Journal of Production, Operations Management and Economics
Vol: 06, No. 01, Jan-June 2026
ISSN: 2799-1008, DOI: 10.55529/jpome.61.16.34 ❒16

Research Paper

Analyzing supply chain integration & its performance metrics to enhance productivity case industry: five food complex industries around

Getu Abdisa Mitiku*
*The University of Gondar, Institute of Technology, Department of Industrial Engineering, Gondar, Ethiopia, Addis Ababa, Ethiopia.

Article Info

Article History:
Received: 10 September 2025
Revised: 18 November 2025
Accepted: 26 November 2025
Published: 13 January 2026

Keywords:
Supply Chain Integrations
Supply Chain Performance Metrics
Supply Chain Productivity Improvement
Integrated Model in the Supply Chain System
Quantitative Evaluation of the Supply Chain

ABSTRACT

Synchronizing supply chain integrations' (SCIs) activities across its functional departments is the most significant to be competitive. In this research, SCI & its performance were examined through addressing problems, including inadequate coordination and poor resource interflows, in the cause firms' comprehensive evaluation of efficiencies. The summaries of the literature revealed gaps as excessive reliance on the SCOR-Model and limited deployments of the best management tools. This study integrated the SCOR model with Managerial Levers Achievement Coordination to close these gaps. Having the conceptualized research framework of this study, using MS-Excel & IBM 24 SPSS, primary and secondary data from case firms were examined. Internal operational integrations (19.9%, 52.6, 21.4 %), SC information coordination (16.5%, 51.4%, 26.6%), are considered as factors of SCIs that influence outcome. Response time (21.4%, 50.0%, 22.9%), quality perspective (19.7%, 36.6%, 38.1%) was low, medium, and high. Also, the impacts of one variable on others have been studied by regression and correlation matrix analysis. Unnecessary expenses were investigated as 29%, 18%, 43%, 11% preventive, appraisal, internal, and external failure, while downtime exceeded 19.9%. Then, a possible solution was proposed, a conclusion derived, and further research areas indicated.

Corresponding Author:
Getu Abdisa Mitiku
The University of Gondar, Institute of Technology, Department of Industrial Engineering, Gondar, Ethiopia, Addis Ababa, Ethiopia.
Email: getua51@gmail.com

Journal of Production, Operations Management and Economics (JPOME)

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1. INTRODUCTION

In business & industrial operational activities, SCIs are the most significant parameters, which are scholarly, highlighted as integrating & collaborating separate SC functional operations and optimally interlinking all of the chains [1], [2], [3], [4]. This study used these foundational concepts as benchmarking and aimed to further extend the discipline. And also, the other scholars mentioned this approach with SC performance metrics (SCPMs) and evaluated the effectiveness of the SC activities [5], [6], [7]. Therefore, the SCIs & their performance measurements are used to monitor the key elements of SC in the process of inter-flows operational data and used to quantify the efficiency and effectiveness of SC activities [8], [9]. Effective SCIs are a critical factor for the SC operations and the overall success of the firm [10], [11], [12]. The current study intended to internalize this in the case of firms.

According to the literature [8], [13] both cash crops and processed food items have fallen from being net exporters to importers in most developing countries in Africa, including Ethiopia. This is a very critical indication that the current case of Industries has been challenging, and the SCPMs are adversely affected. As it is assured by former studies, integrations of potential SC stakeholders, SCPMs on delivery & customer order response resulted as 37.8%, 46.3% respectively, while product flexibility & sale forecast information inter-flows were 29.6% and 33.4% respectively [14], [15], [16]. And also, SCIs and their metrics were mainly influenced by various factors such as sourcing, distributing, and information inter-flows, system down, unnecessary SC expenses (CoQ), low competitiveness in the market, and the late response time of customer orders [17], [18], [19].

Having these factors of the SC operational perspectives, the author of this study conducted this study entitled "Analyzing Supply Chain Integrations and its performance metrics to enhance productivity: in the case of five food Complex Industries around Addis Ababa". This study aimed to answer the critical questions, such as: How can SC productivity and overall profitability be enhanced via monitoring SCIs' potential factors (i.e., internal, external, customers, suppliers, and information) predominantly, in the targeted case firms? In addition to these, this study analyzed the question of the impacts of cost opportunities, system downtime, and resource utilization on the overall SC activities. Correlation matrices and regression analysis were used to examine and define the impacts of the parameters of SCI on its metrics and to link this to develop a possible solution.

To address the aim of this study, the author used specific objectives such as analyzing SCIs and their metrics, evaluating their impacts on the overall productivity, resource utilization, and efficiency and effectiveness of SC activities in the case firms. Then, interpret the findings and propose a possible solution using good management approaches. Through reviewing the literature, identifying research gaps, and completing the study framework as depicted have been completed. This study used 1-6 scoring Likert scale questionnaires, structured & semi-structured interviews, and a review of available industries' SC operational (SCO) reports in primary and secondary data. A purposive data sampling approach has been taken based on some potential pooling factors like SC activities. Literature revealed that SC and analytical models have been used solely in the processes of evaluating SCPMs, but this study proposed the integration of the SCOR model, Managerial Levers Achievement Coordination (MLAC), and tools of Quality Management System (QMS).

Both Quantitative & qualitative data analysis have been deployed in this article through integrating MS Excel, IBM SPSS 24, and other resource utilization analysis tools. For instance, 16.8%, 54.7%, and 23.3% low, medium, and high, respectively, have been assessed on the basis of an empirical finding on SC Cross-Functional Integrations in the case industries. The SCIs & SCPMs, such as response time, quality, costs,

reliability & flexibility aspects, have been averaged below 70%. In addition, the Cost of Quality, as depicted in Figure 9, shows that SCO systems are down as depicted in Figure 11. And also, efficiencies evaluated from the SCO data in the current case firms are evaluated as 77.5%, which requires improvement. These achievements of SCI and its performance can finally adversely affect the productivity of the case firms.

To address these problems, possible solutions using different relevant improvement tools & implementation guideline models are depicted in

Figure *13*. Finally, this study derived its conclusion, with actionable recommendations, and incitement of further investigation areas.

2. RELATED WORK

2.1. Theoretical Concepts & Historical Developments

Supply Chain: It is a sequence of decision-making and execution of materials, information, and finance flows that aim to meet final customer requirements, linking strategies along a continuum from production phases to final consumption [11], [20]. In this research article, the concept has been extended in the analysis of the SCIs in the overall series connections, which have direct effects on performance.

Supply Chain Management (SCM): According to a former study and theoretical definition [21], [22], the concepts of SCM have been defined as an operational management approach that is used to manage cross-functional activities in the entire SC to improve the performance of key activities such as supplying, manufacturing, and distributing operational systems. An author agrees on these fundamental dimensions of SC and has integrated various SC activities to achieve the aim of the study.

2.2. Models of SC Performance Measurements (SCPMs)

Functional-Based Measurement System Model: As the literature revealed, the top level of SCPMs does not cover an entire SC activity, which is technically viable to individual functional departments [23], [24]. To overcome this [25], [26], [27] applied the SCOR model in evaluating SCPMs of manufacturing industries. This paper agrees with the concepts, but it still needs to be merged with other tools.

SC Performance Measurement Pyramid Model: It was proposed by [28] that aiming to link a firm's strategy with its operations by translating objectives from top-down based on customer requirements, and measuring from the bottom up. Even though an author agrees with these former studies, it needs some synchronization with management tools to enhance its functions in SC activities.

