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# Unveiling Dynamics in Nanostores: An Extensive Meta-Analysis of the Interplay of Supply Chain Integration and Operational Performance

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***Abstract*– The purpose of this paper is to explore the intricate interplay between supply chain integration and the operational performance of Nanostores. This study synthesizes eight previous studies to determine the dynamics and correlations that affect these establishments' performance. This meta-analytical study examines sales revenue, customer footfall, and customer satisfaction. The paper uses a systematic review of literature to explain the complex relationship between supply chain integration and operational success. The meta-analysis shows that Nanostores with effective supply chain integration perform better. The study emphasizes the importance of inventory management, supplier relationships, order fulfillment, demand forecasting, logistics and distribution, technology adoption, and returns and reverse logistics in Nanostore operations. This research consolidates and analyzes existing studies to provide valuable insights, but it acknowledges literature limitations. Nanostores are constantly changing, so future research could examine new supply chain strategies and trends to better understand their operations. This study may change society's view of small-scale retailers and their economic impact. The study may spark Nanostore support mechanism discussions, boosting local economies and community development by highlighting supply chain integration's importance. This paper combines research to reveal how supply chain integration affects Nanostore operational performance. The study's unique focus on this specialized sector helps understand retail's challenges and opportunities, enabling better practices and decision-making.***

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## I. INTRODUCTION

Nanostores are vital contributors to local economies, catering to the needs of nearby communities through their distinct small-format retail operations. These micro retailers operate within limited physical spaces, offering a curated selection of merchandise tailored to the preferences of urban residents [1]. In this context, the establishment of a robust supply chain emerges as a critical determinant of the consistent and reliable functioning of nanostores [2]. The seamless integration of supply chain processes is paramount to ensure efficient inventory management, timely replenishment, and responsive customer service [3]. The significance of an effective supply chain in the operational performance of retail businesses, including nanostores, cannot be overstated. [3] underline the pivotal role of the supply chain in governing core business activities such as purchases, sales, and logistics [3]. A well-functioning supply chain empowers nanostores to establish collaborative relationships with suppliers, facilitating prompt inventory restocking and fulfilling client demands to avert product shortages. Consequently, forging strong alliances with suppliers becomes a strategic imperative for nanostores, given their status as micro retailers with limited negotiation resources [4] [5].

While nanostores may face resource constraints, effective supply chain management can empower them to negotiate competitive terms, pricing, and delivery services through adept communication and technological tools [6] [7]. This capacity to optimize procurement not only reduces costs but also amplifies profit margins, bestowing a competitive edge within the market [6] [7]. Moreover, nanostores often operate in densely populated locales, confronting logistical hurdles such as traffic congestion and parking limitations. An optimized supply chain is instrumental in streamlining transportation and delivery processes, culminating in diminished lead times and punctual deliveries [8].

Supply chain integration emerges as a linchpin for nanostores to streamline order fulfillment, aligning with customer expectations for convenience and rapid service [9] [10]. The fusion of these dynamics catalyzes heightened operational performance, thereby enhancing customer satisfaction and engendering cost savings [9] [10]. In this context, the present study embarks on a comprehensive exploration of the intricate interplay between supply chain integration and operational performance within nanostores.

### *A. Research Gap and Justification*

Despite the promising prospects of fortifying the supply chain to augment nanostore performance, the existing research landscape remains undeveloped, necessitating a concerted effort to delve deeper into this crucial domain. Research on the symbiotic relationship between supply chain integration and nanostore operational performance remains nascent, warranting further investigation [11]. This study seeks to bridge this gap in the literature by conducting an extensive meta-analysis, amalgamating insights from discrete studies to unearth generalizable insights.

### *B. Research Questions and Objectives*

Against this backdrop, this research endeavor seeks to address the following research questions:

1. How does supply chain integration impact the operational performance of nanostores?

2. What are the unique challenges faced by nanostores in establishing and managing effective supply chain integration?

The overarching research objective is to comprehensively elucidate the intricate interplay between supply chain integration and nanostore operational performance. By discerning the underlying mechanisms and challenges, this study aims to provide valuable insights that advance both theoretical understanding and practical approaches in this realm.

