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MODERATING EFFECT OF INFORMATION SHARING ON CUSTOMER INTEGRATION AND PERFORMANCE OF MANUFACTURING FIRMS IN RWANDA

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Abstract:
The purpose of this study is to examine the moderating effect of information sharing on the relationship between customer integration and the performance of manufacturing firms in Rwanda. Customer integration involves incorporating customer needs and feedback into manufacturing processes to enhance product and service alignment with market demands. Effective information sharing is posited to strengthen this relationship by facilitating timely and accurate communication of customer preferences throughout the supply chain. The study employs an explanatory research design, utilizing data collected from a sample of managers across various manufacturing firms in Rwanda. A stratified random sampling technique is applied to ensure representation across different sectors of the industry. Data analysis is conducted using inferential statistics, including Pearson correlation and multiple regression analysis, to assess the influence of customer integration on performance and the role of information sharing as a moderating factor. Findings suggest that information sharing significantly enhances the positive impact of customer integration on firm performance by enabling better synchronization of manufacturing processes with customer demands. The study concludes that for manufacturing firms in Rwanda, fostering robust information-sharing practices is essential for maximizing the benefits of customer integration, thereby improving overall competitiveness and market responsiveness.

Key Words: Information Sharing, Customer Integration, Performance of Manufacturing Firms, Rwanda

Background of the Study

In recent decades, the role of supply chain integration (SCI) has become increasingly critical for enhancing the performance of manufacturing firms. Since its conceptualization in the early 1980s, supply chain management (SCM) has gained significant attention in management and operational research, especially in the context of how effective integration of supply chain processes can improve business performance (Ali et al., 2023; Ghariani & Boujelbene, 2024; Suryanto & Mukhsin, 2020). Supply chain integration, which involves the strategic collaboration between manufacturers and their supply chain partners, is essential for optimizing the flow of goods, services, information, and financial resources. The degree of integration, particularly with customers, is a vital factor that directly influences a firm's ability to meet customer needs and, subsequently, its overall performance (Flynn et al., 2010).

Customer integration, a crucial element of SCI, focuses on aligning manufacturing processes with customer requirements, ensuring that the needs and preferences of customers are embedded into the production and service delivery processes. This integration enhances the firm's ability to deliver value through improved product quality, timely delivery, and customized offerings. However, achieving effective customer integration requires more than just structural alignment; it demands robust information sharing between the firm and its customers. Information sharing facilitates better communication, transparency, and responsiveness, allowing firms to adapt quickly to market demands and customer feedback (Zhong et al., 2023).

Information sharing, as a moderating factor in the relationship between customer integration and performance, plays a pivotal role in enhancing the effectiveness of this integration. When accurate and timely information is exchanged between manufacturers and customers, it enables firms to make informed decisions, anticipate market shifts, and coordinate their operations more efficiently. This results in improved operational performance, reduced lead times, and a more agile response to customer needs, which ultimately contributes to better overall performance (Akhtar et al., 2023; Shah & Soomro, 2021).

In the context of Rwanda, where the manufacturing sector is growing yet faces significant challenges such as limited production capacity, high production costs, and unpredictable market conditions, effective customer integration and information sharing become even more critical. The sector has been growing at an annual rate of 7%, with the country's strategic goal of increasing the industrial sector's contribution to GDP to 26% by 2030 (National Bank of Rwanda et al., 2020). To achieve this target, Rwandan manufacturing firms must enhance their ability to meet customer demands while optimizing their internal processes. The need to respond quickly to changing market conditions and consumer preferences makes information sharing a key enabler for successful customer integration.

Despite the growing recognition of the importance of SCI, the specific role that information sharing plays in moderating the relationship between customer integration and firm performance has not been fully explored. Previous studies have acknowledged that information sharing can improve operational performance but have often overlooked its potential to amplify the benefits of customer integration within the supply chain (Zhong et al., 2023). This gap is particularly relevant for the Rwandan manufacturing sector, where firms face the dual challenges of maintaining competitiveness and adapting to external disruptions like global market fluctuations and local economic constraints (Agricultural & Development, 2022).

Therefore, this study aims to investigate the moderating effect of information sharing on the relationship between customer integration and the performance of manufacturing firms in Rwanda. Understanding this dynamic is essential for helping manufacturing firms leverage customer integration more effectively, ensuring that they remain competitive in a challenging market environment. By focusing on the role of information sharing, this research seeks to provide insights into how Rwandan manufacturing firms can enhance their performance through better integration with their customers and more effective use of information flows.

Statement of the Problem

More than 75% of the manufacturing sector in Rwanda and Job opportunities come from SME manufacturing industries (NISR, 2022). For the past ten years, the emphasis has been on how SME supply chains could become more competitive. International Finance Corporation (IFC) in 2022 reported Rwandan SMEs to have an average ROI (return on investment) of 20%. Comparing the country to other African countries, the favorable business climate and government support for small and medium-sized enterprises (SMEs) account for the higher return on investment. Meanwhile, the manufacturing sector's contribution is still low compared to other industries like agriculture, energy, ICT, financial service sectors, and transportation. In developing countries, over 70% of registered SME 'firms shut down during the first two years of operations.

Although the manufacturing sector has strong links to other industries and a lot of potential for economic growth, its GDP value-added has been steadily declining at around 5%, and it only makes up a relatively small share of all product exports (IMF(International Monetary Fund), 2022; National Bank of Rwanda et al., 2020). The food and beverage industries, which make up the two largest subsectors of Rwanda's industrial sector, did not do as well as they had the previous year (National Bank of Rwanda et al., 2020). Other tactics that Rwandan manufacturers might employ to increase productivity and competitiveness include supply chain integration, governmental backing for e-commerce projects, legislative actions, and promotion of SME growth (Omwoyo et al., 2020b).

However, studies (Fernando & Wulansari, 2020; Min et al., 2005; Mofokeng & Chinomona, 2019; Omwoyo et al., 2020a; Zhong et al., 2023) show that one of the factors of the inability to compete relies on SMEs' reluctance to work with other businesses. By promoting effective communication and accurate data sharing among the key stakeholders, companies may reduce their expensive transportation expenses while simultaneously improving productivity and setting themselves apart. Given Rwanda's landlocked location and inadequate transportation infrastructure, this is extremely important for the nation. Digital supply chains can help manufacturing organizations with governance, collaboration, performance measurement systems, and integration of customers, which allows flexibility and the development of unique capabilities (Ali et al., 2023; Panahifar et al., 2018). SMEs must actively collaborate, forge solid bonds with various supply chain partners, and make technological investments to improve integration and communication to address these issues. Thus, the purpose of this study was to investigate the relationship between supply chain integration and industrial system performance and to suggest a model for enhancing the performance of manufacturing firms through information sharing across supply chain integration parameters.

Objectives of the Study

i. To examine the effect of customer integration on performance on the performance of manufacturing SMEs in Rwanda.
ii. To assess the effect of information sharing on the relationship between supply chain integration and the performance of manufacturing SMEs in Rwanda.

Research Hypothesis

Ho_1. Customer integration has no significant effect on performance on the performance of manufacturing SMEs in Rwanda.

Ho_2. Information sharing has no significant effect on the relationship between customer integration and the performance of manufacturing SMEs in Rwanda.

