

# Customer Integration and Performance of Manufacturing Firms in Rwanda

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**Abstract:** A Customer is considered as the source of life for manufacturing organizations whatever they provide either products or services. Customer integration encompasses the focal firm and its collaborative practices, including knowledge sharing with key customers, to better understand and quickly respond to customer demands. Consequentially, with repeated exchange of quality information between the focal firm and critical customers, both sides better comprehend each other's' needs and cooperate, meanwhile improving firm's performance in Rwanda. Stated that the relationship between manufacturing firms and customer integration including information sharing in Rwanda.

**Keywords:** customer integration, and information sharing and performance of manufacturing firms

## 1.1 Introduction

Supply chain integration (SCI) does not focus on a single entity, look at various sub-systems, activities, relationships, and operations. SCI also integrates logistic and marketing functions as the areas that present a product, a price, space, and distribution (Muazu, 2019). The idea behind this lies in the fact that physical distribution is responsible for the movement and storage of goods for consumers and hence plays a role in the selling process of the product. Supply Chain Integration is a network that requires all the nodes in the network, whether inside or outside the firm, to communicate, exchange and share detailed and current information. External integration includes customers and suppliers. A close relationship is necessary between suppliers and customers to help firms achieve a higher level of business performance in terms of customer responsiveness, cost, and time (Nkwabi & Fallon, 2020). Supply chain integration requires all the nodes in the network, whether inside or outside the firm, to communicate, exchange and share detailed and current information. Integrating supply chain is perceived as an approach between different cross functional teams of a firm, internal functions work as a team and external supply chain partners. In supply chain participating members such as manufacturers, suppliers, distributors, and retailers work together in order to achieve the main goal of satisfying customers' needs on time (Muazu, 2019).

### 1.1.1 Resource Based View Theory (RBV)

The resource based theory (RBT) has taken roots from matured and further extended. Essentially, RBV theory is based on the assumptions that firms have heterogeneous resources and these resources are the source of competitive advantage (Chiappori & Salanie, 2003). The theory assumes that a firm's internal resources and capabilities can become a direct source of the firm's sustainable competitive advantage and superior performance. Additionally, sustainable competitive advantage results when the following four attributes of firm's resources are satisfied: valuable, rareness, non-substitutability and inimitability (VRIN). First, firm's resources must be valuable to allow the firm to exploit opportunities or neutralize threats in its external environment. Second, the resources must be rare that are hard for rival firms to acquire. Third, the resources must be imperfectly imitable that other firms cannot easily develop. The firm resources can be categorized as physical capital resources, human capital and organizational capital resources (Conner, 1991).

The physical capital resources are consisted of what the firm possesses and use of physical technology, production facilities, equipment as well as its geographical location and its accessibility to raw materials. Human capital resources include intangible resources such as training, employees experience, judgement, intelligence, relationships and insights of the firm's managers and workers (Daft, 1983). Also, the organizational capital resources include formal and informal planning, coordination systems, formal reporting structure. I also includes its informal and formal intra- organizational and inter-organizational information sharing. The logic of RBV is that resource can be classified as physical capital, human and organizational capital. It can be extended to other resources such as financial capital, technology capital and reputational capital. Resources are defined as something that an organization possesses or access to. These resource can be tangible like infrastructure, or intangible as information sharing. For the purpose of this

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study RBV theory will focus on the role of managerial actions in managing the internal resources provided by different functional departments, and external resources provided by suppliers and customers to enhance firm performance. In this regard, strategic SCI to be successful, practitioners must not focus on one particular inhibitor, but rather consider customer integration, supplier integration and internal functions in combination and then interdependence is viewed as an important part of supply chain integration (Conner, 1991).

Researchers by Grant (1991), argued that for an organization to meet the growing demand of the data driven world new management skills are needed. An example is big data that requires different sets of important skills and predictive analytics such as statistics, forecasting, discrete event and simulation, applied mathematics, finance and accounting (Daft, 1983). An organization can build competent skilled people via hiring and/or training their current employees, managerial skills are highly firm specific and are developed overtime by individuals. Moreover, trained and motivated employees enhance mutual trust, effective information or knowledge sharing, team work that will likely be difficult to imitate by other organizations. Resource Based View (RBV) theory suggests that supply chain integration is a non-substitutable, inimitable, path dependent capability that a firm can develop overtime to achieve sustainable competitive advantage. Similarly, in order to reduce perennial supply chain challenges such as functional silos poor transparency of information, inadequate integration of customer and suppliers relationship, firms need an integrated supply chain framework to tie together the whole network into a single entity and achieve performance. In this regards, RBV will help to discuss the organization and integration across firms in a supply chain (Conner & Prahalad, 1996).

### **1.1.2 Customer Integration and Performance of Manufacturing Firms**

The main argument is that it is important to capture both information on use experiences and resources that are available in the use context in order to understand customers and the aspects of value concretion that are critical for them (Ongeri & Osoro, 2021). This report provides a framework to better understand how to integrate customers in service development by assessing and presenting different methods for obtaining user information. Hence, the report aims to provide a basis for a better understanding of how to integrate customers in service development by assessing different methods of obtaining user information, and by suggesting a new framework that includes four modes of customer integration. The report sets off by describing the theoretical framing of 6 the key concepts of this paper. Here we define customer integration in service development and what it entails (Rwagombwa, 2019). We continue with an overview and analysis of methods for service development and innovation reported in scholarly journals.

Based on this critical review we suggest a new framework with four modes of customer integration in service development, based on customers' use situations and resource contexts (Ongeri & Osoro, 2021). Finally, we discuss our research contributions and the managerial implications it has. Service innovation has developed into an important activity both among private and public sector organizations as well as in other institutions. Innovation means development in its most broad definition. In turn, an equally broad definition of service is the need to find action to a problem and to create value. Thus, service innovation is a development of the ability to reach an improved need solution and through this create value for involved actors. A more general aim with the report is to strengthen the Swedish private and public sector by developing and spreading knowledge of how to integrate their customers. We are confident that this will yield more strong innovative services. Integrating customer in the supply chain refers to the process that helps organization to interact and collaborate with its customers. It involves sharing demand information, help the manufacturer understand better the customer needs and forecast better customer demand. It also implies collaborative involvement of customers with respect to product design, provision of better-quality products at lower cost and more flexibility in responding to customer demand (Djiofack & Niyibizi, 2021).