This research aspires to unravel the intricacies of supply chain integration and its ramifications for the operational performance of nanostores. By combining insights from diverse studies, this paper strives to contribute significantly to the body of knowledge surrounding this critical facet of micro retailing. The forthcoming sections delve into a comprehensive literature review, synthesizing existing perspectives and culminating in the identification of a research gap that this study seeks to address.

## II. Literature Review and Proposals

The literature on supply chain integration employs several various but related definitions of supply chain [11]. According to [12] , it is challenging to recommend realistic solutions about what to integrate, the costs associated with integration, and its advantages because there is no one well-defined concept of supply chain integration. Like this, a shared understanding of supply chain will aid in the development of supply chain literature. Nanostores play a crucial role in supporting local economies by providing essential goods and services to nearby communities. Research by [13] emphasizes the significance of nanostores as a key driver of economic growth and job creation in low-income neighborhoods. Their accessibility and responsiveness to local demand make them an essential component of supply chain integration. Collaborative supply chain strategies involve cooperation among Nanostores, suppliers, and distributors to improve overall performance. Research by [14] demonstrates the effectiveness of collaborative strategies in reducing inventory costs, minimizing stockouts, and optimizing delivery routes for Nanostores. These findings underscore the importance of cooperation among supply chain partners in enhancing Nanostores' performance.

Due to their small size, constrained resources, and focused inventory management, Nanostores encounter particular supply chain issues. The main supply chain issues for Nanostores, including inventory control, transportation, and supplier cooperation, are listed by [5]. Their performance and capacity to efficiently satisfy client expectations are affected by these difficulties.

In general, the literature review indicates that supply chain integration significantly influences the performance of Nanostores. The unique challenges faced by Nanostores require tailored solutions, including the adoption of information technology, collaborative supply chain strategies, and innovative last-mile delivery approaches. By addressing these challenges effectively, Nanostores can enhance their operational efficiency, customer satisfaction, and overall performance, contributing positively to local economies and communities they serve. Further research in this area could provide more insights and strategies to optimize the supply chain performance of Nanostores in addition to enhancing operational performance over the short term and ensuring the long-term growth of the nanostore [15]. Operational performance refers to the efficiency, effectiveness, and overall quality of an organization's day-to-day activities and processes in achieving its goals and objectives. It encompasses a wide range of factors that impact how well an organization carries out its core functions and delivers value to its stakeholders. Operational performance is often a critical factor in determining an organization's competitiveness, profitability, and success in the marketplace. Key aspects of operational performance include efficiency, effectiveness, productivity, flexibility and agility, innovation, cost control, customer satisfaction, and risk management. Measuring operational performance involves setting key performance indicators (KPIs) that align with the organization's goals and tracking them over time. Common KPIs might include metrics related to production output, customer satisfaction scores, defect rates, employee turnover, and financial performance.

In summary, operational performance is a multifaceted concept that encompasses various factors crucial for an organization's success. It's about efficiently and effectively executing tasks, delivering quality products/services, and continuously improving processes to stay competitive and meet stakeholder expectations.

### *A. Proposals of The Study*

1. **Conceptual Framework Refinement for Supply Chain Integration:** Recognizing the diverse definitions of supply chain integration in existing literature [11], this study proposes the development of a comprehensive conceptual framework. Drawing on insights from various definitions, this framework will encompass key dimensions of supply chain integration, including processes, information flow, and collaboration. The refined framework aims to provide a clearer understanding of supply chain integration, facilitating more informed decision-making and strategic planning.
2. **Tailored Strategies for Nanostore Supply Chain Enhancement:** Building on the role of nanostores in local economies [13], this proposal suggests the formulation of tailor-made supply chain strategies. These strategies will be tailored to the specific challenges faced by nanostores, focusing on inventory control, transportation optimization, and supplier collaboration [5]. By adopting a collaborative approach involving nanostores, suppliers, and distributors, these strategies aim to enhance overall operational performance.
3. **Integration of Technology for Nanostore Supply Chain Optimization:** Leveraging the potential of technology, this proposal advocates for the adoption of advanced technological tools within nanostore's supply chains. Implementation of modern inventory management systems, predictive analytics for demand forecasting, and real-time tracking for efficient last-mile delivery can significantly

contribute to supply chain efficiency and operational performance enhancement.

