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**EFFECT OF SUPPLY CHAIN INTEGRATION ON OPERATIONAL PERFORMANCE  
IN ETHIOPIAN WASH SECTOR**

**A THESIS SUBMITTED TO SCHOOL OF COMMERCE, ADDIS ABABA UNIVERSITY IN  
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OF ARTS IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT**

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# DECLARATION

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“I hereby declare that this research paper entitled “**The effect of supply chain integration on operational performance in Ethiopian WASH sector**” is my own and to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent that has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.”

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## LETTER OF CERTEFICATION

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This to certify that Zelalem Gebreyesus has carried out his thesis work on the topic entitled “**The effect of supply chain integration on operational performance in Ethiopian WASH sector**” under my guidance and supervision. Accordingly, I here assure that his work is appropriate and standard enough to be submitted for the award of Master of Arts in Logistics and Supply Chain Management.

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## ACRONYMS

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<b>CMP:</b>	Community managed project
<b>CRM:</b>	Customer relationship management
<b>DFID:</b>	Development for International development
<b>FDRE:</b>	Federal Democratic Republic of Ethiopia
<b>GTP:</b>	Growth and transformation plan
<b>HA:</b>	Humanitarian Aid
<b>MOE:</b>	Ministry of Education
<b>MOH:</b>	Ministry of Health
<b>MOWE:</b>	Ministry of water and Energy
<b>OP:</b>	Operation performance
<b>SCI:</b>	Supply chain integration
<b>SRM:</b>	Supplier relationship management
<b>SCM:</b>	Supply Chain Management
<b>NGO:</b>	Non-Governmental Organization
<b>NRS:</b>	National Regional States
<b>WASH:</b>	Water, sanitation and Hygiene

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## ABSTRACT

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*During recent decades, the issue of water, hygiene and sanitation (WASH) is critical. How to improve the operation performance of government and non-governmental organization in WASH service implementation has attracted an increasing attention on a global scale. Although there is general understanding on the importance of supply chain integration (SCI), little is known regarding SCI and their impact on operational performance in WASH sector. The study had one main objective to achieve: to assess the effect of supply chain integration on operational performance of WASH sector in Ethiopia. The study employed an explanatory research design and the target population of the study were government and non-government organizations. The indicators of supply chain integration are measured by Self-administered questionnaire using a five point Likert scale. The study applied correlation and regression analysis to investigate the relationship and impact between supply chain integration construct and operation performance. The result of the study indicated that all supply chain integration dimensions and operation performance had a positive relationship with each other and supply chain integration elements have direct impact on operational performance. The study concluded that, the issue of internal integration, external integration and information integration with in the sector were discouraging and below the expectation level. Findings from the study recommend that, supply chain integration is necessary and inevitably for all the processes and activities from supplier to customer and vice versa. In order to improve operational performance in Water and Sanitation organizations in Ethiopia, Supply chain integration needs to be aligned with channel members across WASH sector.*

**Keywords:** supply chain integration, information integration, internal integration, operational performance, external integration and WASH

# **CHAPTER: ONE**

## **INTRODUCTION**

Supply chain integration is the most significant aspects for the success of the WASH sector in governmental, non-governmental and private organizations because they are the engines that drive the sector operation towards successful attainment of their goals. The study was conducted to investigate the effect of supply chain integration on operational performance of WASH sector in governmental and non-governmental organizations in Ethiopia.

### **1.1. BACKGROUND OF THE STUDY**

During recent decades, the issue of water, hygiene and sanitation (WASH) is critical. How to improve the operation performance of government and non-governmental organization in WASH service implementation has attracted an increasing attention on a global scale. This chapter introduces the current WASH situations, as well as the important role that supply chain integration plays in government and non-governmental organization. Subsequently, research questions and objectives were proposed.

Ethiopia is currently undertaking its development endeavor aiming to become a middle-income country level economy by the year 2025 (GTPII 2015, p.45). The Second Growth and Transformation Plan (GTPII) of the WASH sector, which is covering the period from mid-2016 to mid-2020, is thus designed to meet this national development objective. Under the GTPII, Ethiopia is implementing universal access to equitable and sustainable water supply, sanitation and hygiene services to the citizens of the country. The plan mainly focuses on accessibility, service improvement and sustainability of water supply, sanitation and hygiene services that satisfy the needs of lower-middle-income countries' citizens by the year 2020.

Supply chain integration is a performance-improving approach that develops seamless linkages between the actors, levels, and functions within a supply chain to optimize customer service. The objectives of supply chain integration are to improve efficiency and reduce redundancy while also enhancing product availability. Supply chain integration strives to better connect demand with supply, which can both enhance customer service and lower costs. Well-functioning (integrated)

supply chains are characterized by clarity of roles and responsibilities, agility, streamlined processes, visibility of information, trust and collaboration, and alignment of objectives (Flynn et al. 2010, p. 58).

As supply chain emphasizes on the processes management within and beyond organizational boundaries, a measure of its performance is necessary for its effective operation and control. The crucial achievement of firms will depend on management's ability to integrate the company's complex network of business relationships, allowing improved decision making and consequently, reducing cost and customer response time. SCM is not only this but much more and beyond. SCM concerns neither to diminish nor to capitalize on but rather to optimize (integration, coordination, variability, uncertainty management and control) processes for the enterprise. An efficient and responsive SCM aims to move from a simple SC to a well-structured and extended integrated supply chain (Sarewitz 2007, p. 130).

Supply chain integration (SCI) is, to a great extent, concerned with the development of more integrated approaches that hold out the prospect of eliminating many of the inefficiencies directly attributable to supply chain fragmentation. There is evidence of differences in emphasis and approach between different industrial sectors, geographical areas and functional backgrounds. Furthermore, a variety of associated terminologies have also been developed which has added to the complexity. As noted by Chan (2012, p.34), this can limit management's understanding of the SCM concept and the practical effectiveness of its application, particularly in relation to the accomplishment of more integrated supply chain configurations.

Flynn et al. (2010, p.60) stated operational performance and business performance are the two widely used measures of firm performance. Operational performance (OP) is a major determinants to the overall supply chain performance, which usually is the merged result from multiple factors and enablers in the system. Frohlich and Westbrook (2001, p. 123) elaborated that performance measures for a supply chain should incorporate indicators in the operational dimension, such as customer satisfaction and the operational responsiveness to the changing market demand. Similarly, Lai et al. (2010, p. 25) enlisted cost, time, quality, delivery and flexibility as the basic measures of operational performance. While addressing the needs for supply chains to balance

their attention to the environmental concerns, Jakhar (2015, p. 36) developed a green supply chain operational performance framework.

Numerous theoretical and empirical studies have connected supply chain integration to operational and/or business performance (Vanpoucke et al. 2014, p. 124). This link can be explained by the creation of relational assets (Edward 1998, p. 54), which makes supply chain integration difficult to imitate. In addition, supply chain integration helps companies to manage supply chain flows and reduce the detrimental impacts of the bullwhip effect. Smoothing and better managing these material and information flows should result in reduced costs and lead times, and improved on-time delivery and flexibility (Wiengarten et al. 2014, p. 55).

## **1.2. STATEMENT OF THE PROBLEM**

There are constraints in the whole supply chain which critically affects operational performance of an organization such as longer lead times, supply disruptions caused by fragmentations, foreign regulations and port congestion, political and/or economic instability in a source country, and changes in economics such as exchange rates which in turn leads to increasing cost of product, reduces speed of delivery of product and flexibility of the company (Binyam 2014, p. 33).

Effective and efficient supply chain integration via the organizations and across the organization has a great contribution for a better operational performance. Frohlich and Westbrook (2001, p. 87); Swink et al. (2007, p. 150) and Zhao et al. (2011, p. 65) have been suggested that supply chain integration play different roles in operation performance improvement and capability development. Despite the importance of supply chain integration no study has been carried out to investigate impact of supply chain integration on the operation performance in the WASH service in Ethiopia. This study therefore sought to bridge this knowledge gap by answering the research questions.

Rapid and effective WASH operational performance are critical for saving the lives of people across a range of crises and complex humanitarian situations due to conflict, forced migration, disease outbreaks and public health emergencies, acute and chronic malnutrition, and natural disasters (UICEF 2015, p. 56). These interventions are increasingly needed: over the last ten years, the number of people who need the WASH service has more than doubled (UICEF 2015, p. 65).

Due to its impact across multiple sectors, the operational performance of WASH interventions is the central idea for the country development agenda (MOWE 2016, p. 43).

The Ministry of Water and Energy together with development partners have put tireless efforts to ensure that all communities in the country are well served with clean water and improved sanitation. Each and every year, there is massive investment of water interventions going into the water sector (MOWE 2016, p. 56). However, due to problems related to integration of different actors and supply chains up to thirty percent of the WASH schemes in rural Ethiopia are not functioning (MOWE 2016, p. 76). Poor financial performance in the companies, loss of customers, poor quality control and assurance, high cost of operations and failure to improve efficiency in the WASH service delivery are the common constrains (Water Aid 2016, p. 6). Access to WASH in rural areas is still low, and delivering safe, sustainable and affordable WASH in poor urban communities is a major challenge. Isolated communities, people with disabilities and other marginalized groups continue to be denied the same levels of access as their compatriots (UICEF 2016, p. 22).

Supply chain integration gaps were identified by many WASH stakeholders which have expressed their concerns regarding the effectiveness of integration/coordination, harmonization and alignment since there are still limitations with regard to processing harmonized plans and realizing integrated monitoring and harmonization and implementation of WASH interventions. So the sector needs further research studies on integrations to enhance the sector performance to address the wider community (MOWE 2016, p. 13).

Different research studies conducted at the ministry of water and energy indicated that there are a lot of problems related to operational performance include, lack of alignment among different actors within the sector, redundancy of services, uneven distribution of services, lack of expertise and information, inadequate technologies and absence of sharing resources (MOWE 2016, p. 13).

There is a symptoms with in the sector which shows the problem of integration across the different government and non-government organizations. Despite the importance of supply chain integration no study has been carried out to investigate effect of supply integration on the supply chain performance in the WASH sector. Consequently, this study is investigate and determine the effect of supply chain integration on operational performance.

### **1.3. RESEARCH QUESTIONS**

The research questions that were addressed in this study are:

1. What is the effect of supply chain integration on the operational performance of WASH sector in Ethiopia?
2. What is the correlation between internal integration, external integration and information integration?