Rwagombwa (2019)(Eslami et al., 2018), study titled 'Knowledge integration with customers in collaborative product development: evidence from capital goods industry' argued that integrating customer knowledge contribution in each phase of the product development is an essential part of a firm to create a competitive advantage. The customer capabilities and the degree of initiative of the product development project affect the prerequisites for knowledge integration with customer. Manufacturing firms can gain many benefits in collaborating and interacting with customers as they can get more information on customers 'needs and requirements, discover new innovative product ideas and continually receive feedback on their degree to which satisfaction is being met. This does not mean collaborating with customer in product development guarantees success (Djiofack & Niyibizi, 2021).

They argue that customers should be involved in developing new services and be a source of competence for an organization. But, they fail to provide an actual method in their paper, finding it sufficient to outline some key aspects that can encourage this process. Mukasekuru (2018) argued that use-related information is often 'sticky', which means that the information is difficult and costly to acquire, transfer and use in a new situation, such as in the service development process. Mukasekuru (2018) developed a model of how to integrate a new service within an existing service system. User information and experiences – from both customers and employees play a key role in the success of service development.

In order to facilitate learning about customers, their needs, habit and intentions for service, this report presents various methods for how to capture customer information that is relevant for service development. The methods are diverse and focus on different kind of information that is close, or generated by, the customer (Ominde et al., 2022). The methods are sorted based on two dimensions, situation and context. The two dimensions create four modes which the methods are grouped according to. In the 'situation' dimension

customer information can be generated when the customer is in the value creating service situation, in other words when the customer is co-creating value, as well as outside this context. In the first example customer information is generated in the institute and in the other example estate. When the customer is in the institute s/he has a greater ability to generate information about activities and processes, the dynamic aspect of services. The 'context' dimension refers to the physical resources that make the service possible. Experience from resources that makes services possible creates possibilities for customer information that is different from that where the customer does not have the same experience. In this report we call this in context and ex-context respectively (Ongeri & Osoro, 2021).

Developing and offering new services that create value for existing customers, and attract new customers, are fundamental to increase the competitiveness of successful modern organizations. However, Ominde et al. (2022) found that new services have a failure rate of between 40 and 75 percent. We claim that the likelihood of higher market success depends on how well the new or improved service can create value for customers, and this, in turn, depends on how well the innovating company can explore and integrate adequate customer information into a resource constellation that enables the service to be co-created in the intended way. These are all examples of customers playing important roles in developing 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, the argument that the value of a service is co-created with the customers has been argued in an influential broadside by Abate (2018).

They hold that the concept of service is undergoing a paradigm shift: from defining services as a category of market offering to a perspective of value creation (Ominde et al., 2022). While the old school of thought focused on the differences between goods and services, the 'new school' focuses on what goods and services do for the customer. This renders the old dichotomy between goods and services obsolete. The concept emphasizes the need to include the customers in the development process, and that use situations are critical for understanding value creation. While the old school of thought focused on the differences between goods and services, the 'new school' focuses on what goods and services do for the customer. This renders the old dichotomy between goods and service obsolete (Abate, 2018).

### **11.3 Information Sharing**

Information sharing is being increasingly recognized as a lever to drive economic growth. Employing appropriate impact assessment methodology to measure the effectiveness of procurement in achieving secondary policy objectives is increasingly important (Müller & Birkel, 2020). As the complexity of public procurement activity increases so does the difficulty of measuring its impact. The Secretariat has found that while information sharing impacts are widespread, measurement frameworks are unable to systematically demonstrate the benefits or drawbacks of procurement policies. High level indicators can be used for measuring progress against objectives. Data availability and complexity mean that centralized activity can support development of a broader measurement framework that considers the broader procurement system (Nkwabi & Fallon, 2020). Several respondents collect data on the degree to which secondary policy objectives are met and some provide reports to various levels of government. This is particularly the case regarding GPP and support to SMEs: around 70% of surveyed countries collect data or measure the result of procurement processes in light of these two dimensions.

Some respondents use the data in a way that is intended to drive better outcomes, for instance, publicizing that a good or service has achieved a certain status and encouraging further consumption (Nkwabi & Fallon, 2020). For example, in Finland a complex methodology is used for measuring the results of GPP. There is a long list of criteria and any framework agreement of the central purchasing body is evaluated against a set of criteria. Respondents also described procurement data being used to boost consumption of desirable products, for example, green products. Based on these data the Ministry of Environment calculates the share of GPP for each designated item every year. Based on the results the Ministry considers the policies and plans to enlarge the share of GPP for the following year. The number of government purchases from SMEs for each fiscal year is also collated. The most widely adopted approach to supporting SMEs in public procurement therefore aims at ensuring that they are aware of tender opportunities and that competent SMEs have a fair chance of competing for government contracts. By contrast, only a few OECD countries have legislative provisions for bid preference and set-asides, often targeting specific categories of small businesses (Mukasekuru, 2018).

Regarding the simplification of procurement processes, the European Single Procurement Document (ESPD), provided for in Article 59 of the 2014 European Directive on public procurement, is a supplier self-declaration tool. Based on a standard form it offers preliminary evidence regarding exclusion criteria and selection criteria (Nkwabi & Fallon, 2020). The full set of supporting documentation, including attestations and certificates, needs only to be presented by the winning economic operators. Such simplification measures will ultimately enable more SMEs to participate in public procurement. Enterprises operating in global supply chains can potentially generate growth, employment and skills through their operations and sourcing. However, when they fail to operate responsibly then they risk being a contributor to adverse human rights, labor and environment impacts in their operations or supply chains (Mukasekuru, 2018).