### *B. Hypothesis*

The implementation of tailored supply chain strategies, guided by a refined conceptual framework and facilitated by technology integration, will positively correlate with enhanced operational performance in nanostores.

## III. METHODS OF THE STUDY

Meta-analysis was conducted in this study to examine the relationship between supply chain and operational performance of Nanostores. Meta-analysis is a statistical technique used to combine and analyse data from multiple independent studies on a particular research question or topic [16]. It involves the systematic review to collect data, such as study design, sample size, methodology, and outcome measures from individual studies, then extract the relevant statistical results [17] [18]. It provides a quantitative summary of the results, typically in the form of an effect size estimate. This summary measure allows researchers and policymakers to assess the magnitude and direction of the effect, facilitating evidence-based decision-making.

The strength of using meta-analysis lies in its ability to increase statistical power and enhance the ability to detect small but meaningful effects that may not be apparent in individual studies [19]. In addition, it provides a more comprehensive and representative view of the research topic by including studies conducted in various settings, populations, and geographic locations. This improves the generalizability of the findings beyond the limitations of any single study.

For these reasons, in this study, the effect size resulted from analysing 8 studies was used to examine the relationship between the supply chain and the operational performance of nanostores.

### *A .Meta-Analysis Procedure*

Every effect size is first transformed into Fisher's z, and after analysis was performed, all results are transformed back to r correlation [20]. Since all the studies included in the analysis looked at the relationship between SC and operational performance, this paper employed the fixed-effects approach of meta-analysis [21]. If multiple effect sizes per study were reported in the primary articles, a single composite effect size is calculated using formulas as recommended by [22].

Next, the meta-analytical is used to estimate the mean correlation and calculated 95% confidence interval around this mean correlation. To examine the existence of moderators, a chi-square distributed statistic with k − 1 degree of freedom or Q-statistic is calculated, where k is number of samples.

Finally, to provide confidence that publication bias is not a concern, the so-called file drawer number and Egger's regression were calculated. The number of unlocated research that might have an impact on the overall relevance of our findings is estimated using the failsafe analysis [21] [22].

In meta-analysis, Egger's regression test is frequently used to identify publication bias. In other words, if the p-value of Egger's test is not significant, there is no evidence to support the existence of publication bias. Comprehensive Meta-Analysis (CMA) and JAMOVI software were used for the analysis [23].

The approach used was meta-analysis and to discover articles that provided enough statistical data for the meta-analysis, a bibliometric search and systematic review were conducted. A systematic review, which is an organized examination of publications with the aim of achieving the research's purpose, employs systematization to locate, choose, and assess papers. Its goal is to qualitatively examine bibliometric data.

Three steps were carried out in its implementation (See Table I). The meta-analysis, which involves calculating the correlation between several correlation values of each study to generate a final index capable of inferring information about a specific study, was carried out based on the outcomes of the two preceding phases [24].

TABLE I
METHODOLOGICAL STEPS

| Steps | Criterion | Objective |
|---|---|---|
| 1st | Reading of abstracts and keywords | Select publications that meet some of ıe study objectives and have some statistical data |
| 2nd | Reading of the objective and theoretical framework | Identify the articles that relate the topics under study |
| 3rd | Analysis of results and final considerations | To detail the results and identify in them which ones provide possible data to relate IP with innovation in agribusiness, such as quantitative method, sample, correlation coefficient, among others. |

The authors commented on the criteria and goals for each stage of the systematic review. From these data, the so-called effect size, or ES, was calculated. The ES is a way to determine how strongly two variables are related in a statistical population [25]. The results of this ES, whether in Pearson's r or Cronbach's Alpha, are presented in the Forest Plot, which evaluates each individual finding's weight or significance to the connection between the findings and the impact size [26].

Each line in this kind of graph corresponds to single research, with the final line reflecting the combination of findings (the meta-analysis's impact size), which is denoted by a diamond. Each study's outcome is presented as a series of squares that indicate the risk ratio [27].