Balance Score Card Model: It gives a business clear instructions and guidelines on how companies should measure and adopt a way of [29]. Even though there is a limitation on its functionality, the model is used to enable the SC operational management journey to achieve competitive outcomes [28], [30], [31]. It does not give a user-centered development process for internalizing SCPMs, nor does it offer an approach to preserving the significance of defined metrics.

SC Operation References (SCOR-Model): It can advocate that a set of SCPMs can be supported by the SCOR-model, which is comprised of Cycle time and industrial cost metrics [32]. On the other hand, includes the three primary layers of PMs, which can be considered as a mechanism directly solving the needs of SCM [27], [33]. To address the aim of this study, the author designed to use this model by extending its features and technical perspective through incorporating it with other relevant management tools.

2.3. Areas Addressed by Former Scholars

SCOR Model in the Analyzing SCPMs: Former studies claim that a variety of models have been used to analyze SCPMs activities [5], [26]. The author used relevant methods in the current study, which are governed by the [17] which is basically the generic scientific approach, through addressing their gaps in the analysis of SCI and devising their impacts on its performances.

Selected Model for Current Study: Throughout the literature, various scholars have employed different models in the process of assessing SCPMs and indicators of activities. An author mentioned it in the SCPMs

section; those are highly influential on the overall SC productivity and profitability. Among them, the SCOR model was selected based on its cross-functional SCPMs assessment capabilities, compared to others.

Research Gap: In most of the former literatures, the SCOR model, MLAC, and QMS were deployed solely. But, the current study proposes an integrated model, which is conceptualized from the SCOR model, Managerial Levers Achievement Coordination (MLAC), Quality Management System (QMS), and a robust extension of SCM tools, which enabled the author of the current study.

3. METHODOLOGY

3.1. Research Design

Scholars defined it in different ways. Stated this method as "the arrangements of situations for collecting and analyzing data based on pre-defined research objectives and questions". An author adopted this scientific approach to achieve the aim of this paper, which is to enhance SC productivity through analyzing different SCIs and their effects on operational performances through systematic scientific and procedural interactive activities.

3.2. Data Collection

Different methods of data collection have been used from primary and secondary data sources. An author conceptualized it as Figure 1 below & used questionnaires, structured & semi-structured interviews, and reviewed available SC operational reports.

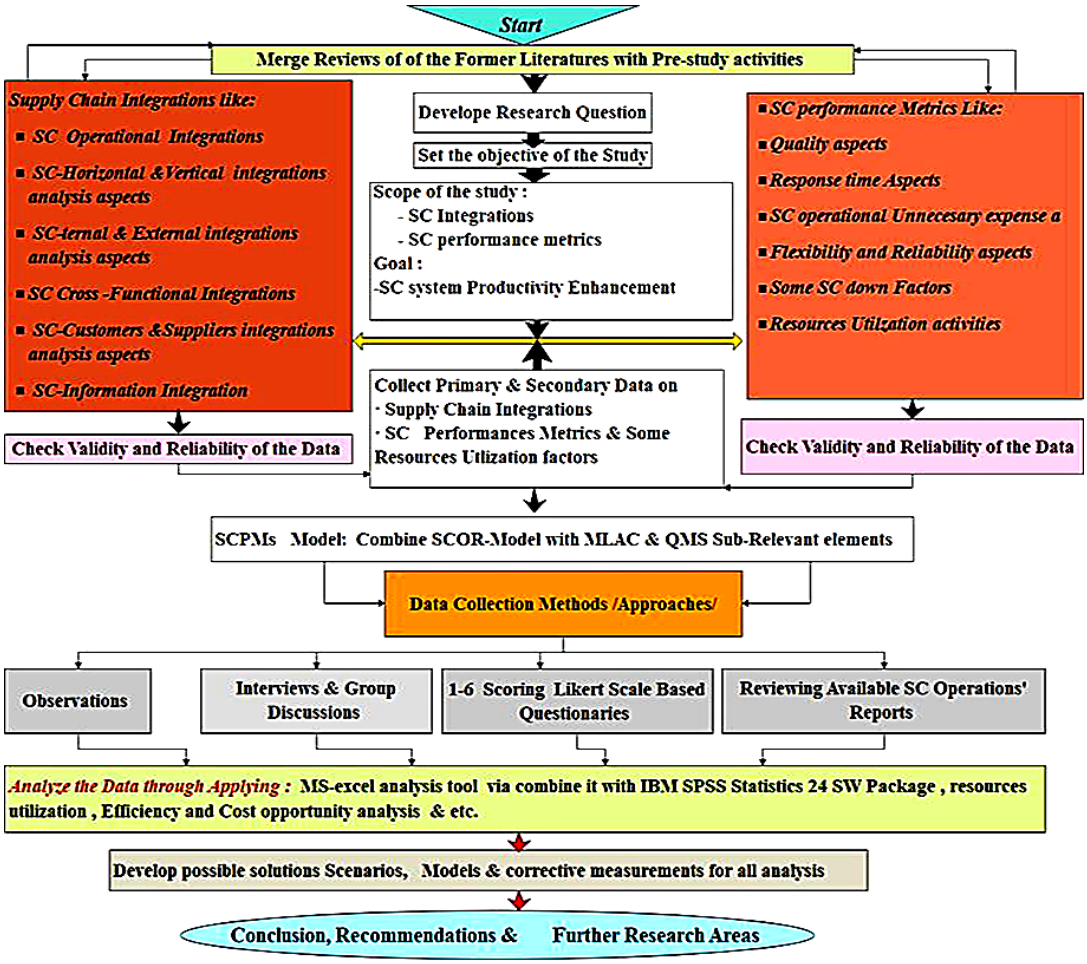

Figure 1. Conceptual Framework of the Research

3.3. Sampling Method

A purposive sampling technical approach has been taken into application due to various potential positive factors. In the procedure of analyzing SCI and measuring its impacts on performance, the study used a method to make credible findings of this study to make it robust and applicable on the ground.

3.4. Methods of Data Analysis

It depends on both the objective of the study and the nature of the variables in the data collected. Having this scientifically endorsed approach, the author has prioritized tools of analysis, such as combinations of Microsoft Excel with IBM 24 SPSS. The method of this study adopts the very essential methodological considerations, such as Ethical considerations, validity test on the design of questionnaires, open & closed-ended types through discussions with research experts, which is significant for achieving the aim of this study. Cronbach's Alpha analysis was used to evaluate the reliability of the data. SCPMs are internalized through the integration of MLAC with the SCOR model.

3.5. Logical Flows of the Study

This is the conceptual framework that conceptualizes the overall methodology of this study, which has been designed after various previous kinds of literature; scientific findings are internalized via contextualization of the current case of SC activities. It aims to smooth to address the case firms' SCI and its impacts on the SC system productivity, and long-term competitiveness. These logical flows of activities used analysis all SCIs phase by phase and show the interaction interfaces.

4. RESULTS AND DISCUSSION

4.1. Analysis of Suppliers' Integration with the Company

SCIs are the most significant element that is primarily required to coordinate & manage various inter-functional operational departments. Data were collected using a 1-6 Likert scale scoring fashion, and analyzed using MS Excel and IBM 24 SPSS. As shown in Figure 2 below, the respondents responded to the statements of the activities in the firm on the company's integration with suppliers, and computed as 10.1%, 57.8%, and 30.9% low, medium, and high, respectively. This SC operational achievement needs management measurements to enhance the coordination and collaboration of these key stakeholders.