LITERATURE REVIEW

Theoretical Framework

Resource-Based View Theory (RBV)

The study aims to investigate the influence of supply chain integration and the performance of SME manufacturing firms using the resource-based view (RBV). The fundamental idea of RBV theory is that companies have access to a variety of resources that give them a competitive

advantage (Barney, 1991). Accordingly, an organization's internal resources and competencies can directly promote enhanced performance and long-term competitive advantage. A sustainable competitive advantage also develops when a firm's resources satisfy the four (4) criteria of valuable, rare, non-substitutability, and inimitability (VRIN). Resources must be valuable before utilizing opportunities or lowering hazards in their external environment (Thoo et al., 2017). The main objective of RBV is to explain why some organizations outperform better than others. To accomplish this, it is critical to highlight the influence of unique, invaluable, and exceptional resources on profitability and organizational performance. These tactics encompass increasing resource levels, procuring resources from both internal and external sources, and offloading excess resources (Barney, *(1991*). In the context of SCI, the RBV underscores the significance of managerial activities of internal resources provided by various functional departments as well as the external resources supplied by suppliers and customers to improve business performance. Plans for the company's distribution of resources must have a favorable impact on business success.

First, a firm can benefit from opportunities or reduce risks in its external environment, and its resources must be valuable. Second, the resources must be rare for competitors to acquire. Thirdly, the resources must be limited and challenging for other businesses to imitate. The company's assets have been classified into three groups, including physical, human, and investment capital. Physical capital resources include things like a firm’s plant, location, assets, technology, equipment, and capacity to purchase raw materials. Human capital resources include the abilities of managers and employees in terms of experience, judgment, intelligence, interpersonal skills, and training. Other forms of organizational capital resources include a company's official reporting structure, coordinating mechanisms, unofficial intra- and inter-organizational linkages, and formal and informal planning (Barney (1991). A particular set of organizational, human, and material capital resources is usually required to accomplish a given plan.

I also consider information sharing between organizations, both formally and informally. RBV logic distinguishes between three types of resources: organizational, human, and physical capital. It can be enhanced by other resources, including cash, technology, and reputational capital (Barney, 1991). Resources are items that are either owned or controlled by the organization. These resources can be tangibles like infrastructure, or intangible, like information sharing. For This study, the RBV theory will primarily focus on the significance of managerial activities in managing the internal resources provided by various functional divisions and the external resources offered by suppliers and customers to improve firm performance. Accordingly, for strategic supply chain integration (SCI) to be successful, practitioners should not concentrate on a single inhibitor but rather take internal functions, supplier integration, and customer integration into account. Interdependence is then seen as a crucial component of SCI (Thoo et al., 2017).

According to a study by Grant (1991), a business needs new management abilities to satisfy the demands of the data-driven world. For example, working with big data necessitates the application of predictive analytics as well as specific, essential competencies from fields like finance, accounting, statistics, discrete event and simulation, forecasting, and applied mathematics. Employing and/or training its present staff members is one way a business might generate competent, qualified workers. Moreover, trained and motivated employees enhance mutual trust, effective information or knowledge sharing, and teamwork that will likely be difficult to imitate by other organizations.

The RBV can serve as the basis for developing the supply chain strategy taxonomy. To attain SCI, a manufacturer's suppliers and customers must collaborate (L. Luo & Flynn, 2023). If a firm is vertically integrated, its internal operations supply the majority of its well-known materials. Vendors and customers are the two additional external sources from which organizations receive resources. According to Amsterdam (2020) distributing a company's limited resources domestically is not as critical as controlling inter-organizational resources to

achieve outstanding performance. Partners in the supply chain often provide critical resources. Suppliers are especially crucial to the focus firm's execution plans and the availability of resources (Schoenherr & Swink, 2012; Thoo et al., 2017). For this study, RBV theory will allow us to explain how an organization's resources can be integrated across the supply chain to improve SME performance.

Conceptual Framework

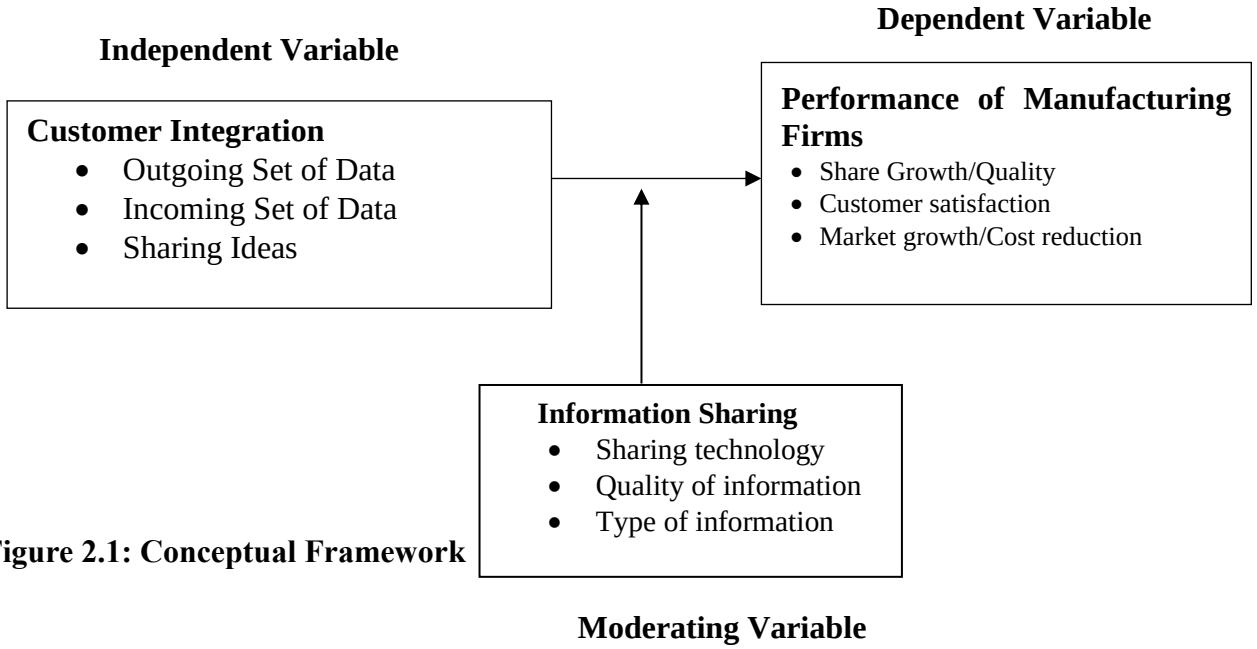


Figure 2.1: Conceptual Framework

Source: Researcher, 2024

Customer Integration

Customers demand unique solutions to unique needs. Being able to adapt to various customer requirements is the key, and companies need to know and understand their customers if they want to accomplish this (Dzogbewu et al., 2021). To co-create value together with customers, their preferences and positions are important. Customers are integrated in the co-creation of value but also need to be integrated in the development of services (Ominde et al., 2022). Integrating customers refers to incorporating them into various aspects of a company's processes, policies, and decision-making. This strategy emphasizes how important it is for the company and its clients to collaborate to generate value and achieve shared goals. The customer is a manufacturing company's lifeblood, regardless of the goods or services the company offers to the customer. Customer integration includes the target business and its collaborative operations. It consists of information sharing with key customers and a better understanding of their needs. Customer integration represents a form of social construct and involves the exchange of social assets such as information (Nguyen Thi & Nguyen Thi Thu, 2022). These assets and structures, in conjunction with each other, allow supply chain partners to start interacting and form an alliance in the long run (Abate, 2018). The resulting moderating effects eliminate preconceived notions of risks associated with disclosing information and improve collaboration. Consequently, better operational performance is one of the outcomes of regular, high-quality information sharing between the focal company and customers. It encourages improved communication and mutual awareness of needs between the two parties (Yu et al., 2013).