Additionally, meta-analysis enables the assessment of study heterogeneity, or the degree of diversity between the results, which may be slightly or highly significant [22] [24] (Hunter; Schmidt, 2004, Vieira et al., 2020). The chi-square (X2) or I-square (I2) that covers from 0% to 100% is used to statistically quantify heterogeneity.

Up to 50% is regarded as a significant level, between 50% and 75% substantial heterogeneity, and over 75% major heterogeneity [28]. The correlation of results, or the effect magnitude, will be more suspect the greater the heterogeneity.

The funnel scatter plot was used to assess the so-called publication bias, which is the propensity for published results to deviate significantly from reality, as part of the analysis of the results.

The funnel plot shows that studies with more variability appear at the top of the funnel and around the mean by displaying the variance (or sample size) on the y-axis and the correlation coefficient on the x-axis [29].

## IV. RESULTS AND DISCUSSION

Once the bibliometric and the systematic review were performed, 8 articles (Table II) were obtained for the meta-analysis.

TABLE II
DATA FOR THE META-ANALYSIS

| Number | Authors | Pearson (r) or Cronbach's Alpha | Sample (*n*) |
|---|---|---|---|
| [1] | Magutu, 2015 | 0.522 | 627 |
| [2] | Thavorn, 2020 | 0.352 | 247 |
| [3] | Jacobs & Mafini, 2019 | 0.223 | 73 |
| [4] | Mohamud& Mwangi, 2021 | 0.253 | 100 |
| [5] | Ahmad & Zabri, 2016 | 0.415 | 100 |
| [6] | Khan, 2022 | 0.298 | 107 |
| [7] | Reklitis, 2021 | 0.632 | 300 |
| [8] | Ahmad & Zabri, 2018 | 0.458 | 100 |

The Fisher r-to-z transformed correlation coefficient was used as the analysis's result metric. Data were fitted to a fixed effects model. The I2 statistic and the Q-test for heterogeneity [30] are presented. To determine if studies may be outliers and/or important in the context of the model, student zed residuals and Cook's distances are utilized. Studies are regarded as possible outliers if their student zed residual exceeds the 100 x (1 - 0.05/(2 X k)) percentile of a standard normal distribution (i.e., applying the Bonferroni correction with two-sided alpha = 0.05 for the k studies included in the meta-analysis). Studies are deemed important if their Cook's distance is more than the median and six times the Cook's distance interquartile range [31].

The analysis comprised a total of k=8 studies. Fisher r-to-z transformed correlation coefficients were detected, with values ranging from 0.2268 to 0.7447, and most estimations were positive (100%). Based on the fixed-effects model, the estimated average Fisher r-to-z transformed correlation coefficient was = 0.5129 (95% to 0.5614). As a result, the average result was substantially different from 0 (z = 20.7072, p 0.0001). The statistical heterogeneity, which is shown by the Q-test, indicates that the genuine results tend to be heterogeneous (Q (7) = 40.7606, p 0.0001, I2 = 82.825%); it will have significant values if I2 > 57% [24]. I2 = 82.825% from this meta-analysis shows significant heterogeneity (See Table IV), indicating that the results of the analysis were very variable (Fig. 1). In comparison to the other studies, one study [32] had a weight that was relatively high (i.e., weight 3/k, or a weight that was at least three times as high as having equal weights across trials). One research [33] that had a value greater than 2.7344 and may be a potential outlier in the context of this model was identified through an analysis of the student zed residuals.

Following the level parameters of Pearson's correlation coefficient as shown in Tables III and IV, the value of r = 0.51 indicates a high positive correlation between the variables. Thus, the meta-analysis object of this study shows that supply chain integration and operational performance are related.

Based on the above discussion, this research makes a contribution to the SCI literature. Therefore, to the best of our knowledge, this paper is the first attempt to provide a meta-analysis in the context of SCL to integrate and analyze the empirical findings of the SCI–operational performance in nanostore relationship. The results comprehensively conclude that there are benefits to operational performance from applying integration in the supply chain.