### **1.1 4 Performance of manufacturing firms**

One firm's performance measure is quality which is measured in a number of ways including: parts per million, customer defects per supplier and field failure rates by purchase item and by supplier (Li, Cui, Huo & Zhao, 2019). A study on the role of logistics in

manufacturing firms' performance in some states in Northern Nigeria. Using a cross sectional examination of members of the Manufacturers Association of Nigeria (MAN), with a sample of 144 firms, using regression analysis through PLS -SEM show that the performance of manufacturing firms may come from the relationship between inbound and outbound logistics. A Study conducted in Ghanaian manufacturing breweries using the services of a third-party logistics provider (DHL) to assess the importance of outbound Logistics on the performance Management in Manufacturing Companies in Guinea and Ghana. A structured questionnaire was used, the results showed that the relationship between outbound logistics and performance was not significant. The implications of these findings show that managers of manufacturing firms cannot entirely rely on the contributions of logistics to enhance performance (Mat Isa & Mohammad Al Dweiri, 2020).

The performance measurement such as on time delivery, cycle time reduction, responsiveness to schedule changes, mix changes and design or service changes and achieving new product can be used to explain the performance of manufacturing companies. The main objective was to shed some light on performance measurement. The issues relevant to current practices using multiple regression analysis, cluster analysis and gap analysis show that performance can be measured by responsiveness, time /and delivery. In this context, performance is measured as the amount of time in weeks or months from concept to first shipment or delivery of final product to the market with the objective of continuous reduction of time to the market (Mostafa, Hamdy & Alawady, 2019).

The present goals and objectives are mainly in terms of profitability, liquidity, growth and stock market performance (Müller& Birkel, 2020). Performance measurement practices have been defined as the main components to creating a performance measurement framework that is practical and sustainable and which will provide worthwhile management information about an organization. These practices include metrics, approaches, tools systems and processes used in performance measurement. Metrics include; management of the organization processes, clear roles and responsibilities, continuous learning and model success. Approaches include; financial and non-financial approaches. The tools include safety stock, information technology integration, self-evaluation and feedback. By ensuring performance measurement people are able to change rather complex processes into simplified conceptual information for easy communication and action (Mukasekuru, 2018).

Manufacturing firms in Rwanda have over time moved from the use of traditional to the use of modern approach to performance measurement (Müller& Birkel, 2020). The modern approaches to performance measurement include; Return on Investments (ROI), Return on Assets and customer satisfaction among others. They are; the financial perspective, customers' perspective, internal business processes perspective and organizational learning perspective. Other performance measures include quality and cost with common price performance looking at actual purchase cost against planned purchase price and cost looking at cost changes and cost avoidance. A cost change is the increase or decrease in cost resulting from a change in purchasing strategy while cost avoidance represents the difference between a price paid and a potentially higher price which might have occurred if a purchase had not been obtained at a lower price (Nkwabi & Fallon, 2020).

Firms expect a lot from their suppliers because they are confident that they have filtered their suppliers on very efficient basis but still they are uncertain about the quality of the items to be delivered, on time delivery. Although integrated marketing communications have been widely studied, the online context opens up new possibilities for analyzing their management and the use of new formats and media within the communication strategies of advertisers (Nyile, Shale & Osoro, 2022). As we have seen in this study, the use of IMC programs offers a competitive advantage for organizations, helping them to improve their client relations, increase their brand equity and achieve better financial results. In fact, the current direction, based on the new technologies and the interactive media used by companies, is so important that it is generating new names that are associated with the original concept of integrated marketing communication, such as "interactive integrated marketing communication" or "online integrated marketing communication commitment to quality, technology leverage, and overall performance of suppliers.

## 2.1 Research Methodology

The primary purpose of explanatory research was to explain why phenomena occur and to predict future occurrences (Osoro, Muturi & Ngugi, 2016). Explanatory studies are characterized by research hypotheses that specify the nature and direction of the relationships between or among variables being studied. This research design was therefore best suited for this study because the study sought to test different research hypothesis. Research Philosophy The system of assumptions and beliefs that control the way the research interprets the world is referred to as research philosophy. It is a knowledge foundation, and the nature of that foundation involves crucial assumptions about the researcher's worldview (Rahi, 2017). This study identified two types of research philosophy namely: phenomenological and Positivist philosophy. Realism, or pragmatism could be the research philosophies. These ideologies share a set of assumptions, and these assumptions explain why they were used as examples of bigger philosophies. To uncover the causes that influence outcomes, this study employed a positivist research philosoph. The items were subjected to factor analysis whose result is as shown in Table 1.1 below.

**Table 1.1 Factor Loading for Customer Integration**

Customer Integration	Factor Loadings
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Manufacturing firms have established outgoing set of data entry	.826
Incoming set of data is charged with ensuring internal operational integration	.786
Firms are satisfied with the effectiveness of customer sharing ideas	.760
Manufacturing firms holds functional team meetings on regular basis	.876
Meetings in our firms helps to determine the strengths and weaknesses of the firm	.852
Satisfied with functional team meetings in manufacturing firms	.862
Real time information is a key aspect of internal Customer integration in firms	.443
Our firms has various sources of real time information in manufacturing entity	.833
Real time information helps the firms to stay informed and alert	.789
Customer integration can affect performance of manufacturing firms	.488
<b>Overall Factor Loading</b>	<b>.749</b>

Among the ten items that were used to measure demand customer integration he one that required the respondents to indicate if proper customer integration facilitate efficient manufacturing of firms loaded the highest with a factor loading of 0.876. The item that loaded lowest was that which required the respondents to indicate if projecting demand for company’s goods facilitates prediction of customer integration in the market and improved performance through shorter period in return on investment by real time integration with factor loadings of 0.443 and that which required them to indicate if customer integration mathematical model computation that are commonly used in projecting trends for the manufacturing in the market to gain competitive advantage. Since items did not meet the required factor loading threshold of 0.5, they it was dropped from the analysis and later re-formulated.

