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The Effect of Supply Chain Management Practices on Performance of Enterprises: Mediating Role of Innovation Capacity and Competitive Advantage

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Research Article

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Abstract

The empirical evidence on the sequential mediating role of innovation capability and competitive advantage in the relationship between supply chain management practice and SME performance is limited. Hence, this study aims to examine the effect of supply chain management practices on the performance of SMEs, utilizing innovation capability and competitive advantage as mediators. The study is grounded in the resource-based view and dynamic capability view. Questionnaires were administered to gather data from 411 participants, comprising owners, managers, and experts, of whom 395 were complete and valid. Data were analyzed using R 4.6.1 software and Partial Least Squares (PLS) based Structural Equation Modeling (SEM). The empirical results of the study reveal that supply chain management practices, innovation capability, and competitive advantage have a positive and significant influence on SMEs' performance. Furthermore, supply chain management practices can positively and significantly affect SMEs' performance when mediated by innovation capability and competitive advantage. The R2 value for SMEs' performance, innovation capability, and competitive advantage is 0.708(70.8%), respectively, indicating that 70.8% of the variations in SMEs' performance can be explained by SCMP, innovation capability, and competitive advantage. Similarly, the R2 values for innovation capability and competitive advantage are 0.526 and 0.379 (52.6% and 37.9%), suggesting that SCMP can explain over 52.6% and 37.9% of the variation in innovation capability and competitive advantage, respectively. These findings imply that excellence in supply chain management practices alone does not guarantee superior organizational performance has to be backed by innovation capacity and translated into competitive advantage, especially in the context of SMEs. This study contributes to the existing supply chain management literature by examining how supply chain management practices, innovation capability, and competitive advantage facilitate SMEs' performance in developing countries. The paper also advances the supply chain management practices literature by theorizing and validating an important but rarely studied sequential mediation role of innovation capability and competitive advantage. Thus, this study extends our understanding of the mechanisms through which supply chain management practices affect SMMEs' performance.

Keywords: *Supply chain management practices (SCMP), Innovation capability (INN), Competitive advantage (COM), Small and medium manufacturing enterprises (SMEs), performance (PRS)*

1. Introduction

Small and medium-sized enterprises (SMEs) are crucial for attaining sustainable growth via industrialization. The contributions of SMEs to GDP growth and employment opportunities are generally recognized. SMEs contribute to sustainable economic growth in both developed and developing countries (Qamruzzaman & Kler, 2023). In addition,

Ayalu et al. (2023) also stated that SMEs have emerged as one of the most important tools for addressing economic and social issues and achieving development goals. Half of the world workforces are engaged in SMEs (Kumar, 2017; World Bank, 2022). SMEs' contributions to GDP and employment opportunity are differing from continent to continent as well as from country to country. In Europe, SMEs contribute 50% to 70% to the total GDP, and 60% to 70% of total formal employment; in North and Latin America 40% to 60% to the total GDP and over 60% job creation (Tsegay, M. 2019; World Bank, 2022a). Africa and Sub-Saharan African up to 50% of the total GDP, and 60% to 80% of job creation (Ramatu and Kasim, 2020) and in Ethiopia up to 3.4% of the total GDP, and 80% to 90% of job creation (Tsegay, M. 2019; Mehari, A. 2020; Zhang & Ayele, 2022).

Manufacturing SMEs in Ethiopia are critical drivers of local economic recovery and employment. However, these enterprises face severe structural challenges, including cracked logistics infrastructure, irregular input and supply chains, and constrained access to formal finance (Isho et al., 2022; Minbale et al., 2024; Shebeshe, 2025). According to the report of the Bureau of Manufacturing of the Tigray region, before the war, around 6,416 SMEs were registered and operated their businesses. Of the total, 5,525 are small, 891 are medium-sized, and contribute 13% of Ethiopia's total industry GDP growth. Besides this, SMEs' in Tigray have been created, promising jobs and fairly generating income; but after 2020/21 SMEs' in Tigray faced direct loss of their business, reduced their operation by 60% -80%, structural damage, intentional looting, complete closure of their businesses, broken their supply chain, etc. and contributed to financial and socio-economic losses (CIPE, 2022; Tsegay et al., 2024).

Strategic flexibility and firm performance vary as conditions change: competitive intensity and resource combination activities strengthen the relationship, but environmental munificence and managerial links weaken it (Guo & Cao, 2024). Despite this, small and medium manufacturing enterprises (SMEs') performance, which involves operational and financial aspects (Kiyabo & Isaga, 2020), continues to be an ongoing struggle for small and medium-sized manufacturing enterprises (SMEs') operating in resource-scarce settings, especially in areas experiencing instability and economic turbulence. In such circumstances, having good SCMP makes firms innovative and competent in the market (Opaleye et al., 2025).

SCMP has a significant role in influencing SMEs' performance (Obiri-Yeboah et al., 2026). In addition, Ababou (2024) found that SCMP has positive relationships between firm performance indicators, including economic-financial and commercial dimensions. In addition, SCMP SMEs should have a competitive advantage in terms of cost, quality, differentiation, time to market, or delivery dependability (Li et al., 2006a). A firm's competitive advantage is the ability to provide products and services effectively, meet market demands, and outperform rivals in local or global markets (Putu et al., 2021). Gaining and maintaining competitive advantage, which involves being able to outperform competitors in cost, quality, speed, flexibility, or differentiation (Porter, 1991). Kiyabo and Isaga (2020) found that SMEs operating in resource-scarce settings, especially in areas experiencing instability and economic turbulence, are struggling to survive**.**

Opaleye et al. (2024) stated that, in the context of a rapidly changing global landscape characterized by troubles such as instability, pandemics, economic volatility, changing consumer demands, and shifting technology, supply chain management (SCM) is vital for SMEs. SMEs should focus on delivering high-quality products, ensuring on-time delivery, maintaining flexibility, and minimizing operating costs achievable through enhanced SCMP (Obiri et al., 2026). SCMP has a positive and significant effect on SMEs' competitiveness, such as cost, quality, flexibility, and delivery (Zhou and Getele, 2025). In addition, (Rangga et al., 2025; Yadav, 2026) findings reveal that SCMP has a direct and positive relationship with the competitiveness of SMEs. While large corporations rely on economies of scale, SMEs leverage SCMP to exploit their native advantages such as flat organizational structures and faster decision-making to effectively compete with industry giants.