Scholars Aslam et al. (2023); Fernando & Wulansari (2020); and Flynn et al. (2010) defined customer integration as the extent to which a business proactively engages a customer as a partner in managing supply chain resources, information flow, coordinated product and service development, and expectations in a seamless way. Supply chain management categorizes supply chain integration as integrating customer, internal, and supply in the chain (Aslam et al., 2023; Flynn et al., 2010). Businesses are better able to anticipate and understand the

demands of their customers when they are involved in the process of creating goods and services that better suit those needs. From this literature, customer integration refers to building and maintaining a strong relationship and partnership with major customers (Nguyen Thi & Nguyen Thi Thu, 2022). It is measured by indicators such as customer contact, feedback, and responsiveness. An important conclusion of the study is that different methods for customer integration are suitable for collecting different kinds of customer information.

Customer involvement in determining best practices helps manufacturers gain valuable insight into customer preferences, needs, and expectations (Dzogbewu et al., 2021). It also leads to business and product development aligned with market demand. Involving the customer in product design allows the company to understand their needs and create products according to their needs in the market. It also increases customer satisfaction and loyalty, as customers receive products that meet their needs. Fianko et al. (2023) customer involvement facilitates real-time product testing and early product reviews. These concepts accelerate product development, reducing lead times and time-to-market for new products. Close collaboration with customers allows manufacturers to receive prompt requests (Agag et al., 2023). It also helps coordinate inventory, production planning, and supply chain management.

According to Fourie (2015), customer integration can boost manufacturing companies' overall competitiveness. It enhances product development and improves customer happiness all at the same time. Therefore, researchers stressed the linkage between customer integration and customer value (Fianko et al., 2023; Flynn et al., 2010). In this context, they provide three parameters, namely, understanding the customer needs, expectations, preferences, and purchasing power of the customer is essential before trying to increase customer value. When developing a product or a service for the market, it is simpler to understand and consider client needs when designing using a customer-centric knowledge base such as this one. Flynn et al. (2010) argue that real-time customer feedback helps manufacturers make the necessary improvements. It also helps to incorporate customer feedback and reduce the likelihood of costly redesigns after launch. By carefully examining the needs and expectations of their customers, manufacturers can tailor their products and services to either meet or exceed their expectations (Yang et al., 2023). High customer satisfaction is linked to positive word-of-mouth, repeat business, and potentially even an increase in market share. Customer integration promotes flexibility in the production process, which enables companies to respond quickly to changing client demands (Yang et al., 2023).

To stay competitive, successful modern businesses must develop and offer innovative products and services that attract potential consumers while enhancing existing customers. On the other hand, Ominde et al. (2022) discovered that 40–75% of newly launched services fail because of poor customer relationship integration. We agree that a new or enhanced service's potential for potential market success depends on its ability to deliver value to customers, which is dependent on the creative company's ability to collect and incorporate sufficient user data into a constellation of resources that will allow the service to be co-created as intended. These are a few examples of customers who have significantly influenced the provision of services. Nevertheless, the understanding of how to methodically integrate users in service development remains limited. In the academic community and among service researchers in particular (Fianko et al., 2023), (Reaidy et al., 2021), the development in consumer behavior has positioned him as a powerful and important partner in the supply chain. Because of this change, business firms today collaborate with customers in a more integrated and dynamic way, especially in the supply chain processes (Fianko et al., 2023).

Manufacturers can differentiate themselves from competitors by creating products that better meet the requirements and needs of consumers (Agyei-Owusu et al., 2022). Achieving this requires manufacturing forms incorporating consumer feedback into the production processes. This difference may give rise to a market share and competitive advantage. A strong relationship with customers leads to loyal customers and enhances partnerships (Fernando &

Wulansari, 2020). Brand enthusiasts are more likely to remain loyal to a company that improves or prolongs the life of its goods. Customer integration helps producers keep ahead of industry trends and make informed strategic decisions by enabling data-driven decision-making (Aslam et al., 2023). To summarize, integrating customers into manufacturing firms' processes brings innovation, increases customer satisfaction, and gives a firm a competitive advantage. It also creates and sustains strong customer relationships, which is an ongoing, dynamic process that requires effort (Aslam et al., 2023; Khanuja & Jain, 2020).

Performance of Manufacturing SMEs

Manufacturing organizations are evaluated based on attributes or metrics that enable the assessment of whether the strategic goals provide data and input that is directly related to the performance of the Supply chains (Saleheen & Habib, 2023b). The characteristics provide a framework for locating and evaluating solutions that help satisfy the needs for choices that improve business operations. Performance measuring is the process of determining the effectiveness and efficiency of an action. Metrics include things like process management within the organization, clear roles and duties, continuous learning, and model success. Takayabu (2024). It is essential to evaluate each supply chain's performance independently in order to consider industry-specific regulations. There are two types of approaches to measure the performance of manufacturing firms. Financial and non-financial approaches fall under these two categories. Information technology integration, safety stock, feedback, and self-evaluation are some of the techniques (Zhou & Li, 2020). Among the many methods used in modern performance measurement are return on assets, return on investments (ROI), and customer satisfaction. Kaplan & Norton's 1992 balanced scorecard proposes four main perspectives for evaluating performance. These consist of different viewpoints on finances, customers, business operations, and organizational learning (National Bank of Rwanda et al., 2020).

Supply chain performance measurement uses measure ten manufacturing criteria (SCPM). The ten supply chain performance measurement attributes that the researcher categorized for a manufacturing firm were Financial Health, Collaboration, Velocity, Resilience, Reliability, Continuous Improvement, Visibility, Work People Health, Sustainability, and quality service (Ali et al., 2020; Saleheen & Habib, 2023b). Organizational performance refers to how well a business achieves its objectives in terms of money and the market (Agyei-Owusu et al., 2022; Z. Ali et al., 2020). Organizations in this context implement appropriate policies and methods to improve their financial performance, encourage innovation, and offer greater consumer pleasure. Flexibility, speed, quality, and cost are used to explain the performance of manufacturing firms for this study. An organization's flexibility is its ability to swiftly adapt to changes in the market, including modifications to product mix, schedules, and quantity. Speed performance is the measure of how quickly a good or service is delivered to a consumer; the faster the delivery, the better the speed performance (Takayabu, 2024).

In this context, Information sharing through "Collaborative Planning, Forecasting, and Replenishment (CPFR) has been used to identify collaboration in supply chain management. Businesses use collaborative strategies like vendor-managed inventory (VMI) and continuous replenishment programs (CRP) (Asamoah et al., 2015; Panahifar et al., 2018; Saleheen & Habib, 2023b). The term "collaboration" is too broad, the perspective of SC, an additional definition is essential due to an over-reliance on technology and an incapacity to discern between the types of people one should collaborate with (Barratt, 2004).

Information Sharing

In the supply chain, manufacturing organizations work together to produce and distribute goods to customers. These organizations include retailers, distributors, manufacturers, suppliers, and

peripheral ones like logistics service providers (Jen et al., 2022). Previous studies have demonstrated the need for information sharing across production sites, distributors, retailers, and third-party organizations like logistics service providers. Supply chain management has become simpler because of technology, which is also necessary for better supply chain management (Panahifar et al., 2018). Scholars like Shin et al. (2019) asserted that real-time supply chain data offers a trustworthy indicator of trustworthy indicator of information quality in the supply chain. Insufficient data for planning and forecasting produce inaccurate information. Inaccurate information weakens trust between parties and makes it easier for the supply chain system to make erroneous decisions (Kauppi et al., 2023). Decision-making becomes more difficult in the supply chain when participants keep information until they have more precise information (Panahifar et al., 2018).

Scholars such as Nguyen Thi & Nguyen Thi Thu (2022) have underscored the need to share reliable data. They concluded that an information-centered collaborative supply chain should incorporate data on inventory, demand, forecasts, production and shipment schedules, and ongoing activities.

