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RESEARCH PAPER

Supply Chain Environmental Uncertainty, Competitive Advantage, and Operational Performance in Manufacturing Industry

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ABSTRACT

Goal: This study investigates the impact of Supply Chain Environmental Uncertainty (SCEU) on competitive advantage and operational performance in manufacturing companies. The mediating role of competitive advantage and the moderating role of supply chain environmental uncertainty in the relationship between competitive advantage and operational performance were examined.

Design/ Methodology/ Approach: This paper used quantitative approach to confirm the conceptual model. Data was collected through questionnaires from directors/operational managers in 121 large and medium-scale manufacturing companies in Southeast Sulawesi Indonesia. The analysis employs Generalized Structured Component Analysis (GSCA) to test the direct, mediating, and moderating effects of supply chain environmental uncertainty.

Results: The findings demonstrate a significant positive influence of supply chain environmental uncertainty on competitive advantage and operational performance. However, competitive advantage does not significantly affect operational performance. The study reveals that competitive advantage is perfect mediator between supply chain environmental uncertainty and operational performance, while supply chain environmental uncertainty is a moderating predictor between competitive advantage and operational performance.

Practical Implications: The research has implications for manufacturing company managers adapting to supply chain environmental uncertainty through supplier, customer, and technology considerations. It emphasizes the importance of adapting to supply chain environmental uncertainty to enhancing competitive advantage and operational performance in the manufacturing industry. Efforts to improve operational performance and strategically integrate competitive advantage should consider the business environment, including suppliers, customers, and technology.

Limitations: This research is limited to large and medium-scale manufacturing industries, hindering generalization to other industries, particularly small-scale ones. Additionally, researchers can consider additional contextual factors such as supply chain integration, supply chain agility, and total quality management.

Originality/Value: This study expands the theoretical framework of supply chain environmental uncertainty, competitive advantage, and operational performance through empirical testing of a theoretical model. The findings support the proposed model's validity and highlight the mediation role of competitive advantage and supply chain environmental uncertainty, providing a reference for future theory development and model building.

Keywords: Supply Chain Environmental Uncertainty; Competitive Advantage; Operational Performance; Manufacturing Industry.

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1. INTRODUCTION

Today's global competition in the manufacturing industry, the main challenge is environmental uncertainty, so can be assumed not individual enterprise competition, but supply chain competition. The failure of manufacturing organizations in Indonesia, in general, can be attributed to their inability to adapt to the challenges of supply chain management. The uncertainties within the supply chain pose significant obstacles, leading to inefficiencies and subpar operational performance. The rapidly changing business landscape, driven by complex consumer demands, technological advancements, and evolving economic trends, necessitates a proactive supply chain management approach. Therefore, organizations that fail to adapt and optimize their supply chain processes effectively to face the risk of lagging behind in terms of competitive advantage and overall performance (Chee, Boon-Itt, & Wong 2011, and Rua et al., 2018).

The manufacturing sector in Southeast Sulawesi Province assumes a strategic and vital role in regional economic development (Saragih, 2010). The fluctuating trends in the number of large and medium-sized manufacturing companies in Southeast Sulawesi from 2018 to 2022, for instance, there were 117 companies in 2018 as compared to 77 and 85 companies in 2019 and 2020 respectively. Subsequently, the number rose to 105 in 2021, and in 2022, it reached 121 companies, which piqued the researcher's interest to conduct a study on this phenomenon (Central Statistics Agency (CSA), 2022). These fluctuations can be attributed to environmental uncertainty, resulting in certain companies' temporary or permanent closure, reclassification as small-scale industries, and the emergence of new competing enterprises.

This study highlights the intriguing phenomenon of the value-added production obtained from large and medium-scale manufacturing industries in Southeast Sulawesi also exhibited fluctuation. In 2018, the value-added production was IDR. 12.15 trillion, which increased to IDR. 12.76 trillion in 2019. However, there was a decline in IDR 10.29 trillion in 2020, followed by an increase to IDR 12.95 trillion in 2021 and further rising to IDR 14.34 trillion in 2022 (Central Statistics Agency (CSA), 2022). The fluctuating trends in the number of companies and production value have generated interest in conducting a study on this phenomenon. There are indications that these fluctuations may be caused by the environmental uncertainty and the insufficient attention given to SCEU by manufacturing companies, which can have implications for their competitiveness and performance. Hence, further investigation and research are needed to gain a deeper understanding of the underlying factors and their impact on the manufacturing sector in Southeast Sulawesi, Indonesia.

Building upon the Resource-Based View (RBV) theory, the current research aims to contribute to the development of manufacturing companies by exploring how to allocate limited resources among specific production factors in a manner that enhances competitive advantage. Competitive advantage in manufacturing companies can be achieved through the management of valuable, rare, and non-substitutable resources (Barney, 2015). Furthermore, within the RBV theory, strategic management of companies necessitates the ability to adapt to environmental uncertainty, ultimately driving competitiveness and improving social and economic outcomes (Chen et al., 2005). However, criticisms of the RBV perspective often overlook the critical factors imposed by the environment (Hart & Dowell, 2011). The debate surrounding environmental uncertainty prompted studies focusing on company adaptability and strategies to address uncertainty for enhanced competitiveness and performance. In a competitive environment, companies face pressure to enhance competitiveness, leading to evolving sources of competitive advantage (Porter & Kramer, 2006).

Previous studies in various sectors, conducted by Milad (2019), Tarek (2020), Astuty, Pasaribu, Rahayu, & Habibie (2021), Zhao, Noordin, & Sondoh (2022), Koç, Delibaş, & Anadol (2022), and Hatani (2023) found a significant positive impact of environmental uncertainty on competitive advantage. However, Bagur-Femenías, Martí, & Rocafort (2015) reported no significant influence. Based on the analysis of 21 reviewed studies (see Table 1), stated a disparity regarding the impact of environmental uncertainty on firm performance. Out of these studies, 15 researchers found a significant positive influence, while 3 researchers identified a negative impact (Fernandes & Solimun, 2017b; Hee, 2017; Francis, Sharma, Gaur, & Ueno, 2018). Additionally, 2 researchers reported no significant influence (Fernandes & Solimun, 2017a; Inman & Green, 2022), and 1 researcher found a negative and non-significant effect (Beatriz & Barba-Sánchez (2018).

The majority of previous studies have demonstrated a significant positive relationship between competitive advantage and firm performance, as observed in studies by (Kiyabo & Isaga, 2019; Silvia & Fabio, 2020; Zhao et al., 2022; Wongsansukcharoen & Thaweepaiboonwong, 2023; Yuwanda et al., 2023). Conversely, studies by Astuti, Suhadak,

Rahayu, & Wilopo (2018), Beatriz & Barba-Sánchez (2018), and Pratami Wulan & Raharja (2019) found a non-significant negative impact of competitive advantage on operational performance. While several studies have explored SCEU and operational performance in Manufacturing Industry independently, few have delved into the potential mediating role of Competitive Advantage, particularly in the context of the manufacturing industry in Indonesia.

The current study empirically evaluates a theoretical model and previous research findings. It designs an alternative model and develops the supply chain environmental uncertainty into sub-variables (supplier uncertainty, demand/customer uncertainty, and technology uncertainty) adapted from (Hatani, 2023, Kim & Choi, 2016, Tarek, 2020, and Zhao et al., (2022). The competitive advantage variables (price competition, delivery dependence, product innovation, and time to market) are adopted from Silvia & Fabio Cassia (2020), Kiyabo & Isaga (2019), and Zhao et al. (2022). The operational performance variables (cost-effectiveness, production quality, and production flexibility) are adapted from Allegrini & Monteduro (2018) and Hee, (2017), aiming to bridge the literature gap, and provide a foundation for future research in the development of the research model. Despite the criticality of the issue, there's a dearth of research investigating how different SCEU adopted by the manufacturing industry in Indonesia specifically impact operational performance in the Manufacturing Industry and how competitive advantage might bridge the gap.