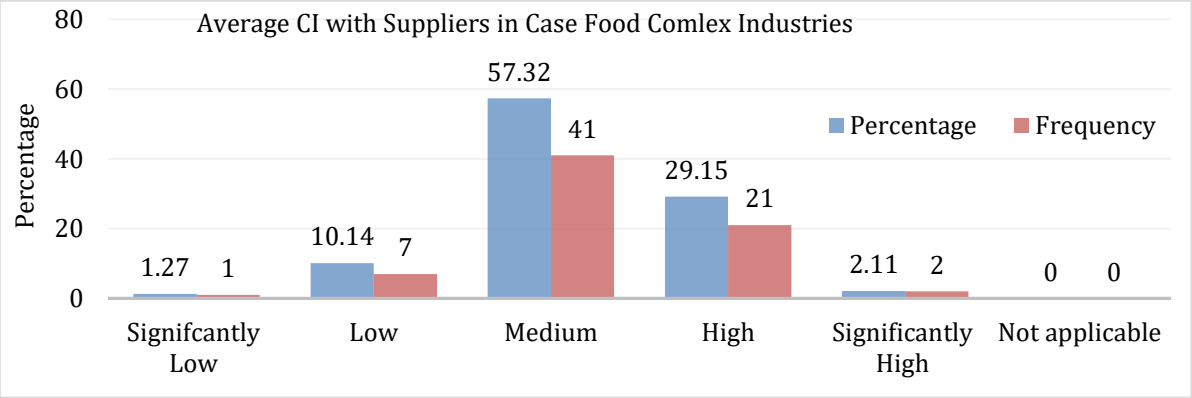

Figure 2. Empirical Findings on the Company's Integrations with Suppliers

4.2. Analysis of SC Cross Functional Integration (CFIs)

Respondents answered on the item of "inter flows of SCOs and on monitoring SC warehouse activities, order-driven suppliers interactions, internal and external customers SC activities empirically, resulted as 22.5%, 56.3%, and 15.5% low, medium, and high, respectively, which is stated in Qn8 and as

shown in Figure 3 below in the case firms. Effective and efficient integration of these key elements of SCIs is a very critical parameter for the overall SC productivity of the firms.

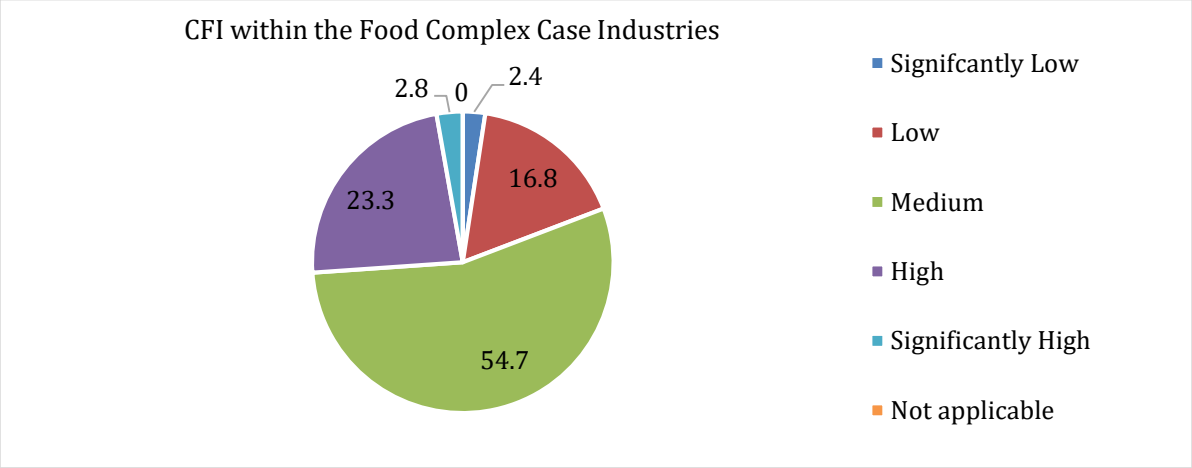

Figure 3. SC Cross Functional Integrations

4.3. Analysis of SC Internal Operational Integration

This study highlighted that effective resources are a very significant parameter for the enhancement of the competitiveness of the case firm. As shown in Figure 4 below, internal SC integration (ISCIs) was evaluated as 33.7%, 49.7 %, and 11.3% low, medium, and high, respectively (Qn9). And also, SCOs of coordinating operations; planning across the firms empirically demonstrated as 22.5%, 57.7%, and 18.3% as low, medium, and high. This means the level of resource utilization was below the expected level, which indicates, on average, below 65%, and adversely affects the productivity of the firms.

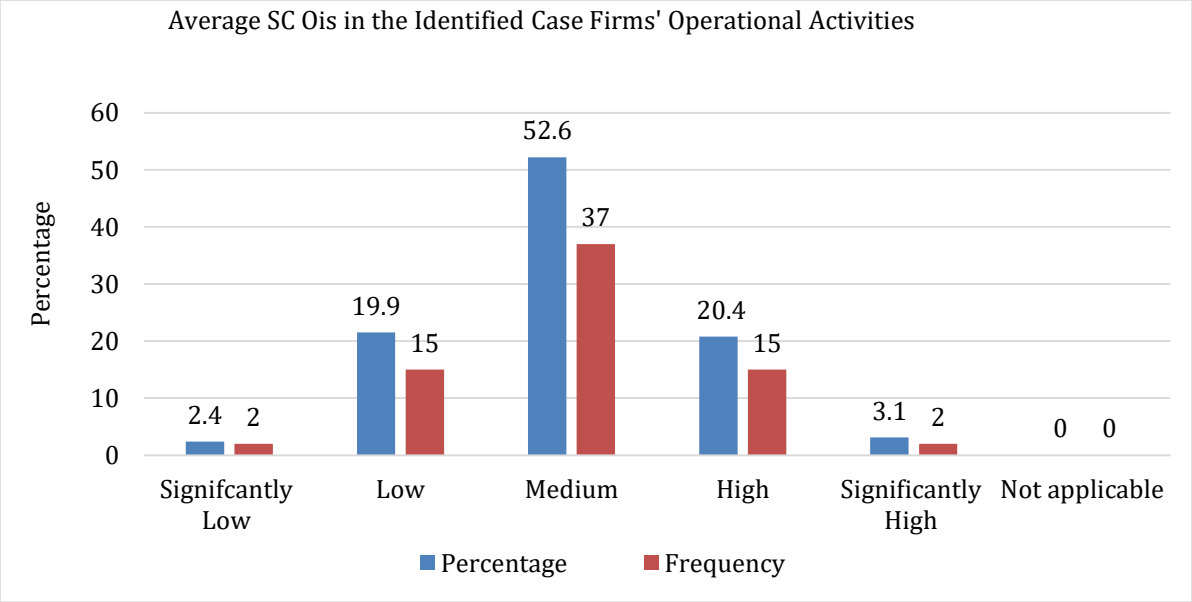

Figure 4. SC Internal Operational Integrations

4.4. Analysis of SC Information Integration (SCIIs)

Effectively and efficiently running the SC activities in manufacturing is a vital determinant of devising optimal SC networking and coordination of demand and supply information. To address the practical concerns of SCIs on the ground, this study used 1-6 scoring Likert scale questionnaires. As shown in Figure 5 below, the author used MS-Excel with IBM 24 SSPS in the analysis, and the result revealed that

as 16.5%, 51.5%, 26.5% low, medium, and high, respectively. The industry practitioners can conveniently adopt the implications of the findings.