Supply chain management and innovation capability combine to help businesses adapt quickly to market changes and create new products (Elfawal & Adel, 2021). SCMP strongly improves the innovation capability of SMEs by enabling fast information flow, flexible resource use, and close partner collaboration (Faisal and Gabriel, 2016). In addition, SCMP directly enhances SMEs' innovation capability by providing the operational flexibility and rapid feedback loops needed to test, adapt, and launch new ideas (Opaleye et al., 2025). In theory, both resource-based view (RBV) and dynamic capability view (DCV) are critical; yet, in the resource-scarce, disrupted context of Tigray as well as in Ethiopia, an important question arises: Do supply chain

management practices (SCMP), innovation capability (INN), and competitive advantages (COM) act independently, synergistically, or sequentially to enhance SMEs' performance (PRS)? Despite these findings, important gaps remain. First, the sequential ordering between SCMP, INN, and COM remains unresolved. Some studies support SCMP to INN, where as other support INN to SCMP; these competing orderings have not been adequately tested within a single integrated model. Second, even though SCMP is recognized globally as a tool to enhance COM and SMEs' performance; its application in localized, post-disruption environments remains poorly understood. Traditional models assume access to advanced digital infrastructure for supply chain visibility, overlooking how resource-constrained firms achieve INN and COM through localized networks and operational flexibility. Third, existing literature frequently explores these variables in isolation or via direct linear pathways, there remains a critical empirical gap regarding the *sequential, multi-stage mediated mechanisms* (SCMP → Innovation → Competitiveness → Performance) operating within highly constrained Sub-Saharan markets.

This study addresses this gap by presenting a comprehensive empirical investigation into the sequential linkages between SCMP, INN, COM, and overall performance among SMEs manufacturing in Tigray, Ethiopia. By positioning these relationships within the joint theoretical designs of RBV and DCV, this study aims to uncover the exact strategic pathways through which capital-starved, logistically challenged Tigray-Ethiopian enterprises can build resilience, optimize operational output, and achieve sustainable competitive survival. This research was carried out using SPSS for descriptive analysis. Structural equation modeling (SEM) of partial least squares (PLS), a multivariate statistical technique, was used to analyze the results and test the hypotheses that were set.

2. Literature review

2.1 Theoretical background and hypotheses development

Small and medium enterprises (SMEs) form a dominant share of the private sector in developing countries, and account for more than 50 percent of jobs in their respective economies. In addition to their positive employment effects, the growth and vitality of these firms are also important for comprehensive economic growth, diversification of the economic base, and as a source of innovation that is exhibited by some of the start-ups

(Kumar, 2017). SMEs' performance is influenced by internal and external factors like managerial skill, access to the workplace, entrepreneurial capability, technology, and competition (Engidaw, 2021). However, one of the most significant determinants is supply chain management practices, which shape the SMEs' innovation capability, competitive advantage, and performance (Sabir et al., 2023; Obiri-Yeboah et al., 2025). Implementing SCMP enhances INN and COM, a critical factor in maintaining a competitive edge in dynamic markets (Sonar et al., 2022).

In the existing literature, the resource-based view (RBV) developed by Barney (1991) and dynamic capacity theory (DCT) developed by Teece et al. (1997) and subsequently refined by researchers (Teece, 2007) offer a demanded framework for understanding the relationship between SCMP and SME performance.

Resource-Based View (RBV) posits that firms achieve sustainable competitive advantage not primarily through external market positioning (Porter, 1990) but through the possession of internal resources that exhibit four specific attributes: they must be valuable, rare, inimitable, and non-substitutable (the VRIN criteria). Resources encompass all assets, capabilities, organizational processes, firm attributes, information, and knowledge controlled by a firm that enable it to conceive and implement strategies that improve efficiency and effectiveness (Barney, 1991; Hart, 1995). The RBV theory guides the identification of firm supply chain management practices and strategic antecedents. According to RBV, the identification and possession of internal strategic resources contribute to a firm’s ability to create and maintain a competitive advantage (Hart, 1995; Lubis, 2022). The dynamic perspective of RBV helps explain a firm’s competitive advantage in changing environments and, therefore, facilitates a better understanding of how a firm's supply chain management practice impacts performance (Singh et al., 2018).

Teece et al. (1997) introduced the Dynamic Capability View (DCV) as an extension of the Resource-Based View (RBV). Dynamic capabilities (DCs) are defined as ‘the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments’ (Teece et al., 1997). DCV builds on a firm’s ability to rapidly and constantly adapt, reconfigure, and innovate. This has led academicians to theorize firms' competitive advantage, innovative capability, firms performance as a dynamic capability because innovation capabilities are always

allied with change and improvements (Golgeci and Ponomarov, 2013; Golgeci & Ponomarov, 2026; Kindström et al., 2013). DCV has a specific focus on innovation and value creation (Ferreira & Coelho, 2020; Katkalo et al., 2010). According to this view, innovation activities are indirectly related to a firm's performance through reconfiguring its operational processes or routines, which, in turn, generate value for the firm (Zahra et al., 2006). The researcher argues that a firm's SCMP need to invest in building innovativeness as DCs to mitigate vulnerabilities in an uncertain environment, which, in turn, creates value through SCMP to survive in the long run. More importantly, the dynamic capability view (DCV) is exceptionally relevant to the manufacturing sector because it explains how firms can sustain a competitive advantage in environments defined by rapid technological shifts, supply chain disruptions, and intense global competition. Traditional frameworks like the Resource-Based View (RBV) focus on leveraging existing assets, but manufacturing today requires the continuous arrangement, renewal, and transformation of those assets (Taghizadeh & Behzadi, 2026).

Manufacturing environments possess specific, complicated characteristics that make DCV a critical framework for survival and growth. Moreover, in SMEs, SCMP is not just about providing resources to the organization; it is also about the ability to swiftly adjust to shifting market conditions, which is essential for maintaining an innovation capability and competitive advantage in the supply chain. Reviewing the existing literature also highlights the projecting role of the SCMP approach across various theoretical perspectives, including dynamic capabilities theory, strategic innovation, and organizational ambidexterity, as well as in empirical research (Shams et al., 2020; Santoro, 2025). This theoretical support aims to highlight the significant influence of SCMP on SME performance by examining the sequential mediation factors of innovation capability and competitive advantage, which enhance SME performance. Drawing on DCT (Augier & Teece, 2018) and RBV (Barney, 1991), SCMP models from the literature; we explore how SCMP promotes a positive working environment conducive to enhanced SME performance sequentially.

2.2 Supply chain management practice and SMEs' performance

Even though there is no universally agreed-upon definition of SCM, for this research, SCM is defined as "a process of coordination of the business functions across the businesses within the firm and across businesses within other firms in the supply chain

for providing and improving products and information flows from suppliers till end customers to enhance firm performance and satisfy customer needs, wants, and requests", which is aligned with the integrated SCM stream (Moh'd et al., 2016). SCMP is typically characterized by the strategic supplier relationship, customer relationship, information sharing, information quality, internal lean practice, and postponement to enhance their innovation capacity, competitive advantage, and firm performance (Moh'd et al., 2016). Moreover, supply chain permeates the firm through its capabilities, information sharing, information quality, logistical processes, strategic supplier partnerships, and mindsets (Dalvi and Kant, 2018; Tukamuhabwa et al., 2023). Scholars consistently highlight different interconnected dimensions of SCMP. Dlamini et al. (2026) mentioned Strategic suppliers' relationships, customer relationships, information sharing, and information quality. Whereas Habtemariyam et al. (2022) use six dimensions: strategic suppliers' relationship, customer relationship, information sharing, information quality, internal lean practice, and postponement. These dimensions serve as the operational mechanisms through which innovation capability, competitiveness, and firm performance are achieved in the supply chain management practice (Pono & Munizu, 2021).