Environmental uncertainty impacts on competitive advantage and company's performance are still debatable, presenting an intriguing research opportunity. Hence, this study evaluates the theoretical models and previous research findings, as well as designs an enhanced model of SCEU to contribute to the theoretical literature and bridge the research gap. Consequently, this study addresses these research questions: RQ1. Does manufacturing companies' high level of SCEU adaptation have a significant impact on competitive advantage and operational performance? RQ2. Does competitive advantage influence the operational performance of manufacturing companies? RQ3. Does competitive advantage mediate the relationship between SCEU and operational performance, and does SCEU moderate the impact of competitive advantage on operational performance? Hopefully, this will contribute towards the understanding of how manufacturing companies adapt and strategize in response to supply chain environmental uncertainty, with the ultimate goal of enhancing competitive advantage and performance.

2. LITERATURE REVIEW

The research model is based on the Natural Resource-Based View theory (NRBV), which critiques the resource-based view theory by Barney, (2015) for its limited focus on internal resources. Hart (1995) argues that sustainable competitive advantage requires aligning internal resources with the external environment. The NRBV theory as proposed by Hart (1995), emphasizes the utilization of both internal and external resources. Hart & Dowell (2011) further emphasize the importance of integrating external resources to achieve competitive advantage. Porter (2009) highlights the significance of considering both internal and external factors for company performance and competitive advantage.

2.1 Supply Chain Environmental Uncertainty (SCEU)

SCEU refers to a company's ability to anticipate environmental changes from both internal and external sources that impact strategic decisions, resource availability, information, organizational structure, and performance (Frank et al., 2017). Uncertainty in technology, regulations, and social expectations are inevitable characteristics of the business environment (Francis et al., 2018). While supply chain environmental uncertainty has been extensively studied, there are variations in how it is measured and conceptualized (Frank et al., 2017). Supply chain flexibility is influenced by the uncertainty in production processes and demand, which are key considerations in supply chain environmental uncertainty (Ulf Merschmann & Ulrich, 2011). Environmental uncertainty leads to a company's inability to predict conditions resulting from uncertain internal and external factors (Rasi et al., 2019). The factors of environmental uncertainty (supply, demand, and technology) and the three components of supply chain integration (supplier and customer) have significant but different effects on supply chain integration components (Xu & Long, 2021).

Increasing environmental uncertainty creates higher interdependence among supply chain partners within the resource-based view approach (Paulraj & Chen, 2007). Environmental uncertainty, especially in the supply chain, poses both opportunities and threats to a company's competitive advantage and operational performance Poulis and Wisker (2016). This research focuses on the internal and external dimensions of environmental uncertainty, namely suppliers, customers/demand, and technological uncertainty. It emphasizes the importance of

considering upstream (supply uncertainty) and downstream (demand/customer uncertainty) supply chain uncertainty, along with technological development, for effective supply chain implementation.

Empirical studies consistently demonstrate a significant positive influence of environmental uncertainty on competitive advantage and firm performance. For instance, Tarek (2020), Astuty et al. (2021), Laguir et al., (2022), Zhao et al., (2022), Koç et al. (2022), and Hatani (2023) found a significant positive influence environmental uncertainty and competitive advantage. Conversely, Bagur-Femenías et al. (2015) reported no significant influence. In terms of firm performance, Kafetzopoulos et al. (2019), Amit & Gupta (2020), Aisjah & Prabandari (2021), Ahammad et al. (2021), Laguir, Modgil, et al. (2022), Pashutan et al. (2022), Min & Kim (2022), Zhao et al., (2022) found a significant positive impact of environmental uncertainty. However, Beatriz & Barba-Sánchez (2018), and Inman & Green (2022) found no significant influence, while Hee (2017). Francis et al., (2018) reported a negative influence. Furthermore, Fernandes & Solimun (2017b), found both a negative and non-significant relationship between environmental uncertainty and business performance. Previous research findings on the impact of environmental uncertainty on competitive advantage and firm performance have yielded inconsistent results. While some studies have found a negative and non-significant influence, the majority suggest a positive and significant effect. Addressing this debatable nature, this study proposes the following hypotheses:

Hypothesis 1: Higher levels of adaptation to SCEU significantly enhance the competitive advantage of manufacturing companies.

Hypothesis 2: Higher levels of adaptation to SCEU significantly improve the operational performance of manufacturing companies.

Table 1 - Review of Research Gaps

Research Gaps		Authors (year)	Findings
Gaps 1. SCEU Competitive Advantage	→	Harash (2015), Poulis and Wisker (2016), Agnes Aryani & Anni Aryani (2016), Kim & Choi (2016), Beatriz & Barba-Sánchez, (2018),Milad. (2019), Tarek (2020), Astuty et al. (2021), Laguir et al., (2022), Zhao et al., (2022), Koç et al. (2022), and Hatani (2023).	+ Significant
		Bagur-Femenías et al. (2015)	Not significant
Gaps 2. SCEU operational performance	→	Harash (2015), Poulis & Wisker (2016), Agnes & Anni Aryani (2016), Allegrini & Monteduro (2018), Mahlagha et al. (2018), Hengky et al., (2018), Haruna Isa M. (2019), Kafetzopoulos et al. (2019), Amit & Gupta (2020), Aisjah & Prabandari (2021), Ahammad et al. (2021), Laguir, Modgil, et al. (2022), Pashutan et al. (2022), Min & Kim (2022), Zhao et al., (2022), and Hatani (2023).	+ Significant
		Fernandes & Solimun (2017), Hee (2017). Francis et al., (2018), Beatriz & Barba-Sánchez (2018), Inman & Green (2022).	Negative not significant
Gaps 3. Competitive Advantage operational performance	→	Hatani et al. (2016). Famiyeh (2017), Priyanka et al. (2017), Juan (2017), Sigalas & Papadakis (2018), Potjanajaruwit (2018), Anwar et al. (2018), Rua et al. (2018), Kiyabo & Isaga (2019), Silvia & Fabio (2020), Yuniarta *et al.* (2020), Indra & Isyanto, (2021); Zhao et al. (2022), Wongsansukcharoen & Thaweepaiboonwong (2023); Hatani (2023): and Yuwanda et al., (2023).	+ Significant
		Heredia & Alejandro (2017), Astuti et al. (2018), Beatriz & Barba-Sánchez (2018), and Pratami & Raharja (2019),	Negative not significant
Gaps 4. SCEU → Competitive advantage → operational performance			
Bagur-Femenías *et al.* (2015), Zhao et al., (2022), and Hatani, (2023).(Harash, 2015)			Partial & Complete Mediation
Beatriz & Barba-Sánchez (2018)			Not Mediation

Source: Author, 2023

2.2 Competitive Advantage and Operational Performance

Competitive advantage plays a crucial role in the success of the manufacturing industry by enabling organizations to develop strategies to maintain their position against competitors

(Porter, 2009). It is a multidimensional concept that relates to the long-term performance of a company in relation to its rivals (Kaplan & Norton, 2007). This study focuses on the significance of competitive advantage in obtaining a favorable competitive position and enhancing operational performance in the manufacturing industry. Operational performance of manufacturing companies encompasses strategic capabilities such as cost efficiency, product performance improvement, and production flexibility (Krajewski et al., 2019). Additionally, competitive advantage is a multidimensional concept that ultimately relates to the long-term performance of a company with its competitors (Man et al., 2002). Consistent with opinions by Raharja (2017), that strategy is very important for companies to be able to compete with other companies based on company performance both internally and externally. Thus, competitive advantage is assumed to be the ability to synergize the company's strategy with internal competitors and external opportunities, as well as adjust the strategy to the environment in which the company competes. In perspective with Yang et al. (2018), competitive priorities are reflected in lower costs, improved quality, enhanced delivery performance, speed and reliability, and flexibility. Therefore, the dimensions used to measure competitive advantage in this study are: (a) price competition, (b) delivery speed or reliability, (c) product innovation, and (d) time-to-market (Ali et al., 2024; Do et al., 2020; Hatani, 2023; Zhao et al., 2022).