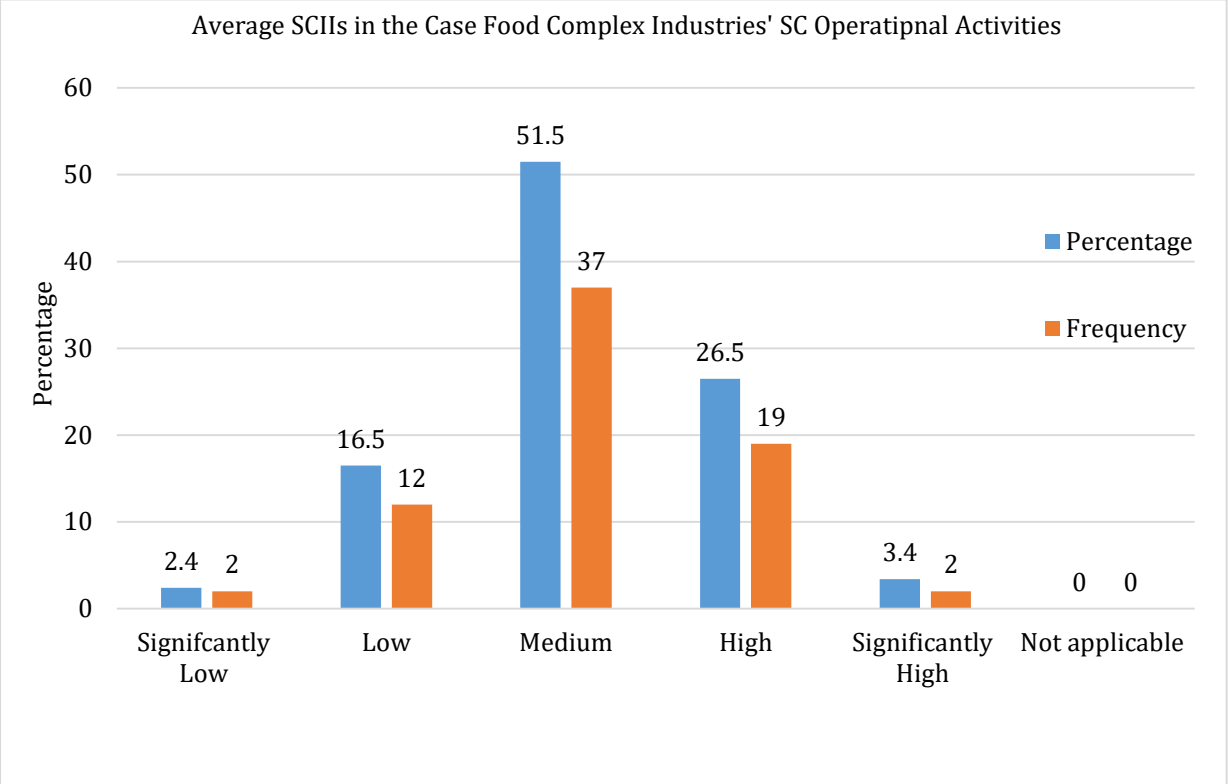

Figure 5. Respondents' Responses on Sciis

4.5. Analysis of Company Integrations with Potential Customers

Having this concept, the author collected data and analyzed it using supposed analysis tools. For instance, Figure 6 customer satisfaction in the order process and meeting the expectation is shown as 19.7%, 47.9%, and 28.2%, low, medium, and high, respectively (Qn13). This study underscores that designing an optimal SC network and monitoring the activities is a significant approach that can enhance performance in the case industries. As shown in

Figure *13* and Table 2, the SC activities of the case firms showed low performance, which needs to be addressed in the proposed solution section?

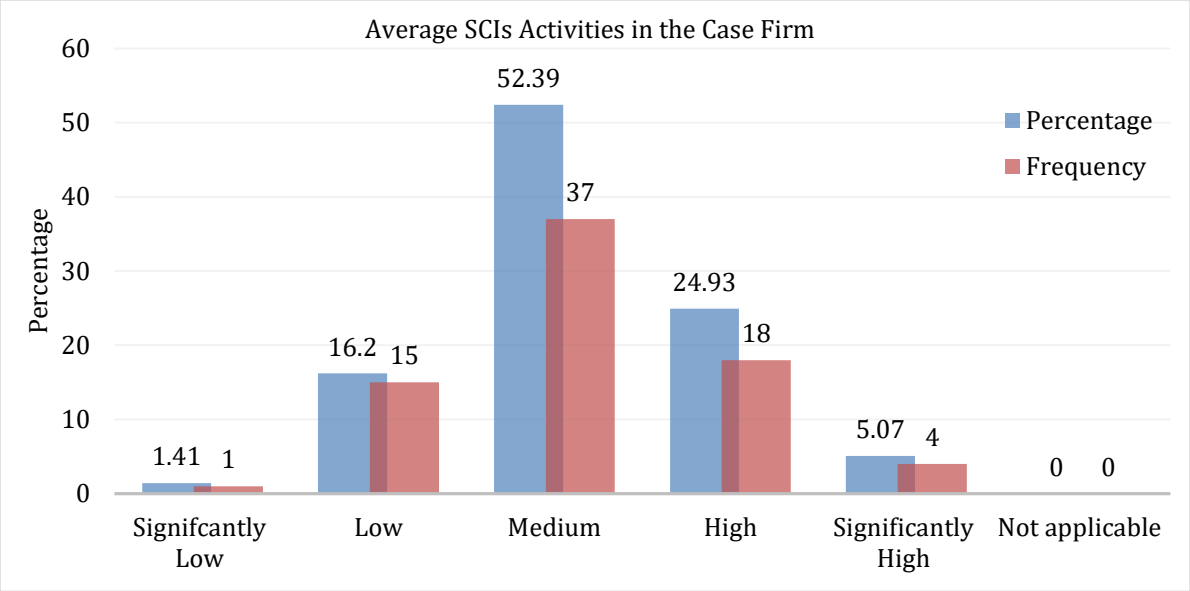

Figure 6. Respondents' Responses on Customers Suppliers' Integration

4.6. Analysis of Response Time to Evaluate SCPMs in the Case Firms

As shown in Figure 8 below, the paper internalized SC operationally oriented elements, which the author endorsed as relevant to case firms' SC activities and long-run impacts on productivity, profitability, and competitiveness in case firms. As an empirical finding of this study, it resulted as 21.5%, 52.2%, and 20.8% as low, medium, and high, respectively, which is shown in Figure 7.