Several studies have identified a positive correlation between supply chain management practice (SCMP) and SMEs' performance (PRS) (Bargouthi et al., 2025). Supply chain management practice (SCMP) has been shown to positively influence firms' competitiveness and performance (Mehregan et al., 2023; Obiri et al., 2025). Besides to this, Halen (2024) also found that supply chain management acts as a vital predictor and direct enhancer of operational effectiveness and competitive performance. Based on this justification, the researcher hypothesizes the following.

H_1. Supply chain management practices positively influence the SMEs' performance.

2.3 Supply chain management practice and SMEs' innovation capability

SCMP empowers SMEs to swiftly respond to market volatility, configure flexible supplier networks, and leverage real-time data, which directly fuels their internal innovation capability and overall market resilience (Elfawal & Adel, 2021 Opaleye et al, 2024). SCMP focuses on managing supply chain activities and helps to enhance SMEs' innovation capability, allowing businesses to design new products, adapt workflows, and

handle sudden disruptions through shared knowledge and advanced technology (Awuah, 2026; Elfawal & Adel, 2021).

The findings of Elfawal & Adel (2021) show that supply chain management practices have a positive, significant influence on SMEs' innovation capabilities. Research confirms that information sharing, collaborative networks, and flexible internal processes act as direct drivers for product and process innovation, which in turn significantly mediates and boosts overall firm performance. Based on this reason, the researcher hypothesizes the following.

H_2. Supply chain management practices positively influences the SMEs' innovation capability.

2.4 Supply chain management practice and SMEs' competitive advantage

The RBV considers a firm's core competence to be its ability to react quickly to situational changes and build further competencies or dynamic capabilities (Eisenhardt & Martin, 2017). Henceforth, a firm's competitive advantage is associated with the configuration of resources and capabilities as the markets evolve (Ugrinov et al., 2024). In a dynamic environment, managers whose firms' competitive advantage is important seek new patterns to guide their companies (Shebeshe, 2025). Because competitive advantage is closely related to the concept of competition, it is usually considered as the ability of people, companies, economies, or regions to compete on an internal and/or international scale (Farhikhteh et al., 2020).

SCMP helps to harness customer value and achieve a sustainable competitive advantage (Isho et al., 2022). It uses strategic supplier partnerships, customer relationships, information sharing, information quality, internal lean practices, postponement, supply chain integration, and coordination to react quickly to market shifts, unexpected disruptions, and changing customer needs. This practice builds strong market competitiveness by allowing companies to deliver customized products faster than rivals (Ambe, 2010; Murat, 2012).

SMEs improve their competitive advantage by using supply chain management practices. Supply chain management lets small firms react fast to sudden market changes, cut delivery times, and satisfy customers better than larger rivals. By staying

flexible in sourcing and sharing data quickly, resource-limited firms can survive disruptions and grow (Muangmee et al., 2022; Tesfa, 2025).

Scholars and academicians finding reveals that strategically having a good SCMP, SMEs are better positioned to develop distinctive competitive advantages, foster business model innovation, improve organizational effectiveness, and strengthen their competitive advantage in highly volatile markets (Jahed & Quaddus, 2022; Shahrokh et al., 2026). Based on this rationale, the following hypothesis is developed.

H_3. Supply chain management practices positively influence SMEs' competitive advantage.

2.5 The mediating role of innovation capability

The dynamic capabilities theory was applied to supply chain and mainly concentrated on the bullwhip effect that arises from the lack of information sharing amongst companies in the supply chain. An organization with smart SCMP responds to altering markets, coordinates business processes through sharing information, risks as well as benefits, and enhances the competitive advantages of supply chain partners on top of improving operational performance (Elfawal & Adel, 2021).

In the scientific and academic literature, firm performance driven by innovation is widely represented by four key dimensions: innovative performance, production performance, market performance, and financial performance (Gurhan et al., 2011; Yusheng & Ibrahim, 2020). Innovation directly drives business success by creating unique market spaces, optimizing operational efficiencies, and delivering differentiated value that outperforms competitors. Strategic adoption across product, process, and market dimensions builds sustainable growth (Psomas, 2015). The findings of Al-azzam et al. (2024) indicate that innovation strategy boosts a company's competitiveness (Al-azzam et al., 2024). In addition, the findings of Fan et al. (2026) show that firms with higher innovation efficiency exhibit significantly greater profitability, and that human capital amplifies the positive relationship. These results highlight the pivotal role of internal strength in transforming R&D inputs into profitable outcomes, particularly during periods of technological and environmental uncertainty.

E. R Lestari (2020); Dereli (2015); Ferreira & Coelho (2020); Kafetzopoulos et al. (2019); rapid changes in markets, technology, and customer needs mean that old

ways of working no longer guarantee success. Innovation has significant positive direct effects on SMEs' performance (PRS) (Eltamo & Ravi, 2026). Firms use innovative approaches to adapt to these competitive pressures, create unique value, and improve their overall business results. Innovation capability indirectly boosts firm performance by enhancing internal capabilities (competitiveness), driving lower costs, delivering quality products, differentiation, on time market and delivery dependability. New products and better processes help companies win new customers and beat their rivals (Salfore et al., 2023; Bui et al., 2026).

Based on the above-mentioned rationale, H_4 is hypothesized.

H_4. Innovation capability positively influences the SMEs' performance.

H_{4a}: Innovation capability mediates the relationship between supply chain management practice and SMEs' performance.

2.6 The mediation role of competitive advantage

There are still many open questions related to the definition of competitive advantage, competitive advantage factors, the applicability, and the practical approaches to foster competitive advantage (Voinescu & Moisoiu, 2015). Competitive advantage theory explains how firms, industries, and nations build an advantage to create value, boost productivity, and secure market share in a global economy. It spans company strategies and national policies (Putu et al., 2021). Competitive advantage directly drives SMEs' performance by shaping profitability, growth, and market share. Firms achieve stronger market results through core drivers like innovation, strategic value creation, and operational efficiency (Putu et al., 2021).

Competitive advantage acts as a vital partial or full mediator between supply chain management, innovation capability, and organizational performance. Supply chain management practice builds efficiency through strategic supplier relationships, customer relationships, information sharing, information quality, internal lean practices, and postponement, which enhances competitive advantage like cost leadership, speed-to-market, product quality, and customer service differentiation, ultimately driving superior financial and operational performance outcomes (measured via operational efficiency, profitability, market share, and customer satisfaction) (Pono & Munizu, 2021; Ya-Juan, 2024).