This research study focuses on strategic competitive advantage, a crucial factor for achieving a favorable competitive position and enhancing operational performance in the manufacturing industry. Previous findings indicate a significant positive impact of competitive advantage on operational performance, including cost-effectiveness, product performance, and production flexibility (Pashutan et al. (2022), and Laguir Gupta, et al. (2022). However, there is a lack of consensus among researchers regarding the relationship between these variables. Some studies Silvia & Fabio (2020), Yuniarta *et al.* (2020), Zhao et al., (2022), Wongsansukcharoen & Thaweepaiboonwong, (2023); and Yuwanda et al., (2023) support a positive and significant influence, while others Heredia & Alejandro (2017), Astuti et al. (2018), and Pratami & Raharja (2019), suggest a non-significant or negative effect. This discrepancy may be attributed to differences in measurement indicators and the scope of competitive advantage and firm performance. Based on the prior arguments, more hypotheses are purposed:

Hypothesis 3. Higher competitive advantage positively impacts the operational performance of manufacturing companies.

2.3 Mediating Role of Competitive Advantage and Moderating Role of SCEU

Based on the NRBV theory and contingency perspective, firms are seen as resource bundles capable of adapting to environmental uncertainty to achieve competitive advantage and operational performance (Hart, 1995). The interaction between different resources can enhance a firm's competitiveness if they possess economic value and are utilized effectively (Porter, 2009). Therefore, this study integrates SCEU as a crucial factor influencing competitive advantage and operational performance in the manufacturing companies, both directly and indirectly through moderation and mediation effects.

This study explores the influences of SCEU, competitive advantage, and operational performance in the context of manufacturing firms. Previous research, conducted by Bagur-Femenías et al. (2015), Zhao et al., (2022), and Hatani, (2023), supports the mediating role of competitive advantage in the relationship between environmental uncertainty and firm performance. However, Beatriz & Barba-Sánchez (2018) present contrasting findings, suggesting that competitive advantage may not serve as a mediator. Additionally, Yu et al. (2017) found that environmental uncertainty moderates the effects of supply chain integration on operational performance, while Koufteros et al. (2005) did not find significant moderation effects. These divergent findings underscore the need to investigate the mediating role of competitive advantage and the moderating role of SCEU on operational performance. Therefore, these hypotheses are put forward:

Hypothesis 4. High levels of competitive advantage mediate the relationship between SCEU and operational performance in manufacturing companies.

Hypothesis 5. The degree of SCEU adaptation moderates the relationship between competitive advantage and operational performance in manufacturing companies.

Based on empirical evidence in Table 1, this study aims to investigate and understand the relationships among SCEU, competitive advantage, and operational performance, as depicted in Figure 1. The study seeks to develop and propose alternative models based on empirical findings within the scope of this research.

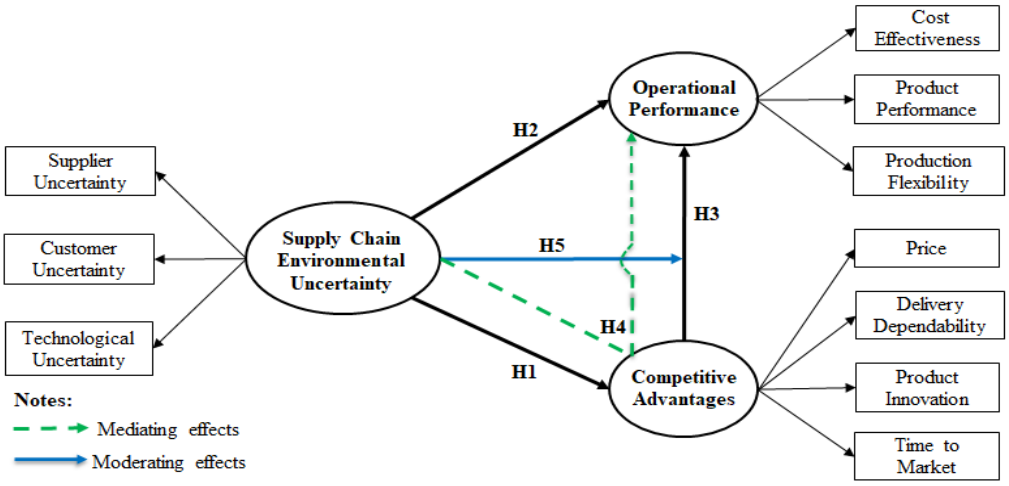

Figure 1- Research framework and conceptual basic model

3. RESEARCH METHODOLOGY

This study is a positivist study that adopts a quantitative approach to confirm the conceptual model. It is applied research that uses causal methodology to test hypotheses and explain variable relationships based on theory and data. The aim is to provide explanations and select alternatives within an explanatory research framework (Ferdinand, 2014 and Schindler, 2014). This research utilized a survey method involving the distribution of questionnaires to collect data. The survey method allows for capturing the respondents' current conditions (Sekaran and Bougie, 2016). The research surveyed directors and operational or supply chain managers who possess a comprehensive understanding of the company's policies related to supplier environmental uncertainty, competitive advantage, and operational performance. The study targeted medium and large-scale manufacturing industries, classified according to the International Standard Industrial Classification of All Economic Activities (ISIC) and the Indonesian Standard Classification of Economic Fields (KBLI), which is continuously adjusted and modified to suit the local conditions in Southeast Sulawesi Province.

3.1 Population, Respondent and Data Collection

According to the directory of medium and large-scale manufacturing companies in Southeast Sulawesi Province, the number of such companies fluctuated over the past five years (2018-2022). In 2018, there were 117 companies, which decreased to 77 in 2019 and increased to 85 in 2020. Subsequently, in 2021, the number rose to 105, and in 2022, it reached 121. This fluctuation can be attributed to supply chain environmental uncertainty, leading to temporary or permanent closure of some companies, reclassification as small-scale industries, and the emergence of new competing enterprises. The classification of manufacturing companies into medium and large-scale industries is based on the business scale determined by the Ministry of Industry. Medium-scale companies employ up to 19 workers and have an investment value of at least one billion rupiahs, or employ at least 20 workers with an investment value of up to fifteen billion rupiahs. Large-scale companies employ at least 20 workers and have an investment value exceeding fifteen billion rupiahs (Central Statistics Agency (CSA), 2022).

Therefore, the target population for this study comprises directors, operational managers, and supply chain/logistics managers who represent the management level of manufacturing companies. The population is derived from the directory data of medium and large-scale manufacturing companies in Southeast Sulawesi Province, classified according to the 2-digit KBLI code, as shown in Figure 2, and the field of business.