To help manufacturing firms reduce lead times and inventory costs, suppliers and customers have developed collaborative systems like VMI and CPFR, to help with information-sharing techniques (Nkwabi & Fallon, 2020; Panahifar et al., 2018). The exchange of data regarding inventory levels can help decision-makers in a distribution supply chain make better choices regarding transshipment, order replenishment, and where to put safety stock. The vendor-managed inventory (VMI) helps to oversee the supplier activities and share accurate information. On the other hand, VMI helps the supplier monitor the movement of the stock and advises the client on important issues, such as replacing inventory. In this instance, managing information sharing and security is necessary to optimize the benefits of business collaboration (Panahifar et al., 2018). Moreover, they assert that partners find it easier to confirm product stock levels when they have accurate information. In this context, we agree that accurate information significantly improves trust and collaboration in the supply chains.

Empirical Review

Customer integration refers to the process by which an organization integrates its customers' needs, preferences, and feedback into different aspects of operations. These include product development, production processes, and service delivery. Customer relationship management aims to improve customer satisfaction by understanding the needs, desires, and expectations (Zhong et al., 2023). Tasks related to customer integration include resolving issues, having face-to-face conversations with customers, responding to their complaints, increasing customer satisfaction, and developing long-lasting networks with them. For an organization to achieve organizational performance needs to foster collaboration, transparency, and responsiveness (Dzogbewu et al., 2021).

By involving customers in product development, manufacturing companies may ensure that their products meet specific consumer wants and market demands (Ali et al., 2023). Ultimately, this might result in more innovative, competitive, and customer-focused products, which could increase both sales and market share. Understanding customer feedback provides insight into product quality and performance(Agag et al., 2023). By immediately identifying and resolving issues and incorporating customer feedback into their quality control systems, manufacturing organizations may enhance customer satisfaction and generate higher-quality products(Nguyen Thi & Nguyen Thi Thu, 2022). Customer integration helps manufacturing organizations in demand forecasting, streamlining production schedules, and optimizing inventory levels. Tailored solutions that more effectively meet the customer's demand of the client can increase customer retention and loyalty (Nguyen Thi & Nguyen Thi Thu, 2022).

Adopting CPFR manufacturing company to help consumers and suppliers collaborate on planning and decision-making. This collaborative strategy can improve lead times, enhance inventory control, and increase the overall effectiveness of the supply chain (Asamoah et al.,

2015). Provide spaces or online communities where suppliers and customers may communicate, exchange information, and work together on different supply chain tasks like placing orders, managing inventory, and developing new products (Pattanayak et al., 2024a). Provide a way for clients to voice their opinions about the quality of the services, the efficiency of the delivery, and overall satisfaction. The business can improve operations and proactively address customer complaints or problems by using other customer input. Establish key performance indicators (KPIs) that align with both operational objectives and consumer expectations (Saleheen & Habib, 2023b).

Information Sharing and Performance of Manufacturing SMEs

The survival of any organization depends on sharing the right information (Tiwari, 2021). With the advance in technology, information sharing in the supply chain serves as an enabler of long-term collaboration and coordination which leads ultimately to competitive advantage. Effective information sharing in the supply chain increases the efficiency of the organizational performance in the manufacturing sector (Li et al., 2019). Information sharing plays a crucial role in the success of manufacturing SMEs. Managers who share the right information with their team members can ensure that everyone is on the same page and working towards the same goal (Fernando & Wulansari, 2020). This can lead to improved communication, increased productivity, and better decision-making (Kamble et al., 2020). Additionally, sharing information with suppliers and customers can lead to better relationships, increased trust, and ultimately, increased business success (Pattanayak et al., 2024b). Therefore, it is important for manufacturing SMEs to prioritize information sharing as a key component of their overall performance measurement strategy.

Information technology (IT) is used as a tool to access, analyze information, and execute it to improve the performance of the supply chain (Huggins et al., 2014). Lack of information managers cannot know what customers want, how much inventory is in stock, and when more products are produced or shipped (Vafaei-Zadeh et al., 2020). A study conducted using Smart PLS-3 for the analysis of the data gathered from the textile firms of Pakistan found that the levels of information shared between firms have positive and significant effects on supply chain performance and the relationship is mediated by extranet technology applications, namely, EDI, VMI, and POS, respectively (Hamann-Lohmer et al., 2023). Furthermore, information sharing presents a significant amount of advantage to manufacturing companies (Vafaei-Zadeh et al., 2020). Information sharing in supply chains can lead to numerous benefits for manufacturing SMEs, including improved coordination, reduced lead times, increased efficiency, and enhanced customer satisfaction (Vergara et al., 2023). By sharing information with suppliers, customers, and other stakeholders, SMEs can improve their ability to respond to changing market conditions and customer demands. Information sharing can also help to reduce costs and improve quality, as it enables SMEs to identify and address issues more quickly and effectively. Furthermore, information sharing can facilitate collaboration and innovation, which are critical for supporting sustainable growth and development in the manufacturing sector (Mohamed et al., 2023). Overall, information sharing is essential for manufacturing SMEs to compete effectively in today's global marketplace and to achieve long-term success.

According to Zsidisin et al. (2024), IT tools such as the Internet, VMI, and EDI are popular among manufacturing firms for exchanging information with partners. Of these tools, the Internet is most commonly used to exchange information with suppliers (Zsidisin et al., 2024). However, the study highlights that such tools are only useful if they are used to transmit relevant information across the supply chain. Kamble et al. (2020) asserted that the Internet of Things (IoT) and an extension of ICT improve supply chain performance. They also explain that IoT can optimize how people and systems interact, promote best practices for greater performance, and enhance operational efficiency, safety, security, and customer experience. The use of technology can further reinforce supply chain integration and minimize costs by optimizing supply chain operations and reducing human intervention (Zsidisin et al., 2024).

Information sharing in the supply chain can have a significant impact on the performance of SMEs. When SMEs share information with their suppliers, they can better understand the needs and requirements of their customers, which can help them improve their products and services (Li et al., 2019). Additionally, sharing information can help SMEs identify areas for improvement in their operations, allowing them to streamline their processes and reduce costs (Sheikhi et al., 2018). Furthermore, information sharing can help SMEs build stronger relationships with their suppliers and customers, leading to increased loyalty and repeat business (Vafaei-Zadeh et al., 2020). Overall, information sharing is a critical aspect of supply chain management that can help SMEs improve their performance and achieve sustainable growth. Effective information sharing is a critical strategy for companies to survive and thrive, enabling seamless supply chain integration (Vafaei-Zadeh et al., 2020).

RESEARCH METHODOLOGY

This study employed an explanatory research design, focusing on elucidating the relationships between variables through quantitative analysis. The primary objective of this design is to explain why phenomena occur and to predict future outcomes (Osoro et al., 2016). A positivist research philosophy guided the investigation based on theoretical frameworks from which hypotheses were formulated and tested through quantitative methods (Osoro et al., 2016).

The study population comprised managers, chief executive officers, assistant managers, and presidents from 682 manufacturing SMEs in Rwanda, categorized into seven clusters: wood and lumber, leather, food and beverage, rubber and plastic, stationery, textiles, and others. These firms were located in Kigali City, Musanze, Rwamagana, and Muhanga Towns. Managers were considered the most knowledgeable about the interplay between organizational performance and supply chain performance.

Data collection involved a mixed-method approach, utilizing open-ended questionnaires distributed in-person and electronically and semi-structured interviews with twelve purposively selected CEOs/managers. A total of 252 manufacturing SMEs were sampled through random selection, with 227 completed questionnaires analyzed, yielding a valid response rate of 94%. Stratified random sampling was employed to ensure representation across manufacturing sectors, reducing the likelihood of excluding essential population groups (Kotari, 2017).

