectiveness by employing ten attributes to evaluate supply chain performance, with a specific focus on the financial performance termed Financial Health (FH), an attribute to measure supply chain performance in an organization. The study further elaborates Financial Health attributes into five key Performance Measurement Index (PMI) which are Economic Performance, Cost, Budget Variance, Inventory, and Planning Variance —within the context of manufacturing operations, providing insights into various facets of their impact. The study significantly contributes to the industry for practitioners by bringing synergy into the framework and performance measurement attributes, ultimately adding value to the manufacturing industry.

Keywords: *Integrated Supply Chain Performance Measurement (ISCPM), Financial Performance, Disruption, Cost of Goods Sold (COGS), and Supply Chain Performance Measurement.*

1. Introduction

From a supply chain perspective, Bangladesh has encountered a sequence of disruptions and significant crises, stemming from both internal and external factors since 2020. [16] These challenges encompass congestion at international marine ports such as Colombo and Malaysia, an abrupt blockage in the Suez Canal, pandemic-induced lockdowns, the subsequent waves of post-pandemic impacts, the initiation of the Ukraine-Russia War, and the ongoing conflict between Palestine and Israel. Additionally, various factors, including the dynamics among the US, EU, Russia, China, and the Middle East, have significantly affected businesses, particularly oil exploration, trade, and aspects of trade embargoes. [40]

Amidst these macro-environmental issues, business leaders in Bangladesh have grappled with challenges tied to impending visa sanctions, and potential trade embargoes by the US have further intensified the overall gravity and uncertainty of the business and investment landscape. [15]

Unavoidable issues, such as the surge in oil prices, have repercussions across all stages of business operations, leading Bangladesh to import energy at higher costs, thereby depleting the US dollar reserves and adding to the complexity of the situation. Importable items, including commodities like milk powder, edible oil, sugar, and flour, have experienced a notable escalation in costs. Freight costs for shipping have reached unprecedented levels and opening a Letter of Credit (LC) has become challenging due to the shortage of US dollars. Currently, the sustainability of business organizations is precarious, and the cost of doing business has risen substantially. [9]

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Consumer dynamics have undergone changes, aggravated by prolonged suffering from COVID-19, unemployment, and various societal challenges. People have had to dip into their savings, now at a low ebb. Consequently, consumers are exercising extreme caution and refraining from any unnecessary expenditures due to limited options.

This poses a significant challenge for business organizations, as the increase in the dollar price and the rise in the cost of goods sold (COGS) are juxtaposed against a decline in consumer purchasing power. [10]

2. Literature Review

Supply Chain Management (SCM) encompasses the holistic administration of all tasks associated with the production and delivery of products or services, spanning the procurement of raw materials, the production process, distribution, and ultimately reaching the end consumer illustrated in Figure 1.

The primary objective of supply chain management is to optimize and streamline these processes, aiming to

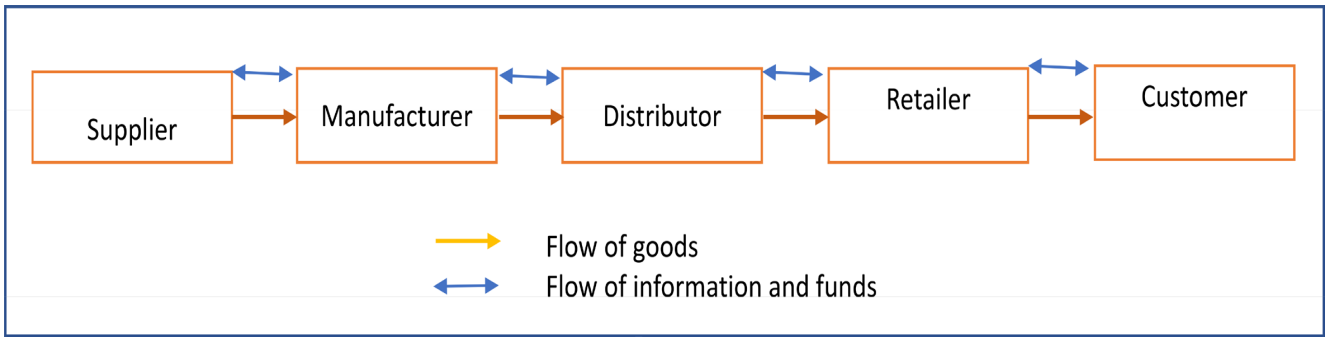

Figure 1. The Flow of Supply Chain Management [31]