**Table 1.2 Factor Loading for Performance of Manufacturing Firms**

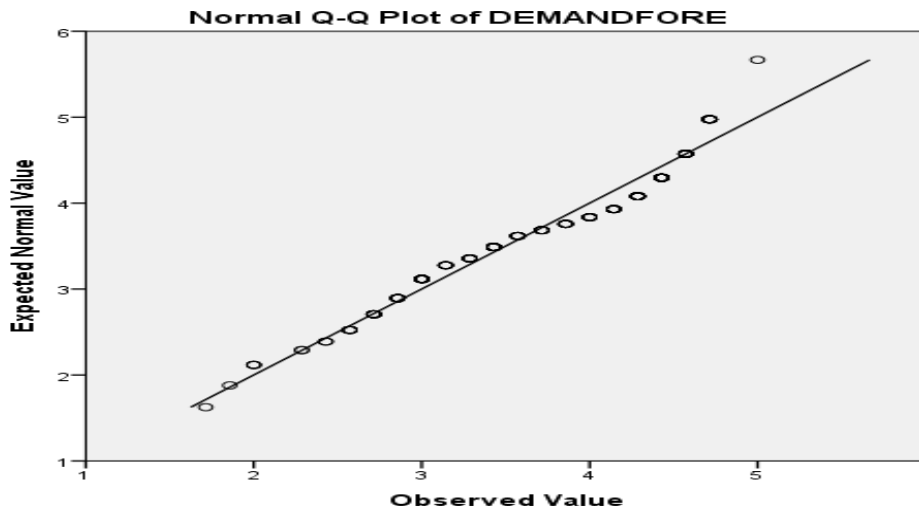
<b>For the last 3-5 years Performance of Manufacturing Firms</b>	<b>Factor Loadings</b>
In our firm the quality of goods and services offered has improved	.671
There are minimal complaints concerning manufacturing goods and services	.648
The cost of manufacturing in our firm is manageable	.611
The cost of manufacturing is always less than the total sales	.714
The cost of manufacturing is always less than the total sales	.893
I am satisfied with the flexibility and reliability of operations in our firm	.725
Effective SC Integration has let to poor performance of man. Firms in Rwanda	.781
For the last 3-5 yrs performance of firms is affected by supply chain Int.	.598
Reduced manufacturing by supply chain integration in manufacturing firms	.711
Due to supply chain integration for the last 3-5 yrs performance of firms is declining	.648
<b>Overall</b>	<b>.697</b>

Ten items were used to measure the dependent variable of supply chain integration of performance of manufacturing firms. Among the ten items, none was dropped from the variable since all the items loaded more than 0.500 often considered to be the threshold. Moreover, the average factor loadings of 0.695 shows that the items were valid in terms of convergent validity.

To establish discriminant validity, it was desired to show that the four independent constructs that should not be related were in reality not related. Discriminant validity was assessed using Inter-Construct Correlation. According to Musau et al. (2018) correlation values of less than 0.5 show low levels of correlations among variables.

**3.1.1 Normality Test for Customer Integration**

As it can be observed in the plots are along the straight line and the data is therefore normal. The second independent variable of the study was Customer integration. The Q-Q plot for this variable is show in Figure 1.1 below.



**Figure 1.1: Normality Test for Customer Integration**

### 2.1.2 Descriptive Statistics for Customer Integration

The second objective of the study was to evaluate the effect of Customer Integration on performance of manufacturing firms in Rwanda. Table 4.19 below, shows that ten items were used to measure the effect of Customer Integration on performance of manufacturing firms in Rwanda. On the statement that “Adoption of communication integration techniques by our company have firm production” the mean was 4.28 and the standard deviation 0.851. Specifically, majority 48.6% (104) of the respondents agreed with the assertion, while 19% (40) of the respondent strongly disagreed. However 21% (45) of the respondents were undecided over the statement. This gave a range of 43.8% (93) of the respondents. This is an indication that many respondents were in agreement with this assertion that, communication integration techniques are responsible for manufacturing firms; a position confirmed by Rwagombwa (2019). On the statement that “Our firm uses internal operations integrations to support its competitiveness in the supply chain.” the mean scored was 3.98 and the standard deviation was 1.036. As a result majority of respondents 49% (104) of the respondents agreed with the statement, while 19.5% (42) of the respondents were undecided. Only 2.9% (6) of the respondents and a few 12.9% (27) of the respondents indicated that they strongly disagreed and disagreed with the statement respectively. As Oteki et al (2018) observes, consumer surveys are critical for manufacturing firm’s success.

The respondents were also asked to indicate if their firm has adopted the use of outgoing data setting to facilitate accurate efficiency in manufacturing schedules. On this statement the mean was 4.15 while the standard deviation was 1.024. Consequently 45.4% (97) of the respondents strongly agreed that outgoing data settings facilitated efficiency in manufacturing schedules; while 5.2% (11) of the respondents of them disagreed. The range for data on this statement stood at 39.2% (83) of the respondents. This is in line with findings of Rwagombwa (2019), in a study of steel manufacturing companies in Rwanda. In another statement the respondents were required to choose whether, satisfied with sharing idea in the company had facilitated flexibility in the manufacturing of firms. On this item, 36.7% (78) of the respondents agreed with the assertion, and another 26.3% (56) of the respondents of them strongly agreed. However only 4.8% (10) of the respondents strongly disagreed with the statement. Other respondents were either disagreeing or undecided, at 14.1% (30) of the respondents and 18.2% (39) of the respondents respectively. The mean yielded was 4.03 while the standard deviation was 1.094, an indication that indeed the respondents agreed with the statement. The most frequent anchor, was that indicating ‘agree’ at 36.7% (78) of the respondents.

Another statement requested to show their level of agreement that holding of meetings often in the firm is critical for meeting performance of manufacturing firms in Rwanda. This scored a mean was 4.02 and the standard deviation was 0.939; thus respondents agreed with this assertion too. From the analysis majority of the respondents, a few 31.9% (68) of the respondents agreed with the statement, another 27.6% (of the respondents strongly agreed, while only 3.8% (8) of the respondents strongly disagreed. This is indication that majority of the respondents supported the statement. Additionally the respondents were required to indicate if their firm uses Delphi forecasting methods for critical leveraging of the firm through cost reduction. This indicator had a mean of 4.21 and the standard deviation was 1.156; indicating a great level of variability. On this statement majority 44.3% (94) of the respondents agreed, while another 24.3% (52) of the respondents strongly agreed. However 15.2% of the respondents of them were neutral and only 4.8% (9) of the respondents indicating that they strongly disagreed with the assertion, the mode thus was 44.3% (94). The results are in line with the findings of Rwagombwa (2019); who reported that satisfied that sharing ideas were critical in manufacturing firms in Rwanda.