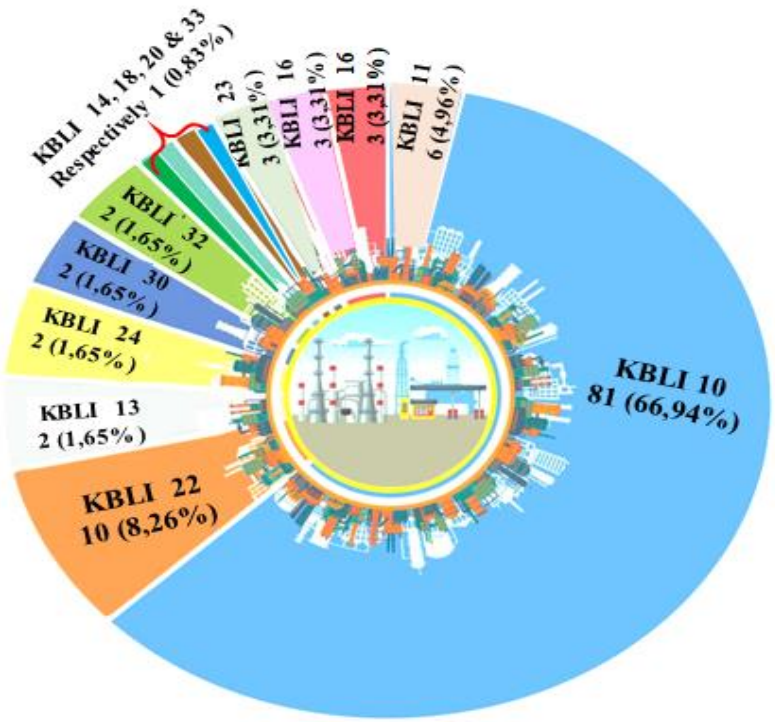

Figure 2 - Distribution of Large and Medium Manufacturing Companies in 2-digit KBLI

The data collection method employed in this study was a survey using a questionnaire. Out of the 121 visited companies, only 107 companies at the management level agreed to complete the questionnaire. Additionally, researchers encountered difficulties accessing 9 companies due to lack of permission from the company's management. Furthermore, 5 companies provided incomplete responses to the questionnaire. As a result, the analysis was based on data collected from 107 respondents, representing a response rate of 88.43 percent.

3.2 Measurements of Variables

Based on theoretical analysis and previous research findings, the operational definition, measurement, and questionnaire design for each research construct are as follows: First, SCEU is measured by dividing the scale into three dimensions: supply chain uncertainty, customer or market demand uncertainty, and technological uncertainty based on scales developed by Kim & Choi (2016), Rua et al. (2018), Milad. (2019), Koç et al. (2022), and Hatani (2023). Second, the measurement of competitive advantage includes four dimensions: price, delivery reliability, product innovation, and time to market, adopted from previous research by Priyanka et al. (2017), Kiyabo & Isaga (2019), Silvia & Fabio (2020), Zhao et al., (2022), and Hatani (2023). Thus, the study assesses competitive advantage through four variable dimensions and 12 statement items. Third, Operational performance can be defined as the manufacturing industry's ability to achieve cost efficiency, product performance improvement, and production flexibility. In this study, three dimensions are used to measure the operational performance of companies: cost effectiveness, product performance/quality, and production flexibility, adapted from Poulis & Wisker (2016), llegrini & Monteduro (2018), and Tiep Le et al. (2021) consisting of three variable dimensions and 11 items.

The questionnaire design for this research is based on a combination of five-point Likert scale. Therefore, the measurement of SCEU, competitive advantage, and operational performance variables is conducted in the large and medium-scale manufacturing industry in Southeast Sulawesi Province. Respondents in this study are managers, owners, and senior staff who indicate their agreement or disagreement with each statement. A five-point Likert scale is used: 1 = strongly disagree/poor, 2 = disagree, 3 = disagree or neutral, 4 = agree/good, and 5 = strongly agree/good, adopted from (Sekaran and Bougie, 2016). The questionnaire is divided into four main sections: basic data (company and respondent profile), SCEU, competitive advantage and operational performance.

3.3 Data Analysis Method

This study utilizes Generalized Structured Component Analysis (GSCA) as the data analysis

method. GSCA, developed by Hwang & Takane (2015), is an alternative to Structural Equation Modeling (SEM) that addresses its weak theoretical foundations and provides theoretical confirmation. Traditionally, there are two approaches to SEM modeling: (1) Covariance-based Structural Equation Modeling, implemented in software such as LISREL, AMOS, EQS, and Mplus, and (2) Partial Least Squares (PLS), implemented in software like Smart-PLS, VisualPLS, LVPLS, and PLS-Graph. Recently, a third approach, GSCA, has been introduced and applied using the GSCA software (Hwang, et al. 2010). According to Hwang & Takane (2015), GSCA consists of three elements: (1) a way to determine the linear model, (2) optimization criteria, and (3) an algorithm to obtain estimates. The goal of GSCA is to replace factors with linear combinations of indicators (manifest variables) in SEM. Singularities and multicollinearity issues often pose serious challenges in covariance-based SEM analysis. Hwang, et al. (2010) state that GSCA allows for the presence of multicollinearity, which refers to strong correlations among exogenous variables. GSCA analysis measures the fit of the measurement model, structural model, and overall model, providing a combined measure of goodness of fit between the measurement and structural models.

4. DATA ANALYSIS RESULT

The profiles of respondents were directors and managers in large and medium-scale manufacturing companies currently operating in the Southeast Sulawesi Province. The majority of the respondents were male (78.50%), with a significant proportion falling between the ages of 33-45 years (47.66%). Most respondents had over 10 years of work experience (73.83%) and held a bachelor's degree (61.68%). The majority of companies had a workforce size ranging from 22-99 employees (57.01%). In terms of management level, the majority of respondents were operational/production managerial positions (62.62%). See Table 2 for further details.

Table 2 - Profile of the respondents

Characteristics Respondents	% responses	Characteristics Respondents	% responses
Gender		**Age (years):**	
Male	78.50	21 – 32	31.78
Famale	21.50	33- 45	47.66
Education:		46-58	20.56
Diploma	22.43	**Work history (years):**	
Bachelor	61.68	4 - 10	26.17
Magister	15.89	11 - 20	58.88
Position of respondents:		21 - 32	14.95
Directors/general managers	21.50	**Number of employees:**	
Operational/production manager	62.62	22-99	57.01
Supply chain/logistics managers	15.89	100-347	42.99

Notes: n =107

4.1 Variable Description and Measurement Model Evaluation

Survey results conducted with directors and managers of large and medium-scale manufacturing companies in the Southeast Sulawesi Province, presented in Table 3, indicate that the majority of respondents perceived SCEU to be good, with a mean score of 3.81. This suggests that the anticipation of SCEU in manufacturing companies, reflected through changes in supplier uncertainty, customer/demand uncertainty, and technological uncertainty, is well implemented. Furthermore, based on the empirical findings, the majority of respondents perceive competitive advantage to be good, as indicated by a mean score of 3.70. This reflects respondents' positive views on competitive advantage, encompassing price competition, delivery reliability, product innovation, and time to market. Respondents rated product innovation highest, followed by delivery reliability, price competition, and time to market, indicating the competitive nature of product innovation compared to competitors. In terms of operational performance, respondents perceive it to be good, with a mean score of 3.81. Respondents rated the improvement in product performance highest, followed by cost efficiency, and flexibility of production, indicating the achievement of high-quality production that meets customer needs, produces low-defect and reliable products, and satisfies customer.