Moreover, the government is struggling with real challenges and enduring multiple pressures from the US and EU counterparts. The prospect of an IMF loan is contingent upon meeting stringent criteria. The precarious situations faced by Sri Lanka and Pakistan serve as cautionary examples. During these trying times, business organizations and entrepreneurs face the daunting task of ensuring the financial health and sustainability of their companies amid a complex and uncertain economic landscape. [10] Therefore, this research conducts an examination utilizing both primary and secondary data to evaluate and diagnose a company's financial performance termed Financial Health (FH) in the study. Business leaders need to be aware of these findings, facilitating consensus decisions and ensuring ongoing monitoring of financial health at every phase. An essential aspect under scrutiny is the intricate correlation between the financial well-being of a business and the performance of its supply chain, given the inherent connection between upstream and downstream supply chain activities. [41,9]

The effective functioning of the supply chain assumes a pivotal role in influencing various elements, including overall sales and operational efficiency. The availability of goods hinges on the procurement process within the supply chain, necessitating the implementation of appropriate pricing strategies. Additionally, the distribution of goods is closely intertwined with the dynamics of the supply chain. [34]

Through this methodology, we intend to illuminate the interplay between financial health and the efficiency of supply chain operations.

maximize efficiency, reduce expenditures, and elevate customer satisfaction. [11] The fundamental components of SCM encompass planning, sourcing, manufacturing, logistics, delivery fulfillment, and reverse logistics. Achieving effective supply chain management requires seamless coordination and collaboration among diverse entities within the supply chain, ranging from suppliers and manufacturers to distributors and retailers. Modern technologies, including data analytics, artificial intelligence, and blockchain, are increasingly being harnessed to augment visibility, transparency, and efficiency in supply chain operations. A successful implementation of supply chain management contributes to cost savings, heightened customer satisfaction, and a strengthened competitive position in the marketplace. [12,31]

Companies in Bangladesh, like those in many other nations, are vulnerable to financial performance challenges after the COVID-19 pandemic and the Ukraine-Russia War for several reasons are as follows: increased cost, foreign exchange challenges, global energy price volatility, global supply chain disruptions, economic slowdown, consumer spending, the decline in remittance, political and social instability, trade relations and export challenges, and debt & financial obligations, etc. [26,36]

The repercussions of the Russia-Ukraine conflict have triggered a series of ripple effects across global markets, particularly impacting an end-to-end supply chain, notably the food sector, which profoundly affects 170 million Bangladeshis. Ukraine's inability to export grain has worsened a worldwide hunger crisis, resulting in catastrophic ramifications worldwide. [17,18]

The conflict poses a significant setback to the global economy, causing substantial disruptions in trade, and shocks to food and fuel prices, therefore heightening inflation and imposing constraints on global financial conditions. Beyond the human suffering and humanitarian crisis resulting from the Russian invasion of Ukraine, the broader global economy grapples with the impacts of sluggish growth and accelerated inflation. [5,19]

Since the outbreak of the Russia-Ukraine conflict, inflation has averaged 8.14 percent, surpassing the acceptable threshold of 5 percent [17]. The Bangladeshi Taka (BDT) has depreciated by approximately 25 percent, while reserves have contracted by roughly 28 percent. Moreover, the Bangladeshi Taka (BDT) has experienced a devaluation of 10.08% against the dollar. Over the initial nine months (July-March) of the 2021-22 fiscal year, import payments surged by 44%, export income rose by 33%, and remittances witnessed a notable decline of 18%. As a trading nation heavily reliant on imports for fuel and industrial raw materials, numerous companies encounter challenges initiating Letters of Credit (LCs) due to banks' reluctance arising from foreign exchange shortages. [5,22,]

Trade between Bangladesh and Russia amounted to US$1.14 billion in the last fiscal year (FY21), representing a fraction of Bangladesh's total global trade valued at US$104.35 billion [6,13]. Trade disruptions, particularly exports, are expected to entail significant costs. In the preceding fiscal year, Bangladesh exported $665.30 million to Russia, with approximately 95 percent comprising textiles and clothing. However, the ongoing conflict poses challenges to sustaining exports, potentially leading to a substantial decline in export figures for the fiscal year 2022-2023. [4]

The overall conflict has precipitated a crisis in the cost of living in Bangladesh, rapidly depleting the central bank's reserves and necessitating the implementation of stringent austerity measures by the government.