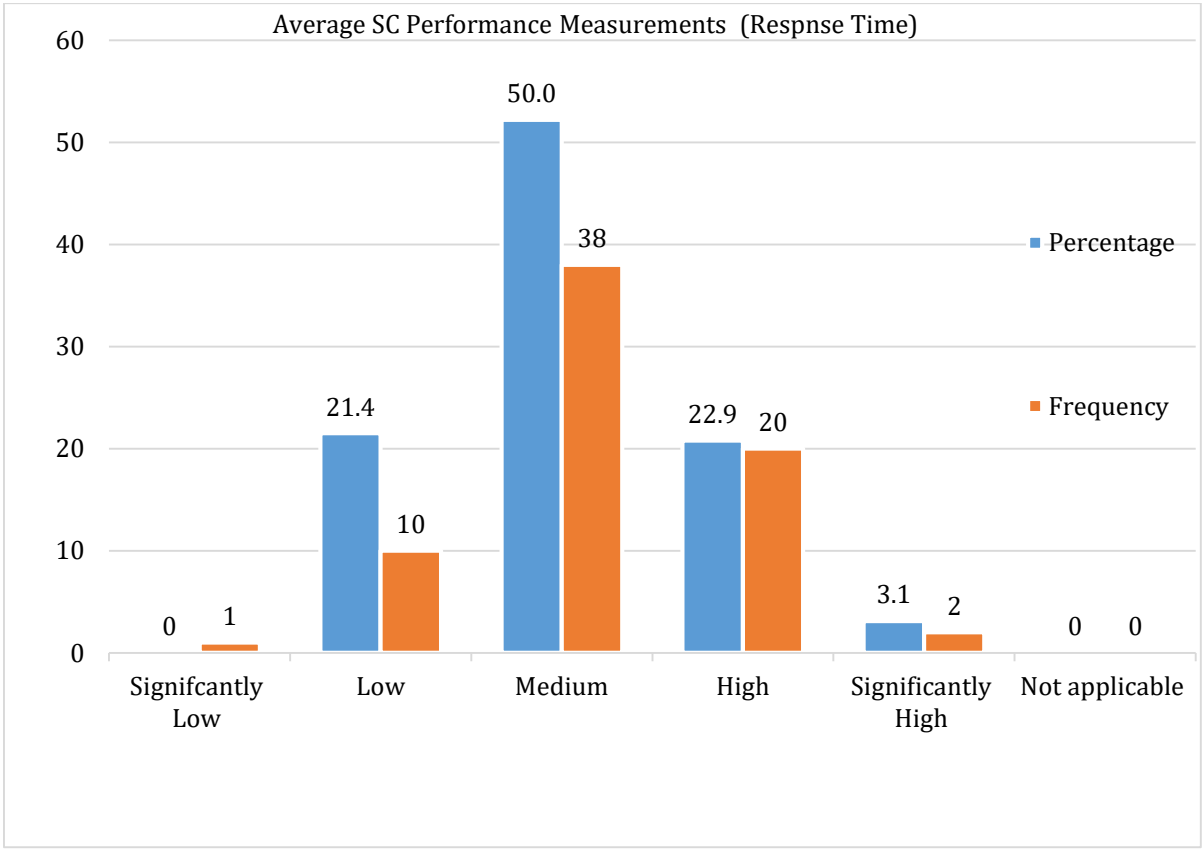

Figure 7. Respondents' Responses on SCPMs (Response Time)

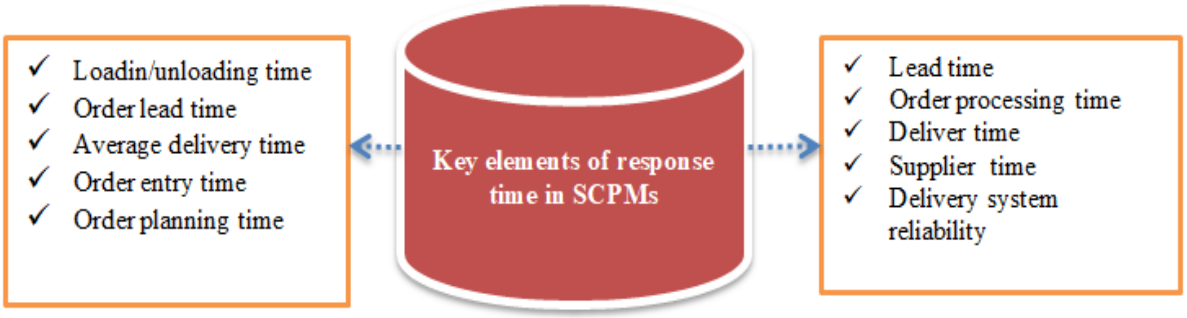

Figure 8. Key Elements of Response Time in SCPMs

4.7. Analysis of SCPMs (Unnecessary Expense)

It is the most significant tool for gauging the achievements of SC activities' performance and monitoring the effectiveness of quality improvement practices. As shown in Figure 8, the main categories of this non-value added SC expenses - Preventive, Appraisal, Internal, and External Failure, revealed as shown in Figure 9 below, 21.3%, 59.0%, and 14.7% as low, medium, and high, respectively, in the case firms.

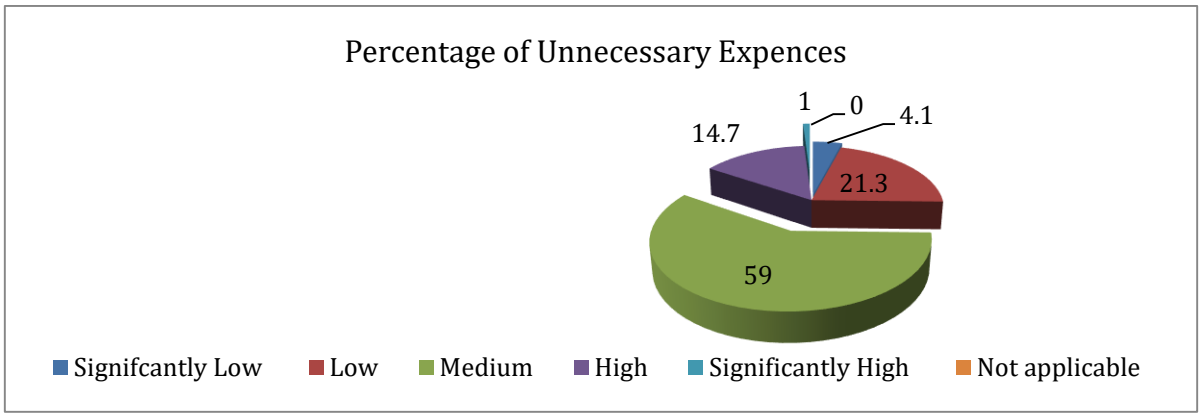

Figure 9. Respondents' Responses on SCPMs (Unnecessary Costs)

4.8. Analysis of Correlation Matrix

This is used to define the relationship between SCI and its PMs in SC activities, which have been defined from summarized data. This paper internalized and used the coefficient of correlation (r), which was an essential determinant to summarize the relationship between two variables with a single number that ranges from -1 to + 1, referring to the degree of correlation. The 2-tailed test of statistical significance at the level of 95% significance, and the p-value was < 0.05. Analysis is engaged, and the impacts of these parameters are considered to make a decision. As defined by a former scholar (MacEachron, 1982), when "r" falls between 0.40 and 0.60, it is considered a moderate relationship, between 0.60 and 0.80 is high, and between 0.80 and 1 is a very high relationship. As shown in the following Table 1, the Pearson's correlation examination is conducted for SCI with a response time perspective, which was indicated as a positive correlation. And also, in the case of food complex industries, the small correlation by a coefficient (r = 0.612, N =71) and significance at 0.01, and SC information integration (SCIIs) correlation coefficient with SCPMs by response time (r = 0.752, N =71) with the significance of 0.01. Significance level of 0.01 (2-tailed), Strength and statistically significant +ve correlation found between SCIIs and SCIs with (r = 0.752, N 71). The practical implication of this relationship between SC variables is underscored by the author to determine the overall SC productivity.