Although our study found that both SCI and OP have positive effects on overall firm performance, the results show that the impact of customer satisfaction on operational performance is higher than that of customer footfall, a conclusion that supports some of the existing research [41] [42]. Additionally, compared with customer satisfaction, customer footfall is less studied [42]. Therefore, it is possible that an insufficient sample could have interfered with the analysis. The lack of research regarding customer satisfaction in the supply chain also reflects the popularity of supply chain customer footfall. Some authors even ignored customer footfall, recognizing only customer satisfaction as a contributor to performance improvement [43] [44]. However, this research expands the current literature by providing evidence that both customer satisfaction and footfall have positive contributions to increasing operational performance.

TABLE III
FIXED-EFFECTS MODEL (K = 8)

| | Estimate | SE | Z | P | Cl Low Bound | Cl Upper Bound |
|---|---|---|---|---|---|---|
| Intercept | 0.513 | 0.0248 | 20.7 | <0.001 | 0.464 | 0.561 |

TABLE IV
STATISTICAL HETEROGENEITY OF EFFECT SIZE

| Tau | Tau² | I² | H² | R² | df | Q | p |
|---|---|---|---|---|---|---|---|
| 0.000 | 0 (SE= NA) | 82.83 % | 5.823 | . | 7.000 | 40.761 | <0.001 |

The correlation between the two variables, SCI and OP, results in the effect size (ES), or effect size of the correlation. First the contribution of each of the eight correlated frame finds was shown in the Forest Plot graph (Fig. 1), analyzing the weight of each and its coefficient range.

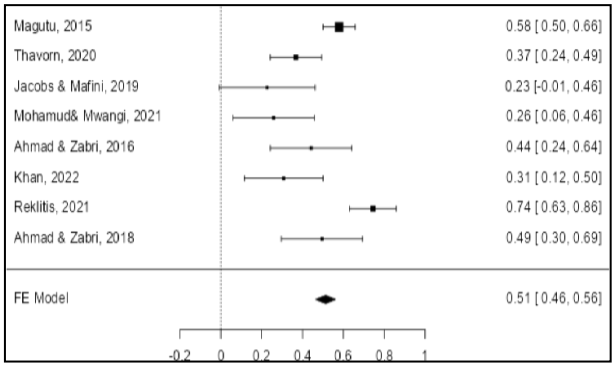


Fig.1 Forest Plot of ES.

### A. *Publication Bias*

Publication bias is a sort of bias that may appear in meta-analysis, as it is difficult for researchers to find all the relevant research on a topic [34]. Articles that support research ideas are more likely to get published than those that reject them. Publication bias was examined using a funnel plot and a fail-safe N since it may have an impact on the reliability of results [35]. The funnel plot appearing in Fig. 2 was nearly symmetrical, quantitatively indicating that the publication bias of the sample was within an acceptable range. Fail-safe N was also employed to identify publication bias. According to [36] [37], fail-safe N can be used to determine the required number of studies with zero effect size to yield a non-significant value. Using [38] approach, fail-safe N was 911.000 ($p < 0.0001$). Therefore, the results of the fail-safe N suggest that there was no significant publication bias in the sample articles.

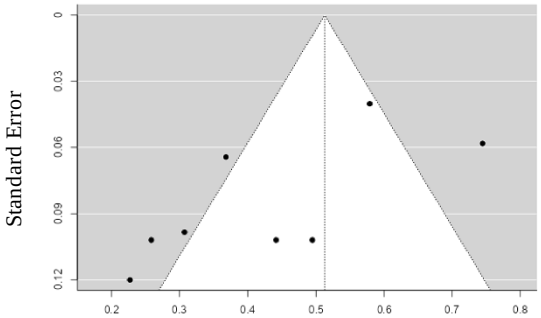


Fig.2 ES Funnel Plot.

The funnel plot is a representation of the relationship between effect size on the horizontal axis and a metric of study size (often standard error or accuracy) on the vertical axis. The top of the graph shows large studies, which tend to group together close to the mean effect size. Since there is more variation in samples in estimations of effect sizes in the smaller studies, they will be distributed throughout a range of values and appear closer to the bottom of the graph. We would anticipate that the studies would be evenly distributed around the total impact size in the absence of publication bias. The bottom of the figure, however, should indicate a larger concentration of research on one side of the mean than the other if there is bias. This would reflect the fact that smaller studies (which are found at the bottom) are more likely to be published if they have bigger than average effects and are therefore more likely to satisfy the need for statistical significance.