The empirical model evaluation using GSCA in this study involved two stages: (1) Evaluation of the measurement model, which included assessing discriminant, convergent, and composite

reliability (alpha), and (2) Evaluation of the structural and overall model using fit indices such as FIT, AFIT, GFI, and SRMS, as follows:

1. Measurement Model Evaluation

Three criteria were used to evaluate and assess the measurement model in this study, as explained below:

a. **Discriminant Validity,** was evaluated by examining the square root of the AVE ($\sqrt{\text{AVE}}$). Table 3 results of discriminant validity testing for the reflectively measured variables based on $\sqrt{\text{AVE}}$ values. The data analysis results show $\sqrt{\text{AVE}}$ values ranging from 0.952 to 0.986 (SCEU = 0.968, CA = 0.976, OP = 0.952, and moderating variables UESC*CA = 0.986). Therefore, all tested latent variables demonstrate that $\sqrt{\text{AVE}}$ values exceed the correlation between each pair of variables, indicating satisfactory levels or good discriminant validity (Hair et al., 2017).

Table 3 - Resuts of discriminant validity

Variables	Means	S.D.	$\sqrt{\text{AVE}}$	SCEU	CA	OP	M (SCEU*CA)
SCEU	3.81	0.72	0.928	1	0.932 (0.020)*	0.943 (0.026)*	0.965 (0.007)*
CA	3.70	0.77	0.876	0.932 (0.020)*	1	0.920 (0.028)*	0.971 (0.006)*
OP	3.81	0.70	0.922	0.943 (0.026)*	0.920 (0.028)*	1	0.929 (0.024)*
M (SCEU*CA)	14.563	4.887	0.926	0.965 (0.007)*	0.971 (0.006)*	0.929 (0.024)*	1

Notes: * significant at .05 level; SCEU = Supply Chain Environmental Uncertainty, CA= Competitive Advantage, OP = Operational Performance, M (SCEU*CA) = Moderating (SCEU*Competitive Advantage).

As shown in Table 3, the mean, discriminant validity, and theoretical correlations of all latent variables are presented. The bivariate correlations between SCEU, CA, OP, and M (SCEU*CA) range from 0.920 to 0.971 with significance at the $\rho < 0.05$ level, indicating acceptable validity criteria. Furthermore, the $\sqrt{\text{AVE}}$ values for all latent variables exceed the correlation between each pair, indicating a very good level of discriminant validity. Based on the evaluation of the local model fit measures or the measurement model in this study, it can be concluded that the measurement model, evaluated based on discriminant, composite reliability, and convergent validity meets the criteria and demonstrates high fit and reliability.

b. **Composite Reliability (Alpha),** the reliability of variables was evaluated using composite reliability (alpha). The data analysis results in Table 4 show that the alpha values for the latent variables range from 0.895 to 0.984 (SCEU = 0.919, CA = 0.895, OP = 0.907, and moderating variables UESC*CA = 0.984). The evaluation of composite reliability (based on alpha values) for each reflectively measured construct indicates that the criteria are met, as the composite reliability values exceed 0.70 (Hair et al., 2017). Therefore, the composite reliability test results for all latent variables ≥ 0.70 indicate adequate reliability of the measurement scale, which is acceptable.

c. **Convergent Validity**, measures the validity of indicators as latent variables, indicated by the estimated factor loadings. The evaluation of convergent validity for each measurement scale was conducted using estimated factor loadings (for SCEU, CA, OP, and the moderation variable UESC*CA). Table 3 shows that all indicators for their respective latent variables are statistically significant ($\rho < 0.05$), with estimated factor loadings ranging from 0.844 (CA4, time-to-market indicator) to 0.951 (SCEU1*CA1, interaction between supplier uncertainty and price indicator). These results suggest strong convergent validity of the theoretical latent variables. Additionally, the Average Variance Extracted (AVE) values for all latent variables exceed the recommended cutoff of 0.50, indicating strong convergent validity. This implies that the correlations among all indicator variables of the latent variables (EUCM, CA, OP, and SCEU * CA) are positive and significant, reflecting the tested constructs in the research model.

2. Evaluation goodness of fit structural and overall model

Results of data analysis in this study, presented in Figure 3, allow for the evaluation of the goodness of fit of the structural model using FIT and AFIT. Additionally, the overall model evaluation is indicated by GFI and SRMS, explained as follows:

1. Measure goodness of fit of the structural model: Based on the data analysis results, the evaluation of the goodness-of-fit test for the structural model in this study is as follows:
   a. FIT value = 0.779, indicating that the model formed in this study can explain 77.90% of the analyzed variables. Therefore, the variability of SCEU, CA, OP, and the moderation variable (SCEU * CA) can be explained by this research model is 77.90%, while remaining 22.10% is explained by other variables outside the research model. From the FIT value, it can be concluded that this research model has excellent accuracy as it exceeds 75%.
   b. AFIT value represents adjusted FIT, considering that there is not only one variable affecting the operational performance of the company in this study. Furthermore, the testing of the influence between variables occurs hierarchically, both directly and indirectly, through the mediation of CA and the moderation of the variable SCEU*CA. Therefore, it is better to interpret the model's accuracy using Adjusted FIT. The data analysis results show an AFIT value of 0.770, meaning that the proportion of variability in SCEU, CA, OP, and the moderation variable SCEU*CA explained by the model is 77%. Thus, the obtained Adjusted FIT value indicates that the formed model has excellent accuracy.
2. Measure goodness of fit of the overall model: Through GSCA analysis, the evaluation of the goodness-of-fit of the overall model is conducted using GFI and SRMS. The data analysis results show a GFI value of 0.996, significantly above the recommended threshold of 0.90. This indicates that the formed model can be considered appropriate or very good. However, the SRMR value of 0.574 > 0.1 indicates poor fit. This condition arises due to the uncertain measurement directions between variables and the complexity of the model.

Table 4 - Results of the Mean, Latent Variables' Measurement, and Convergent Validity

Laten Variables (source)	Indicator and measurement items	Mean	Loading		AVE	Alpha
			Estimate	CR		
SCEU. Supply Chain Environmental Uncertainty (Laguir et al., 2022; Zhao et al., 2022; Milad. 2019)	**SCEU1. Supplier Uncertainty (SU):**	**3.68**	0.946	47.14*	0.686	0.848
	SU1. Suppliers performance quality is unpredictable	3.56	0.860	18.13*		
	SU2. Types of raw materials from suppliers vary	3.82	0.872	30.14*		
	SU3. Use of technology from suppliers is unpredictable	3.72	0.677	6.45*		
	SU4. Suppliers' delivery time can easily go wrong.	3.64	0.887	23.37*		
	SCEU2. Customer Uncertainty (CU):	3.84	0.898	25.14*	0.722	0.809
	CU1. Customers often change their order with different product	3.79	0.859	19.91*		
	CU2. Anticipation information the sale of low products	3.93	0.842	13.64*		
	CU3. Customers' product preferences change over month	3.80	0.848	20.9*		
	SCEU3. Technology Uncertainty (TU):	3.92	0.940	50.24*	0.702	0.787
	TU1. Using core production technologies that often change	4.05	0.896	20.96*		
	TU2. Competitive advantage can be obtained because of technological changes	3.84	0.753	12.34*		
	TU3. Changes in technology can many new products	3.87	0.859	19.01*		
CA. Competitive Advantage (Ali et al., 2024; Hatani, 2023; Zhao et al., 2022; Kiyabo & Isaga, 2019).	**CA1. Price competition (Pr):**	**3.73**	0.882	23.27*	0.835	0.900
	Pr1. Achieve/maintain lowest production cost.	3.79	0.917	29.57*		
	Pr2. Offer competitive prices.	3.65	0.938	34.76*		
	Pr3. Able offer prices as low/lower than our competitors.	3.74	0.886	19.61*		
	CA2. Delivery Dependability (DD):	**3.70**	0.894	26.61*	0.732	0.813
	DD1. Provide reliable delivery to we customers	3.70	0.778	6.52*		
	DD2. Deliver customer order on time.	3.67	0.914	27.55*		
	DD3. Provide dependable products delivery.	3.73	0.869	32.64*		