Research shows that SMEs with higher competitive advantage achieve significantly better financial returns, higher survival rates, and stronger market growth. Core drivers include innovation, resource optimization, and market agility (Mansouri et al., 2022; Markus & Rideg, 2020). Findings reveal that there is a positive relationship between innovation capabilities and competitive advantage (Ferreira & Coelho, 2020), and competitive advantage and SMEs' performance (Keelson et al., 2024). Based on this rationale, the researcher hypothesizes the following.

H_5. Competitive advantage positively influences SME performance.

H_{5a}: Competitive advantage mediates the relationship between supply chain management practice and SME performance.

H_{5b}: Innovation capability mediates the relationship between supply chain management practice and SME competitiveness.

2.7 Conceptual Framework of the study

SCMP of firms applies in various ways that directly influence innovation capability, SMEs' competitive advantage, and indirectly affect SMEs' performance (Duong and Nguyen, 2018; Javid and Amini, 2023; Li *et al.*, 2006b; Opaleye *et al.*, 2026). This study proposed a conceptual framework (Fig. 1) that indicated that supply chain management practices (SCMP) have a significant influence on SMEs' performance (PRS). Moreover, innovation capability (INN) and competitive advantage (COM) mediate the relationship between SCMP and SMEs' performance (PRS) sequentially, thereby enhancing overall outcomes. Based on the above theoretical background, the following research hypotheses were developed based on the principles of dynamic capability theory and resource-based view theory, which posits that the dynamic perspective of RBV helps explain a firm's competitive advantage in changing environments and, therefore, facilitates a better understanding of how a firm's supply chain management practices (SCMP) affect SMEs' performance (PRS) (see Fig. 1)

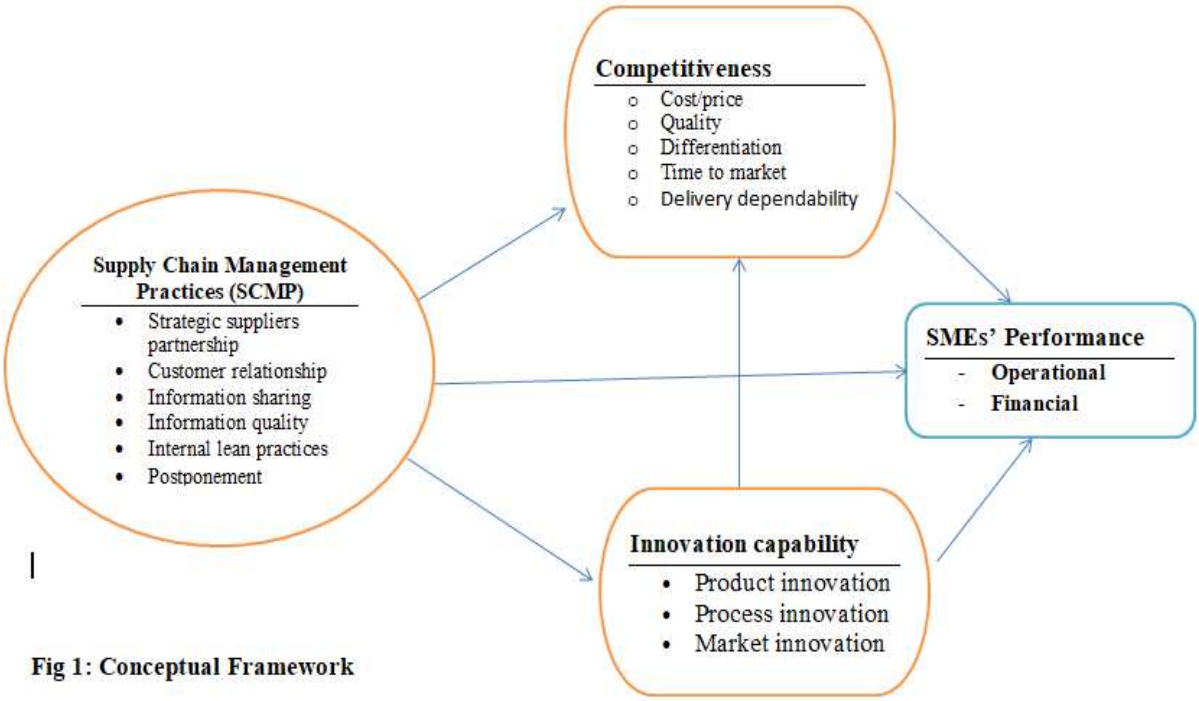


Fig 1: Conceptual Framework

Source(s): Authors' own work

3. Methodology

3.1 Population and data collection procedure

In Ethiopia, in 2019/20, the registered SMEs were 111,547; but in 2023, the Ministry of Labor and Skills Minister's report indicates there are more than 2 million enterprises in the country, and 98% of these are categorized as SMEs. From these, more than 6,000 SMEs (in manufacturing only) are registered in Tigray (MLS, 2023; Tesfa, 2025). According to the reports of the bureaus of manufacturing of Tigray Region, 50% of the total SMEs are operating their business in 5 zonal towns (see Table 1 below).

The study sample consisted of 411 SMEs selected through proportionate stratified random sampling from the 5 Zonal towns of Tigray Region, Ethiopia. The sampling frame was drawn from the bureaus of manufacturing of Tigray Region, encompassing all registered SMEs in these zonal towns, and the city administration that met the inclusion criteria (employed more than 5 people, established before 2020 G.C). Given the small population size, a census approach was considered. However, due to resource constraints and logistical challenges, a proportionate stratified random sampling was employed to ensure representativeness across the key geographic strata.

The sample size (411) was determined using a standard formula for finite populations with a 5% margin of error. The proportionate allocation across the regional strata was calculated as follows. Sample size calculation: the desired sample size (n) was determined using the formula:

$$\mathbf{n} = \frac{\mathbf{N}}{1+\mathrm{N}\,(e2)}$$ ***16% DE (design effect)**

Where:

N = 3083 (Total targeted SMEs in five zonal towns), e = 0.05

Therefore, $\mathbf{n} = \frac{\mathbf{3083}}{1+3083\,(e2)}$ = 354 +354*0.16 = **411**

The proportionate allocation across the strata:

$$\mathbf{ni} = \frac{\mathbf{Nhn}}{\mathrm{N}}$$

Where: ni = sample size using the proportionate stratified random sampling
Nh = total stratified population
n = desired sample size
N = total population

Table 1: proportionate sample size determination

s/no	Zonal town	Metal and woodwork	Textile and garment	Agro processing	Construction inputs	Chemical packaging	Others	Total	Sample size	Firm Size
1	Shire	15	3	12	3	1	11	**45**	**6**	Medium
		42	59	14	21	2	26	**164**	**22**	Small
2	Adigrat	20	7	4	12	1	2	**46**	**6**	Medium
		120	72	21	73	2	46	**334**	**45**	Small
3	Axum	37	2	15	2	0	4	**60**	**8**	Medium
		67	35	19	18	3	31	**173**	**23**	Small
4	Mekelle	90	178	85	129	9	120	**611**	**81**	Medium
		481	356	170	258	18	240	**1523**	**203**	Small
5	South Eastern	3	5	1	2	0	7	**18**	**3**	Medium
		16	49	6	18	5	15	**109**	**14**	Small
Total		***891***	***766***	***347***	***536***	***41***	***502***	***3083***	***411***	

Source: Tigray- manufacturing bureau

A total of 411 surveys were distributed in offline mode, and 403 were returned. Of these, 8 were incomplete, yielding 395 complete questionnaires.