The sub - questions were:

1. What is the effect of internal integration on the operational performance of WASH sector?
2. What is the effect of information integration on operational performance of the sector?
3. How does the external integration of the stakeholders affect operational performance of the WASH sector?
4. What is the association between internal integration and external integration, internal integration and information integration, and external integration and information integration?

### **1.4. OBJECTIVE OF THE STUDY**

#### **1.4.1 GENERAL OBJECTIVE:**

The objective of the study was to assess the effect of supply chain integration on operational performance of WASH sector in Ethiopian case.

#### **1.4.2. SPECIFIC OBJECTIVES:**

The study was guided by the following sub- objectives:

1. To study the effect of internal integration on the operation performance of Ethiopian WASH sector.
2. To confirm the effect of information integration on operation performance of WASH sector.
3. To evaluate the effect of External integration on operational performance of WASH sector.

4. To identify the correlation between internal integration, external integration and information integration

### **1.5. SCOPE OF THE STUDY**

The study was encompass the effect of internal integration, external integration and information integration on operational performance such as efficiency, quality, time and delivery but it lacks other operational performance parameters like profitability. The study focuses on organizations involved in WASH sector activities as a source, distributors and retailers and it didn't consider the view of customers. Geographically, the study was also focuses on employees working in various stakeholders under WASH interventions throughout Ethiopia

### **1.6. SIGNIFICANCE OF THE STUDY**

Different research was conducted on effects of supply chain integration on operation performance on different sectors like manufacturing and business enterprise and unfortunately no research was conducted on WASH sector at national and regional level. As a consequence the study is an eye-opening for the sector at the national level for further assessment.

The study focused on the Supply chain integration of the WASH sector in Governmental and non-governmental organizations. This will be the background on the realization that, supply chain integration is very important to the WASH sector even with the little attention is given by different researchers in the discipline. The issue of applying supply chain integration practices in the WASH sector is a fairly new phenomenon in Ethiopia; hence there is need for extensive research to unravel the various underlying dynamics of the research topic so as to be applied to increase their operational performance.

The rationale of the study will support to generate new knowledge and comprehensive approaches to be used by organizations to help them manage their Supply Chain integration. The findings of this study will be valuable to diverse segments of the people. Different organization will benefit from the findings of this study as they will have the knowledge of the SCI practices that enhance the operation performance of the organizations. Government and non-government organizations will be benefited from the findings of this study by getting to understand the effect and

contributions of SCI practices and procedures that promote efficient WASH service. Consequently, it can accelerate the WASH coverage and operational performance.

This research will develop a model for SCI which integrates existing theory, and explains the critical factors influencing SCI and their impact on operational performance in WASH sector. The model will provide a framework in which the relationships between SCI constructs and operational performance dimensions.

## 1.7 DEFINITIONS OF TERMS

In the study, the following conceptual and procedural were used:

- **Supply Chain:** A network of institutions that have strong bonds from upstream to downstream in all processes and activities in such a cohesive manner that makes a value for organization and for end customer (Christopher 1994, p. 45).
- **Operational Performance:** Group of standards and benchmarks that are adopted and used by the organizations to achieve competitive advantage, customer satisfaction, and maximum level of profitability. In this study supply chain operational performance was measured by the following dimensions: Flexibility, Time (Speed), Quality, and Cost (Frohlich and Westbrook 2001, p. 56).
- **Supply Chain Integration:** The process of collaboration within supply chain players that manage inter and intra-organization activities to achieve effective and efficient flow of products, services and information to provide a maximum value to the customer in right place at suitable price and high speed (Frohlich and Westbrook 2001, p.71).
- **Supplier Integration:** The long-term relationship between the organization and its suppliers (Li et al. 2014, p. 21).
- **Internal integration:** represents the integration of all internal functions from material management to sale and distribution (Baharanchi 2011, p.55).
- **Information integration:** also called referential integration is the merging of information from heterogeneous sources with differing conceptual, contextual and typographical representation (Woods 2016, p.29).
- **Supplier integration:** integration back down to the suppliers represents a change in attitudes from conflict to cooperation starting with product development, supply of high

quality products, process and specification change information, technology exchange and design support (Baharanchi 2011, p.41).

- **Customer integration:** demand management practices through long-term customer relationship, satisfaction improvement, and complaint management (Tan et al., 1998).
- **Flexibility:** The ability of organization to adapt to fluctuation in demand in term of product or service specification, volume, and on-time delivery (Frohlich and Westbrook 2001, p.49).
- **Time (Speed):** Delivery time that is required by the company to provide the product or and services to the customer according to agreed timetable (Frohlich and Westbrook 2001, p.33).
- **Quality:** features of products which meets customer needs and thereby provide customer satisfaction". In this study quality defined as the degree to which supply chain integration meets customer needs and demands (Juran and Godfery 1998, p.67).
- **Cost:** The total costs and expenses that are incurred by completing all and or specific activities and operations within supply chain (Juran and Godfery 1998, p.34).

### **1.8 LIMITATION OF THE STUDY:**

The study was focused on the evaluation of the influence of supply chain integration on operational performance of the WASH sector from government and non-government organization perspectives. These stakeholders include Ministry of water and energy, ministry of health, ministry of education, ministry of Finance and economy and nongovernmental organizations and private companies. So, the study assessed the effect of supply chain integration from the perspective of such stakeholders only and it lacks the customer perspectives and this can be a limitation of the study. The study was also assessed the effect at a country wide at higher officials and the effect on different livelihood and regions are the limitations of the study. This study was be carried out on Ethiopian WASH sector stakeholders, so generalizing the results of this sector on other sector are questionable. In addition, the study was carried out on Ethiopian setting; also generalizing Ethiopian WASH sector results to other countries may be questionable.

## **1.9 ORGANIZATIONS OF THE STUDY**

This thesis is organized into five chapters. The current chapter, chapter one, introduces the background to the study, supply chain integration concept and the practice of supply chain integration in WASH sector, research problem, research questions, rationale and significance of the study, and expected managerial and theoretical contributions. This chapter provides the background to the main concepts of the thesis and discusses the current state of the previous research on the main topic. The overall purpose, research objectives and scope of the study are outlined.

The second chapter reviews the literature on SCM, SCI, operational performance and WASH sector supply chain integration. The chapter presents the theoretical foundation of the main concept of Supply Chain Integration and operational performance in general and its effects and relationships in WASH sector in particular.

The third chapter discusses the research design and methodology. The methodology chapter discussing on the overall structure and research design in this research thesis, as well as a description of the applied methodological approaches.

The fourth chapter presents, data analysis and results and discussion of results. Finally, the fifth chapter presents conclusion and recommendations, including the theoretical and managerial implications of this research, study limitations, and future research.

## **CHAPTER TWO**

### **RELATED LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This chapter looks at the past studies on the impact of supply chain integration on operation performance. The chapter also presents literature and previous studies that have been conducted on supply chain integration approaches and their link to operation performance and also describes facts and circumstances of the WASH sector. Finally, the conceptual framework for the study is presented.

#### **2.2. THEORETICAL REVIEW**

##### **2.2.1 SYNOPSIS OF SUPPLY CHAIN MANGMENT**

Supply chain management is a system where organizations, people, technology, activities, information and resources are involved in moving a product or service from supplier's to customer. Supply chain activities transform natural resources, raw materials and components to finished products. According to Christopher (2004, p. 12), a supply chain is a network of institutions that have strong bonds from upstream to downstream in all processes and activities in such a cohesive manner that make a value for organization and for end customer.. This includes sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing and customer service.

Supply chain management is a system that improves all activities which carried out by organization. It is a complex system which covers all supportive activities from suppliers to after sales services. Supply chain management is the management of the network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers (Harland 2006, p. 54). Supply chain management spans all movement and storage of raw materials, work in progress inventory and finished goods from point of origin to point of consumption. It is a process of managing the flow of raw material, transforming raw material into finished products and distribution of the products to the consumer. In short, supply chain links the source of supply (supplier) to the owner of demand (consumer). Through the supply chain process,

the end user (consumer) hopes to get the right supplier, in the right quantity and quality, at the right time and in the right location. The SCM involves five basic processes namely planning, sourcing, making, delivery and return (Christopher 2004, p. 21).

According to Stadler (2004, p. 65) elaborated various definitions of SCM given by different authors as, an activity of linking different units of organizations along a SC and coordinating materials, financial and information flows in order to fulfill customer demands with the objective of boosting competitiveness of the supply chain of an organization as a whole. Therefore SCM entails the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving long term performance of individual companies and the supply chain as a whole. Stank et al. (2005, p. 32) describe supply chain management as a strategic level concept.

Supply chain management (SCM) links a firm with its customers, suppliers and other members of the supply chain system, including logistics and warehousing companies. The goal of SCM is for members in the organizations to integrate, work together, and build a partnership with each other to increase the competitive advantage of the supply chain as a whole (Mentzer et al. 2001, p. 23).

### **2.2.2. THE THEORY OF SUPPLY CHAIN MANAGEMENT**

Handfield and Nichols (2002, p.8) states that the supply chain involves activities associated with the flow and transformation of goods from the raw materials stage (extraction), through to the end user, as well as the associated information flows. However, Mentzer et al. (2001, p.24) limit their definition of a supply chain to the flow of products, services, finances, and/or information from a source to a customer, whereas Lambert et al. (2003) see a two way flow of information. Edward (2008, p. 43) add to physical flow of goods and flow of information the flow of funds to certain types of supply chains such as those found with point of sale retail operations. Management of the SC is, therefore, basically the management of the relationships and activities among the members of organizations (system).

The concept of SCM has been considered from different perspectives, such as purchasing and supply management, logistics and transportation, operations management, marketing,

organizational theory, management information systems (Croom et al. 2000, P. 26). The focus of SCM is integration of three broad functions namely supplier relationship management (SRM), internal supply chain management (ISCM) and customer relationship management (CRM) with a view to managing the smooth flow of product, information and funds among the supply chain partners and delivering superior value to the end customers (Chopra & Meindl 2006, p. 34). As per the definition of Supply Chain Council (2002), the supply chain encompasses every effort involved in producing and delivering a final product from the supplier's supplier to the customer's customer. Most of the SCM definitions cited material/physical, finances, services and/or information flow as key concepts of activities. Zsidisin et al. (2000, p. 10) described the primary goal of SCM as effectively managing the flow of materials and information from supply sources to the final point of sale. SCM has also been described as the management of raw materials, in-process materials and finished-goods inventories from the point of origin to the point of consumption and the planning and control of materials and information from suppliers to end customers.