Consequently, the war, originating a thousand kilometers away a year ago, has laid bare the enduring vulnerabilities of the Bangladeshi economy, prompting the government to seek assistance from the International Monetary Fund for support. [42]

Bangladesh grapples with the repercussions of the war, particularly in terms of importing fuel and grains. Dependent on oil imports, Bangladesh faces challenges due to heightened global oil prices. Annually importing nearly 1.0 million tons of wheat and maize from Russia, the country's current situation remains uncertain given the global sanctions imposed on Russia, potentially necessitating sourcing these essential commodities from alternative markets at significantly higher prices. [9,10]

Challenges in exporting products arise from the Russia-Ukraine conflict, with Europe being a critical destination for Bangladeshi goods.

Elevated fuel and energy prices, domestic market inflation, and rising unemployment impact export shipment, alongside heightened freight charges inflating exportable goods' prices. Economic sanctions imposed on Russia by the USA, the UK, and their allies introduce numerous economic uncertainties. [13,42]

As Bangladesh participates in both importing and exporting a diverse array of goods, it confronts heightened freight expenses that have significantly risen on a global scale owing to the crisis and subsequent economic sanctions. This surge in freight costs has consequently triggered a widespread escalation in product prices. According to a report, the conflict is anticipated to lead to a 5.0-8.0 percent surge in freight charges along the trade route, with computers and electronic products poised to be particularly impacted, potentially experiencing a price increase of up to 11.4 percent. [5,3]

The convergence of the COVID-19 pandemic, and the geopolitical tensions, such as the Ukraine-Russia War, has created a complex and challenging environment for businesses in Bangladesh. The interconnectedness of the global economy means that local companies are susceptible to a range of external factors that can impact their financial health and overall sustainability. Adaptability, resilience, and proactive management strategies are essential for companies to navigate these uncertainties successfully. [25,23]

Financial Statement analyzes (i) Income Statement, (ii) Balance Sheet, and (iii) Cash Flow Statement. An income Statement studies revenue, expenses, and profits over a specific period to understand the company's operational performance. The Balance Sheet evaluates assets, liabilities, and equity to determine the company's financial position at a given point in time. Cash Flow Statement analyzes (i) cash inflows and (ii) cash outflows to understand the company's liquidity and ability to meet short-term obligations. [7]

Income Statement	Revenue, Expenses, Profit
Balance Sheet	Asset, Liability, and Equity
Cash Flow	Cash Inflow and Cash Outflow
Liquidity Ratio	Current Ratio, Quick Ratio
Profitability	Net Profit Margin, Return on Investment
Solvency Ratio	Debt-to-Equity Ratio, Interest Coverage Ratio.
Efficiency Ratio	Inventory Turnover, Accounts Receivable Turnover
Growth Ratio	Revenue Growth, Market Share
Risk Management Ratio	Contingent Liabilities, Risk Reserves.
External Factors Ratio	Economic Conditions, Industry Trends.

Table 1: Financial Analysis Metrics [27]

An income statement is a financial statement that shows a company's revenues, expenses, and net income over a specific period.

A balance sheet is a financial statement that summarizes a company's assets, liabilities, and shareholders' equity at a specific point in time. [28]

Cash Flow is a financial statement that tracks the flow of cash in and out of a business, categorizing it into operating, investing, and financing activities. [14]

The liquidity position of a company is assessed through the current ratio and quick ratio analysis. The current ratio measures the relationship between current assets and liabilities, gauging short-term liquidity and the ability to cover immediate obligations. Meanwhile, the quick ratio evaluates the company's capacity to meet short-term liabilities without relying on inventory sales. [27]

On the other hand, profitability ratio analysis encompasses net profit margin and return on investment (ROI). The net profit margin calculates the proportion of net profit relative to revenue, providing insights into the company's profitability. ROI assesses the efficiency of capital utilization by evaluating the return generated on investments. [27]

Solvency ratio analysis focuses on the debt-to-equity ratio and interest coverage ratio. The debt-to-equity ratio scrutinizes the balance between debt and equity, shedding light on the company's reliance on borrowed funds. The interest coverage ratio evaluates the company's ability to meet interest payments on outstanding debt. [1]

Efficiency ratio analysis comprises inventory turnover and accounts receivable turnover. Inventory turnover assesses the speed at which inventory is sold and replenished, indicating proficiency in inventory management. Accounts receivable turnover measures how efficiently the company collects payments from customers. Growth ratio analysis examines revenue growth and market Share.

Revenue growth analyzes the rate at which the company's revenue increases over time, while market share assesses the company's standing relative to competitors in the market.