In this survey, 75% of respondents were male, and 25% were female. Regarding academic titles, 56.6 % were Degree, 21.5% Diploma/certificate, 9.2% Master's, and

12.7% Informal training. The sample included 104 (25%) from Medium and 307 (75 %) from Small.

3.2 Measures

To measure the variables in the model, the researcher used an adapted multi-item scale based on prior research to test the hypotheses. To minimize measurement errors, this study addressed common method bias, which can affect the validity and conclusions about the relationships among variables (Podsakoff & Podsakoff, 2019). Content validation of the research instrument was ensured through expert reviews, including feedback from my supervisor and a group of experts from ten SMEs in the study area. Experts with expertise in manufacturing were selected based on their relevance to the target sample. The pilot study feedback was positive, and minor corrections were made based on their recommendations to refine the final questionnaire. This process confirmed that all items were clear, meaningful, and capable of collecting intended information. The content validity index for the evaluated variables exceeded 0.71, indicating strong item content (Almanasreh et al., 2019).

Additionally, to verify the reliability of the instrument, internal consistency was assessed using Cronbach's alpha values with desirable coefficients above 0.6. Respondents were asked to rate their agreement with each statement using a scale from 1 to 7, where 1 represented "strongly disagree' and 7 represented strongly agree.'

The specific measurements of the variables are detailed below.

1- Supply chain management practices (SCMP) were measured by adapting the Multifactor Supply Chain Questionnaire developed by Li *et al.* 2006b), Amedofu et al. (2019), and Mehregan et al. 2023) in the course of assessing supply chain management practices and used it in the present study. As far as supply chain management practices are concerned, in the multiple-scale questionnaire rating form, 29 items were selected and adapted for this study.
2- Innovation capability (INN) was measured using the innovation dimension questionnaire by Gunday et al. (2011) and Kafetzopoulos & Psomas (2015), which measures innovation capability through 21 items related to product, market, process, and organizational innovation.

3- Competitive advantage (COM) was measured by using the Competitive Advantage Questionnaire scale developed to evaluate five key facets of competitive advantage: conceptualizing as cost/price, quality, and differentiation, time to market, and delivery dependability. For this study, 22 items were selected and adapted, and further validity and reliability of the scale were confirmed through factor analysis.
4- SMEs' performance (PRS) (operational and financial): to measure this construct, a questionnaire was adopted from the study done by Tetteh et al. (2024), who developed the scale to measure SMEs' performance in the Ethiopian context. From the questionnaire, 10 items related to SMEs' performance were adapted for this study.

3.3 Data analysis and results

This study utilized partial least squares structural equation modeling (PLS-SEM) with R4.6.1 software. To examine the direct and indirect effects of SCMP on SMEs' performance with INN and COM as the mediator, the PLS-SEM approach was used to run the analysis because of its advantage in handling the analysis of second- and first-order constructs in both the measurement and structural models simultaneously (Sarstedt et al., 2019). The analysis and interpretation of a PLS model typically involve a two-stage process. The first is the assessment of the measurement model (outer model) and the assessment of the structural model (inner model).

3.4 Measurement model

The first phase of the PLS analysis involves assessing the measurement model, which is crucial for determining measurement quality (Hair et al., 2019). This study applied two main criteria to evaluate the validity and reliability of the measurement model. Initially, confirmatory factor analysis (CFA) was conducted to assess the reliability of individual items, internal consistency, discriminant validity, and convergent validity. The reliability of the individual items was measured by the factor loadings (standardized) of each item on its respective construct.

Typically, loadings should be at least 0.7, indicating that over 50% of an item's variance is explained by its constructs. However, items with lower loadings may still be acceptable if other items within the constructs have sufficient loadings (Sarstedt & Liu, 2024; Sarstedt et al., 2021). Items with loadings below 0.4 are recommended for

removal, whereas items with loadings below 0.7 may remain unless their removal increases internal consistency metrics above acceptable levels. In this research, nearly all items in the measurement models had loadings ranging from 0.5 to 0.8 for their respective constructs. Therefore, there was no need to remove those items (see Table 2).

Furthermore, to ensure the robustness of the statistical model, potential collinearity issues among the constructs were also carefully examined. Variance inflation factor (VIF) values were calculated for all constructs included in the analysis. The results indicated that all VIF values were well below the commonly accepted threshold of 3 (see Table 2), suggesting that multicollinearity does not pose a significant concern in this study. This provides additional assurance regarding the validity and reliability of the model estimates.

Reliability was assessed using Cronbach's alpha, rho_A, and composite reliability; statistics for both were greater than the recommended value of 0.700 (Faraj et al., 2015). The rho_A value returned was between the Cronbach's alpha and composite reliability (Sarstedt et al., 2019); it was also found to be over 0.70, hence indicating good reliability (Henseler, Hubona, & Ray, 2016). Convergent validity was acceptable because the AVE was higher than 0.50 (see Tables 2 and 3). Discriminant validity was assessed by comparing the correlations among the latent variables with the square root of AVE (Fornell & Larcker, 1981) and heterotrait–monotrait ratio of correlations (Henseler, Ringle, & Sarstedt, 2015), with values below the (conservative) threshold of 0.85. Hence, discriminant validity is established (see Tables 3 and 4).

Table 2: Reliability and validity analysis

Construct	**Item**	**Loading**	**Alpha**	**rho_A**	**CR**	**AVE**	**VIF**		**Item**	**Loading**	**Alpha**	**rho_A**	**CR**	**AVE**	**VIF**
Strategic supplier partnership	SSP1	0.746					***2.285***	***Market innovation***	MKI1	0.876					***2.331***
	SSP2	0.697					***1.814***		MKI2	0.772	0.857	0.867	0.903	0.701	***1..719***
	SSP3	0.798					***2.628***		MKI3	0.855					***2.190***
	SSP4	0.912	0.89	0.902	0.913	0.568	***2.151***		MKI4	0.84					***2.068***
	SSP5	0.734					***2.053***	***cost***	PCA1	0.649					***1.413***
	SSP6	0.725					***1.911***		PCA2	0.793	0.765	0.784	0.849	0.586	***1.546***
	SSP7	0.677					***1.779***		PCA3	0.815					***1.741***
	SSP8	0.714					***1.979***		PCA4	0.794					***1.733***