Primary data were collected via semi-structured questionnaires, which facilitated cost-effective and convenient summarization of responses. The collected data were coded and analyzed using SPSS version 26, employing descriptive statistical techniques such as frequency, mean, and standard deviation, alongside content analysis for qualitative responses. Inferential statistics, including regression and correlation analysis, were utilized to derive insights from the data.

RESEARCH FINDINGS AND DISCUSSION

The target sample population was 252 respondents which was composed of CEOs, Managers /DGs, or presidents of manufacturing firms. Out of this targeted sample population, twenty - five (25) respondents participated in the pilot study; thus, excluded from the final analysis. Two hundred and twenty-seven (227) respondents were given the questionnaires and filled out through the tablets where 213 respondents fully participated and gave their views. The overall response rate therefore stood at 94% (percent). This response rate was deemed satisfactory, as suggested by Sekaram and Bougie (2018), who recommend at least 75% (percent) as a rule of thumb for minimum responses.

Descriptive Analysis of the Study Variables

Customer Integration

The respondents were probed on various indicators of customer integration and the performance of manufacturing firms in Rwanda. This objective was measured using the following indicators: outgoing set of data, incoming set of data, and sharing ideas in the opinion statements given. The responses were rated on a 5-point Likert scale where respondents either indicated not at all, small extent, moderate extent, large extent, and very large extent. In this study, the scale of not at all and small extent indicated disagree, whereas large and very large

extent meant agreed. The results were expressed as frequencies, percentages, mean, and standard deviation, as shown in Table 1 below.

Table 1: Descriptive Analysis of Customer Integration

Statements on Customer integration	1 %	2 %	3 %	4 %	5 %	Mean	Std Dev
Integration of customers after disruptions	0(0)	0(0)	37(17.2)	147(69)	29(13.8)	3.98	.557
Out of the adoption of integration, an outgoing set of data has been achieved	2(1)	0(0)	30(14.1)	131(61.7)	51 (24.1)	4.17	.608
Supply chain alignment has been made possible by integration	0(0)	0(0)	29(13.8)	125(58.60	59(27.6)	4.24	.629
Integration reduces supply chain vulnerability and improves adaptability	0(0)	0(0)	23(11.0)	110(51.7)	79(37.2)	4.25	.639
Our supply chain is prone to vulnerabilities and disruptions from both external factors and internal factors ranging from financial to internal business-process susceptibilities.	0(0)	2(1)	7(3.4)	118(55.2)	88(41.4)	4.37	.553
Manufacturing firms cope with disruptions and vulnerabilities either reactively or proactively	0(0)	0(0)	15(6.9)	140(65.9)	58(27.2)	4.20	.551
An outgoing set of data enables manufacturing firms to handle the effects of unforeseen changes, ambiguity, and volatile environment in which these organizations operate in	0(0)	0(0)	22(10.3)	125(58.6)	66(31.0)	4.21	.610
Integration practices give manufacturing aid organizations the aptitude to survive, adjust, and keep their operations running in times of turbulent change	0(0)	0(0)	37(17.2)	140(65.5)	37(17.2)	4.01	.588
Through integration practices, our supply chains have an apparent ability to recover from inevitable risk events more effectively than others	0(0)	0(0)	29(13.8)	139(65.2)	45(21)	4.17	.584

Key: 1-Not at all; 2-Small Extent; 3-Moderate Extent, 4-Large Extent and 5- Very Large Extent

The respondents were asked to indicate the extent to which integration enables the supply chains to become resilient upon disruptions. The majority of the respondents (82.8%) agreed that integration contributes to the resilience of supply chains, and 17.2% moderately agreed. By manufacturing firms adopting integration design in their supply chains, flexibility has been achieved, as indicated by 85.8% and 14.1% of the respondents who agreed and moderately agreed, respectively. Adoption of supply chain integration by manufacturing firms has also made possible supply chain alignment. Integration is indicated by 88.9% of the respondents to improve sharing ideas and reduce supply chain vulnerability, defined as the susceptibility of the supply chain to the probability and significance of disruptions.

Respondents (96.6%) agreed that manufacturing processes through supply chains are prone to vulnerabilities and disruptions from both external factors and internal factors, such as financial and internal business-process vulnerabilities, and 3.4% moderately agreed. In response to this, the manufacturing firms cope with disruptions and vulnerabilities either reactively or

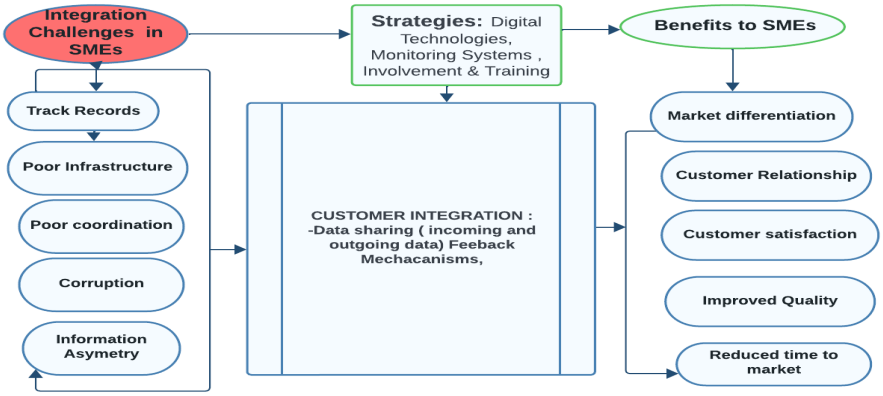
proactively, as 93.1% of the respondents agreed while 6.9% moderately agreed with the statement. A large number of the respondents (89.6%) agreed, and 10.3% moderately agreed that the outgoing set of data enables manufacturing firms to deal with the effects of unplanned changes, uncertainty, and the volatile environment in which these organizations operate. Furthermore, 82.8% of the respondents indicated that integration practices give manufacturing firms the capacity to survive, adapt, and sustain their operations in the face of turbulent changes, while 17.2% moderately alluded to that. By manufacturing firms adopting integration design in their supply chains, they have an apparent ability to recover from inevitable risk events more effectively than others, as indicated in 86.2%. On the other hand,13.8% of the responses agreed and moderately agreed with the statement. In general, resilience is typically focused on bringing supply chain operations back to their previous condition following a crisis, and some manufacturing processes through supply chains have painfully proven to not be resilient. This is in line with the findings of Ongeri and Osoro (2021).
Nevertheless, many manufacturing processes through supply chains in Rwanda have emerged stronger than they were prior to crises and disruptions, learning valuable lessons and rapidly reconfiguring to meet emergent needs, suggesting that the concept of resilience needs to be reimagined.

In general, the findings in Table 4.9 indicate that the integration design of supply chains enables the manufacturing process through supply chains to be resilient by achieving the elements of flexibility, alignment, and reduction in supply chain vulnerability. Manufacturing processes through supply chains are prone to vulnerabilities and disruptions emanating internally or externally to the organizations. The adoption of integration design in supply chains gives manufacturing firms the capacity to survive, adapt, and sustain in the event of turbulences. Integration design enables manufacturing processes through supply chains to recover from inevitable risky events in an effective way. The findings of this study corroborate the findings of Ongeri and Osoro's (2021) study on self-organization, adaptability, organizational networks, and inter-organizational coordination, with empirical evidence from manufacturing firms in Uganda. The study also asserted that customer integration enhances resource utilization, helps in meeting needs and saving lives, and ensures time targets are met. Further, Muazu (2019) established that supply chain re-engineering and risk awareness were significant predictors of customer integration in organizations.