Risk management analysis includes contingent liabilities and risk reserves. Contingent liabilities scrutinize potential future liabilities that could impact financial health. Risk reserves focus on establishing reserves for potential risks such as legal claims or economic downturns.

External factors analysis considers economic conditions and industry trends. Economic conditions assess the influence of broader economic trends on the organization, while industry trends evaluate the organization's alignment with industry trends and disruptions. [2]

The financial health (FH) of an organization serves as a crucial indicator of its overall well-being, reflecting its fiscal robustness and stability. Evaluation of various financial metrics and indicators is necessary to gauge the organization's ability to meet financial obligations, sustain operational continuity, and foster long-term growth. [27]

3. Research Methodology

This research is composed of both secondary and primary data. The primary data comprises a comprehensive survey questionnaire completed by 207 respondents representing 24 manufacturing sectors in Bangladesh. The researcher distributed self-administered questionnaires via email to supply chain stakeholders, including SCM professionals, employers, and employees. A total of 1,832 emails were dispatched for this purpose. Additionally, the study delved into secondary data obtained from indexed journals in Scopus and Web of Science (WoS), as well as from books and conference proceedings. [8]

While extensive research has been conducted on supply chain performance measurement (SCPM) encompassing cost and non-cost perspectives, as well as strategic, functional, and operational aspects, many manufacturing companies still struggle to achieve precise performance evaluation due to the absence of an Integrated Supply Chain Performance Measurement (ISCPM) model and insufficient knowledge within the industry [29].

There is a notable lack of comprehensive guidelines for researchers to assess SCPM in the manufacturing sector, addressing attributes and performance measurement indices from both cost and non-cost perspectives, evaluating strategic, functional, and operational levels, and aligning models using techniques such as Analytical Hierarchy Process (AHP) or Structural Equation Modeling (SEM) to gauge organizational bottom-line impacts [35].

Presently, SCPM is predominantly evaluated using financial and non-financial measurement systems. While global companies have adopted either the Supply Chain Operations Reference (SCOR) model or the Balanced Scorecard (BSC) model, significant challenges persist [33,32].

Despite the widespread adoption of the Balanced Scorecard model (BSC) for SCPM in corporate settings, the model faces numerous limitations. Over time, it has become evident that the BSC model lacks consideration for leadership or capacity building in performance assessment, primarily serving as an observation and monitoring tool rather than a developmental apparatus. Additionally, it leans toward strategic rather than planning or operational levels and lacks appropriate guidance for business operations, market competition replication, mathematical or logical associations, and intra- and inter-firm comparisons [38]. Moreover, the BSC model is impractical for small organizations due to its managerial complexity, inadequate consideration of cause-and-effect relationships in selecting performance measures, and predominant focus on internal corporate perspectives [39].

External factors such as risk, government regulations, uncertainty, collaborations, sustainability, and continuous improvement are overlooked, along with environmental, social, and sustainability factors.

The model also fails to address critical elements such as buyer-supplier relationships, supplier networks and strategies, employee motivation, engagement, team building, agility, resilience, and future business opportunities [30].

The researcher classified ten supply chain performance measurement attributes in Figure 2, for a manufacturing firm at different stages from supplier relationship management (SRM), internal supply chain management (ISCM), and customer relationship management (CRM) also illustrated in Figure 2 are Financial Health (FH), Collaboration (CL), Velocity (VC), Resilience (RE), Reliability (RL), Continuous Improvement (CI), Visibility (VS),Work People Health (WPH), Sustainability (SS), and Service Excellence (SE). [29]