### A. *Begg and Mujumdar rank Correlation Test*

The funnel plot illustrates the typical instance of publication bias. Small studies are more likely to be included when they demonstrate a reasonably substantial treatment impact while large studies are more likely to be included regardless of their treatment effect. In these conditions, the size of the research and the magnitude of the effect will be inversely correlated. [39] suggested that this correlation can serve as a test for publication bias. In more detail, they advise that we calculate the rank order correlation (Kendall's tau b) between the treatment effect and the standard error (which is mostly determined by sample size) for the study. This method has some significant limitations. Although a substantial association raises the possibility of bias, it does not specifically address its effects. A non-significant association, on the other hand, may not be indicative of bias because of poor statistical power. According to the continuity-corrected normal approximation, Kendall's tau b in this instance is -0.17857 (adjusted for ties, if any), with a 1-tailed p-value (preferred) of 0.26809 or a 2-tailed p-value of 0.53619.

### C. *Egger's Test of The Intercept*

Egger recommends that we measure this similar bias by estimating the standardized effect (effect size divided by the standard error) using precision, which is the inverse of the standard error. The regression line's slope (B1) in this equation represents the magnitude of the treatment effect, while the intercept (B0) represents the bias. The rank correlation strategy may not be as advantageous as this one. In some cases, this test could be more effective. Additionally, this method may be expanded to incorporate several predictor variables, allowing us to evaluate the effects of numerous variables, including sample size, on the treatment effect at the same time. With t=1.65158 and df=6, the intercept (B0) in this instance is -3.73076, with a 95% confidence interval of (-9.25808, 1.79656). The suggested 1-tailed p-value is 0.07485, while the recommended 2-tailed p-value is 0.14971.

### D. *Duva, and Tweedie's Trim and Fill*

If the meta-analysis had captured all the relevant studies, we would expect the funnel plot to be symmetric. That is, we would expect studies to be dispersed equally on either side of the overall effect. Therefore, if the funnel plot is actually a symmetric, with a relatively high number of small studies (representing a large effect size) falling toward the right of the mean effect and relatively few falling toward the left, we are concerned that these left-hand studies may actually exist and are missing from the analysis. [40] developed a method that allows us to impute these studies. That is, we determine where the missing studies are likely to fall, add them to the analysis, and then recompute the combined effect. The method is known

as 'Trim and Fill' as the method initially trims the asymmetric studies from the right-hand side to locate the unbiased effect (in an iterative procedure), and then fills the plot by re-inserting the trimmed studies on the right as well as their imputed counterparts to the left, the mean effect. According to a fixed effect model, the computer searches for missing studies solely on the left side of the mean effect (the user controls these settings). The technique shows that no research is lacking based on these factors. The point estimate and 95% confidence interval for the pooled studies using the fixed effect model is 1.03311 (0.92246, 1.14376). These variables remain the same whether Trim and Fill are used. According to the random effects model, the aggregated studies' point estimate and 95% confidence interval is 0.91687 (0.63364, 1.20010). These variables remain the same whether Trim and Fill are used. Fail-safe N Calculation using the Rosenthal Approach is shown in Table V. Fig. 3 also depicts the distribution of the real impacts.

TABLE V
PUBLICATION BIAS ASSESSMENT

| Test Name | Value | p |
|---|---|---|
| Fail-Safe N | 911.00 | <.001 |
| Begg and Mazumdar Rank Correlation | -0.340 | 0.252 |
| Egger's Regression | -4.257 | <.001 |

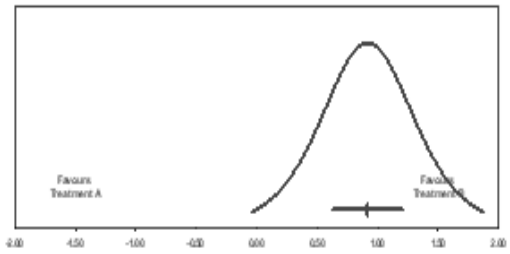

Fig.3 Distribution of True Effects.