Mentzer et al. (2001, p. 17) defined SCM as 'the systematic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole. According to Walters and Lancaster (2000, p. 39), supply chain management is the management of the interface relationships among key stakeholders and enterprise functions that occur in the maximization of value creation which is driven by customer needs satisfaction and facilitated by efficient logistics management. Elmuti (2002, p. 98) defined supply chain management as the works to bring the supplier, the distributor and the customer into one cohesive process. According to Dainty et al. (2001, p. 28), supply chain management has recently concentrated on closer relationships between parties involved in the flow of goods from the supplier to the end-user. However, the concept of SCM adding value for consumers and stakeholders highlights that the value-added components of SCM, such as technical support and training services, clearly separates it from traditional logistics management (Chopra & Meindl 2006, p. 11). Further, the concept of adding value in the supply chain is becoming even more important.

### **2.2.3. SUPPLY CHAIN INTEGRATION**

The Webster's Dictionary defines the term "integration" as "the unified control of a number of successive or similar economic or especially industrial processes formerly carried on independently" (Webster's 1966, p.1452). Based on this dictionary definition, SCI can be defined as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes to provide maximum value to the customer at low cost and high speed. This definition indicates that SCI is comprehensive and encompasses a variety of activities, some of them are internal, and others are external including both upstream with suppliers and downstream with customers. In order to comprehensively identify SCI, we break SCI into three dimensions: internal integration, supplier integration, and customer integration (Flynn et al. 2009, p. 23).

Today, firms tend to integrate their supply chain systems with the channel partners to increase performance. Awad & Nassar (2010, p. 58) claimed that the developments in supply chain management in the form of supply chain integration had not only offered the potential to reduce costs but also to increase revenues, profits and performance of the firms. But he also stated that there were some challenges associated with the integration of supply chain management by the channel members. It was also argued in the paper of Awad & Nassar (2010, p. 75) that the most significant form of supply chain integration was information sharing.

Supply chain integration is a set of activities concerned with the coordination of product flows between supply chain partners, including transactions, materials movements, procedures, and optimization processes, taking into consideration the underlying information flows (Frohlich and Westbrook (2001, p.82); Sahin and Robinson (2002, p. 22). Wong et al. (2011, p.57) defines SCI as the strategic collaboration of both intra- organizational and inter-organizational processes, with integration referred to as a unified control of a number of successive or similar economic or especially industrial processes formerly carried on independently.

At the tactical level, the literature suggests two interrelated forms of integration, i.e., information exchange and operational integration tactics (e.g. Kulp et al. 2004; Leuschner et al. 2013; Frohlich and Westbrook 2001). Information exchange refers to the coordination of information transfer and

communication, while operational integration points to joint activity development, collaborative work processes and coordinated decision making among supply chain partners (Gimenez et al. 2012, p. 41).

### **2.2.3.1. INTERNAL INTEGRATION**

Organizations must have willingness to integrate capabilities through data, system and process internally before they engage in meaningful external integration. Flynn et al. (2010, p. 62) explained internal integration, as a systematic way of creating inter-functional interaction, collaboration, coordination, communication and cooperation that takes functional areas together to create a cohesive organization. However, “the effort required to identify key functional activities and their interrelationships has caused many companies to change from integrating and managing supply chains by functions to integrating and managing them by process (process management)” (National Research Council 2000, p. 34).

Flynn (2010, p.37) discusses internal integration as a comprehensive integrated planning and control system that manages the flow of goods into and out of an organization. In addition, he emphasizes that internal integration is a necessary step that must be embarked on before external integration can be achieved. Internal integration is an initial stage toward accomplishing supply chain integration (Stevens 2006, p. 56). He was also emphasized that internal supply chain integration needs functions in an organization to be coordinated and integrated to achieve customer value and satisfaction.

Internal integration efforts break down functional barriers and facilitate sharing of real-time information across key functions (Wong et al. 2007, p. 33). Internal integration is the extent to which business functions work cooperatively and interact through cross-functional process integration to resolve conflicts and achieve mutual goals (Danese et al. 2013 and Pagell 2004). The integration of data among internal functions, use of cross functional teams in process improvement, enterprise application integration in internal function, strong integrative inventory management, real time searching inventory and utilization of periodic interdepartmental meeting. This implies that the employees need an improvement along the internal activities of the enterprise (Biniyam 2016, p. 36).

### **2.2.3.2. EXTERNAL INTEGRATION**

External integration is composed of integration of an organization with key suppliers and customers (Lambert et al. 2006, p. 54). External integration with suppliers is defined by many researchers as the degree of co-ordination between manufacturer and its upstream partners (e.g., Peterson et al. 2005; kim 2002; Frohlich 2002). In addition, external integration with customers is defined as the degree of coordination between manufacturer and its downstream customers (e.g. Bowersox 1989; Narasimhan & Kim 2002 and Frohlich 2002). External integration composed of supplier and customer integration.

#### **2.2.3.2.1. SUPPLIER INTEGRATION**

Supplier integration involves strategic joint collaboration between a focal firm and its suppliers in managing cross-firm business processes, including information sharing, strategic partnership, collaboration in planning, joint product development and so forth (Lai et al. 2010, p. 34 and Wong et al. 2011, p. 68). The exchange of information with supplier through information network, quick ordering system, creation of good strategic partnership with supplier and the stability of procurement with supplier are critical issues which are neglected by the enterprise (Biniyam 2016, p. 45).

#### **2.2.3.2.2 CUSTOMER INTEGRATION**

Customer integration involves strategic information sharing and collaboration between a focal firm and its customers which aim to improve visibility and enable joint planning (Fisher et al. 1994, p. 54). Customer integration enables a deeper understanding of market expectations and opportunities, which contributes to a more accurate and quicker response to customer needs and requirements (Swink et al. 2007, p. 22) by matching supply with customer demand (Wong, Boonitt and Wong 2011, p. 32). Its attribute included; linkage with customer through information network, the computerization of services for customer ordering, use of effective communication with major customer, the establishments of quick ordering system with customer, follow up with major customer for feedback and the frequency of contacts with supplier (Biniyam 2016, p. 46).

#### **2.2.3.4. INFORMATION INTEGRATION**

Coordination's of activities are vital in supply chain management. This point is also greatly perceptible for information management in the chain, information management systems and the data transaction. Coordinated and appropriate information between partners will lead to growing impacts on the speed, accuracy, quality and other aspects. Information integration which composed of the issues like; free sharing of accurate information along the line of supply chain, the timely sharing of information with members of supply chain, strong coordination on the flow of information among supply chain partners and the strong utilization of information among supply chain partners are vital points ignored by the enterprise (Biniyam 2016, p. 31).

Kaipia (2007, p. 44) emphasized strongly on importance of information sharing in better SC coordination. Raja guru and Matanda (2013, p. 54) worked on effects of inter organizational compatibility on supply chain capabilities while taking mediating effect of inter organization information system integration. They emphasized the importance of integration of information system among SC partners in terms of lowering inventory cost and minimizing risk of barriers to better performance.

Flynn (2010, p. 9) suggested that significant progress in supply chain management can be achieved through the integration of business processes and information flow between business partners. Lai et al. (2008) defined information integration as using information and communication technology in order to coordinate decisions and activities between an organization and its partner. IT has tremendous impacts on Supply chain agility of the firm in terms of better responding to market fluctuations through timely, adequate and accurate flow of needed information among supply chain partners which in turn makes positive impacts on the firm's sales, market share, profitability, execution of coordinated plans, and customer satisfaction (Degroote & Marx 2013, p. 54).

#### **2.2.4. LEVEL OF INTEGRATION**

In order to realize the benefit of establishing collaborative linkages amongst the supply chain Muckstadt et al. (2001, p. 87) established a set of guiding principles for supply chain partners. Their findings state that supply chain relationships should be established and managed differently from one another. They defined four categories of supply chain integration which may exist simultaneously in a supply chain because companies can treat their customers differently from their suppliers. For defining their categories Muckstadt et al. used three dimensions of supply chain integration: (1) Level of information systems integration, (2) Level of business process integration and (3) level of decision systems integration. These three dimensions resulted in four categories of supply chain integration:

**Communicators:** This is the most basic relationship, customers transmit orders to the firm and the firm is expected to respond to these orders. This is called a type four relationship. **Coordinators:** When firms evolve and share more detailed data about operational activities such as inventory levels and customers' demand, a coordinating relationship exists. This is also called a type three relationship.

**Cooperators:** When companies start to communicate plans that influence the demand or capacity of the firm where partners have to deal with, a type two relationships exists. Achieving this level of interaction requires a sustainable information infrastructure and supporting business processes.

**Collaborators:** When companies carefully plan capacity and decide jointly where and in what quantities inventories of various types should exist, a type one relationship exists. Companies must also decide in advance what actions will be taken when various unplanned events occur. Strategic and tactical plans must be created collaboratively to achieve maximum effectiveness.

#### **2. 2.5. ENABLERS OF SUPPLY CHAIN INTEGRATION**

The main drivers of integration are listed by Hadfield and Nichols (1999, p. 34) as:

- The information revolution;

- Increased levels of global competition creating a more demanding customer and demand driven markets; and
- The emergence of new types of inter-organizational relationships.

As today's world of business continues to exhibit intense competition and globalization, arguments have been mounted that supply chains need integrating to boost firms' competitiveness operational performance outcomes (Wong et al. 2011; Ozdemirs and Aslan 2011 and Juttner et al. 2010). However, knowledge of drivers of SCI is still very limited and extant knowledge about how SCI influences operational performance of firms operating in environment of great uncertainty is dearth (Matos and Hall 2007, p. 55).