Laten Variables (source)	Indicator and measurement items	Mean	Loading		AVE	Alpha
			Estimate	CR		
	CA3. Product Innovation (PI):	**3.82**	0.883	28.63*		
	PI1. Provide customized products.	3.82	0.930	45.4*		
	PI2. Alter our product offerings to meet client needs.	3.81	0.833	14.67*	0.816	0.889
	PI3. Respond well to customer demand for new features.	3.84	0.942	63.07*		
	CA4. Time to Market (TM):	**3.56**	0.844	22.34*		
	TM1. Deliver product to market quickly.	3.53	0.864	25.93*		
	TM2. Have time-to-market lower than industry average.	3.56	0.887	27.89*	0.715	0.797
	TM3. Have fast product development.	3.59	0.782	13.92*		
OP. Operational Performance (Roy & Satpath, 2019; Allegrini & Monteduro, 2018; Hee, 2017; Poulis and Wisker, 2016).	**OP1. Cost Effectiveness (CE):**	**3.84**	0.900	30.12*		
	CE1. Produce products with low costs	3.60	0.914	37.59*	0.822	0.890
	CE2. Produce products with low inventory costs	3.56	0.874	28.81*		
	CE3. Produce products with low overhead costs	4.36	0.931	46.98*		
	OP2. Product Performance (PP):	**3.76**	0.928	33.55*		
	PP1. High performance products meet customer needs	3.75	0.884	25.39*		
	PP2. Produce consistent quality products with low defects.	3.81	0.906	36.85*	0.721	0.871
	PP3. Offer high reliable products meet customer needs.	3.68	0.812	6.37*		
	PP4. High quality products that meet customer needs	3.79	0.789	13.27*		
	OP3. Production flexibility (PF):	**3.84**	0.937	34.61*		
	PF1. Rapidly change production volume.	3.72	0.879	20.14*		
	PF2. Produce customized product features.	3.88	0.777	14.19*	0.676	0.836
	PF3. Product specifications within same facility	3.95	0.917	32.99*		
	PF4. Capability to make rapid product mix changes	3.82	0.699	5.26*		
Moderate variables (SCEU*CA)	SCEU1*CA1	3.78	0.951	66.80*		
	SCEU1*CA2	3.82	0.929	51.11*		
	SCEU1*CA3	3.82	0.930	46.99*		
	SCEU1*CA4	3.81	0.909	37.15*		
	SCEU2*CA1	3.84	0.913	46.05*		
	SCEU2*CA2	3.81	0.949	66.54*		
	SCEU2*CA3	3.82	0.918	40.70*	0.857	0.984
	SCEU2*CA4	3.86	0.895	31.86*		
	SCEU3*CA1	3.83	0.930	54.79*		
	SCEU3*CA2	3.88	0.926	47.30*		
	SCEU3*CA3	3.86	0.936	62.36*		
	SCEU3*CA4	3.82	0.922	39.96*		

Notes: CR* = significant at .05 level

4.2 Structural Model and Hypothesis Testing Result

This research model represents a simplified or abstracted version of the real-world system and phenomena of a complex problem. Structural Equation Modeling (SEM) based on the GSCA approach was used to analyze and empirically explain the influence between three latent variables: SCEU on CA and OP, both directly and indirectly through the mediating role of CA and the moderating variable SCEU in the manufacturing industry in Southeast Sulawesi. Based on

the conceptual framework, the researcher proposed a preliminary model based on the theoretical framework and previous research findings. Trial and error testing was conducted, referring to actual empirical facts. The data analysis and model testing based on the proposed conceptual framework using the GSCA approach are presented in Figure 3.

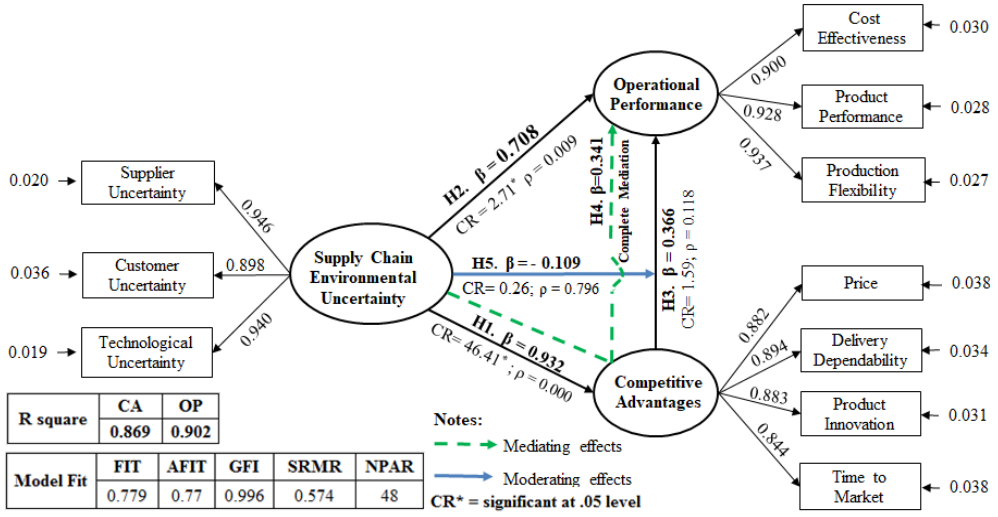

Figure 3- Research mode and hypothesis testing results

The model development with the highest Adjusted FIT value can be chosen as the better model and further developed. The aim is to analyze, evaluate, and assess the testing model according to more realistic empirical facts. The evaluation of the structural model based on the theoretical framework, as shown in Figure 3 and Table 5, indicates that SCEU has a significant positive influence on competitive advantage (β = 0.932 and ρ-value = 0.000 < 0.05), thus supporting H1. Similarly, SCEU positively and significantly influences on operational performance (β = 0.708 and ρ-value = 0.009 < 0.05), supporting H2. Interestingly, the path coefficient of GSCA reveals that competitive advantage does not have a significant influence on operational performance (β = 0.366 and p-value = 0.118 > 0.05), rejecting H3.

The testing of the mediating role of competitive advantage between SCEU and operational performance was conducted following the recommended procedure by Hair et al. (2017). First, the total effect and significance of the exogenous and endogenous variables were evaluated, as presented in Table 5. The data analysis results obtained from the GSCA output show that the mediating effect of competitive advantage on the influence between SCEU and operational performance (H4) is positive and significant (ß = 0.932 and ρ-value = 0.000 < 0.05). The direct effect of SCEU on operational performance is positive and significant (ß = 0.708 and ρ-value = 0.009 < 0.05). The path coefficient for the direct influence of competitive advantage on operational performance is positive but not significant (ß = 0.366, and ρ-value = 0.118 < 0.05). After including the mediating variable of competitive advantage, SCEU influence on operational performance through competitive advantage is positive and significant (ß = 0.341 and ρ-value = 0.000 > 0.05). Thus, it can be concluded that competitive advantage plays a perfect mediating role in the influence between SCEU and operational performance, supporting H4.