Based on above results, The study of [33] indicates the highest positive correlation between the variables appear in their framework. According to [33] , the importance of sales revenue, customer footfall, and consumer satisfaction lies in their capacity to provide a comprehensive understanding of the influence of supply chain integration on performance. Sales revenue serves as a key metric for assessing the financial performance of a business, providing a clear indication of the impact that efficient supply chains have on overall performance. The number of customers visiting a store is indicative of its appeal and convenience, offering valuable insights into the extent to which supply chain integration contributes to the overall quality of the shopping experience. client satisfaction is a metric that evaluates the efficacy of supply chain operations in fulfilling client requirements, hence impacting customer loyalty and the likelihood of repeat transactions. Collectively, these measures provide a holistic perspective on the extent to which supply chain integration enhances the performance of a retail establishment, encompassing both financial benefits and enhanced customer satisfaction.

## V. CONCLUSION

This study provides insights into the relationships between integration of supply chain and operational performance of nanostores. The supply chain integration emphasizes the importance of implementing practices jointly with suppliers as well as customers to build relationships that help achieve a seamless flow of goods, materials and information in the supply chain.

Meta-analytical approach used in this study helps in gaining deeper insights beyond the findings of individual studies and provides a foundation for building theory in this important research stream in operations and supply chain integration area. While there is an overall understanding of the impact of supply chain integration on operational performance, this study intended to undertake a systematic statistical approach for analyzing these relationships. Based on the results of the study showed the importance of nanostore in local economies [13], in improving inventory control, transportation optimization, and supplier collaboration [5]. By adopting a collaborative approach involving nanostores, suppliers, and distributors, these strategies aim to enhance overall operational performance. In addition, this study suggested methods that advocate for the adoption of advanced technological tools within nanostore's supply chains. Implementation of modern inventory management systems, predictive analytics for demand forecasting, and real-time tracking for efficient last-mile delivery can significantly contribute to supply chain efficiency and operational performance enhancement.

It is essential to acknowledge some limitations associated with this study. This study involved an in-depth review of the previous research and an extensive expenditure of resources to collect data in order to obtain findings that are both valid and reliable. However, it is important to acknowledge that there are certain limitations inherent in this study, as well as in any other meta-analysis. These limitations include the possibility of deviations from perfect construct validity in the dependent and independent variables, as well as the potential for reporting and transcriptional errors.

However, sampling error and error of measurement in the dependent and independent variables were considered by using construct reliability and assigning weights to studies depending on sample sizes. There are obviously many more studies that investigate integration and performance relationships in supply chains. However, some studies needed to be left out due to lack of access to relevant information to conduct the analysis. Nevertheless, the sample size used to conduct a meta-analysis of correlations in this study is representative of the domain and is in line with the data used in other meta-analytic studies. Because only 8 studies examined the effect of SCI on operational performance, we suggest future studies be conducted in this direction. Future research should also consider if there is a difference in performance based on the pressures for implementing SC practices. It is also worthwhile to analyze in more detail the reasons why some industries and

geographical regions have higher benefits from adopting SC practices. The mixed findings of this study pave the way for the examination of the relationships between supply chain integration and different operational performance measures to further understand the nature of the field. Specifically, a broader conceptualization of quality performance that considers the time sensitive nature of this performance dimension should offer insights that extend the current findings. A more holistic conceptualization of performance measures would aid in tightly linking supply chain integration with operational performance.

Also, interesting this article has made noteworthy advancements in understanding the operational performance of nanostores and supply chain sectors. Additionally, it offers valuable insights into the economic and social consequences, which hold immense significance in the contemporary business landscape.

### *A. Limitations of The Research*

While this research contributes both theoretically to the literature on the relationship between supply chain integration (SCI) and operational performance, as well as practically to business strategies, it does come with certain limitations. Firstly, inherent limitations of meta-analyses come into play. Gathering data from diverse sources spanning different time periods might introduce biases in understanding questionnaire content, potentially leading to inaccurate evaluations [44]. Secondly, due to the inability to amass an extensive number of sample studies for all variables, the examination could only focus on the impact of various dimensions of supply chain integration on overall performance, rather than delving into individual performance metrics. Consequently, the influence of distinct dimensions of SCI on varied performance measures such as supply chain performance, innovation performance, and general performance remains ambiguous. Lastly, due to constraints in data availability, a comprehensive analysis of the SCI-operational performance relationship, as well as unexplored areas in this domain, couldn't be effectively conducted. Drawing from both the significant contributions and the limitations identified within this study, we offer several recommendations for prospective research directions. Given the heightened emphasis on sustainability within the realm of supply chain integration (SCI) research, we encourage forthcoming researchers to delve into how supply chain integration impacts sustainability factors such as environmental and social performance. This could involve investigating the influence of supply chain integration on a firm's adoption of circular economy practices and its engagement with environmental and social governance, all of which contribute to gaining a competitive edge.