### **2.2.6 BARRIERS OF SUPPLY CHAIN INTEGRATION**

Sammuel and Kashif (2013, p. 49) suggested various types of supply chain barriers and these include:

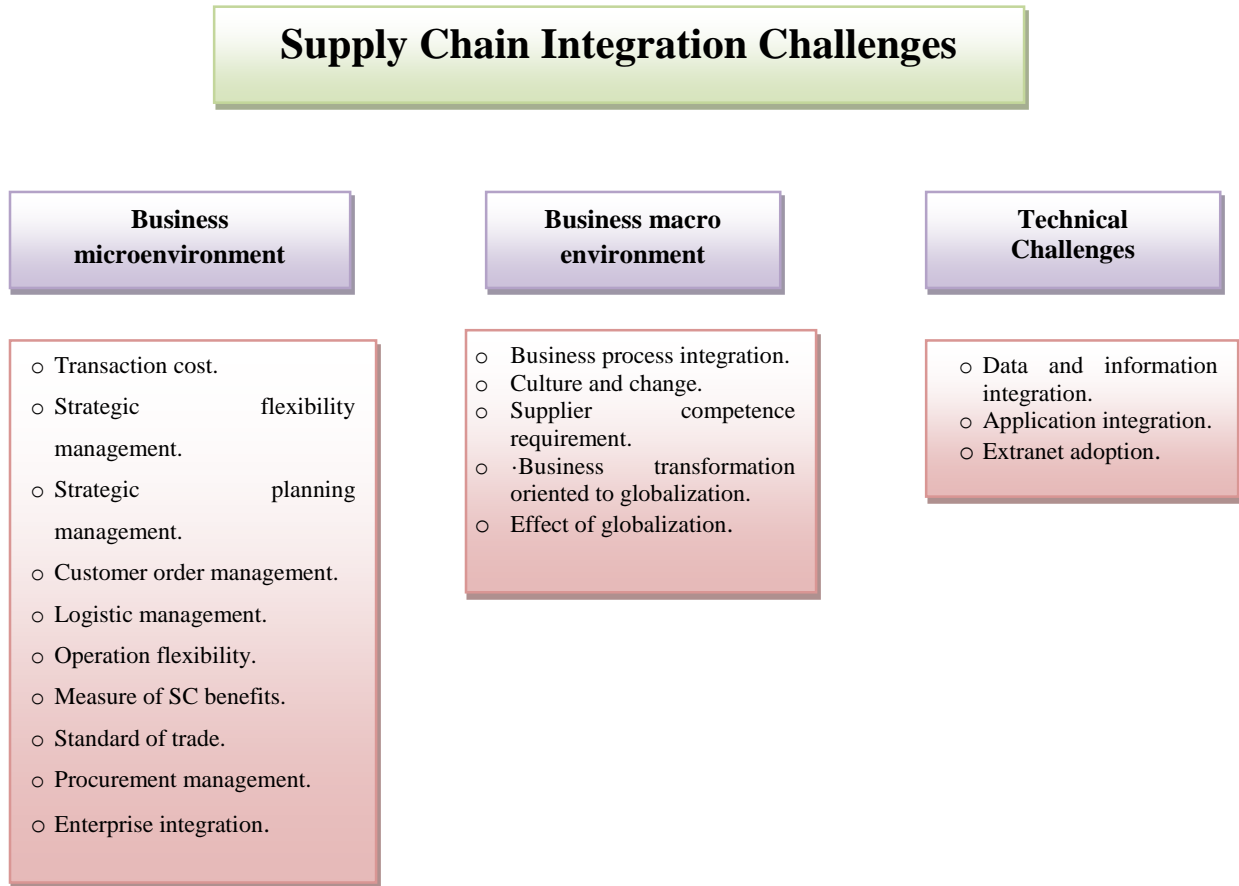
- a. Lack of information Technology
- b. Lack of information sharing
- c. Lack of trust
- d. Demand distortion-bullwhip
- e. System incompatibility
- f. Lack of knowledge
- g. Cost of integration

Ellinger et al. (2006, p. 68) investigated five barriers to SCI: these are; insufficient knowledge of the other function; lack of communication; poor working relationship; conflicting goals; and lack of direction from senior management. Moberg et al. (2003) explained barriers to supply chain execution, which were lack of trust, poor understanding, internal politics, misaligned goals and objectives, weak management information systems, short-term orientation to goals, and other supply chain complex issues.

Barratt (2004, p. 76) described various barriers to SCI on all levels of integration and stated that these barriers exist on tactical, operational and strategic levels of the organization. As far as it is important to know the barrier, the more important is to find the facilitators or solutions to these

barriers to SCI. There are several challenges involved in management of effective supply chain which include information system misalignment, poor trust and inventory management (Flynn, 2010, p. 39).

**Fig 1:** Classification of SC integration challenges



Source: Hussain *et al* 2013, p. 57

### 2.2.7. OVERVIEW OF OPERATION PERFORMANCE

Corbett and Van Wassenhove’s model considers three dimensions of performance: cost or efficiency, quality and time. Efficiency refers to the best possible use of all available resources in order to maximize output. This results in low cost products thanks to the reduction of waste and enables the factory to give value to customers. Traditionally quality has been defined in terms of conformance to specification and hence quality-based measures of performance have focused on issues such as the number of defects produced and the cost of quality. With the advent of total quality management (TQM) the emphasis has shifted away from conformance to specification and

moved towards customer satisfaction. In either case, firms must obtain high levels of quality performance in order to improve or, at least, maintain their level of competitiveness. The first dimension of time-based performance is reliability. This means fulfilling delivery commitments. On-time deliveries may have a significant impact on customer satisfaction, which makes it an issue to be taken seriously in operations management. The second time-related dimension refers to the speed of production processes, which is frequently measured as the time elapsing between materials reception and delivery of product to the customer. One of the main goals of just in-time (JIT) and other production planning and control systems (e.g., Optimised Production Technology) is to improve the flow of production processes, in order to respond more rapidly to customer demands (Corbett and Van Wassenhove 2005, p. 66).

## **2.2.8 FACTORS AFFECTING PERFORMANCE MEASUREMENT**

Along with the benefits of performance measurement comes various challenges. The returns on performance measurement are uncertain and very difficult to acknowledge in the short-term. Therefore it is difficult to account for the benefits of performance measurement. Sometimes performance measurement may give negative results hence making the whole process very risky to undertake (Fellar 2007, p. 43). Different measurable outcomes such as productivity, employment, competitiveness and growth are sometimes not compatible with each other hence selection of a measure can offer specious precision. There may be trade-offs among measures such that greater accuracy in one generates uncertainty in the other (Sarewitz 2007, p. 73). Establishing the right metrics to use in performance measurement is also a challenge since the strategic business plan of the organization needs to be tied. Lack of effective use of limited budgets on performance measurement leads to its failure. The final limitation is that to date there is limited evidence of the contributions that performance measurement has made to improve managerial decision making (Fellar 2007, p. 81).

## **2.3 EMPIRICAL REVIEW**

### **2.3.1 Supply Chain Management (SCM)**

The concept of “supply chain management (SCM)” has gone through huge developments globally. SCM seeks to enhance competitive performance by closely integrating the internal cross-functions

within a company and effectively linking them with the external operations of suppliers, customers, and other channel members to be successful (Otchere, Annan & Anin 2013, p.78). The objective of supply chain management is to maximize the overall value generated rather than profit generation (Otchere et al 2013, p.56). Although the importance of supply chain relations is widely acknowledged, seamless coordination is rarely achieved in practice coupled with several challenges (Hussain and Nassar 2010; Otchere et al. 2013, p.132).

### **2.3.2 Supply Chain Integration (SCI)**

Supply chain integration is defined as “the extent to which all activities within an organization, and the activities of its suppliers, customers, and other supply chain members, are integrated together” (Narasimhan et al. 1998, p.45). SCM has three independent variables in its original scale they are: internal, suppliers and customer integrations. Some also considers integration in two levels: internal integration and external integration (Tutuncu and Kucukusta 2008, p.78). Finally, Stevens (1989) classifies supply chain integration into three levels, from functional integration to internal integration and to external integration. However, this study focuses only on internal and external integration, because functional integration is a pre-requisite for all firms to implement and achieve Internal Integration (Otchere et al 2013, p.68). The dominant belief is that supply chain integration (SCI) is a useful approach to improve various measures of firm performance (Van der Vaart and Van Donk 2008, p.89). The basis of integration can therefore be characterized by cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes (Pagell 2004, p.77).

### **2.3.1 Internal Integration**

Internal integration involves cross functional teams that may bring together a carefully selected array of specialists who share information and make product, process, and manufacturing decisions, jointly and simultaneously (Koufteros et al 2005, p.132). Internal integration is defined as a process of inter-functional interaction, collaboration, coordination, communication and cooperation that bring functional areas together into a cohesive organization (Flynn et al 2010, p.69). Furthermore, Supply chain partners who exchange information regularly are able to work as a single entity, and can understand the needs of the end customer better and hence can respond

to market change quicker (Stein 1998, p.44). A prerequisite for successful SCM is internal integration (Lambert et al. 1998, p.24). Also, companies with a low internal integration strategy will achieve low level of external integration and companies implementing the full internal integration strategy will have the highest levels of external integration (Gimenez and Ventura 2005, p.21). Generally, it is believed that firms achieve a relatively high degree of internal integration before they attempt to develop a higher degree of external integration (Otcere et al. 2013, p.41). Internal integration can be accomplished through automation and standardization of each internal logistics function, the introduction of new technology, and continuous performance control under formalized and centralized organizational structure (Bowersox 1989, p.55).

### **2.3.2 External Integration**

As the competitive environment is becoming increasingly challenging, firms are undertaking efforts to compete along multiple fronts. However, many firms find it difficult to compete in the market by relying on their internal resources and competencies alone. They have turned to collaborate with their customers and suppliers to obtain information and complementary resources, which they can deploy to build competitive advantage. External supply chain integration reveals two major areas of emphasis. They are: Customer integration (CI) and Supply integration (SI). Supplier integration also called “backward” integration (Frohlich and Westbrook 2001, p.32) refers to the process of interaction and collaboration between an organization and its suppliers to ensure an effective flow of supplies (Zhao et al, 2011). Customer integration, also called “forward” integration (Frohlich & Westbrook 2001, p.28) refers to the process of interaction and collaboration between an organization and its” customers to ensure an effective flow of products and/or services to customers (Zhao et al. 2002, p.37). Customer integration involves sharing demand information, help the manufacturer to understanding better the customer needs and to forecast better customer demand, as well as 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 (Flynn et al. 2010, p.14).