Table 1. Correlation Matrix Analysis

Variable	1	2	3	4	5	6	7	8	9	10

1. Customers' integrations with the company	1									
2. SC internal operation integrations	0.753**	1								
3. SC cross-functional integration	0.726**	0.756**	1							
4. SC information integrations	0.635**	0.615**	0.711	1						
5. Customer integration with Suppliers	0.727**	0.721**	0.752**	0.734**	1					
6. SCPM (Response Time)	0.732**	0.702**	0.723**	0.588**	0.728**	1				
7. SCPM (Quality aspects)	0.679**	0.698**	0.612**	0.519**	0.731**	0.837**	1			
8. SCPM (Cost aspects)	0.612**	0.563**	0.545**	0.479**	0.672**	0.691**	0.621**	1		
9. SCPM (Reliability & Flexibility)	0.007**	0.014**	0.054**	0.080**	0.015**	0.072**	0.034**	0.118**	1	
10. SCPM (Reliability & Flexibility)	0.220**	0.240**	0.235**	0.106**	0.178**	0.080**	0.172**	0.239**	0.089**	1

Note: **Correlations significant at 0.01 level (2-tailed), *Correlations significant at 0.05 level (2-tailed), N=71.

4.9. Regression Analysis

Under this, some assumptions, such as the multi-collinearity, linearity, and normality test, were examined to determine the impact of one variable on the other. Here, independent variables (SC integrations), with the significant value ($P<0.05$, $\beta = 0.374$ and $t=1.47$), have greater impacts on SCPMs (quality) in SC activities. The response time (SCPMs) by SCIIs has been impacted through a positive slope, significance ($P<0.05$), and the sum of squares ($R2 = 0.299$), which implies that the SCIs impact the dependent variables (SCPMs) by 29.9% in the cause firms' SC activities.

4.10. Analysis of Cost, Productivity, Efficiencies & Effectiveness

Unnecessary Expenses

They can adversely affect the performance and productivity of the system in the case of firms. As shown in Figure 10, the analysis demonstrated as 29%, 18%, 43%, and 11% SC activities of preventive, appraisal, internal, and external expenses, respectively, on average of 2019/2020 in the case of food complex industries.

$$\textbf{Efficiency } (\eta) = \frac{\textbf{Actual Output}}{\textbf{Effective Capacity}} * 100 \ ) \ = = \frac{\textbf{7912.817 tons 6 months}}{\textbf{11482 tons per 6 months}} * 100$$

$$\underline{\eta = 68.92\%}$$

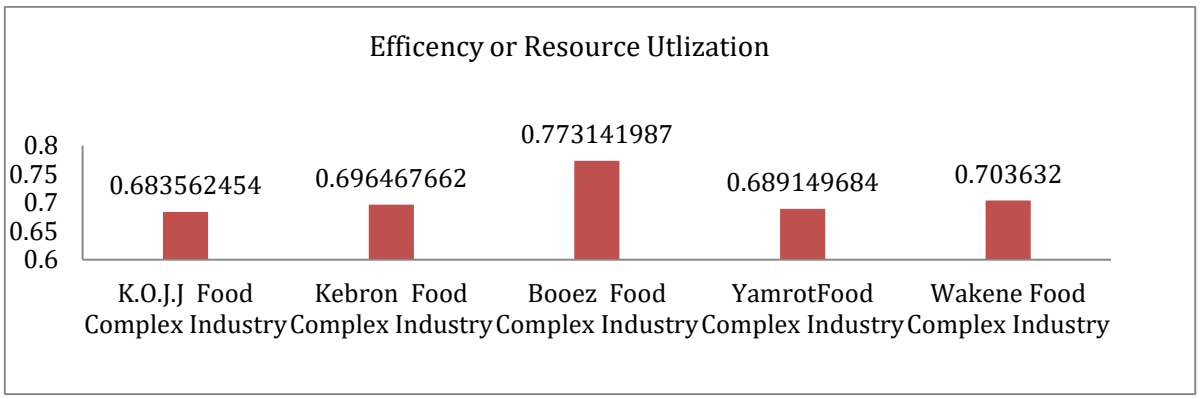

Figure 10. Resource Utilization Analysis

An Assessment of Downtime

The SC productivity can be directly impacted by these factors. This analysis took the single sample of Case Company A to investigate the level of efficiency, as shown in the analysis. Metrics: operational time (8 hours/3 shifts, 24 hours/day, and 26 days /month).

$$\text{Wheat Flour} = 2995.2 \frac{\text{tons}}{\text{month}} = 115.2 \frac{\text{tons}}{\text{day}} = 4.80 \frac{\text{tons}}{\text{hour}} = 48 \frac{\text{kuntal}}{\text{hour}} \quad \text{w/c production capacity}$$

$$\text{Pasta} = 998.4 \frac{\text{tons}}{\text{month}} = 38.4 \frac{\text{tons}}{\text{day}} = 1.6 \frac{\text{tons}}{\text{hour}} = 16 \frac{\text{kuntal}}{\text{hour}}$$

$$\text{Macaroni} = 1747.4 \frac{\text{tons}}{\text{month}} = 67.21 \frac{\text{tons}}{\text{day}} = 2.80 \frac{\text{tons}}{\text{hour}} = \frac{28\text{kuntal}}{\text{hour}}$$

Over 6 months, 3744 operating hours, based on 24 hours/day and 26 working days/ month, total production capacity = 39586.2 tons. The findings revealed that 1032.76 utilized (27.64%), about 9501. 4-ton has been lost per 6 months of SC operations. The rest were computed using the same method, as shown in Figure 11.

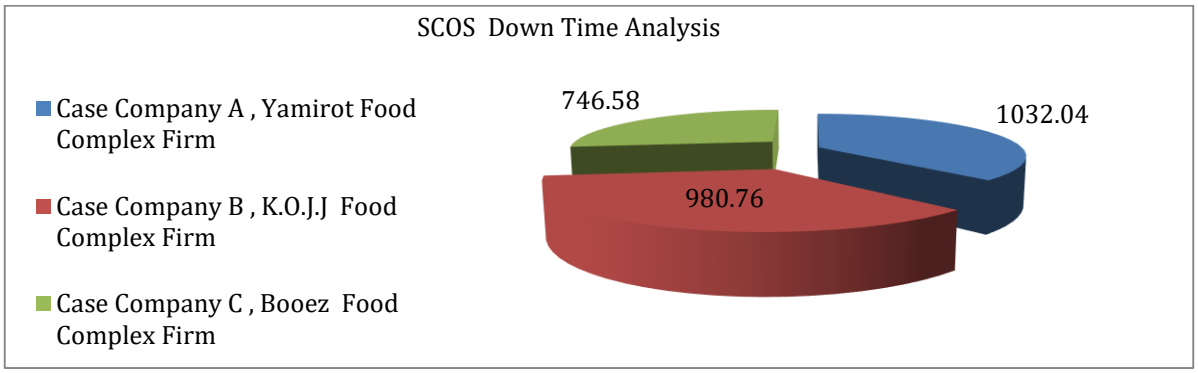

Figure 11. An Assessment of Downtime

4.11. Summary of Findings

Company Integration with Suppliers

In the above analysis, the study summarized the process of networking suppliers strategically in SC activities of the case firms, which empirically revealed as 11.3%, 61.9%, and 20.9% low, medium, and high, respectively. This outcome is an indication of a poor SC network in the company, and requires interventions of highly committed daily SC activities.