Table 5 - Summarizing path coefficients and hypothesis testing results

		Path Coefficients				Result	
Direct influence		**Estimate**	**SE**	**CR**	**ρ-value**		
H1.	SCEU → CA	0.932	0.020	46.41*	0.000	significant	Accepted
H2.	SCEU → OP	0.708	0.261	2.71*	0.009	significant	Accepted
H3.	CA → OP	0.366	0.230	1.59	0.118	not significant	Rejected
Indirect effect (Mediation)							
H4.	SCEU → CA → OP	0.341	0.086	3.956*	0.000	significant	Accepted
Indirect effect (Moderation)							
	SCEU → CA	0.932		46.41*	0.000	significant	Predictor
H5.	SCEU → OP	0.708		2.71*	0.009	significant	Moderati
	M (SCEU*CA) → OP	-0.109		0.26	0.796	not significant	ng

Notes: CR* = significant at .05 level; SCEU = Supply Chain Environmental Uncertainty; CA= Competitive Advantage; OP = Operational Performance, M (SCEU*CA) = Moderating (Supply Chain Environmental

Uncertainty *Competitive Advantage).

The results in Table 5 indicate that the moderating variable SCEU has a significant influence on competitive advantage and operational performance. However, the testing results show that the influence of SCEU moderation and competitive advantage on operational performance is negative and not significant, suggesting that the SCEU moderating variable acts as a predictor of moderation. Based on these findings, there is insufficient evidence (H5 rejected) to conclude that the moderating role of SCEU, which is the effectiveness of the interaction between SCEU and competitive advantage, has a negative and non-significant influence on operational performance. Therefore, the synergy between SCEU and competitive advantage does not significantly strengthen the influence on operational performance. The study also tests the structural model's goodness of fit by comparing FIT, AFIT, GFI, and SRMS between the proposed model (Figure 2) and the development model presented in Figure 3. EUSC is an exogenous variable, competitive advantage acts as a mediating variable, and EUSC*CA serves as a moderating variable. The path coefficients (GESCA) for EUSC towards competitive advantage and operational performance are significant. However, competitive advantage does not significantly impact operational performance, and the moderating variable EUSC*CA has a negative and insignificant effect on operational performance.

The GSCA test results presented in Table 6 indicate that the proposed model in Figure 3 has the highest FIT and Adjusted FIT values compared to the model developments in Figure 3. Hence, based on the theoretical framework, the proposed model is considered highly suitable for parameter estimation, measurement model evaluation, and assessment of structural and overall model goodness of fit. The evaluation of the six development model (DM) Table 6. DM1-DM6 shows excellent goodness-of-fit for both structural and overall models, with FIT and AFIT values above 60%. This indicates the accuracy and acceptability of the research model development, serving as a reference for future researchers, particularly in the manufacturing industry of all scales. The objective is to analyze a more realistic model, as emphasized by Hwang & Takane (2015) and Hair et al. (2017) in terms of the principles of elaboration, analogy, and dynamics.

Table 6 - Comparison of proposed models, and models development

Models	Model Fit			
	FIT	AFIT	GFI	SRMR
Figure 3. Proposed model based on theoretical framework	0.779	0.770	0.996	0.574
Development Models (DM):				
DM1. Additions constructs of second-order SCEU	0.657	0.642	0.914	0.354
DM2. Additions constructs of second-order CA	0.752	0.740	0.994	0.095
DM3. Additions constructs construct of second-order OP	0.728	0.717	0.995	0.085
DM4. Additions constructs of second-order SCEU and OP	0.667	0.651	0.929	0.318
DM5. Additions constructs of second-order CA and OP	0.732	0.718	0.994	0.096
DM6. Additions constructs of second-order SCEU, CA and OP	0.686	0.669	0.935	0.320

Notes: FIT = goodness-of-fit; AFIT = Adjusted goodness-of-fit; GFI= Goodness of Fit Index; SRMR = Standardized Root Mean Square Residual)

The rationale behind testing the proposed alternative model based on the theoretical framework and model development is grounded in the logical reasoning supported by the observed reality that effective anticipation of both internal and external supply chain environmental uncertainty is essential for achieving competitive advantage and operational performance. Likewise, any company aiming to enhance competitive advantage and operational performance must synergize the integration of internal and external supply chain environments through win-win solutions among business partners (Heizer et al., 2017, and Krajewski et al., 2019).

5. DISCUSSION

This research focuses on the context of large and medium-scale manufacturing industries in Southeast Sulawesi Province. The purpose to explore the influences of SCEU on competitive advantage and operational performance, considering the moderating effect of SCEU and the mediating effect of competitive advantage. The findings reveal that higher SCEU anticipation, reflected through changes in supplier, customer, and technological uncertainty, positively and significantly contributes to increased competitive advantage and operational performance in the manufacturing industry. The results of this study are consistent with Paulraj & Chen (2007), who highlight the importance of environmental uncertainty in the supply chain context and its role in achieving organizational goals. Additionally, the findings align with the research conducted by Agnes Aryani & Aryani (2016), Zhao et al., (2022), and Hatani (2023), which support the positive and significant influences of SCEU on competitive advantage and operational performance. Furthermore, the significant influence of SCEU on competitive advantage is also supported by Kim & Choi (2016), Beatriz & Barba-Sánchez (2018), Milad. (2019), Tarek (2020), Astuty et al. (2021), Koç et al. (2022), and Hatani (2023).

The study confirms that effective SCEU anticipation, demonstrated by managers' ability to foresee supplier, customer, demand, and technological changes, contributes to competitive advantage and operational performance. Respondents also reported favorable competitive advantage and operational performance outcomes. Thus, proactive SCEU anticipation from both internal and external sources improves pricing, delivery dependency, product innovation, market timeliness, cost efficiency, product performance, and production flexibility. In Southeast Sulawesi, the study reveals a significant and positive impact of SCEU on the performance of large and medium-scale manufacturing firms. These findings align with prior research by Haruna (2019), Kafetzopoulos et al. (2019), Amit & Gupta (2020), Aisjah & Prabandari (2021), Ahammad et al. (2021), Laguir, Modgil, et al. (2022), Pashutan et al. (2022), Min & Kim (2022), Zhao et al., (2022), and Hatani (2023). found no significant influence of SCEU on firm performance. Contrarily, Hee (2017). Francis et al., (2018), Beatriz & Barba-Sánchez (2018), and Inman & Green (2022) discovered a notable negative impact on international joint ventures' performance in China. Fernandes & Solimun (2017b) identified no significant negative effect on business performance in Indonesia. These variations underscore the intricate nature of the relationship between environmental uncertainty and firm performance.

Supplier uncertainty is the strongest indicator of SCEU whereas competitive advantage is reflected in delivery dependability, and operational performance is indicated by production flexibility. Anticipating changes in supplier uncertainty improves delivery dependability and enhances production flexibility, thereby enhancing operational performance in manufacturing companies in Southeast Sulawesi. The findings confirm the significant positive influence of SCEU on competitive advantage and operational performance, aligning with Barney (2015) Natural Resource-Based View theory, which emphasizes unique value creation and natural resources for competitive advantage.