The statement that, “holding team meeting in our firm has disclosed the strength and weakness of our performance in production.” the mean was 4.15 while the standard deviation was 1.154, this was an indication that majority agreed with the statement, showing high level variability. Thus 28.6% (61) of the respondents strongly agreed, while 38.1% (81) of the respondents agreed, representing the mode. However 21.8% (46) of the respondents of those who participated were undecided over the assertion and 4.8% (10) of the respondents had strongly disagreed with the statement. The findings resonates with a study conducted by Ongeru and Osoro (2021), who affirmed that demand projection in tea factories was a catalyst in improving sales of the tea products.

On the statement that, “Our firm has adopted customer integration that creates supply relationship management practices for performance of manufacturing firms in Rwanda”, majority 42.9% (91) of the respondents agreed. A few 15.7% (33) of the respondents strongly agreed, whereas 13.8% (29) of the respondents and 9% (19) of the respondents strongly disagreed and disagreed respectively. Some 18.3% of them were undecided on whether customer integration practices created performance of manufacturing firms in Rwanda. The mean was 4.21 and the standard deviation was 1.015. This showed that a greater percentage of the respondents were in agreement with this assertion, in the performance of manufacturing firms. The response range on this statement was 32.9% (70) of the respondents, with the lowest being ‘strongly disagree’ and the highest response from respondents being ‘strongly agree at 43.9% (94) of the respondents.

The other statement asked the respondents in this study to confirm if their firm uses real time customer integration in establishing the performance of manufacturing firm in Rwanda in order to fulfil the demand. This had 39% (83) of the respondents who agreed, 17.1% (36) of the respondents of them strongly agreed. Those who were undecided were 23.3% (50) of the respondents and another 6.7% (14) of the respondents and 13.8% (29) of the respondents strongly disagreed and disagreed respectively. The statement scored a mean of 4.22 and the standard deviation was 0.802, an indication of limited dispersion from the mean. It further indicated that a big number of the respondents either strongly agreed or agreed with this assertion, which is in line with studies conducted by Rwagombwa (2019). According to them real time communication integration was at the centre of fulfilling of performance of manufacturing firms in Rwanda.

Finally, the respondents were required to mark whether, their firm has been embracing customer integration to support the improvement of performance of manufacturing firms during production processes. On this statement; majority 47.1% (100) of respondents agreed, a few 11.4% (24) of the respondents of them strongly agreed while 24.8% (53) of the respondents were neutral. In addition 3.9% (8) of the respondents and 12.7% (27) of the respondents strongly disagreed and disagreed respectively. The mean was 4.43 and the standard deviation was 0.917. This clearly indicated that a good number of the respondents either agreed or strongly agreed 46% (98) of the respondents and 12.4% (26) of the respondents, that adoption of demand forecasting techniques supports the improvement of resources in production. The response range on the other hand was 43.3% (92) of the respondents where the highest ‘strongly agreed’ at 47.2% and the lowest 4.9% (10) of the respondents. This position is supported by Rwagombwa (2019), in their study on inventory management and organizational performance in Maleka. The descriptive results for the variable are as shown in Table 4.19;

**Table 1.3: Descriptive statistics on Customer Integration**

Statement	1	2	3	4	5	Mean	Std. Dev.
Adoption of establishing outgoing data of our firm.	19% N (40)	6.6% N (14)	21% N (44)	48.6% N (102)	4.8% N (10)	4.28	0.851
Our firm ensure internal integration competitiveness in the supply chain.	2.9% N (4)	12.9% N (27)	19.5% N (43)	49% N (103)	15.7% N (33)	3.98	1.036
Our firm is satisfied with sharing information	6.6% N (14)	5.2% N (11)	19% N (42)	23.8% N (50)	45.4% N (93)	4.15	1.024
<b>Our firm customer integration is good</b>	4.8% N (10)	13.8% N (29)	18.6% N (39)	36.7% N (77)	26.3% N (55)	4.13	1.094
Adoption of customer integration in our firm performance	3.8% N (8)	13.8% N (29)	21.9% N (46)	31.9% N (67)	28.6% N (60)	4.02	0.939

Our firm holds functional team meetings	4.8% N (10)	11.4% N (24)	15.2% N (32)	44.3% N (93)	24.3% N (51)	4.20	1.153
<b>Our firm meetings discloses strength and weakness</b>	4.8% N (10)	6.7% N (14)	21.8% N (46)	38.1% N (80)	28.6% N (60)	4.15	1.154
Our firm real time customer integration is good for manufacturing firms.	13.8% N (29)	9% N (19)	18.6% N (39)	42.9% N (90)	15.7% N (33)	4.21	1.015
Our firm's internal operations is good for manufacturing	6.7% N (14)	13.8% N (29)	23.3% N (49)	38.1% N (80)	18.1% N (38)	4.22	0.802
Our firm 's performance is affected by customer integrations	3.8% N (8)	12.9% N (27)	24.8% N (52)	47.1% N (99)	11.4% N (24)	4.43	0.917

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**Key: N = 213    Strongly Disagree =1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5**

### 2.1.3 Descriptive Statistics on performance of Manufacturing Firms

The dependent variable for this study was performance of manufacturing firms in Rwanda. The study aimed at determining the relationship between supplier relationship management and performance of manufacturing firms in Rwanda. The table 4.27 below shows the descriptive results for the dependent variable, of this study. From the ten items used to measure performance of manufacturing firms in Rwanda; the one which required the respondents to indicate if their company had efficient production process because of reliable lead times by suppliers of raw materials; had the lowest mean of 3.39 and a standard deviation of 1.398. Precisely this item had, majority 41% (87) of the respondents agree with the statement, while 21% (45) of the respondents strongly agreeing. On the contrary a few 19% (40) of the respondents strongly disagreed, while only 6.6% disagreed. Another 12.4% (26) of the respondents were however undecided.