Additionally, we propose that future researchers contemplate refining questionnaire designs to distinctly differentiate between various learning types (absorptive or joint learning) and content categories (business, process, or technical knowledge). Such a nuanced approach can yield more comprehensive insights from respondents and enhance the depth of information gathered.

Furthermore, there lies value in exploring the impact of alternative learning types (e.g., single-loop or double-loop learning) and different information sources (e.g., other supply chain partners) on the relationship between supply chain integration and performance. This broader investigation can significantly enhance our comprehension of the intricacies underlying the SCI-performance dynamic.

### *B. Managerial Implication*

The findings of this research have practical implications for owners of nanostore involved in SCI. First, we provide solid evidence that SCI can improve operational performance and is independent of industry type and degree of economic development in the region. Although learning from both customers and suppliers has positive effects on performance, the former is more important. Therefore, to maintain a firm's competitiveness, we recommend that owners of nanostore allocate more resources to learning from customers in the SCI process. In addition, SCI content is an important factor affecting operational performance. The results show that compared with customer footfall focused on product development, customer satisfaction focused on process optimisation and market information is superior in improving firm performance. Therefore, owners should develop a learning plan that focuses more on market information and process optimisation to attain a stronger competitive position.

### *C. Theoretical and Methodological Implication*

Within this meta-analysis, we systematically synthesized existing empirical findings concerning the relationship between supply chain integration (SCI) and operational performance (OP), aiming to draw a comprehensive conclusion. Additionally, we delved into the influence of potential moderating factors on the SCI–OP relationship.

To begin, our outcomes unveiled a substantial and positive correlation between SCI and OP, aligning with the conclusions of certain prior empirical studies [45] [46], while contradicting others [47]. Notably, both customer footfall and customer satisfaction exhibited significantly positive impacts on operational performance. Furthermore, our findings corroborated [48] research, highlighting those gleaning insights from customers yields a more pronounced effect on performance compared to insights garnered from suppliers. This underscores that customers offer valuable market knowledge for new product development, directly enhancing product innovation and consequently bolstering operational performance. Concurrently, the knowledge imparted by suppliers' aids in refining both end products and manufacturing processes, thereby augmenting a firm's product development capabilities and overall performance [49].

Next, the meta-analysis underscored the impact of how operational performance is defined on the relationship between supply chain integration (SCI) and performance. Within the empirical research, some studies have exhibited gaps in exploring performance at the SCI level. In our investigation, we not only established performance metrics at the firm level,

encompassing financial and innovation aspects, but also considered performance at the supply chain level within nanostores. Our findings conclusively validate the positive and substantial effects of SCI on operational performance metrics. However, it's noteworthy that the impact on financial performance emerged as the least pronounced. Viewed through the lens of the knowledge-based view (KBV), SCI emerges as a potent avenue for firms to secure a competitive edge by enhancing connections with supply chain partners and elevating adaptability to shifting market dynamics [50]. Nonetheless, it's important to acknowledge that the implementation of SCI necessitates investments and resource allocations, including technology adoption and time allocation for collaborative activities. This could result in a delayed commensurate return in the immediate term. Furthermore, firms operating within mature markets often prioritize refining existing processes and concentrating on efficiency enhancements rather than focusing solely on financial expansion [47]. Lastly, the study revealed a robust and significant impact of SCI on operational performance for both developed and less-developed regions. Despite substantial dissimilarities in cultural, educational, and business contexts across various regions and countries [44], our results underscore that the level of economic development doesn't emerge as a decisive factor. Thus, it becomes evident that SCI can be effectively implemented across countries and regions with varying degrees of economic advancement.

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