The findings also demonstrate a positive but non-significant influence of competitive advantage on operational performance in manufacturing companies. This aligns with previous studies by Heredia & Alejandro (2017), Astuti et al. (2018), Beatriz & Barba-Sánchez (2018), and Pratami & Raharja (2019) which found a non-significant impact of competitive advantage on operational performance. Therefore, this research does not support the claim made by Porter (2009) and Krajewski et al. (2019) that high competitive advantage improves operational performance. These findings differ from studies by Hatani et al. (2016). Famiyeh (2017), Priyanka et al. (2017), Sigalas & Papadakis (2018), Potjanajaruwit (2018), Rua et al. (2018), Kiyabo & Isaga (2019), Silvia & Fabio (2020), Yuniarta *et al.* (2020), Zhao et al., (2022), Wongsansukcharoen & Thaweepaiboonwong, (2023); and Yuwanda et al., (2023); which found a significant and positive influence of competitive advantage on firm performance through cost effectiveness, product performance, and production flexibility. The study indicates that while competitive advantage has a positive impact on operational performance, this relationship is not statistically significant. Therefore, indicators such as price, delivery dependency, product innovation, and market timeliness reflections of competitive advantage do not significantly contribute to cost efficiency, product performance, and production flexibility in the manufacturing industry.

The successful improvement of competitiveness and achievement of operational performance goals present opportunities for large and medium-scale manufacturing companies in Southeast Sulawesi to effectively utilize competitive advantage to enhance operational performance. Consistent with Raharja (2017) viewpoint, the company's strategy to enhance competitive advantage should be based on operational performance. Thus, competitive advantage can be

achieved by integrating competitive advantage strategies with operational performance, primarily through supply chain environmental adjustments. The testing demonstrates that competitive advantage plays a significant mediating role between environmental uncertainty and operational performance in manufacturing companies, serving as a perfect mediator. This indicates that the significant improvement in competitive advantage is influenced by SCEU, and competitive advantage significantly affects operational performance in manufacturing companies. Moreover, SCEU has a significant positive impact on operational performance. The perfect mediating role of competitive advantage provides evidence that manufacturing companies' operational performance, which can adapt optimally to SCEU, contributes to achieving competitive advantage and, ultimately, enhancing operational performance.

The findings of this study confirm the statement made by Beheshtifar & Zare (2013) that competitive advantage can be achieved through high creativity and sustainability in manufacturing companies, driven by rapidly changing SCEU, ultimately enhancing operational performance. This viewpoint is also supported by Paulraj & Chen (2007), who emphasize that SCEU is a fundamental element in strategic management that contributes to gaining competitive advantage, thereby improving operational performance. The findings of this study are further supported by Bagur-Femenías *et al.* (2015), Zhao et al., (2022), and Hatani, (2023), highlighting the mediating role of competitive advantage between SCEU and operational performance. Thus, this study provides evidence supporting the NRBV theory, as proposed by Hart (1995) stating that NRBV encompasses the internal characteristics of companies for developing unique and difficult-to-imitate resources and capabilities that adapt to environmental uncertainty. Furthermore, consistent with Porter (2009) perspective, the interaction between different resources leads to a company's ability to achieve competitive advantage, economic value, and sustainable utilization.

The moderation role of SCEU in relation to competitive advantage and operational performance represents a moderator predictor, strengthening the influence of competitive advantage on the operational performance of manufacturing companies. However, the effectiveness of the interaction between SCEU and competitive advantage does not significantly strengthen the impact on operational performance in the large and medium-scale manufacturing industry in Southeast Sulawesi. This implies that the moderation variable SCEU only acts as a predictor, where the direct interaction between competitive advantage and operational performance does not provide substantial contributions. Nevertheless, direct adaptation to SCEU conditions can enhance competitive advantage and operational performance. The results of this study are supported by Hosseini & Sheikhi (2012), which found the moderating effect of environmental uncertainty on the relationship between competitive capability and firm performance. Thus, managerial decisions are affected by environmental conditions involved in the processes of material supply uncertainty, production, market demand or customer, and technological uncertainty.

The findings of this study provide evidence supporting the competitive advantage theory proposed by Heizer et al. (2017), suggesting that companies with good capabilities in environmental, social, and financial impact management in decision-making can achieve high operational performance. Thus, this study offers new insights to manufacturing company managers, highlighting that competitive advantage is expected to be explained through changes in SCEU, ultimately enhancing sustainable operational performance.

6. RESEARCH IMPLICATION

This study contributes by expanding the theoretical framework of SCEU, competitive advantage, and operational performance through empirical testing of a theoretical model. The findings support the proposed model's validity and highlight the mediation role of competitive advantage and SCEU, providing a reference for future theory development and model building. The study introduces the novel use of the GSCA method to demonstrate the integrated role of competitiveness and SCEU on operational performance. Whereas prior studies reviewed employed interdependence methods (regression analysis, OLS, non-linear, ANOVA, Tobin's Q, econometric models, and binary logistic regression), variance-based SEM (AMOS and LISREL), and covariance-based SEM such as PLS for testing the effects of SCEU, competitive advantage, and operational performance.

Practically, the research has implications for manufacturing company managers in adapting to SCEU through supplier, customer, and technology considerations. It emphasizes the importance of adapting to SCEU for enhancing competitive advantage and operational performance in the manufacturing industry of Southeast Sulawesi. Efforts to improve operational performance and strategically integrate competitive advantage should consider the business environment, including suppliers, customers, and technology. Additionally, the study suggests that companies in Southeast Sulawesi and Indonesia should adapt to SCEU while respecting local culture and wisdom, while also considering regional and global initiatives.

This research is limited to large and medium-scale manufacturing industries in Southeast Sulawesi, hindering generalization to other industries, particularly small-scale ones. Furthermore, the inclusion of respondents from suppliers, customers, and competitors is recommended to measure SCEU, competitive advantage, and operational performance. Future research can expand the scope to include various processing industries and involve respondents from different enterprise sizes and roles. Additionally, researchers can consider additional contextual factors such as supply chain integration, supply chain agility, total quality management (TQM), and economic growth.

7. CONCLUSIONS

The research findings show that anticipating SCEU positively influences competitive advantage and operational performance. Manufacturing companies that anticipate high SCEU changes, both internal and external, significantly contribute to improving competitive advantage through factors such as price competition, delivery reliability, product innovation, and time-to-market. This, in turn, enhances operational performance in terms of cost efficiency, product performance, and production flexibility. However, the direct impact of competitive advantage on operational performance is not significant. Competitive advantage acts as a perfect mediator between SCEU and operational performance. Higher anticipation of SCEU leads to increased competitive advantage and operational performance, but competitive advantage has not yet made a significant contribution to improving operational performance. Additionally, SCEU anticipation does not moderate the relationship between competitive advantage and operational performance in manufacturing companies. The moderation effect of SCEU on competitive advantage and operational performance is significant, but its influence is negative and not significant, suggesting that the SCEU moderation variable acts as a predictor rather than a significant enhancer. Therefore, the synergy between SCEU and competitive advantage does not significantly strengthen the influence on operational performance in manufacturing companies.

Recommendations can be proposed for managers of Manufacturing industry in Southeast Sulawesi, Indonesia. That is, manufacturing company management should focus on anticipating SCEU changes, as the level of supplier uncertainty is perceived to be low according to managers' statements. Strategically, manufacturing companies can enhance supplier uncertainty anticipation by improving supplier performance quality, reducing variations in raw material types from suppliers, increasing the use of supplier technology, and improving supplier delivery time.

Competitive advantage, specifically the timeliness of product delivery to the market, should be a serious concern for managers. Strategic actions to improve timeliness include accelerating product delivery to the market, ensuring that the product delivery time is lower than the industry average, and fostering rapid product development. Lastly, the operational performance indicator perceived as low by managers is production flexibility. To enhance production flexibility, managers can take operational and strategic actions such as swiftly adjusting production volumes, developing rapidly customizable product features, improving product specifications, and enhancing the ability to quickly change the product mix.

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