### **2.4 SUPPLY CHAIN INTEGRATION AND PERFORMANCE**

Several studies have analyzed the link between supply chain integration and performance, and have produced mixed results. Many studies found a positive relationship between integration and

performance. Frohlich and Westbrook (2001, p. 45), for example, show that a wide scope of integration is positively associated with performance improvements. Whereas their results suggest that significant performance improvement can only be gained when firms progress towards high degrees of supply chain integration, Flynn et al. (2010, p. 34) and Schoenherr and Swink (2012, p. 23) show that even small-scale supply chain integration efforts can lead to beneficial efficiencies. Other studies, however, found weak to even negative effects of supply chain integration on performance (e.g. Vereecke and Muylle 2006 and Swink et al. 2007). A recent meta-analysis by Leuschner et al. (2013, p. 32) confirmed the overall positive relationship between supply chain integration and performance. In addition, this meta-analysis pointed out important differences among integration tactics: while information exchange was found to be positively related to performance, the study did not find evidence for a positive relationship between operational integration and performance. Another meta-analysis by Mackelprang et al. (2014, p. 54) also confirmed the positive association between supply chain integration and performance, but indicated that between 13 and 33 percent of examined performance outcome relationships were non-significant. In other words, under

#### **2.4.1 Information integration and operational performance**

In supply chain, the importance of coordinating activities is important. This point is also noticeable for information management in the chain, information management systems and the data transaction. Coordinated and appropriate information between partners will lead to growing impacts on the speed, accuracy, quality and other aspects. Effective information management will lead to greater coordination in the chain. Information integration is the extent that operational, tactical and strategic information are transferred between business partners and the central company. Elahi et al. (2009, p.34) downward flow of material in supply chain should be supported through information flows from bottom to top. Kalakota and Robinson (1997, p.19) suggested that significant progress in supply chain management can be achieved through the integration of business processes and information flow between business partners.

## **2.4.2 Supplier integration and operational performance**

In the supplier-facing component of integration, a number of studies have found a positive association between supplier integration and operational performance (e.g., Petersen et al. 2005; Devaraj et al. 2007). Nevertheless, others have reported no direct association between supplier integration and operational performance (e.g., Stank et al. 2001; Flynn et al. 2010) or supplier integration and business performance (e.g., Flynn et al. 2010), and yet others find a negative association (e.g., Stank et al. 2001; Swink et al. 2007) between supplier integration and operational performance. Although failing to uncover direct effects, Flynn et al. (2010), for instance, find that the interaction between the external dimensions of integration is associated with operational performance. As for business performance, similar to customer integration, the few existing studies focusing on this aspect have not found a direct positive association between supplier integration and business performance (Flynn et al. 2010) or between integration intensity and business performance (Rosenzweig et al. 2003, p.52).

## **2.4.3 Customer integration**

For the customer-facing component of integration, the literature indicates that this dimension is directly (Wong et al. 2011, p.22) and indirectly (Devaraj et al. 2007, p.63) associated with improved operational performance. However, other studies contradict the customer-facing to operational performance association (e.g., Swink et al. 2007). As for business performance, studies have not found a direct positive association between customer integration and business performance (e.g., Flynn et al. 2010; Koufteros et al. 2010) and the link seems to remain under investigated and unclear.

## **2.5. OVERVIEW OF WASH SECTOR**

Since 1990, 2.6 billion people have gained access to an improved drinking water source and 2.1 billion to an improved sanitation facility through the collective efforts of sector stakeholders (UNICEF 2016, p. 32). The MDG drinking water target of halving the proportion of people without access was met globally and nationally in 147 countries (UNICEF 2016, p. 66). Over the same period, the importance of encouraging improved hygiene behaviors became entrenched in sector programming and plans. In spite of these gains, much still remains to be done. The MDG sanitation

target was missed by a wide margin: there were almost as many people without access to improved sanitation at the end of 2015 (2.37 billion) as there were in 1990 (2.45 billion), with sanitation coverage below 50 percent in 47 countries (UNICEF 2016, p. 59).

The proportion of people practicing open defecation fell from 24 to 13 percent, but 946 million people (UNICEF 2016, p. 12). The water target was not met everywhere: Least Developed Countries as a group did not meet the target, and neither did Sub-Saharan Africa: in 2015 a total of 663 million people still lacked access to an improved drinking water source (UNICEF 2016, p. 26). The safety of water supplies remains a challenge, with an estimated 1.2 billion people using water from sources or systems with significant sanitary risks (UNICEF 2016, p. 28). Water system sustainability is a major problem, especially in Sub-Saharan Africa where an estimated 25 to 40 percent of water supply facilities were not working at any given time (UNICEF 2016, p.19). WASH in institutions remains a weak point, with continuing low coverage rates in HCFs and schools (Water Aid 2016, p. 42)

Access to WASH in rural areas is still low, and delivering safe, sustainable and affordable WASH in poor urban communities is a major challenge (Water Aid 2016, p. 37). Strong national systems and effective supply chain management are pre-requisites for the delivery of quality sustainable WASH services (Water Aid 2016, p.35). Support for strengthening national sectorial supply chain systems and capacity must be framed within the context of each county (UNICEF 2016, p. 42).

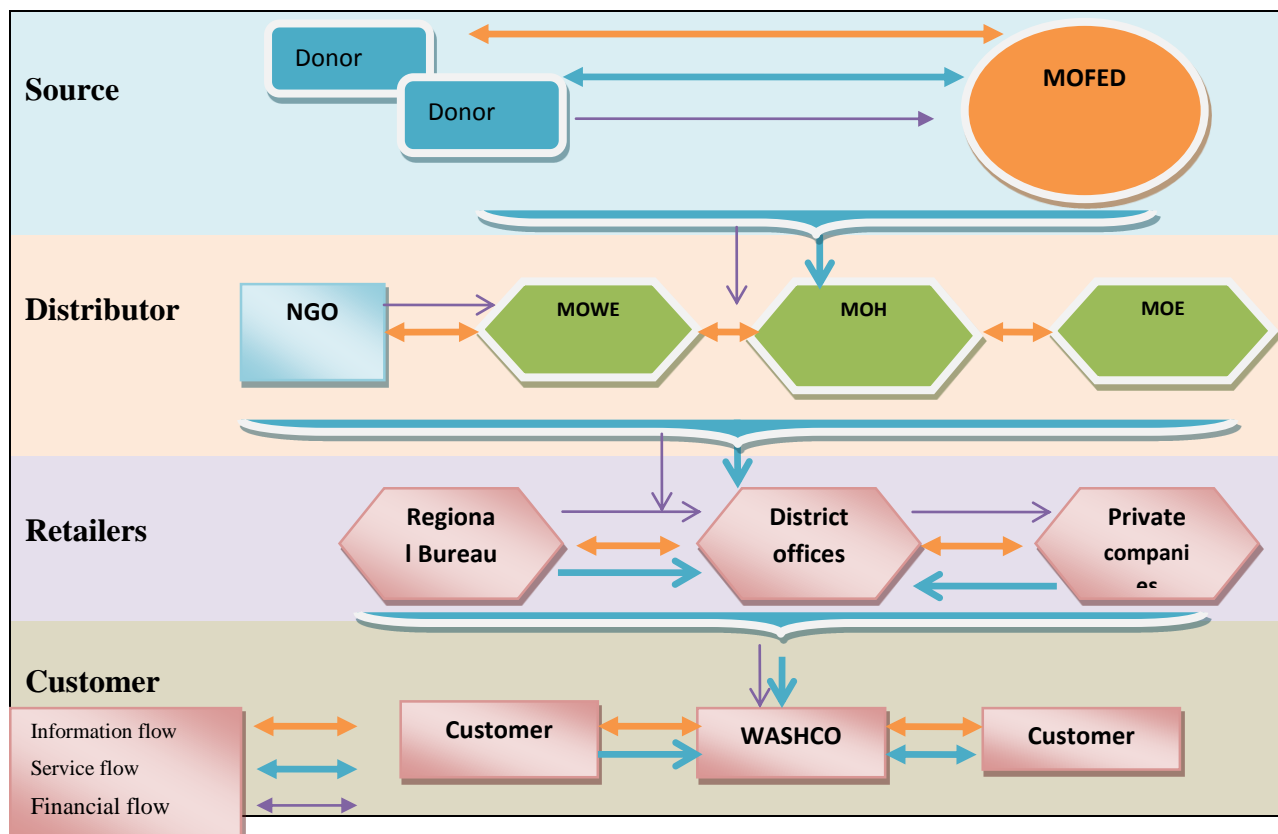
### **2.5.1. WASH SECTOR: ETHIOPIAN PERSPECTIVE**

The federal ministries of Water and energy and health and the regional Bureaus of Water Resources and health are the key responsible organizations for water supply and sanitation programmes implementation at the national and regional levels. Projects and programs supported by different donors constitute the major part of Ethiopia's WaSH sector. Non-Governmental Organizations (NGOs) are currently playing a very significant role as financier in the rural water supply and sanitation sector of Ethiopia

The government budget represents the major financing source; the sector remains heavily aid-dependent: financial resources channeled by donors are currently of a similar scale to those allocated by the government (Water Aid 2016, p. 16). Most donors continue to channel finance

through project structures, and the high transaction costs created by this fragmentation has put a severe strain on the limited capacity of the MoWR and other sector institutions. Recognizing these challenges, both the government and donors have been actively working over the past few years to change the way in which development assistance in the water supply and sanitation sector is delivered. The Ministry of Water and Energy together with development partners have put tireless efforts to ensure that all communities in the country are well served with clean water and improved sanitation. The government and NGO are the two key actors for implementing the national WASH programmers in collaboration with Donors and community based organizations.

Figure: 2 Supply chain of wash Sector in Ethiopia



Source: MWRE 2015

## **2.5.2. SUPPLY CHAIN INTEGRATION OF ETHIOPIAN WASH SECTOR**

The Ethiopian WASH sector has developed by integration Community-Government-Private sector and external support agencies partnership. The Ethiopian Government has established One National WASH Program as defined in the National WASH Implementation Framework (WIF) in 2011 to support the development and to support the scaling-up of the Community Managed Project (CMP) approach in order to accelerate the rural WASH implementation. Different stakeholders have included in the chain and integrated together for the achievement of the common goal.

Ethiopian National WASH Program – undertaken by rural and urban communities throughout Ethiopia and supported and facilitated by governmental agencies, civil society organizations, the private sector and international donors. It has been prepared in advance of the inception of the fully harmonized and integrated Program. It anticipates how WaSH will be structured, how it will be funded and how it will be implemented when a single Consolidated WaSH Account (CWA) is operational, when coordination structures are in place and when the key sectors and the Non-Governmental Organizations (NGOs) are integrated in planning, implementing and reporting one WaSH Program (MOWE 2015, p. 18).

WASH is designed to integrate: Water Supply (urban, rural and pastoralist) ,Hygiene and Sanitation and WASH in Schools and Health Facilities .This integration is not intended simply as an institutional arrangement to achieve greater efficiency and effectiveness – though that is one objective. The primary objective is to foster integrated behavior among community members in which: safe use of water, healthy hygiene practices and regular use of improved sanitation facilities.