Qualitative Analysis

Customer Integration

Examination of supply chain managers' views on customer integration were examined using two open-ended questions. The first question sought to identify the challenges faced by the manufacturing process through supply chains in implementing customer integration design. Secondly, supply chain managers' opinions were sought on how the manufacturing SMEs process through supply chains can be designed to be resilient to overcome vulnerabilities and disruptions. The following Figure 6, shows the thematic analysis of the managers' views:



Source: Researcher, 2024

From the examination of the views of supply chain managers (figure 6) and track records on performance, insufficient resources (Human and capital), corruption, and information asymmetry emerged as major challenges for Manufacturing SMEs in implementing customer integration. From the findings, these challenges can be resolved through investment in technology, infrastructure, continuous monitoring systems like KPIs, and continuous staff training. The benefits manufacturing SMEs can benefit include market differentiation, customer relationship, customer satisfaction improved quality, and reduced time to market. These results align with (E. Ali et al., 2023; Kamble et al., 2020) who asserted that investments in smart manufacturing bring advantages over traditional manufacturing. While Dzogbewu et al. (2021) argue that the performance could only be achieved when manufacturing firms' managers pay critical attention to internal and external integration.

The findings reveal that SMEs generally possess lower levels of financial, human, and technological resources in comparison to larger firms. The customer integration process, which necessitates investments in technology, training, and organizational restructuring, may exhaust the resources of SMEs. These findings align with Mangla et al. (2018) infrastructure as a barrier to the manufacturing industry in Africa's manufacturing that hinders performance. To Ghariani & Boujelbene (2024), investing in customer relationships, joint knowledge sharing, information sharing, and collaborative planning improves performance. In this context, the findings show that manufacturing SMEs in Rwanda face the challenge of limited access to financing, inadequate infrastructure, and skills gap among the workforce (Ogutu et al., 2023).

A significant percentage of SMEs in the manufacturing sector probably lack the infrastructure technology to support customer integration. They are also challenged by the high costs of implementing collaborative platforms, linking with customer systems, and sharing real-time data. These challenges hinder Manufacturing SMEs from growing and becoming globally competitive. These findings align with (Nkwabi & Fallon, 2020; Omwoyo et al., 2020b) who asserted that the primary issues facing manufacturing SMEs in developing nations include inadequate production capacities, poor customer relationship management, and poor storage infrastructure facilities. Disparities between platforms, data formats, and business processes may complicate integration and call for modifications or workarounds to preserve compatibility (Asamoah et al., 2020). They also claimed that external social networks can be leveraged to enhance supply chain resilience and customer-oriented performance (Asamoah et al., 2020; Mangla et al., 2018).

The findings also reveal that demand uncertainty was identified as a challenge in the implementation of customer integration design in manufacturing SMEs in Rwanda. The uncertainty and unpredictability of events, which are especially common in sudden-onset productions regarding their timing, location, nature, and magnitude, interfere with the prediction of supply and demand. The probability of disturbance, therefore, increases greatly,

which makes response and preparation equally important. The findings align with Abolghasemi et al. (2019) who asserted that the degree to which demand can be projected or forecasted is crucial for making supply chain decisions. The findings confirm Ali et al., (2023) the argument that the manufacturing process through supply chain managers is under constant pressure from unpredictable possibilities of when, where, what, how much, where from, and how frequent. Muazu, (2019); Singhry & Abd Rahman (2019) added that production demand forecasting is challenging, as there is no historical reference, although the data may still be useless if available, as it is not guaranteed to predict future production demand due to the unique nature of productions, in that there will be statistical variations every time a production strike.

Poor coordination and corruption within the manufacturing process through supply chains were identified as a challenge to integration design. In complex emergencies, the sturdier the coordination, the better the quality of services delivered (Yeh et al., 2020). In the absence of coordination, manufacturing firms end up duplicating projects in one place or concentrate attention where it is not needed. Comes, Van de Ongeri, and Osoro (2021) supported this by emphasizing that in several occurrences, the lack of a strong central coordinating mechanism makes the work of manufacturing SMEs look haphazard. Host governments prioritizing bilateral and multilaterals while ignoring manufacturing firms, especially in making decisions was a challenge to supply chain integration. This is because reports or concerns from manufacturing firms are regarded as non-technical and thus not considered (Bag, Gupta & Luo, 2020).

The findings reveal that information asymmetry is a challenge to customer integration due market intelligence gap. Information asymmetry affects customer relationships, especially product features and prices. SMEs could find it challenging to communicate pricing strategies or product features to customers, leading to misunderstandings or dissatisfaction. These findings align with (Kauppi et al., 2023), assert that although transparency might occasionally erode confidence, it can also increase client loyalty. Information asymmetry affects Rwandan manufacturing SMEs' competitiveness, operational effectiveness, risk management, regulatory compliance, and customer relationships. By bridging information gaps and improving transparency and communication within supply chains, SMEs can decrease the effects of information asymmetry and boost their resilience and competitiveness in the market (E. Ali et al., 2023).

Multiple Regression Analysis Results

The research used multiple regression analysis to establish the linear statistical relationship between the independent and dependent variables of this study. The hypotheses, as stated in this study, were tested using regression models as below:

a) *Test of Hypothesis 1: Customer integration and Performance of Manufacturing firms in Rwanda*

A correlation analysis for the construct customer integration was conducted to determine how customer integration correlated with the performance of manufacturing firms. Table 2 indicates that the Pearson correlation coefficient was 0.718. These findings indicate that there is a strong positive linear relationship between customer integration and the performance of manufacturing firms.

Table 2: Correlation Analysis for Construct Customer Integration

Variable		Performance of Manufacturing firms	Customer integration
Performance of Manufacturing firms	Pearson Correlation	1	.708**
	Sig. (2-tailed)		.000
	N	213	213
Customer integration	Pearson Correlation	.718**	1
	Sig. (2-tailed)	.000	
	N	213	213

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The researcher conducted a regression analysis to establish the influence of customer integration on the performance of manufacturing firms. The hypothesis to test for this specific objective was:

> *H_0: Customer integration does not significantly influence the performance of manufacturing firms in Rwanda.*

The histogram in Figure 4.8 indicates that the data was normally distributed. The residual explains the error in the fit of the model to the i^{th} observation yi and is essential in determining the adequacy of the fitted model. This is in line with the findings of Li, Cui, Huo, and Zhao (2019). Analysis of the residual is frequently helpful in checking the assumption that errors are normally distributed with constant variance and in determining whether additional terms in the model would be useful.

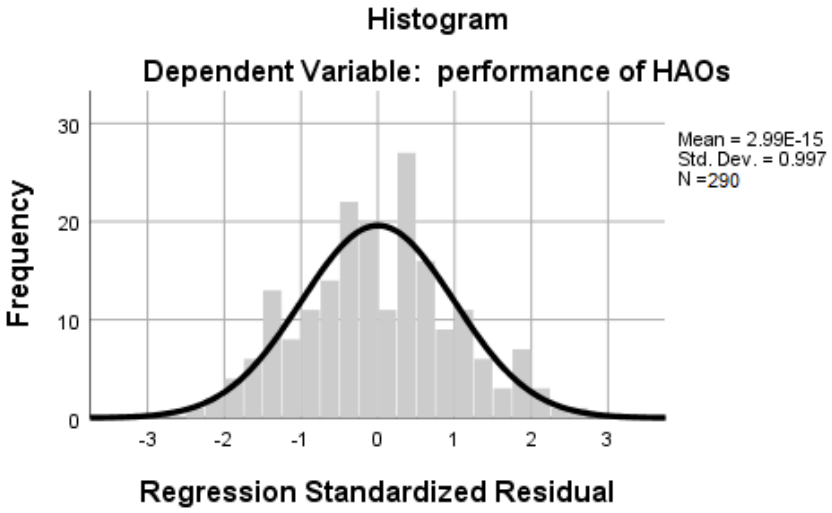


Figure 1: Histogram Customer integration on the performance of manufacturing SMEs

The summary of the linear regression model used for this specific objective indicates a coefficient of determination, R^2=0.501, which means that about 50.1 percent of the change in the performance of manufacturing firms in Rwanda can be explained by customer integration. The result is presented in Table 3 below;

Table 3: Model Summary of Customer Integration

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.718[a]	.501	.492	.67172

a. Predictors: (Constant), Customer integration

b. Dependent Variable: Performance of Manufacturing firms

Table 4 shows the ANOVA result of the regression of the performance of manufacturing firms on customer integration. The result indicates that the significance of the F-statistic is less than 0.05 (F=17.036, p<0.05), an implication that customer integration has a significant influence on the performance of manufacturing firms.