Customer relationship	CRS 1	0.72					***1.359***	***Quality***	QUA1	0.678					***1.334***
	CRS 2	0.764					***1.789***		QUA2	0.724	0.774	0.799	0.854	0.597	***1.543***
	CRS 3	0.796	0.796	0.80	0.86	0.551	***1.868***		QUA3	0.854					***2.006***
	CRS 4	0.69					***1.437***		QUA4	0.82					***1.748***
	CRS 5	0.737					***1.463***	***Time to market***	TMK1	0.68					***1.671***
Information sharing	ISS1	0.653					***1.281***		TMK2	0.85					***2.332***
	ISS2	0.863	0.835	0.859	0.883	0.606	***2.554***		TMK3	0.762	0.858	0.874	0.898	0.64	***1.743***
	ISS3	0.893					***1.241***		TMK4	0.832					***2.190***
	ISS4	0.783					***1.884***		TMK5	0.861					***2.627***
	ISS5	0.671					***1.748***	***Differentiation***	DIF1	0.825					***2.251***
Information quality	IQS1	0.659					***1.432***		DIF2	0.769					***1.888***
	IQS2	0.794					***2.171***		DIF3	0.742	0.849	0.849	0.892	0.624	***1.651***
	IQS3	0.807	0.783	0.793	0.852	0.538	***2.209***		DIF4	0.811					***2.092***
	IQS4	0.744					***1.558***		DIF5	0.799					***2.067***
	IQS5	0.647					***1.263***	***Deliver dependability***	DLD1	0.838	0.754	0.763	0.859	0.67	***1.530***
Internal lean practices	ILP1	0.714	0.756	0.853	0.811	0.59	***1.226***		DLD2	0.848					***1.735***
	ILP2	0.764					***1.279***		DLD3	0.767					***1.420***
	ILP3	0.821					***1.447***	***Financial performance***	FPR1	0.735					***1.203***
Postponement	POS 1	0.695	0.753	0.776	0.81	0.589	***1.220***		FPR2	0.729	0.791	0.788	0.847	0.597	***1.193***
	POS 2	0.852					***1.423***		FPR3	0.648					***1.043***
	POS 3	0.748					***1.281***	***Operational performance***	OPR1	0.815					***1.916***
Product innovation	PDI1	0.844					***1.639***		OPR2	0.872	0.879	0.881	0.917	0.734	***2.379***
	PDI2	0.872	0.796	0.813	0.832	0.627	***1.760***		OPR3	0.875					***2.445***
	PDI3	0.639					***1.180***		OPR4	0.862					***2.268***
Process innovation	PRI1	0.845					***2.331***								
	PRI2	0.703					***1.719***								
	PRI3	0.654	0.741	0.758	0.838	0.567	***2.190***								
	PRI4	0.794					***2.068***								

Source(s): Authors' own work

Table: 3 Higher Order Constructs (Factor loadings, Reliability, AVE, and VIF)

Higher-order construct	Factor loadings	Cronbach's alpha	Composite reliability	AVE	VIF
SCMP	0.692	0.802	0.855	0.692	1.97
INN	0.676	0.798	0.858	0.676	2.01
COM	0.684	0.812	0.870	0.684	1.36
SMEs PRS	0.699	0.835	0.882	0.699	1.86

Source(s): Authors' own work

The second criterion was the AVE test (Fornell &Larcker, 1981). In this method, discriminant validity occurs when the calculation of the square root of AVE is greater than the correlation between the factors in each pair. In other words, the value should be higher than the other off-diagonal elements in the rows and columns, which was the case in the correlation matrix of this study. This demonstrated the discriminant validity of the measurements used. Table 4 presents the findings of the variable correlation-square root of AVE.

Table 4: Variable correlation -root square root of AVE (Fornell &Larcker)

	SCM	INN	COM	SMEs PRS
SCMP	**0.832**			
INN	0.808	0**.822**		
COM	0.796	0.805	**0.827**	
SMEs PRS	0.759	0.787	0.821	**0.836**

Source(s): Authors' own work

Additionally, the HTMT ratio was assessed to determine the discriminant validity of the model. All values for the HTMT ratio were less than 0.85, which is considered acceptable for the proposed constructs (Table 4).

Table 4: Discriminant validity- Heterotrait-monotrait ratio (HTMT)

Constructs	SCM	Innovation capability	Competitive advantage	SMEs performance
SCM				
Innovation capability	0.844			
Competitive advantage	0.839	0.841		
SMEs performance	0.828	0.834	0.849	

Source(s): Authors' own work

3.5 Structural model assessment

Having examined the measurement model's reliability and validity, the next step is to evaluate the structural model. To do so, four different tests were performed to evaluate the inner model as suggested by Ramayah et al. (2018) and Hair et al. (2020). Those different tests are coefficient of determination (R^2), predictive relevance (Q^2), effect size (f^2), and finally, the path coefficient.

Structural equation modeling (SEM) results provide a strong analysis of the proposed model supported by key indicators. The R^2 values measure the explanatory power of the model, with thresholds of 0.75 (substantial), 0.50 (moderate), and 0.25 (weak), respectively (Hair et al. 2019). The results reveal that SCMP explains 90.08% (R^2 = 0.908), innovation capability explains 52.6% (R^2 = 0.526), and competitive advantage explains 37.9% (R^2 = 0.379) of the variance in SME performance, demonstrating sufficient explanatory power for the model. Additionally, Q^2 values were evaluated to assess the predictive relevance of the model (Stone 1974). Q^2 values greater than zero confirmed the predictive relevance of the model for the dependent variable, and the results indicated that the Q^2 values met this criterion. Finally, the goodness-of-fit (GoF) of the model was evaluated. GoF is calculated as the geometric mean of the average communality and average R^2 for endogenous constructs (Tenenhaus et al. 2008; Wetzels et al. 2009). The cutoff value for communality is 0.5 (Fornell and Larcker 1981). The GoF value in this study was 0.715, which shows the strong validity of the PLS model (Wetzels et al. 2009). **Table 5** provides detailed results.

Table 5 Goodness of fit (Q2, R2 and corresponding AVEs of endogenous constructs)

Constructs	Q^2	R^2	AVE
SMEs Performance	0.298	0.908	0.875
Innovation capability	0.215	0.526	0.850
Competitive advantage	0.189	0.379	0.752
Geometric mean		**0.604**	**0.826**
Goodness of fit	**0.715**		

Effect Size Evaluation (f^2)

To assess the effect size, we computed (f^2), which represents the relative impact of the exogenous latent variables SCMP, innovation capability, and competitive advantage on

the endogenous latent variable SMEs performance indirectly. The results of the f^2 effect sizes are presented in Table 6, and assessing $f2$ are that values of 0.02, 0.15, and 0.35, respectively, represent small, medium, and large effects (Cohen, 1988) of the exogenous latent variables. Effect size values of less than 0.02 indicate that there is no effect (Cohen, 1988). From this guideline, we gain valuable insights into the relationship between the exogenous and endogenous variables in our structural model. Firstly, the analysis reveals that the influence of SCMP on innovation is of large magnitude, indicating a significant effect of SCMP on innovation capability. However, the effect of SCMP on competitive advantage and SMEs' performance is relatively moderate, suggesting a moderate impact of SCMP on competitive advantage and SMEs' performance. Similarly, the impact of innovation capability on competitive advantage is large but has a small effect on SMEs' performance, implying a limited influence of innovation capability on SMEs' performance. In addition, the effect size of competitive advantage on SMEs' performance is moderate. Fascinatingly, the analysis suggests that SCMP has a small effect on competitive advantage and SMEs' performance but a high effect on innovation capability; innovation capability has a high effect on competitive advantage, and competitive advantage has a moderate effect on SMEs' performance.