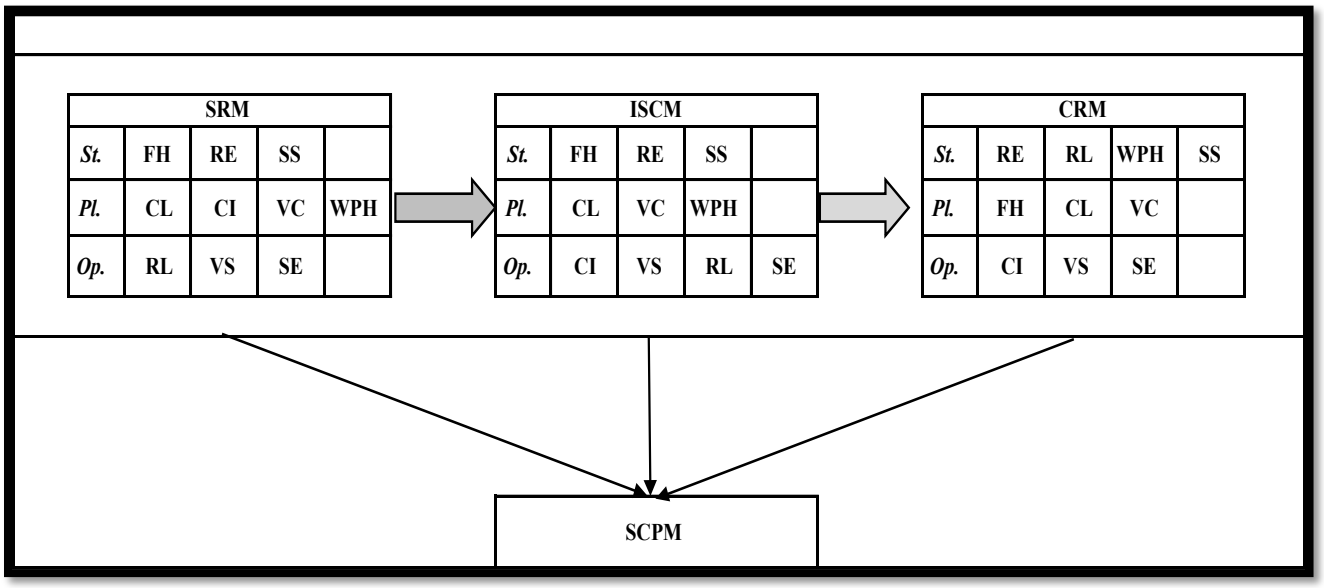

Figure 2. Integrated Supply Chain Performance Measurement (ISCPM) Model [28]

In Table 2, Supply Chain Performance Measurement (SCPM) through financial metrics has been elaborated where the term financial performance has been named as Financial Health (FH). Financial Health (FH) is an attribute amongst the ten-supply proposed chain performance measurement attributes in Figure 2. The Financial Health (FH) attribute is further elaborated into five key Performance Measurement Index (PMI) which are Economic Performance, Cost, Budget Variance, Inventory, and Planning Variance in Table 2.

Economic performance refers to Sales / Revenue, Gross Margin, EBITA, Net Profit, Cash Inflow / Cash Outflow, Market Capitalization, Total Assets, Total Liability, Shareholders' Equity, Cash to Cash Cycle Time, Net Working Capital, Contribution to National Exchequer, Total CSR, Current Ratio, Quick Ratio, Net Profit Margin, Return on Investment Debt to Equity Ratio, Interest Coverage Ratio, Inventory Turnover, Accounts Receivable, Revenue Growth, Market Share, Contingent Liabilities, Risk Reserves, Economic Conditions, and Industry Trends in table 2. [1,2,27]

Cost refers to Expenses, Cost of Goods Sold (COGS), Operating Cost, Production Cost, Production Cost / Unit, Raw Material Consumption / Unit, Total SCM Cost, Logistics Cost, Transport Cost, Distribution Cost / Delivery Cost, and Warehouse Cost, etc. in table 2. [1,2,27]

Budget Variance refers to Budget Variance in Customs Duty, Customs, Penalty, C&F Cost, Demurrage, Handing Damage, Cost of Production / Unit, Annual Wastage, and Delivery Cost / Trip, etc. in Table 2. [1,2,27]

Inventory refers to Inventory Holding Days, Inventory Ageing & Turnover, etc. in Table 2. Planning variance refers to Production in Unit (Plan Versus Actual), Distribution (Plan Versus Actual), Distribution Cost (Plan Versus Actual), Production Cost (Plan Versus Actual), Forecast in Sales (Plan Versus Actual), Supply Chain Cycle Time (Plan Versus Actual), Raw Material Consumption Ratio (Plan Versus Actual), Wastage & Shrinkage (Plan Versus Actual), and Production Quality Failure (Plan Versus Actual) in table 2. [1,2,27]