Company Integration with Customers

Understanding customer requirements is very significant to improve performance. This is assessed from the case firms' SC activities, which resulted as 19.7%, 47.9%, and 28.2% as low, medium, and high, respectively. The solution of this study is summarized in the next sections of Figure *13* and Table 2.

SC Performance Metrics

The study investigated statements such as monitoring variability in delivery time operation in the case firm, with 15.5%, 57.7%, and 19.6% low, medium, and high, respectively. And also, in Figure 7, SCMPs related to quality were evaluated as 18.6%, 58.1%, and 20.5% as low, medium, and high, respectively, which was due to poor SCI operation management.

Potential causes of SCIs & their Performance Metrics that affect SC's Productivity

Under this, poor coordination and inter-linking of orders & purchasing processes, unreliability and variability in information interflows, poor team spirits of workers in the SC system, insufficient commitment of various SC operational stages' participants were internalized as factors that affect SC operations.

4.12. Proposed Solution

This research aims to analyze SCIs & its performance to enhance the overall SC productivity of the case firms. This is revealed through proposing possible SC operational scenarios to achieve significant outcomes, along with the case firm's SC activities. As shown in Figure 12 below.

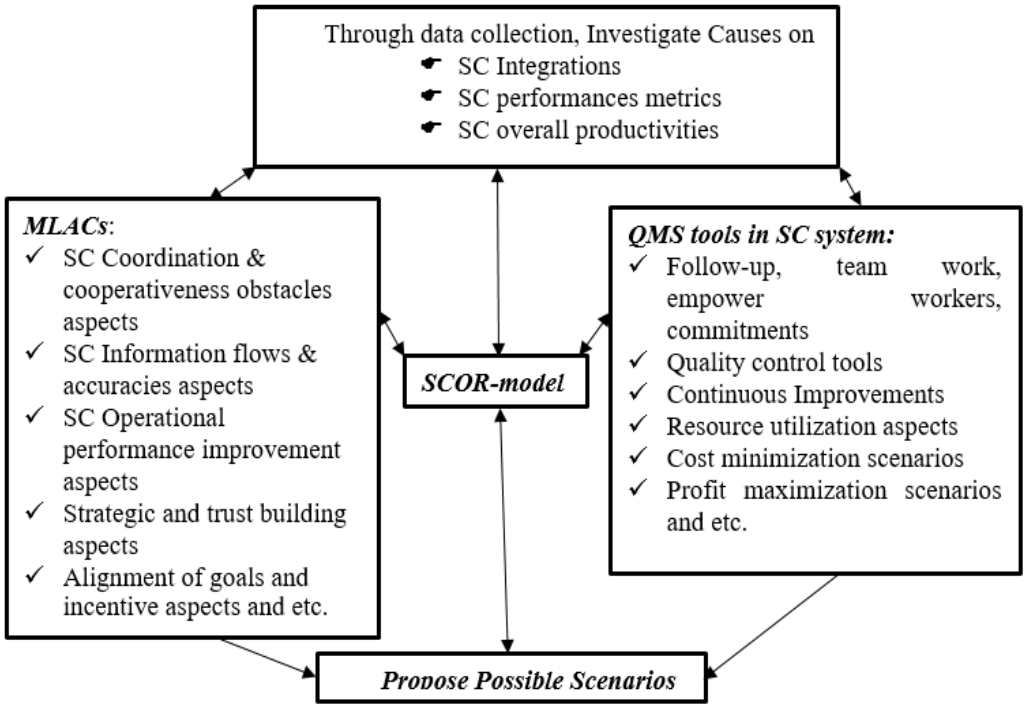

Figure 12. Conceptualizing the Scenarios of Integrating SCIs, SCPMs, ALACs, and QMS Tools

Corrective Measurement

The study proposed the practical interventions as shown in Table 2, which links activities with its corresponded operational responsibilities.

Table 2. Corrective Measures for the Current Case Firms

Causes of SCI in the Case Firms' SC Activities	Corrective Measurements	Responsible Bodies
Suppliers integrations with Company	• Create a smooth relationship between this middleman	✓ Strategists and plan developers
Interferences of brokers	• Design the value chain and SCN to minimize the negative factors of inputs	✓ Managers and the market department.t ✓ Operational managers
Weaknesses of sourcing potential suppliers	• Develop optimal scenarios to create a link with raw material suppliers	✓ Procurement dep't ✓ Supervisors
Low customer response	• Analyse performances and identify their weaknesses, and manage time	✓ Operational, production, ✓ Sales & market dep.t
Inconvenience in the interflow of resources	• Follow–up inter-flows actively • Design process and evaluate	✓ Phase-by-phase SCOs managers
SC Cross-Functional Integrations		
Level of Team spirit in the SC activities	• Collaborating with SC departments	✓ SC managers ✓ Team leader, supervisors ✓ SC coordinators
SC Coordination		
Unskilled manpower	• Update employees via the d/t system • Recruit the relevant disciplined worker	✓ Operational and technical managers
Coordination problems	• Follow up on all SCIOs • Create team spirits in the SCOs system	✓ Operational and different managers and Supervisors
SC information integrations	• Integrating the market value chain frameworks in the SC system	
Demand & Supply information distortions	• Design an SC network to create smooth flows of parameters	✓ Market, sales, and operational managers ✓ Marketing & managers
Customer & Supplier integrations	• Design an optimal modality to collaborate with customers and suppliers.	
Supplying forces the uncertainty of Suppliers	• Sourcing raw material suppliers • Create and manage reliable coordination	✓ Purchasing ✓ Operational managers
Information inter-flows	• Design optimal ways for information and resources to flow • Collaborating with different SC entrants	✓ All SC operations' actors ✓ Plan developers and operational managers

4.13. Proposed Solution Implementation Scenarios/Guidelines/Model

As shown in Figure *13* and Table 2, intervention scenarios have been developed by this study. This integrated proposed solution can be practically revealed by instrumenting various SC operational stages through identifying the problem, collecting, analyzing the data, interpreting the result, and taking action, primarily in the case of firms. The following integrated solution framework is used to achieve high SCIs and its overall productivity in the long-run.

The above implementation integrated framework is proposed to address the SC disruptions that result in low productivity in the current case industries. It was depicted in the above arrow in Figure *13*.

Stage I: All SCIs strategies and planning stages that include various operations.

Internal Integration: All parameters and entrants of SC operations using approaches of managerial levers, achieving coordination, and SC system monitoring and continual improvement practices, which can result in expected outcomes. This paper underlines that SC operational External integrations should be designed optimally.

Stage II: SCIs should be rigorously evaluated to result in competitive outcomes of the case industries. In addition, under this phase, the key elements of SCPMs are suggested to be evaluated through integrating all activities.

Stage III: In this phase, various improvement activities are supposed to be conducted. These can be corrective measures and interventions that are shown in the above Table 2, feedback analysis, review the plan, redesign the SC network for those recorded low achievements, and train all concerned participants in the system.