Table 4: ANOVA of Customer integration

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	10.026	1	10.026	17.036	.000[b]
	Residual	159.494	212	.589		
	Total	**169.520**	**213**			

a. Dependent Variable: Performance of Manufacturing firms

b. Predictors: (Constant), Customer integration

Shown in Table 5 are the coefficients and t-statistics obtained from the model. The constant term $\beta_0 = 4.527$ is interpreted to mean that if customer integration is held constant, then there will be a positive performance of manufacturing firms in Rwanda by 4.53. The regression coefficient for customer integration was positive and significant ($\beta_1 = 0.525$, p<0.05), with a t-value of 4.127. This implies that a unit increase in customer integration is predicted to increase the performance of manufacturing firms by 0.525 units. The findings are in line with existing literature on the subject (Li, Cui, Huo, and Zhao, 2019).

Table 5: Coefficients of Customer Integration

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.527	.532		8.507	.000
	Customer integration	.525	.127	.718	4.127	.000

a. Dependent Variable: Performance of Manufacturing firms

Performance of Manufacturing firms = 4.527 + 0.525 Customer integration

From the results in the Tables above, the decision is to reject the null hypothesis that customer integration does not significantly influence the performance of manufacturing firms in Rwanda and conclude that customer integration has a significant influence on the performance of manufacturing firms in Rwanda. As a matter of fact, production cannot be avoided, but its consequences can be mitigated through a holistic, resilient management of the relief supply chain operations. The findings of this study concur with Baah et al. (2022) that collaborative supply chain practices influence supply chain visibility, shareholder trust, and the overall performance of manufacturing SMEs. Thus, these findings are also in line with Ongeri and Osoro (2021), that a supply chain resilient management strategy improves the performance and effectiveness of manufacturing distribution logistics and relief supply chain operation, while lack of it imposes huge dramatic consequences for stricken populations. Further, Muazu (2019) in their study figured out the platform to encourage a professionalization of the supply chain resiliency disciplines in relief operations and strengthen the corresponding functions during the manufacturing strategy processes after production happening.

Moderating Effect of Information Sharing

The study hypothesis was;

H_{02}: Information sharing does not have a moderating effect on the relationship between customer integration and the performance of manufacturing firms in Rwanda.

The Moderating Effect of Information sharing on the Relationship between Customer integration and Performance of Manufacturing firms in Rwanda.

To test the moderating effect of information sharing on the relationship between customer integration and the performance of manufacturing firms in Rwanda, the study built in the following three models;

Models:

Model 1: $Y = \beta_0 + \beta_2 X_2 + \varepsilon$

Model 2: $Y = \beta_0 + \beta_2 X_2 + \beta_z Z + \varepsilon$

Model 3: $Y = \beta_0 + \beta_2 X_2 + \beta_Z Z + \beta_{2Z} X_2 * Z + \varepsilon$

The model summary result in Table 5 indicates that the unadjusted coefficient of determination for model 1 is 0.501. This implies that the customer integration considered in this study accounts for only 50.1 percent of the total variation in the performance of manufacturing firms; the remaining 49.9 percent change in the performance of manufacturing firms can be attributed to other factors not considered in this study.

For model 2, the R^2 =0.610, an implication that customer integration and information sharing accounts for about 61.0 percent of the total change in the performance of manufacturing firms, and thus the remaining 39.0 percent of the variation in the performance of manufacturing firms can be accounted for by other factors, not of interest in this study. This echoes the findings of Kauppi et al. (2023) that information asymmetry leads to opportunistic behavior of the suppliers by charging higher prices or providing lower quality products. To reduce information asymmetry in the supply chain. Companies can use transparency, trust, and collaboration to improve communication and information sharing between buyers and suppliers (Panahifar et al., 2018). Hence build long-term relationships that benefit both parties and lead to better supply chain performance (Kauppi et al., 2023; Zsidisin et al., 2024).

For model 3, the R^2 =0.669, and this implies that customer integration, information sharing as well and the interaction between customer integration and the information sharing accounts for 66.9 percent of the total variation in the performance of manufacturing firms, the remaining 33.1 percent change in the performance of Manufacturing firms can be attributed to other factors. The R^2 increased by 10.9 percent when the information sharing was considered in addition to the customer integration and increased by 5.9 percent when the interaction between the moderator and the customer integration was considered.

Table 6: The moderating effect of information sharing on the relationship between customer integration and performance of manufacturing firms in Rwanda

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change
1	.718[a]	.501	.492	.67172	.501
2	.781[b]	.610	.618	.35947	.119
3	.817[c]	.669	.646	.33189	.059

a. Predictors: (Constant), Customer integration
b. Predictors: (Constant), Customer integration, Information sharing
c. Predictors: (Constant), Customer integration, Information sharing, interaction between customer integration and information sharing
d. Dependent Variable: Performance of Manufacturing firms

Table 7 shows the ANOVA results for the models considered in testing for the moderating effect of information sharing on the relationship between customer integration and the performance of manufacturing firms. The results, Model 1 (F-statistics=17.036, $p<0.05$), Model 2 (F-statistics=15.713, $p<0.05$), and Model 3 (F-statistics=15.729, $p<0.05$), indicate that all the three models remained significant despite the use of the different predictors.

Table 7: ANOVA for the Models Used to Test for the Moderating Effect of Information sharing on the Relationship between Customer integration and Performance

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	10.026	1	10.026	17.036	.000[b]
	Residual	169.492	212	.589		
	Total	179.520	212			
2	Regression	17.743	1	8.862	15.713	.000[c]
	Residual	161.797	212	.564		
	Total	179.521	212			
3	Regression	25.434	1	8.478	15.729	.000[d]
	Residual	154.086	212	.539		
	Total	179.521	212			

a. Dependent Variable: Performance of Manufacturing firms

Table 8 presents the regression coefficients, the t-test- statistic, and the significance of the coefficients obtained from the three models used to investigate whether information sharing has a moderating effect on the relationship between customer integration and the performance of manufacturing SMEs in Rwanda. The result indicates that when customer integration considered in this study was used in multiple linear regression, the constant term $\beta_0 = 4.527$, implies that if customer integration is held constant, then there will be a positive performance of manufacturing firms in Rwanda by 4.527. The regression coefficient for customer integration was positive and significant ($\beta_1 = 0.525$, p<0.05), with a t-value of 4.127. This implies that for every unit increase in customer integration, the performance of manufacturing firms is predicted to increase by 0.525 units. This echoes the findings of Vafaei-Zadeh et al. (2020) unstructured and structured customer information sharing improves the operational performance of manufacturing SMEs. These findings differ from Kauppi et al. (2023) that two-sided information asymmetry affects the long-term relationship between suppliers and customers.