Table 6 Results of the f2 Effect Size

	Innovation capability	Competitive advantage	SMEs Performance
SCMP	0.409	0.290	0.160
Innovation Capability		0.368	0.137
Competitive advantage			0.295

3.5.1 Hypothesis testing

Direct relationship

Hypothesis testing was conducted using the bootstrapping method with 5,000 resamples in R4.6.1 software to assess the significance of direct effects within the theoretical framework. The results of the analysis are presented in Table 4, which illustrates the path coefficients and their corresponding p-values (Ringle & Sarstedt, 2021). This approach

ensures robust and reliable estimates, allowing a thorough evaluation of the hypothesized relationships. The p-values provide evidence of the statistical significance of each direct effect, supporting the validity of the proposed theoretical model. Furthermore, the outcomes, path coefficients, standard errors, and t-statistics are detailed in Table 7 and Fig. 2.

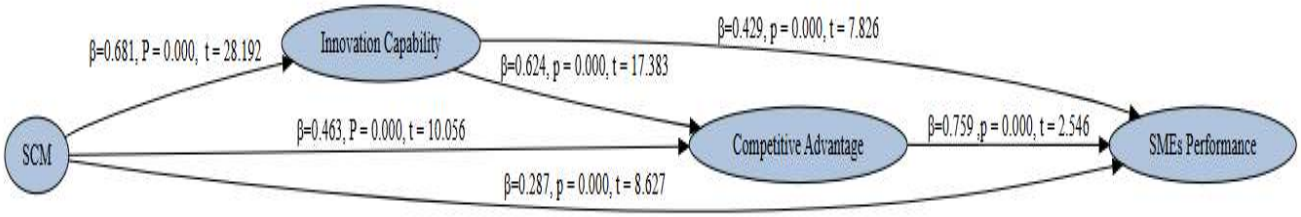


Table 7: Direct relationships of constructs

Direct relationships	Original Est.	Bootstrap Mean	Bootstrap SD	T Stat.	2.5% CI	97.5% CI	Bootstrap P Val	Result
SCM -> INN	0.693	0.695	0.008	18.192	0.891	0.923	0.000	supported
SCM -> COM	0.458	0.460	0.036	10.056	0.297	0.429	0.000	Supported
SCM -> PRS	0.379	0.383	0.044	8.627	0.289	0.463	0.000	Supported
INN -> COM	0.626	0.624	0.036	17.382	0.554	0.688	0.000	Supported
INN -> PRS	0.428	0.429	0.055	7.826	0.324	0.538	0.000	Supported
COM -> PRS	0.758	0.759	0.064	2.546	0.036	0.287	0.000	Supported

The results indicate statistically significant direct effects: Supply chain management practices (SCMP) has a significant positive effect on firms innovation capability (Inn) (β = 0.695; t = 18.192; p < 0.001), supporting Hypothesis **H_1**; supply chain management practices (SCMP) demonstrates a significant positive influence on firms competitive advantage (COM) (β = 0.460; t = 10.056; p < 0.001), thereby supporting Hypothesis **H_2**; supply chain management practices (SCMP) also exhibits a significant positive impact on firms performance (PRS) (β = 0.383; t = 8.627; p < 0.001), confirming **H_3**; firms innovation capability has a positive and significant effect on firms competitiveness (COM) (β = 0.624; t =17.382; p < 0.001), confirming hypothesis (**H_4**). Similarly, innovation capability demonstrates a significant positive influence on firms' PRS (β = 0.429; t = 7.826; p < 0.001), thereby supporting **H_5**. Furthermore, firms' (COM) also exhibit a significant positive impact on firms' PRS (β = 0.259; p < 0.001), confirming Hypothesis **H_6**. These findings are visually represented in Fig. 2, which illustrates direct effects within the theoretical framework. The strong statistical significance (p < 0.001) of these relationships underscores the robustness of the results and validates our proposed hypotheses.

Table 8: Indirect relationships of constructs

Indirect R/ship	*Original Est.*	*Bootstrap Mean*	*Bootstrap SD*	*T Sta.*	*2.5% CI*	*97.5 % CI*	*Bootstrap P Val*	*Result*
SCMP -> INN -> COM	0.569	0.567	0.032	17.630	0.503	0.625	0.000	Supported
SCMP -> COM -> PRS	0.458	0.457	0.024	2.399	0.013	0.107	0.000	Supported
SCMP -> INN -> PRS	0.388	0.389	0.050	7.779	0.294	0.490	0.000	Supported
INN -> COM -> PRS	0.402	0.403	0.040	2.565	0.024	0.180	0.000	Supported
SCMP -> INN -> COM -> PRS	**0.728**	**0.739**	**0.037**	**2.506**	**0.013**	**0.160**	**0.014**	**Supported**

Mediation relationship

To test the mediating effects and relationship of SCMP on COM, INN, and PRS, we first examined the indirect effects of SCMP on COM through INN. The results indicated that SCMP had a positive and significant indirect connection with COM through INN (β = 0.567, t = 17.630; $p < 0.000$), supporting **H7**. Second, we measured the indirect effects of SCMP on PRS through COM. The outcomes showed that SCMP has a positive and significant indirect connection with PRS through COM (β = 0.457; t = 2.399; $p < 0.000$), supporting **H8**. Third, we measured the indirect effect of SCMP and PRS through INN. The result revealed that SCMP has a positive and significant connection with PRS (β = 0.389; t = 7.779; $p < 0.000$), supporting **H9**. Fourth, we measured the indirect effects of INN and PRS through COM. The result revealed that INN has a positive and significant connection with PRS (β = 0.403; t = 2.565; p < 0.000), supporting **H10**. Lastly, we measured the indirect effects of SCMP on PRS through INN and COM. The outcomes showed that INN has a positive and significant indirect connection with PRS through COM (β = 0.729; t= 2.506; p < 0.014), supporting **H11** (See Table 8).

4. Discussion

SCMP plays a critical role in shaping SMEs' performance, particularly through its impact on innovation capability and competitiveness. Firms that exhibit SCMP, such as strategic supplier partnership, customer relationship, information sharing, information quality, internal lean practices, and postponement, enhance innovation capability and competitive advantage to enhance SMEs' performance (financial and operational).

Innovation capability and competitive advantage, in turn, serve as a key mechanism through which SCMP indirectly influences SMEs' performance. When firms enhance their market position, status, and reputation due to their innovation capability and competitiveness, they can design new products and processes, enhance efficient, capable to produce different products, serve their customers on time, and they are also capability to deliver dependably. Thus, innovation capability and firms' competitive advantage act as mediating variables, bridging the relationship between SCMP and improved SME perf ormance. This explanation underscores the importance of fostering SCMP to enhance S MEs' performance.