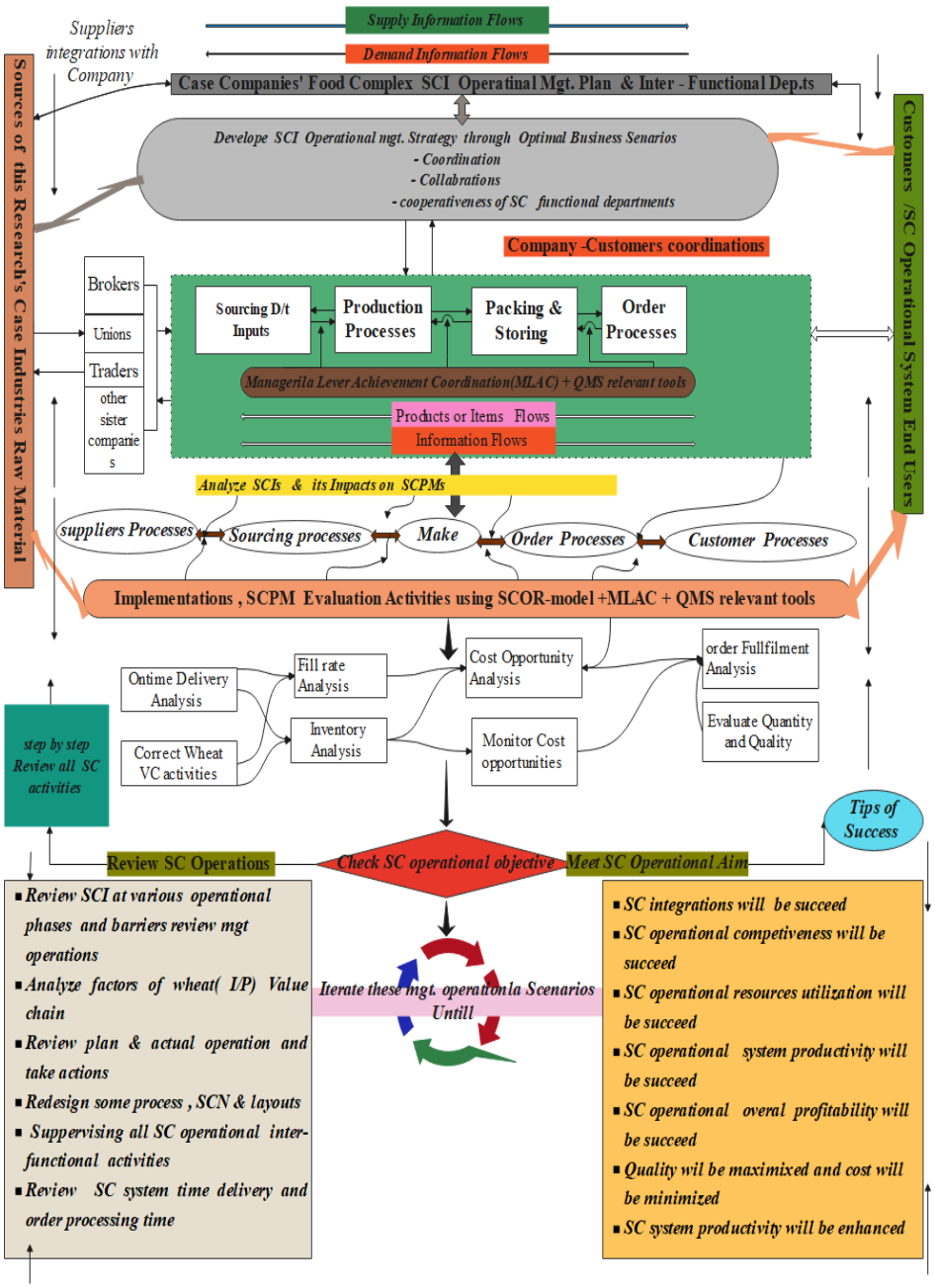

Figure 13. Proposed Model for Enhancing Case Firms' SCI that Gives High SCPM and Overall Productivity

5. CONCLUSION

In this study, the roles of SCIs and their performance activities in the enhancement of productivity were examined in case firms. The findings show that the coordination and collaborations across SC actors remain uneven but significant in determining outcomes. The key SC activities drew a conceptual framework that links integration dimensions with SC performances. As an empirical result of this study, internal operational practices are more developed than external. Major findings highlighted that collaboration with suppliers and customers shows greater variability, which reflects structural and relational challenges within the food industry SC activities.

The findings on PMs indicated that responsiveness and flexibility are more pronounced than cost effectiveness and reliability, implying that there is a trend for case firms to prioritize short-term

operational adjustments over organized performance control. This is an imbalance that need for more comprehensive performance measurement.

SC operations' system preventive, appraisal, internal, and external failure expenses were 29%, 18%, 43%, and 11%, respectively. As a whole, the study contributes to SCM literature through providing empirical findings from the Ethiopian Food–Process Industrial sectors by demonstrating how integrations and PMs jointly impact overall SC productivity. And also, this study facilitated the ways of practical incitements of SC operational managers and agro-industrial policy makers pursuing optimal scenarios to enhance SC effectiveness in the sectors.

Recommendations

Drawing from the empirical findings of this study, several practical and operationally oriented directions are advised. SC disruption needs continuous diagnoses and a proactive monitoring system through contextualized, managerial strategies to achieve high efficiency. In addition, all SC functions, from upstream source activities to downstream distributions market delivery, should be integrated.

Further Research Areas

Future studies may emphasize identifying SC-related operational factors that can majorly affect overall SC system productivity and long-term profitability through advanced analytical approaches such as system modeling, simulation techniques, & hybrid analytical methodological frameworks.

Acknowledgments

The author gratefully acknowledges the academic guidance and constructive feedbacks by Dr. Gulelat Gate and Mr. Mesfin Demissie throughout this paper. I also thank all the case firms' employees who positively engaged in the process of providing necessary SC operational data.

Funding Information

The Author states that no funding was involved in the preparation of this manuscript.

Author Contribution Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Getu Abdisa Mitiku	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The author has seen and agreed with the manuscript's contents; there are no financial interests to report. The author certifies that the submission is original work and is not considered in any other publication. The authors state that there is no conflict of interest.

Informed Consent

This study did not involve human participants or the collection of identifiable personal data; therefore, informed consent is not required.

Ethical Approval

This study did not involve human participants or animal subjects; therefore, ethical approval was not required.

Data Availability

The data that support the findings of this study will be available at http://etd.aau.edu.et/handle/12345678/27900.

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How to Cite: Getu Abdisa Mitiku. (2026). Analyzing supply chain integration & its performance metrics to enhance productivity case industry: five food complex industries around. Journal of Production, Operations Management and Economics (JPOME), 6(1), 16-34. https://doi.org/10.55529/jpome.61.16.34

BIOGRAPHIE OF AUTHOR



Getu Abdisa Mitiku, holds both an M.Sc. in Industrial Engineering from Addis Ababa University and a B.Sc. from Ambo University. His academic training has provided him with a strong foundation in systems integration, production planning & scheduling, productivity improvement, quality control and management, SC and logistics analysis, and process optimization. His expertise also extends to ergonomic and safety regulations, economic feasibility analysis, and work-method design and measurement systems. He has demonstrated excellence in both his academic journey and professional career. Since September 1, 2021, he has served as a Lecturer at the University of Gondar, where he has taught courses such as SCM and Logistics, TQM, Kaizen Practice and Principles, Maintenance Engineering and Mgt, Entrepreneurship for Engineers, and SQC. His contributions reflect a commitment to enhancing organizational productivity and operational efficiency Email: getua51@gmail.com