On the other hand the statement that required the respondents to indicate whether their firm had a reduced manufacturing cost due to the minimal complaints concerning the quality of goods and services offered; scored highest mean of 4.12, with a standard deviation of 0.970. Where a few 27.6% (59) of the respondents agreed, while 36.7% (78) of the respondents which is also the mode strongly agreed. On the other hand 11.4% of the respondents disagreed, and another 5.2% strongly disagreed with this assertion. However a few 19.1% (41) of the respondents indicated neutrality on the statement. This is an indication that majority of the respondents agreed with the statement that there are minimal complaints concerning the quality of goods and services offered, as highlighted by Amsterdam (2020).

Moreover on the statement that; 'Our company has efficient cost of manufacturing in our firm is manageable,' had a mean score of 3.58 with a standard deviation of 1.170. From the results 32.4% (69) of the respondents agreed with the statement, whereas 26.6% (57) of the respondents strongly agreed with the statement. Some 22% (47) of the respondents were however undecided on the statement with another 2.4% (5) of the respondents strongly disagreeing. However 16.6% (35) of the respondents were neutral on this statement. This was an indication that the respondents were unsure whether efficient cost of manufacturing in our organization is manageable not.

Another statement asked the respondents to confirm if their firm had improved cost of production is always less than the total sales. This had a mean score of 3.97 with a standard deviation of 1.376; this showed the highest level of variability in the data set. The figures show that the respondents were in agreement with the assertion, as confirmed by Amsterdam (2020). On this statement 31.9% (67) of the respondents strongly agreed, with the statement, while 29% (62) of the respondents agreed. On the contrary 13.3% (28) of the respondents strongly disagreed while 9.1% (19) of the respondents disagreed with the statement. The median of the statements was 16.7% (35) of the respondents, of the respondents indicating neutrality among some of the respondents.



On the statement that required the respondents to show whether their firm had improved cost of production is always less than the total sales; a few 31.4% (67) of the respondents strongly agreed with the assertion, while another 33.8% (72) of the respondents agreed that their firm had improved resources. However from the results 21% (45) of the respondents were unsure, with 11.4% of the respondents and 2.2% (5) of the respondents disagreed and strongly disagreed respectively on the statement. This construct had a mean of 4.05 and a standard deviation of 0.964, an indication that many respondents agreed with the statement that their firm had improved cost of production is always less than the total sales. A position confirmed by Ahmad and Mamun (2020), who concluded that production design is a requisite for improved resources in firm.

In addition for the statement on whether, ‘our firm has adopted satisfied with the flexibility and reliability of operations in our firm.’ scored a mean of 3.84 with a standard deviation of 1.050. An indication that some respondents were undecided on the assertion. The respondents were further required to indicate whether their firm has integrated the use of IT in its management of workers’ resulting to improved human capital. This statement had a mean score of 3.88 with a standard deviation of 1.076; where majority 42% (89) of the respondents strongly agreed while only 3.3% (7) of the respondents of the strongly disagreed. This statement had response range of 36.7% (78) of the respondents, indicating high level response distribution by the people. This showed that most respondents indicated that their firms had integrated the use of IT in their operations.

Finally on the statements that; ‘Our firm has managed to reduce cost of production by implementing consumer surveys forecasting,’ and that of ‘There is agility in the manufacturing of our firm because of the manufacturing process design adopted,’ scored means of 3.71 and 3.95 respectively with standard deviations of 0.947 and 1.067 respectively. An indication that the respondents were in agreement with the statements, as confirmed by ehuria (2018) in their study, on strategic alignment in organizations for success. They concluded that organizational cost reduction was at the centre of many organization research efforts. From this variable, the highest mean was 4.12 while the lowest mean of 3.39; this yielded a mean range of 0.73 an indication that the data, set were not extremely varied. On the other hand the maximum standard deviation for this variable was 1.398, while the lowest standard deviation of 0.847; this gave a standard deviation range of 0.551, showing limited dispersion of data from this variable.

The overall mean for the dependent variable therefore had an overall mean of 3.91 and standard deviation of 1.083; thus majority of the respondents who participated, agreed at 32.7% (70) of the respondents, another 30.9% (66) of the respondents strongly agreed that there is relationship between inventory control practices and supply chain leverage of firm firms in Rwanda. However 17.3% (37) of the respondents engaged in this study were undecided on whether there is a relationship between supplier relationship management and performance of r manufacturing firms in Rwanda. The descriptive statistics results for the dependent variable are shown in Table 1.4;

**Table 1.4: Descriptive statistics for Performance of Manufacturing Firms**

Statement	1	2	3	4	5	Mean	Std Dev.
Our firm has the quality of goods and services has improved	19% N (40)	6.6% N (14)	12.4% N (26)	41% N (89)	21% N (44)	3.39	1.398
The production of our firm resulting from predictable frequency of supplies of raw materials.	2.4% N (5)	16.6% N (35)	22% N (46)	32.4% N (74)	26.6% N (55)	3.58	1.170
Our firm has improved resources because of strategies in production process.	13.3% N (28)	9.1% N (19)	16.7% N (35)	29% N (63)	31.9% N (68)	3.97	1.376
Our firm has improved resources because of implementing proper process design in the production of firm.	2.4% N (5)	11.4% N (24)	21% N (45)	33.8% N (72)	31.4% N (72)	4.05	0.964
There are minimal complaints concerning the quality of goods and services offered	3.8% N (8)	5.7% N (12)	19.5% N (41)	40% N (84)	31% N (65)	3.84	1.050

Our firm has integrated the use of IT in its management of workers' resulting to improved human capital.	3.3% N (7)	7.1% N (15)	13.3% N (28)	34.3% N (73)	42% N (88)	3.88	1.076
The cost of manufacturing in our organization is manageable	1.9% N (4)	8.1% N (17)	17.1% N (36)	25.8% N (55)	47.1% N (100)	4.04	0.844
The cost of production is always less than the total sales	3.3% N (7)	10% N (21)	17.1% N (36)	31.9% N (67)	37.7% N (79)	3.71	0.949
I am satisfied with the flexibility and reliability of operations in our firm	5.2% N (11)	11.4% N (24)	19.1% N (40)	27.6% N (59)	36.7% N (77)	4.12	0.971
Our firm has ensured flexibility and reliability of operations	4.3% N (9)	7.1% N (15)	14.8% N (32)	35.7% N (75)	38.1% N (83)	3.95	1.067