A notable step towards sector harmonization was made recently by the three largest official development partners: the World Bank, the Department for International Development (DFID) and the African Development Bank, who have all harmonized under a single financing modality channeled through the Ministry of Finance and Economic Development, using a single national program implementation manual and a financial manual. Meanwhile, most other water sector official development partners though still operating in project mode—have coalesced around an emerging Sector-Wide Approach (SWAp), replacing separate individual project missions and

project-based field visits with bi-annual Joint Technical Reviews and an annual WASH Multi-Stakeholder Forum.

Table: 1 Stakeholders of WASH services

Government stakeholders	Donors	Nongovernmental organization	Private companies
MOWE	African Development Bank	IDE	Water Drilling and Water work companies
MOH	Development Assistant group	IRC	Water consultancy firm
MOE	Government of Italy	Norwegian church AID	Importers and retailers
MOFED	Government of Netherlands	ORDA	Manufacturers
Regional and district water office	Government of Japan	OXFAM GB	WASHCo
	Government of Finland	Plan Ethiopia	
	Government of Switzerland	REST	
	World Bank	RIPPLE	
	UNESCO	SNV Netherland	
	UNICEF	Water in Ethiopia	
	DFID	WASH movement	
	WHO	WATER AID	
		CRDA	
		Water sanitation Forum	

Source: MOWE 2015

## 2.6. LITERATURE GAP

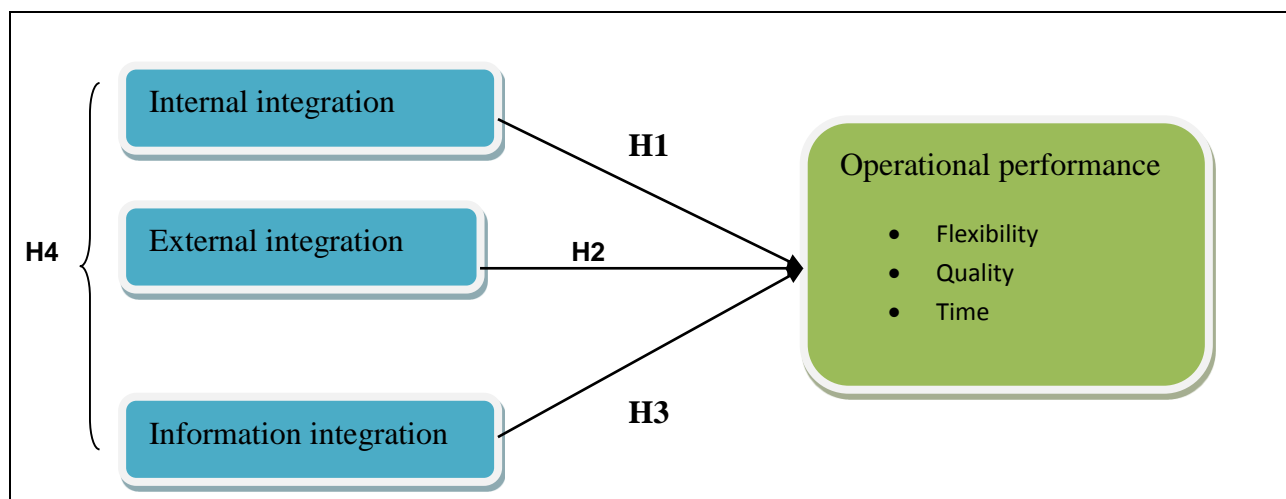
Different researches have been conducted on the effects of supply chain integration on operational performance on different sectors namely manufacturing and business enterprises. But no research is conducted on emphasizing the WASH sector. Consequently, the aim of this study is to further develop the understanding of the effect and relationship between supply chain integration and operational performance. A research studies on the effect of supply chain integration on operational performance were conducted in trading enterprise and chemical companies in Ethiopia (Binyam 2014, p. 43 and Daniel 2015, p. 65). But these researchers were focused on a supply chain integration of a single company and on different sectors from this study.

## 2.7. CONCEPTUAL FRAMEWORK

The study will introduce a conceptual framework that investigates the relationship between supply chain integration and operational performance. In more detail, the conceptual framework of the study will examine causal relationships between four research variables (constructs):

- a. Internal integration (independent variable),
- b. External integration (independent variable),
- c. Information integration (independent variable) and
- d. Operational performance (dependent variable)

**Figure 3: Proposed Conceptual Framework and hypotheses for the Study**



## 2.8. HYPOTHESIS

### 2.8.1 INTERNAL INTEGRATION AND OPERATIONAL PERFORMANCE

Koufteros et al. (2005, p. 12) and Gimenez (2003, p. 65) identified that a positive relationship between internal integration and operational performance. They are also indicated that the positive effect of internal integration on cost, quality, delivery, flexibility, innovation, process efficiency, time-based performance and logistics service performance.

Internal integration is the base for SCI and is positively related to operational and financial performance (O'Leary-Kelly and Flores 2002, p. 87). Previous studies have found that components of internal integration such as cross-functional collaboration and integrative inventory management systems have positive impacts on a firm's performance (Vickery et al. 2003, p. 54).

**H1 = Internal integration has significant effect on Operational performance**

## **2. 8.2 EXTERNAL INTEGRATION AND OPERATIONAL PERFORMANCE**

From the conceptual views of the transaction cost theory, external Integration enables firms to decrease an opportunistic behavior, to minimize production and transaction costs and to enhance their ability to obtain resources. The organizational learning theory also suggests that firms seek to establish a competitive advantage by acquiring external knowledge. According to empirical study results, such as Frohlich and Westbrook (2001, p. 65) and Lau et al. (2010, p. 32), external integration positive results in the operational performance of suppliers and customers.

**H2= External integration has significant effect on Operational performance**

## **2. 8.3 INFORMATION INTEGRATION AND OPERATIONAL PERFORMANCE**

Effective information integration enhances mutual understanding, which reduces miscommunication and prevents unnecessary mistakes, thereby decreasing transaction costs across the supply chain (Frohlich 2002, p. 76; Lee and Whang 2004 and Wu et al. 2006, p. 34). Increased information transparency allows firms to choose suppliers with lower prices, enabling them to produce and deliver products or services at lower cost (Chen et al. 2004, p.54 and Wu et al. 2006, p. 78).

**H3=Information integration has significant effect on Operational performance**

## **2. 8.4 CORRELATION BETWEEN INTERNAL INTEGRATION, EXTERNAL INTEGRATION AND INFORMATION INTEGRATION**

Since skills sets, management systems and technologies required for supplier, customer and internal interactions are quite similar to one another, one could, for example, expect that firms that would be strong on collaborating with suppliers will be also strong in customer and internal

integration (Singh and Power 2009, p. 89). To implement customer and supplier integration successfully, manufacturers need to be internally integrated well because internal integration functions as coordination and learning mechanisms in customer and supplier integration (Marquez et al. 2004, p. 18).

**H4: Internal integration, External integration and information integration are positively related to one another.**

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

Research methodology is a blue print for the study and describes an approach and techniques for studying a research topic. Consequently, the study investigates how the research was carried out. It involved a road map for the collection, measurement and analysis of data.

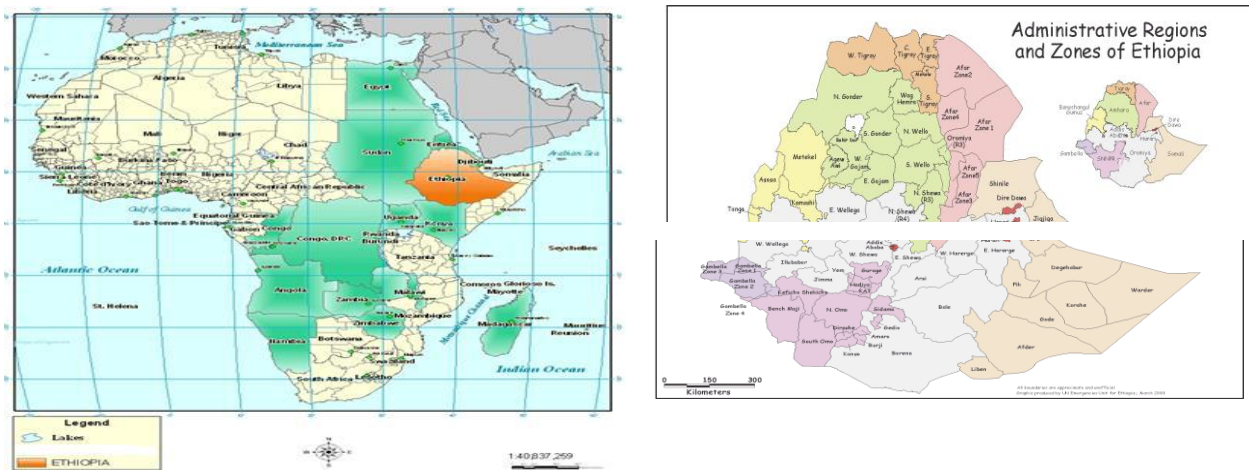
#### **3.2. DESCRIPTION OF THE STUDY AREA**

Ethiopia is a landlocked country located in Eastern Africa bordering the Sudan, Eritrea, Djibouti, Somalia, and Kenya (Fig.4) with a land area of about 1.13 million sq. km and a population of about 100.8 million in 2018 (The Global Competitiveness Report 2018, p.123), out of which only about 16 % live in urban areas. It has a tropical monsoon climate with wide topographic-induced variations. The country has wide topographic features varying between an altitude of 4,620 m above mean sea level (Ras Dejen) to about 120 m below mean sea level (Denakil Depression) with a very difficult terrain (highlands crisscrossed by numerous river valleys and the Great Rift Valley) which made the provision of transport facilities very expensive.

The main development objective of the Ethiopian Government is poverty eradication through accelerated and sustainable development. In about 20 years, Ethiopia's vision is to reach the level of middle-income countries. The long journey towards achieving socio-economic transformation has already commenced with the implementation of effective economic policies and strategies. Ethiopia's economy is growing over 10% and the GDP per capita is estimated to be USD 390 in 2009 (GDP 2015, p.97). Yet, in spite of high rates of growth most Ethiopians live in poverty. Periodic droughts, soil degradation, high population density, high levels of taxation and poor infrastructure (World Bank 2010, p.33) and hence serious imbalance of payments in the country's foreign trade are the main obstacles to sustainable economic growth (Cilliers and Nagel 2014, p.67).

The study was conducted in Ethiopia and incorporate all the stakeholders involved in the WASH sector at national, regional and district level. Ethiopia is administratively sub-divided into nine regional states and two city administrations.