Measurement Index				
Financial Health	1	**Economic Performance**	Sales / Revenue Gross Margin EBITA Net Profit Cash Inflow / Cash Outflow Market Capitalization Total Assets Total Liability Shareholders' Equity Cash to Cash Cycle Time Net Working Capital Contribution to the National Exchequer Total CSR Current Ratio Quick Ratio Net Profit Margin Return on Investment Debt to Equity Ratio Interest Coverage Ratio Inventory Turnover Accounts Receivable Revenue Growth Market Share Contingent Liabilities Risk Reserves Economic Conditions Industry Trends	[1,2,3,27,28]
	2	**Cost**	Expenses COGS Operating Cost Production Cost Production Cost / Unit Raw Material Consumption Cost / Unit Total SCM Cost Logistics Cost Transport Cost / Distribution Cost / Delivery Cost Warehouse Cost	[1,2,3,27,28,14]
	3	**Budget Variance**	Budget Variance in Procurement Item-wise Budget Variance in Customs Duty Budget Variance in Penalty Budget Variance in C&F Cost Budget Variance in Demurrage Budget Variance in Handing Damage Budget Variance in Cost of Production / Unit Budget Variance in Annual Wastage Budget Variance in Delivery Cost / Trip etc.	[1,2,3,27,28,14]
	4	**Inventory**	Inventory Holding Days Inventory Ageing & Turnover	[1,2,3,27,28,14]
	5	**Planning Variance**	Production in Unit (plan versus actual) Distribution (plan versus actual) Distribution Cost (plan versus actual) Production Cost (plan versus actual) Forecast in Sales (plan versus actual) Supply Chain Cycle Time (plan versus actual) Raw Material Consumption Ratio (plan versus actual) Wastage & Shrinkage (plan versus actual) Production Quality Failure (plan versus actual)	[1,2,3,27,28,14]

Table 2. Supply Chain Performance Measurement through Financial Metrics [27,28]

4. Discussion

The researcher classified ten supply chain performance measurement attributes in Figure 2, for a manufacturing firm at different stages from supplier relationship management (SRM), internal supply chain management (ISCM), and customer relationship management (CRM) also illustrated in Figure 2 are Financial Health (FH), Collaboration (CL), Velocity (VC), Resilience (RE), Reliability (RL), Continuous Improvement (CI), Visibility (VS), Work People Health (WPH), Sustainability (SS), and Service Excellence (SE). [29]

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5. Conclusion

The focal point of this study lies in advocating for the adoption and implementation of the Integrated Supply Chain Performance Measurement (ISCPM) model as a strategic tool for assessing the supply chain performance measurement of an organization. The study justifies thoroughly measuring Supply Chain Performance Measurement (SCPM) through financial metrics. In today's contemporary business environments, Supply Chain Management (SCM) occupies a central position within organizations, exerting a profound influence on their overall financial health. By leveraging the ISCPM model, organizations can effectively gauge financial performance by examining various facets of their supply chain operations. Supply Chain Management (SCM) encompasses a multitude of activities, ranging from procurement and production to distribution and logistics. Each of these activities has a direct impact on the organization's financial outcomes. For instance, efficient procurement processes can lead to cost savings, while streamlined production processes can enhance productivity and reduce operational expenses. Furthermore, effective distribution and logistics management can optimize inventory levels and minimize carrying costs. [30,31]

By integrating Supply Chain Performance Measurement through financial metrics, an organization can gain a comprehensive understanding of its operational efficiency and financial viability. The ISCPM model provides a structured framework for this integration, enabling organizations to identify areas of improvement and implement targeted strategies to enhance financial performance. [28]

Moreover, the ISCPM model facilitates alignment between operational activities and financial goals. By aligning supply chain management practices with financial metrics such as revenue growth, profitability, and return on investment (ROI), organizations can ensure that their operational efforts contribute directly to achieving overarching financial objectives. [28]

In summary, the study advocates an Integrated Supply Chain Performance Measurement (ISCPM) model. The researcher classified ten supply chain performance measurement attributes for a manufacturing firm are Financial Health (FH), Collaboration (CL), Velocity (VC), Resilience (RE), Reliability (RL), Continuous Improvement (CI), Visibility (VS), Work People Health (WPH), Sustainability (SS), and Service Excellence (SE). [27]

Furthermore, the study elaborates the financial health (FH) which stretches on five key attributes—Economic Performance, Cost, Budget Variance, Inventory, and Planning Variance within the context of manufacturing operations, providing insights into various facets of their impact. [20,29]

The study pioneers a new academic frontier by integrating innovative methodologies and tools from supply chain performance measurement into the evaluation of organizational financial performance. This approach enhances traditional financial analysis methods, providing a holistic understanding of how supply chain dynamics influence financial outcomes. [21]

Additionally, it creates opportunities for interdisciplinary collaboration among scholars in supply chain management, finance, and operations research, fostering knowledge exchange and driving future research and innovation in this area. Ultimately, the study bridges the gap between supply chain management and financial analysis, shedding light on their interconnectedness and paving the way for further exploration in this evolving field. [21]

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