**Key: N = 213 Strongly Disagree =1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5**

### 3.1 Multicollinearity Test

Variance Inflation Factor (VIF) and Tolerance Levels were used to measure the problem of multicollinearity in the multiple regression models. VIF statistic of a predictor in a model is the reciprocal of tolerance and it indicates how much larger the error variance is for the unique effect of a predictor (Oteki *et al.*, 2018). According to Ominde *et al.*, (2022) a VIF of more than 10 indicates the presence of multicollinearity. The results for the multicollinearity test is as shown in Table 1.5 below;

**Table 1.5 Multicollinearity Test**

Coefficients <sup>a</sup>	Collinearity Statistics	
	Tolerance	VIF
Communication Integration	.136	7.289
Customer Integration	.132	7.623
Collaborative Integration	.171	5.804
Measuring Integration	.122	8.254

The results of tolerance and VIF as shown in Table 4.33 indicates that there was no problem of multicollinearity among the independent variables because no variable had a VIF value exceeding 10 and no tolerance statistic was below 0.100 as suggested by Rwagombwa (2019). The data therefore satisfied the condition of non-multicollinearity and was fit for linear regression.

#### 3.1.1 Heteroscedasticity Test

As asserted by Ominde *et al.* (2022), homoscedasticity condition is fulfilled when at each level of the predictor variables; the variance of the residual terms is constant. However, when this condition is not fulfilled then heteroscedasticity condition occurs, which means the variance of the residual terms is a variable. Testing for homoscedasticity was necessitated by the use of hierarchical multiple regression as the principal inferential statistical approach. In this study, homoscedasticity was tested using Levene's test of equality of variances of inventory control practices across supply chain. Under this test, the assumption was that the variance of adoption levels was equal across groups defined by inventory control analytics. The null hypothesis was that the data was not homoscedastic. The result for the test is shown in Table 1.6 below.

**Table 1.6: Testing for Heteroscedasticity**

Variable	Levene Statistic	df 1	df 2	Sig
Communication integration	2.251	1	10	.174
Customer Integration	1.623	1	10	.484

Collaborative Integration	0.674	1	10	.420
Measurement Integration	0.484	1	10	.628

From the results shown in Table 1.6 above, it was concluded that all the four independent variables were homoscedastic and not heteroscedastic, since the p-values are all greater than 0.5 implying that the null hypothesis that the error variance of the dependent variables across groups is equal was rejected and alternative was taken.

**3.1.2 Auto-correlation Test**

Auto-correlation is a characteristic of data which shows the degree of similarity between the values of the same variables over successive time intervals. It occurs when there are series of numbers and a pattern existing such that values in the series can be predicted based on the preceding values in the series (Ongeri and Osoro, 2021) Also known as serial correlation, auto-correlation implies the correlation among the values of the same variables but at different times or periods and arises whenever the same variable is observed over time.

According to Rwagombwa (2019), autocorrelation refers to the degree of correlation of the same variables between two successive time intervals. It measures how the lagged version of the value of a variable is related to the original version of it in a time series.

The Durbin-Watson statistic is commonly used to test for autocorrelation. It can be applied to a data set by statistical software. The outcome of the Durbin-Watson test ranges from 0 to 4. An outcome closely around 2 means a very low level of autocorrelation. An outcome closer to 0 suggests a stronger positive autocorrelation, and an outcome closer to 4 suggests a stronger negative autocorrelation (Durbin and Watson, 1971).

Durbin-Watson test is frequently employed to detect the presence of residual serial correlation from least squares regression analyses. However, the Durbin-Watson statistic is only suitable for ordered time or spatial series Rwagombwa (2019). If the variables comprise cross-sectional data coming from random sampling, the test will be ineffective because the value of Durbin-Watson’s statistic depends on the sequence of data points. In this study, the researcher did not execute auto-correlation analysis test because the nature of the data collected for pilot testing was cross-sectional data in nature. Since the pilot study was only done once and not over successive time periods. Autocorrelation test would only be significant when dealing with time series data; and not cross-sectional data. Time series data refers to a sequence of values for only one variable recorded over time. It is a sequence of measurements of the same variable(s) made over time. Usually the measurements are made at evenly spaced times, for example weekly, monthly or yearly etc. The data helps in determining lags for a specified number. Therefore auto correlation function (ACF), is only applicable to time series data.

**3.1.3 Autocorrelation Test**

One of the basic assumptions for regression analysis is that the residuals of the model should be independent, that is, the residuals should not be auto correlated. Durbin Watson test was conducted to check for auto correlation. A value toward 0 indicates positive autocorrelation, a value near 2 signifies non-autocorrelation and a value toward 4 indicates negative autocorrelation. The rule of thumb is that Durbin-Watson statistic values in the range of 1.5 to 2.5 are relatively normal. Values beyond this range could be cause for concern. This is in agreement with the findings of Ongeri and Osoro (2021), values under 1 or more than 3 are a cause for concern. The results in Table 1.7 shows that the Durbin-Watson d =1.976, which is in the normal range hence it was assumed that there was no auto-correlation in the multiple linear regression data.

**Table 1.7: Durbin-Watson Test for Autocorrelation**

Model	Durbin-Watson
1	1.976

**3.1.4 Multicollinearity Test**

Multicollinearity is a case of multiple regression whereby the predictor variables are themselves highly correlated. Multicollinearity poses serious effects on the least squares estimates of the regression coefficients, the most significant of which is resulting to the acceptance of the null hypothesis more readily (Muazu,2019). Multicollinearity diagnostics was conducted using Variance Inflation Factor (VIF) and Tolerance statistics. The VIF is the reciprocal of the tolerance statistics. The variance inflation factor (VIF) for each term in the model measures the combined effect of the dependences among the repressors on the variance of that term. One or more large VIF indicate multicollinearity. Tolerance is inverse of the coefficient of determination ( $R^2$ ). Tolerance is estimated by  $1 - R^2$ . Other factors equal, researchers crave soaring levels of tolerance, as low tolerance levels could severely affect results that involve multiple regression analysis. A VIF of above 5 is usually regarded as evidence of Multicollinearity. While a tolerance statistic of less than 0.20 is also taken as a cause for multicollinearity concern. The results in Table 4.36 shows the test results for multicollinearity using tolerance and VIF. With tolerance values being more than 0.2 and VIF values below 5, it was concluded that there was no multicollinearity problem in this study. This is in line with the findings of Ongeri and Osoro (2021).