Figure 4: Geographical location and administrative region of Ethiopia



### 3.3. RESEARCH DESIGN

Research design is a general term that covers a number of separate but related issues associated with a research study (Blaxte 2010, p. 65). Ornstein (2013, p. 43) defined research design as a strategic framework for action that serves as a bridge between research questions and the execution or implementation of the research. Saunders & Lewis (2014, p. 63) outlined different types of research methodology into categories as exploratory, descriptive and explanatory. This study employed an explanatory research design, because it aims to explore the cause and effect relationship between supply chain integration and operational performance at WASH Sector in Ethiopian cases. The study was explore the supply chain integration profile of Ethiopian WASH sector by investigation the experience of different government and nongovernmental stakeholders at higher level.

### **3.4. RESEARCH APPROACH**

The study problem was answered through a combination of qualitative and quantitative approach in order to reduce the limitation and increase the quality and flexibility of the data (Robinson 1998, p.32).

### **3.5 STUDY POPULATION, SAMPLING AND UNIT OF ANALYSIS**

#### **3.5.1. TARGET POPULATION**

Creswell (2013, p.48) has defined a target population as gathering of individuals and items that are the main emphasis of a scientific enquiry. According to Welman et al. (2005, p. 48). A study population may be individual persons, groups and organizations from which the values of the variables of interest could possibly be determined. The target population in this study were government and non-government organizations involved in the national and local level WASH interventions and registered in the national WASH frameworks. There are various governmental, Non-governmental and private organizations registered in the WASH framework documents (MOWE 2014, p. 59).

#### **3.5.2. SAMPLING TECHNIQUE**

Sampling design and the sample size are important for establishing the representativeness of the sample in terms of generalizability of the subsequent findings to the entire population of interest (Veal 2005, p.44). Sampling is the process of selecting a sufficient number of members of the population of interest, which can be done purposefully or randomly. For this study, as the population size was large, it was important to apply sampling techniques to select study participants (Sekaran 2003, p.144). Consequently, the study adopted a probability sampling techniques. According to Kothari (2004, p.22) probability sampling is a sampling technique where the samples are gathered in a process that gives all the individuals in the population equal chances of being selected.

Using stratified sampling approach, (See Appendix II) organizations involved in WASH sector were divided in to three strata based on their supply chain roles i.e.: source, distributors and retailers.

Table 2: Stakeholders of WASH services

Supply chain level	Type of organization	Total number of Organizations
Source	Donor	12
	Government	1
Distributor	Government	3
	NGO	14
Retailers	Regional	11
	District	373
	Private	51

Source: MOWE, 2015

All the mentioned organizations have Supply chain departments to manage the flow of information, finance material and products within the organization and across the organizations. Consequently, the data was collected from such department and it was valuable to serve the research purposes and the data was considered as primary data in this field.

According to Taro Yamane's (1973), the study applied a simplified formula to determine the required sample size at 95% confidence level, and allowable error = 0.05% and number of respondents at each level.

$$n = \frac{N}{1+N(e)^2}$$

**Where:** 'n': is the sample size,

'N': is the total number of employees in the factory, and

'e': is the level of precision. Substitute numbers in formula:

$$n = \frac{465}{1+465(0.05)^2}$$

$$n = 215$$

After calculating the sample size by substituting the numbers into the Yamane formula, the numbers of sample were **215**. Only one respondent was selected per organization but two

respondents from source and distributors and add a 15 percent contingency and accordingly a total of 261 respondents were participated on the study proportionally across the supply chain members.

Table 3: Number of Sample selected

Supply chain level	Type of organization	Total number of Organizations	Number of sample selected	% of representation	No of respondents per organization	No of respondents per SC level
<b>Source</b>	Donor	12	5	42	10	12
	Government	1	1	100	2	
<b>Distributor</b>	Government	3	2	67	6	18
	NGO	14	6	50	12	
<b>Retailers</b>	Regional	11	6	54	7	231
	District	373	172	46	198	
	Private	51	23	45	26	
<b>Total</b>		<b>465</b>	<b>215</b>	<b>46</b>	<b>261</b>	<b>261</b>

*Source; Own Computation, 2019*

### 3.3.3 UNIT OF ANALYSIS

The unit of analysis of the study includes employees who work at supply chain department at WASH sector in government and nongovernment organizations. Therefore the unit of analysis was at organizational level. The data obtained from primary sources were triangulated with the secondary data to draw a valid conclusion.

### 3.4 DATA COLLECTION METHOD

The researcher used primary and secondary data collection methods. Standard questionnaire was employed as a primary data gathering mechanism and secondary data was collected from annual reports, journal articles, books, online sight and others. Data related to organizational level variables were collected from a variety of sources such as financial records, activity and financial reports and surveys of Chief Executive Officers (CEO), who are presumed to be representing of their organization.

### **3.4.1 Questionnaire**

Self-administered close ended questionnaire was used to collect data from employees at different levels in different organizations in the WASH sector. The indicators of supply chain integration were measured using a five point Likert scale (1=strongly disagree; 5=strongly agree) where higher values indicated stronger integration. The study was adopt a standard questionnaire used by Evans (2013, p.72) and Barbara et al (2010, p.55).The questionnaires were also changed and arranged to online formats by using Google form application and e-mailed for some participants who were at regional level. A questionnaire survey was used as a primary data collection instrument in the study, as it allows easy access to a large number of respondents. Questionnaire survey has also been one of the most commonly used instruments in studies measuring SCM and performance (Boon-itt & Paul 2006, p.79). Thus, due to the aforementioned benefits, in this study, the data required to meet its objectives was gathered through a survey, whereby the questionnaire was mailed to the target population sample at regional and woreda level through coordination with the national WASH movement office. This approach was chosen because it was cost-effective, required minimal involvement on behalf of the researcher, and increased the survey population without increasing variable cost. It was also easier to secure participation from individuals who would otherwise not take part in the study, as they were not accessible in person. Finally, it provided enough time for participants to think about questions before responding (Cooper & Schindler 1998).

### **3.5 PILOT STUDY**

Pilot studies are a vital part of survey-based research, as they are conducted prior to commencing the main study, allowing the researcher to test the data collection instrument on a group of respondents drawn from the same population as the individuals that would respond to the main survey. The main aim of pilot studies is identifying problems in the questionnaire instructions or design. Thus, its findings indicate whether the respondents would have any difficulty in understanding the questionnaire due to ambiguous or biased questions (Sekaran 2003, p.13). Many researchers have suggested the use of different combinations of the pre-test or pilot study methods (Churchill 1995, p.43). The pre-test methods used in this thesis were interviews and expert input (advisor). The pilot study was divided into two parts. First, interviews with the purchasing and

supply executives and used the result to improve the questionnaire and the hypotheses generated from the literature. In addition, purchasing and supply executives, and academics advised on the clarity of the instructions and validity of the questionnaire.

The pilot study data was analyzed through basic statistical methods using SPSS software (version 20). Responses were analyzed in terms of their validity and relevance to the research objectives. The respondents' summative feedback was also carefully reviewed and summarized. Careful note was also made of all the cases where the respondents tended to respond similarly to all items by, for example, repeatedly selecting a certain point on the scale (Sekaran 2003). The following seven tests focus on the missing value assessment, demographic profile of respondents, multivariate outliers assessment, multivariate normality assessment, multicollinearity test and Cronbach's Alpha were used in the pilot study. The subsequent analyses of the revised questionnaire confirmed that the instrument was ready for use in the main survey.

### **3.6. DATA ANALYSIS**

The data was analyzed by computer Statistical Package software for Social Sciences version 20. Data cleaning allows evaluating the impact of missing data, identifies outliers, and tests for the assumptions underlying most multivariate techniques. The aim of these data examination procedures is elimination of any potential for introducing biases into the results.

#### **3.6.1. Data cleaning methods**

##### **3.6.1.1. Missing data**

Missing data assessment aims to identify any missing values pertaining to the study variables, as these may affect data interpretation and analysis (Hair et al. 2010). In multivariate analysis, missing data results in the reduction of the sample size available for analysis. Missing data was manipulated or analyzed by using SPSS to identify any missing information on the respondent's responses.

### **3.6.1.2. Multivariate outliers**

After completing the missing data analysis, multivariate outlier detection needs to be performed. Outliers are observations with a unique combination of characteristics that are distinctly different from the remaining observations (Hair et al. 2010). Typically, unique characteristics include unusually high or low values, or a unique combination of values across several variables that make the observation stand out from the others. Outliers were identified by calculating the Mahalanobis distance, which is the distance of a particular case from the centroid of the remaining cases, where the centroid is the point created by the means of all the variables (Tabachnick & Fidell 2001). Thus, in multivariate outlier detection, as there are several dimensions, Mahalanobis ( $D^2$ ) measure is the multidimensional position of each observation compared with the center of all observations on a set of variables. Consequently, Mahalanobis distance was calculated for all observation and expressed by plot to clearly identify its distributions.

### **3.6.1.3. Multivariate normality**

Normality refers to the correspondence between the distribution of a given data set and the normal distribution, which is the benchmark for statistical methods as it allows many inferences to be made based on its properties (Hair et al. 2006, p.11). There are many statistical methods that can only be applied if the distribution of scores on the dependent variable is normal. Normal distribution is characterized by a symmetrical, bell shaped curve, in which mean, mode and median coincide and lie in the middle of the graph (Gravetter & Wallnau 2000, p.77). Normality can be assessed to some extent by obtaining skewness and kurtosis values. The skewness value provides indication of the symmetry of the distribution, while kurtosis pertains to the peakedness or the flatness of the distribution compared with the normal distribution (Kenny & Keeping 1962, Pallant 2005, p.41). Finally, data set normality was verified via the normal probability plot (Normal Q-Q Plot). In this test, Q-Q plot of each measurement item should be generated, in order to verify that all data is scattered as closely to a straight line as possible. Once the data passes the aforementioned tests, it can be confirmed that the data set is normally distributed (Hair et al. 2010, p.23). Thus, in this study, the data was assessed by calculating skewness and kurtosis, as well as by performing the 5% Trimmed Mean test and producing the normal Q-Q plot.

#### 3.6.1.4. Multicollinearity

Multicollinearity is the extent to which a particular construct can be explained by other constructs in the analysis (Hair et al. 2006, p.42). It occurs when the variables that appear distinct and unrelated actually measure the same thing. Hence, when the dependent variables are highly correlated, this phenomenon is referred to as multicollinearity (Pallant 2005, p.71). High correlation among variables may be harmful for multiple regression analysis and other multivariate data analyses. In this context, when the correlation coefficient between measurement items exceeds 0.8, this is considered an extreme value (Hair et al. 2010, p.19). Hence, in the study the data was tested for the presence of multicollinearity. Here, it was assumed that, when the correlation coefficient between measurement items exceeded 0.8, one of the highly correlated variables should be removed.