This study investigated the relationships between SCMP, innovation capability, competitive advantage and SMEs' performance, with a particular focus on the sequential mediating role of innovation capability and firms' competitive advantage. The primary objective was to examine the direct connections between SCMP and SMEs' performance as well as to assess the mediating effect of innovation capability and SMEs' competitiveness on these relationships.

The findings indicate that the relationship between SCMP with INN; SCMP with COM; SCMP with PRS; INN with COM; INN with PRS; and COM with PRS is positive and significant in Tigray, Ethiopia, with the results achieving statistical significance at the 0.05 level using a two-tailed test, consistent with the findings of (Ali & Mallan, 2025; Duong Vu & Xuan Quynh, 2018; Isho et al., 2022; Jahed & Quaddus, 2022; Javid & Amini, 2023; Karia, 2024; Kenneth and Nguwasen, 2026; Niguse et al., 2025; Tukamuhabwa et al., 2023; Vukasović et al., 2021). The study revealed that SCMPs are more likely to experience higher innovation capability (Liu et al., 2024) and competitiveness (Kuncoro & Kusumawardhani, 2024; Pono & Munizu, 2021; Shahrokh et al., 2026). The study also revealed that innovation capability and competitive advantage affect SMEs' performance (Setyawati, 2026; Thanh et al., 2021; Vukasović et al., 2021). This finding supports the proposed hypotheses (H_1, H_2, H_3, H_4, H_5, and H_6), all of which were confirmed in this study.

In addition, the research demonstrated an indirect link between SCMP and SME performance, which is consistent with previous studies (Elfawal & Adel, 2021; Pono & Munizu, 2021; Ngatno et al., 2021; Ya-Juan Dong, 2024). Innovation capability and competitiveness were found to play a significant mediating role: SMEs that have

innovation capability and competitiveness are more likely to have a good market position and positively influence their performance. This confirms Hypotheses ***H_7, H_8, H_9, H_{10} and H_{11}***

The results are consistent with dynamic capability theory, which posits that DCV builds on a firm's ability to rapidly and constantly adapt, reconfigure, and innovate. This has led firms to build innovative capability, competitive advantage, and performance in a dynamic environment; innovation capabilities are always allied with change and improvements. These findings provide a deeper understanding of how innovation capability and competitiveness significantly influence the positive impact of SCMP on SMEs' performance in the Tigray region.

5. Contributions of the study

Theoretical contribution

This study addresses the existing gap in the literature and enriches our understanding of SCMP, innovation capability, competitiveness, and SMEs' performance. By applying RBV and DCV, it explores how SCMP affects SMEs' performance. The findings demonstrate that innovation capability and competitive advantage mediate the relationship between SCMP and SMEs' performance.

This study integrates RBV and DCV theory with SCMP frameworks, offering new insights into how SCMP enhances SMEs' performance and, in turn, enhances their sustainability.

Practical implications

Practically, this study offers valuable insights for SMEs in Tigray, Ethiopia, by identifying effective SCMP practices that enhance SMEs' performance and their productivity. This emphasizes the crucial role of SCMP in improving SMEs' outcomes, particularly through strategic supplier partnerships, customer relationships, information sharing, information quality, internal lean practices, and postponement. SMEs are encouraged to adopt SCMP to boost SMEs' innovation capability, competitive advantage, and performance, ultimately leading to greater efficiency and effectiveness. Training programs for SME owners and government experts should focus on enhancing SCMP to improve their performance.

The findings suggest that SCMP inspires and enhances SMEs' innovation capability and competitive advantage by focusing on product innovation, process innovation, market innovation, cost, quality, and differentiation, time to market, and delivery dependability. These are the core constructs that define and measure innovation capability and competitiveness in business operations frameworks, including market sensitivity, virtual integration, network collaboration, and process alignment, and improve SMEs' performance.

6. Conclusion

This research was conducted on SMEs operating in the manufacturing sector in the Tigray region. The aim was to study the effect of SCMP on the performance of enterprises: the mediating role of innovation capacity and competitive advantage. A total of six direct and five indirect hypotheses were tested using a structural equation model based on survey data collected from 395 SMEs. The empirical evidence supported all ten hypotheses.

The research results revealed that SCMP is crucial for the performance of SMEs. SMEs with strategic supplier partnerships, customer relationships, information sharing, information quality, internal lean practices, and postponement can enhance the performance of enterprises through innovation capability and competitive advantage through high efficiency and by implementing adaptable and flexible working processes to adapt to new changes. Additionally, innovation capability and competitive advantage positively and significantly mediate the relationship between SCMP and the performance of enterprises, suggesting that SCMP can be considered the forerunner of innovation capability and competitive advantage based on the results. The strong correlation between these factors indicates that firms that fail to build partnerships with suppliers, customer relationships, sharing information, and verifying its accuracy, internal lean practices, and postponement struggle to improve innovation capability (product innovation, market innovation, process innovation) and their competitive advantages in terms of quality, cost, flexibility, time to deliver, and delivery dependability, leading to an inability to sustain their business without combining these internal capabilities.

The research findings contribute to the supply chain management literature by demonstrating that supply chain management practice can indirectly impact the performance of enterprises (SMEs) in the manufacturing sector through innovation

capability and competitive advantage. Overall, these findings can help SME owners and managers understand how to enhance their supply chain, innovate, and create new opportunities for job creation, ultimately contributing to general economic growth.

Limitations and suggestions for future study

This study had several limitations and recommendations for future research. First, the study, conducted within the specific context of Tigray SMEs and generalized to another sector, might be difficult. Therefore, further research could apply this model to other sectors to examine its effect. Second, studies in developing countries are difficult to apply to other countries, especially developed countries, because of their different dynamics/conditions. Therefore, future researchers can be replicable, but with caution, by observing specific country-wise scenarios. Thirdly, while this study provided valuable insights, some limitations should be considered. For instance, individuals who responded via online methods may differ systematically from those who responded offline in terms of demographics, access to technology, or motivation to participate. These differences could introduce bias and affect the generalizability of the results. Despite efforts made to maximize response rates through reminders and multiple contact attempts, some eligible participants did not respond, which may further limit the extent to which the findings can be generalized to the broader population. Future research should aim to address these limitations by employing strategies such as weighting responses, imputing missing data, or conducting sensitivity analyses to assess the robustness of the findings.

Fourth, there is a need to focus on using the best scientific methods to measure SMEs' performance, such as observing the SCMP in manufacturing sectors by designing an interview-based study, which might provide a more in-depth understanding of the SCMP impact on SMEs' performance in Tigray, Ethiopia. Finally, more studies on IOT or AI could provide valuable insights. In the future, some intervening and mediating variables, such as human capital, TQM, government policy, environment turbulences, will be of interest to researchers.

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