**Table 1.8 : Test of Multicollinearity Statistics**

Variable	Tolerance	VIF
Communication integration	.813	1.239
Customer integration	.748	1.346
Collaboration integration	.619	1.635
Supply Chain Integration	.697	1.501
Information sharing	.673	1.485

**3.1.5 Heteroscedasticity Test**

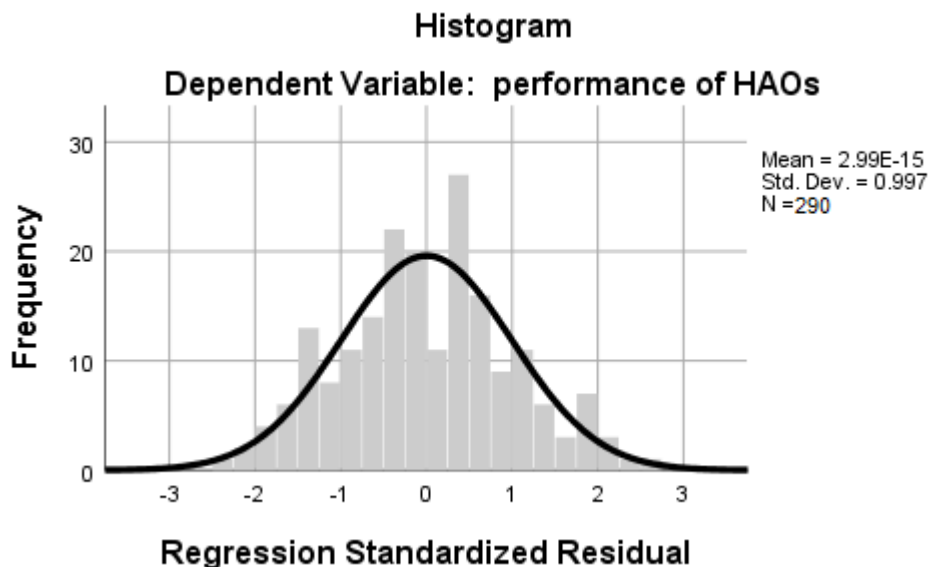
Another assumption of multiple regressions is that the residuals are homoscedastic. Heteroscedasticity in regression analysis occurs when the variance of the residuals (errors) vary across the observations. The study employed Breusch-Pagan to test the null hypothesis that the errors have equal variance (errors are homoscedastic) versus the alternative hypothesis that the errors are heteroscedastic. Breusch-pagan test gives a chi-square value and a significance value, whereby a p-value < 0.05 indicates that there is heteroscedasticity while a p-value greater than 0.05 indicates heteroscedasticity does not exist. Table 1.9 shows the results obtained from running the tests. From the table, the Breusch-Pagan test p-value was 0.481, which was greater than 0.05 indicating that heteroscedasticity does not exist thus the assumption of homoscedasticity of the residuals had not been violated. This is in line with the findings of Ongeru and Osoro (2021).

**Table 1.9: Heteroscedasticity Test Results**

Test	Chi-square value	Sig.
Breusch-Pagan	3.483	.482

*H<sub>0</sub>: 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*<sup>th</sup> observation *y<sub>i</sub>* and are 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 1.1: Histogram Customer integration on performance of manufacturing firms**

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 1.10 below;

**Table 1.10: Model Summary of Customer integration**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.718 <sup>a</sup>	.501	.492	.67172

- a. Predictors: (Constant), Customer integration
- b. Dependent Variable: Performance of Manufacturing firms

Table 1.11 shows the ANOVA result of the regression of 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 performance of manufacturing firms.

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**Table 1.11: ANOVA of Customer integration**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	10.026	1	10.026	17.036	.000 <sup>b</sup>
	Residual	159.494	212	.589		
	Total	169.520	213			

- a. Dependent Variable: Performance of Manufacturing firms
- b. Predictors: (Constant), Customer integration

Shown in Table 1.12 are the coefficients and t-statistic 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. This is in line with the findings of Li, Cui, Huo and Zhao (2019).

**Table 1.12: 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 result in Table 1.12 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 that customer integration has a significant influence

on the performance of manufacturing firms in Rwanda. As a matter of the fact, production happening 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 Ongeru and Osoro (2021), that, a supply chain resilient management strategy improve the performance and effectiveness of manufacturing distribution logistics and relief supply chains operation, while lack of it imposed 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.

### Summary

Customer integration on performance of manufacturing firms in Rwanda. This objective was measured using outgoing set of data, incoming set of data and sharing ideas in the opinion statements given. The findings in the study revealed that integration design of supply chains enables manufacturing process through supply chains to be resilient by achieving the elements of flexibility, alignment and reduction in supply chain vulnerability. Manufacturing process through supply chains are prone to vulnerabilities and disruptions emanating internally or externally to the organizations. The adoption of integration design in supply chains give manufacturing firms the capacity to survive, adapt and sustain in the event of turbulences. Integration design enables manufacturing process through supply chains to recover from inevitable risky events in an effective way. Poor coordination within the manufacturing process through supply chains was identified as a challenge to integration design. In extreme tragedies, strong coordination is of importance to the effective delivery of aid to victims. In the absence of synchronization, manufacturing firms end up duplicating projects in the same area, or may all be working in one location or totally in an undeserving population. In most cases, lack of strong central coordinating mechanism make the work of manufacturing firms look haphazard. Host governments tend to bilateral and multilaterals and in most cases seem to ignore manufacturing firms especially in making decisions.

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