When the moderator is included, the results of model 2 show that customer integration (β=0.539, p<0.05) and the moderator information sharing (β=0.274, p<0.05) have a significant positive influence on the performance of manufacturing firms. In model 3, the interaction effect between the customer integration and the moderator (information sharing) was investigated. The result indicated that there was a significant positive influence on the performance of manufacturing firms from the interaction between information sharing and customer integration (β= 0.492, t = 1.836, p<0.05).

Table 8: Coefficients for the Models Used to Test for Moderating Effect

Model		Coefficients[a] Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.527	.532		8.507	.000
	Customer integration	.525	.127	.708	4.127	.000
2	(Constant)	2.668	.342		7.801	.000
	Customer integration	.539	.218	.539	2.427	.000
	Information sharing	.274	.008	.281	1.880	.001
3	(Constant)	3.873	.283		13.686	.002
	Customer integration	.654	.070	.663	9.343	.000
	Information sharing	.356	.075	.357	4.347	.000
	Customer integration * Information sharing	.492	.219	.572	1.836	.000

a. Dependent Variable: Performance of manufacturing firms

Thus, the regression models after moderation becomes:

Model 1: $Y = 4.527 + 0.525X_2$

Model 2: $Y = 2.668 + 0.529X_2 + 0.274Z$

Model 3: $Y = 3.873 + 0.654X_2 + 0.326Z + 0.402X_2Z$

The study hypothesized that information sharing does not have a moderating effect on the relationship between customer integration and the performance of manufacturing firms in Rwanda. The rule of thumb is that if there is a significant influence on the dependent variable from the interaction between the moderator and independent variable, moderation is supported. Otherwise, the moderation is not supported. From the results in Table 4.53 to Table 4.65, the null hypothesis is rejected, and the study concludes that information sharing has a moderating effect on the relationship between customer integration and the performance of manufacturing firms in Rwanda.

Conclusion

Customer Integration

Regarding customer integration, it could be concluded that customer integration had a positive significant linear influence on the performance of manufacturing SMEs in Rwanda. Manufacturing processes through supply chains are prone to vulnerabilities and disruptions emanating internally or externally to the organizations. The adoption of integration design in supply chains gives manufacturing SMEs the capacity to survive, adapt, and sustain in the event of turbulences to save the lives of vulnerable populations. Integration design enables the manufacturing process through supply chains to recover from inevitable risky events effectively and efficiently, which minimizes wastage of scarce resources.

The findings from the study revealed the various challenges faced in the implementation of supply chain integration by manufacturing SMEs as insufficient resources, demand uncertainty, poor coordination among the manufacturing actors, indifference to development approaches, and community poverty and illiteracy. For manufacturing processes through supply chains to overcome these vulnerabilities, local resource mobilization makes it possible to raise funds from local businesses, individuals, government, and locally generated income. For this to be realized, manufacturing SMEs need to have strong Leadership, systems that shun fraud, apparent plans, and internal credibility arising from the proper design of their supply chains.

Proper coordination of manufacturing activities and the ability to forecast demand plays an important responsibility in the employment of supply chain integration by manufacturing SMEs. In addition, the increase in numbers and complexity of productions intensifies the need for the manufacturing department to include the local emergency capacity in its pre-production plan and reinforce the capacity as a part of resilient development plans. The findings of this study indicate that local capacity is one of the main fields in need of improvement and on which to build in the country. To build on the resilience of supply chains, manufacturing SMEs should strive to make local capacity building an essential field in emergency response where partnerships bring together knowledge and manufacturing experience in a working relationship that is collaborative, risk sharing and involves the affected populations to avert, alleviate and prepare for productions.

Manufacturing SMES utilize business continuity frameworks to predict threats and come up with organized containment strategies to safeguard major proficiencies from the destructive effects of protracted shortages. Business continuity is an administrative method that detects hazards and shortcomings that might affect the consistency of organizational setups and procedures. The business continuity framework enables the organization to develop pliability

and the capacity to effectively respond to crisis. By creating time for a process called business impact analysis, organizations can react swiftly and efficiently to safeguard processes, thereby decreasing damages and expenditure. Sourcing officers should evaluate their weaknesses, establish the implications, and come up with strategies for operating under pressure

Moderating Effect of Information Sharing

The findings revealed that information sharing has a moderating effect on the relationship between supply chain integration and the performance of manufacturing SMEs in Rwanda. The study concluded that supply chain integration is positively associated with the performance of manufacturing SMEs in Rwanda. Organizational structure is an important aspect in the realization of swift production response. This means that a frail structure impedes effective, efficient, and well-timed production response. It is, therefore, essential to ensure that the organization structure in manufacturing SMEs is flexible to attain easy coordination among the bureaucrats in the case of an emergency. Age and size of manufacturing SMEs were also found crucial in the establishment of networks, resource mobilizations, and maneuverability giving organizations an operational advantage to respond fast to disruptions. This makes the manufacturing SMEs reach many hard-to-reach areas and populations. Concisely, most manufacturing SMEs have partially implemented integration design in their supply chains knowingly or unknowingly. Despite the implementation of supply chain integration, manufacturing SMEs still witnessed elements of poor information sharing and poor coordination, sluggish response, wastage in the supply chains, and disruptions of the chains, all affecting the efficient and effective handling of customer needs.

Recommendations

The study findings indicate that manufacturing SME is not a one-man show, and all the parties involved are potential influencers of the operations. With production getting more frequent and severe, manufacturing SMEs that rely on global supply chains to secure their inbound materials and outbound product flows are highly affected. Manufacturing SMEs need to stay resilient, no matter what hits. The study recommends that investors/entrepreneurs build and strengthen the local capacity to prevent, prepare for, alleviate, and contain manufacturing crises, with the aim of making sure that governments and societies can efficiently perform their obligations and coordinate effectively with manufacturing actors. This also includes the promotion of local industries and local supplies, increasing communication integration and customer integration in the event of global supply chain disruptions. Particularly in sudden onset crises, neighboring communities, on a voluntary basis, undertake immediate manufacturing assistance. It may take some days for organized national or international manufacturing SME to get to the affected places. Local capacities save lives in the first vital hours, thus responsiveness.

Manufacturing SMEs should seek the help of technology to ensure resilience in their supply chain. The presence of modern technologies, such as in-memory computing and improved analytics algorithms, helps organizations solve complicated supply chain challenges with ease and without wasting quality time. Rapid analysis and data accuracy are two crucial factors for organizations aiming for resilient supply chains. Organizations need to deploy versatile digital supply networks to be ready to deal with the unexpected and unpredictable events that continue to unfold. There is a need to reimagine the manufacturing process through supply chains and move from a static view of the supply chain to envisioning a supply chain as an organic system. Like dancing, there is a need to follow both established steps and improvise when necessary.

The study recommends that, in an effort to ensure customer integration and preparedness, supply chain managers should formulate backup or continuity plans long before production strikes to ensure minimal supply chain disruptions. For the productions that allow for advanced warning, supply chain managers can proactively reroute supplies to other ports or roads, stock

up on parts for production, and communicate with beneficiaries and vendors. When emergency supply chain management is involved, a fraction of alertness could save the day. Investing seemingly small portions of time and resources for the sake of being prepared can prove to be a great decision when production occurs, reducing the effect on people and infrastructure.

The study recommends the use of outsourcing, spare capacity and use of local suppliers to mitigate against manufacturing process through supply chain vulnerabilities. In addition, supply chain professionals should come up with new ways of predicting demand in a volatile, uncertain, complex, and ambiguous environment, learning from data from previous productions. The manufacturing process through supply chain actors needs to be familiar with supply chain vulnerabilities and the implications to the community and its lifelines so they can come up with reliable plans for responding to productions and adapt easily in times of crisis.

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