#### 3.6.2 Descriptive statistics

The basic information of the respondents were analyzed and summarized using descriptive statistics in form of frequency and percentage. Central tendency measures such as mean and standard deviation were applied to analyze the practice of supply chain integration.

#### 3.6.3. Regression and Correlation

The study applied correlation and regression analysis to investigate the relationship and impact between supply chain integration construct and operation performance. The study adopted Pearson correlation and simple linear regressions to verify the four hypotheses. The regression equation was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \alpha$$

- Where:**
- Y:** is the dependent variable (operation performance),
  - $\beta_0$ :** is the regression coefficient/constant/**Y**-intercept,
  - $\beta_1$ ,  $\beta_2$ ,  $\beta_3$  and  $\beta_4$ :** are the slopes of the regression equation,
  - $X_1$ :** is Information sharing

**X<sub>2</sub>**: is External integration

**X<sub>3</sub>** is internal integration,

### **3.7. ETHICAL CONSIDERATION**

Ethics in social studies refers to a code of conduct and adherence to expected social norms and behaviors while conducting research. Ethical conduct should also be reflected in the behavior of the researchers who conduct the investigation, the participants who provide the data, the analysts who provide the results and the presentation of the study findings (Veal 2005, p.66). Ethical norms must be respected in each step of the research process, including data collection, data analysis and reporting, and even in the dissemination of study findings, whether through conference presentations and scientific publications, or publishing information on the internet (Sekaran 2000, p.55). As the participants in this study were employees of different organizations at different level, it was essential that all individuals were treated fairly and ethically throughout the study. Of equal importance was ensuring that the information they provided was safe guarded and treated as confidential, in line with business ethics and code of conduct. In this study, in order to ensure that all ethical standards and requirements were met, the research method, survey procedure, consent form, ethical application, and information sheets to participants were submitted. Various aspects of ethical considerations have already been covered in the study. One of the primary responsibilities of the researcher was treating the information given by the respondents as strictly confidential and guarding their privacy. To ensure that all respondents understood the extent of their involvement in the study and how the information they shared would be subsequently used, the purpose of the research was explained in the covering letter (information sheet to participants) that accompanied the mailed questionnaires.

### **3.8 VALIDITY AND RELIABILITY TEST**

The content validity was assured by using multiple sources of data (literature such as previous studies, expert interviews) to develop and refine the model and measures. The construct validity which deals with the consistency of the questions was assured by structuring the questionnaire according to the specific objectives. To ensure internal validity, the research was builds on explanations drawn from supply chain management theory and existent literature, and addresses rival explanations for the results. Pilot study and practitioners and researchers review were

conducted to confirm that the findings are generalizable for external validity. The reliability was tested by using the Cronbach's Alpha coefficient value. Cronbach Alpha should be over 0.70 to produce a reliable scale and any scale with Cronbach Alpha less than this standard should be eliminated (Sekaran 2005, p. 123). The Cronbach's Alpha coefficient of the study was 0.879. George and Mallery (2003), states that at least a value of 0.7 is recommendable and therefore the instrument was accepted as highly reliable.

Table 4: Reliability statistics of the pilot study

<b>Cronbach's Alpha</b>	<b>N of Items</b>
.879	38

*Source; Survey Results and Own Computation, 2019*

## **CHAPTER FOUR:**

### **RESULTS AND DISCUSSION**

#### **4.1 INTRODUCTION**

This chapter presents results and related analysis of the data on the effect of supply integration on operational performance of WASH sector in Ethiopia. Besides, the chapter presents the findings of the study and discussions on the outcomes. The findings were intended to answer the study's research questions. The data analysis was conducted using a triangulation of techniques: descriptive analysis, correlation matrix, and linear regression analysis. The data was analyzed using Statistical Package for Social Science (SPSS v.20). Based on the methodologies, research design and tools of the study the data was collected from 242 respondents. From the total 261 questionnaire distributed 242 were returned, this represented a 92% response rate. This is a reliable response rate for data analysis as Mugenda (2003, p.91) pointed that for generalization a response rate of 50% is adequate for analysis and reporting, 60% is good and a response rate of 70% and over is excellent.

#### **4.2 DATA EDITING AND CODING**

Following data collection from the government and non-government organization at different level (see appendix 2 of target group list), editing of the data was undertaken in order to check the omission, completeness, and consistence of the data. Editing is a part of the data processing and analysis stage (Zikmund 2003, p.53). There were no missing data for all measurement items in the constructs for the conceptual model and general information section.

Coding was used to allocate numbers to each answer (Malhotra 1996, p.39) and facilitates the transfer of data from the questionnaire to SPSS version 20. Coding can be done before the questionnaire is answered (pre-coding) or after (Devaus 1995, p.23). In this thesis, the coding procedure was conducted by establishing a data file in SPSS, and all measurement items were all pre-coded with numbers (see survey questionnaire in Appendix 1).

### **4.3. DATA SCREENING**

Before running further statistical analysis, screening of data and variables were conducted to make sure they are reliable and valid for testing causal theory because the estimation methods used assume specific conditions, and the violation of these assumptions leads to inappropriate solution (Kline 2010, p.19). In this section, the data were examined from two different perspectives: i.e. missing data analysis and outliers and normality.

#### **4.3.1. OUTLIERS AND NORMALITY**

The data were assessed to determine normality of distribution because correlation analysis and regression analysis both need variables to be normally distributed. The distribution of variables to be used in the analysis was checked for normality (Hair et al. 2006, p.124).

A visual examination of the normal probability plots of the residuals (errors in predicting sample data), indicated a normal distribution of the values, and meet the assumption of normality. In order to assess the distribution of the variables, it was necessary to check for outliers. Outliers are defined as “observations with a unique combination of characteristics identifiable as distinctly different from the other observations” (Hair et al., 2006, p.64). The outliers in the study could be divided into two different categories: uni-variate outliers and multivariate outliers (Hair, et al., 2009). The uni-variate outliers on variable basis do not exist in this study because Likert-scales was used in the study, which means all variables were on ordinal scales with five intervals.

To detect the multivariate outliers, we need to calculate the mahalanobis distance (independent variables: all survey items, dependent variable: case no.) and then create a line chart based on this distance. Figure 6 presents that the mahalanobis distance of all cases were in a small region (between 0.00 and 10.00) and thus conclude that there are no multivariate outliers in the study.

Next step was to check the normality of the data for a particular variable since the assumption of these data were that they are normally distributed. The normality was measured by two indicators: skewness and kurtosis. Skewness assesses whether the distribution of responses are heavily concentrated on one end of the scale. The actual deviation from the normality of distribution was determined using skewness and kurtosis. Skewness refers to the “measure of symmetry of a distribution; in most instances the comparison is made to a normal distribution,” and Kurtosis refers to the “measure of the peakedness or flatness of distribution when compared with a normal

distribution” (Hair et al., 2006, p.37). Thus, there was no reason to exclude variables based on skewness because all variables in this study are based on Likert-type scales. Kurtosis is another measure, compared with normal distribution, to check if the distribution is flat or peaked. Both data that are tightly distributed or distantly distributed around the mean have kurtosis issues.

Table: 6 Skewness and kurtosis result

	N	Std. Deviation	Skewness		Kurtosis		Fisher skewness Coefficient	Fisher Kurtosis Coefficient
		Statistic	Statistic	Std. Error	Statistic	Std. Error		
Internal Integration	242	.49522	.022	.156	.072	.312	0.0451	0.1451
External Integration	242	.53210	-.158	.156	-.965	.312	-0.2963	-1.8137
Information Integration	242	.56516	-.062	.156	-.216	.312	-0.10889	-0.38217
Operational performance	242	.39693	-.407	.156	-.603	.312	-1.02632	-1.51955

*Source; Survey Results and Own Computation, 2019*

To determine the seriousness of skewness and kurtosis of the distribution, Fishers skewness and kurtosis coefficient can be used (kellar and kelvain 2012, p.56). If the results falls between -1.96 and 1.96, it suggests that the distribution is not significantly different from normal distribution (kellar and kelvain 2012, p.87). Table 6 and appendix 3 showed that, the Fishers skewness and kurtosis coefficient of the study were lies between -1.96 and 1.96 and therefore the data were free from any skewness and kurtosis issues. A variable with an absolute value of Kurtosis index greater than 10.0 indicates there is a problem with normality and values greater than 20.0 indicate a more serious normality problem (Kline 2005, p.11). Therefore, the acceptable absolute value of skewness and kurtosis should not exceed three and ten respectively and the study results were also in the acceptable range.

### 4.3.3 RELIABILITY ANALYSIS

After unidimensionality is determined, reliabilities can be estimated for each construct. The scale reliability feature of SPSS version 20 was used to determine reliabilities for each construct using Cronbach’s alpha. Table 7 shows the reliabilities of final constructs.

Table: 7 Cronbach's Alpha result of all items

<b>Cronbach's Alpha</b>	<b>N of Items</b>
.883	38

*Source; Survey Results and Own Computation, 2019*

The Cronbach's Alpha result of 38 items under dependent and independents variables was 88 % and it has alpha value on acceptable reliability range.

Table: 8 Cronbach's Alpha result of variables

	<b>Cronbach's Alpha</b>	<b>N of Items</b>
Internal integration	.71	10
External integration	.746	10
Information integration	.72	7

*Source; Survey Results and Own Computation, 2019*

The internal integration have reliabilities of 0.71 which are above the required value of alpha (0.7) recommended, and external integration have reliabilities between of 0.746 and which are acceptable. The information integration construct has the reliability of 0.72 and it was not removed because it has alpha value on acceptable reliability boundary.

#### **4.4. DEMOGRAPHIC DATA PRESENTATION AND ANALYSIS**

It is necessary to analyze the demographic profile of the respondents to validate reliability of the data collected. Accordingly, the respondents were asked to respond to their year of experience, level of education and rank in their organizations. The information processed by SPSS were summarized as follows. So this section presents the respondent profiles result from 242 questionnaire.

##### **4.4.1 POSITION OF THE RESPONDENT IN THE ORGANIZATION**

Participant job position is the variable which was considered in the study. The researcher included the job position in the study to see whether the study included participants from different level.

The result from table 9, indicated that the majority of the respondents 55.4% (n=134) were high level, whereas 27.7% (n=67) were middle level. The rest of the participants were low level position

16.9% (n=41). In terms of the respondent's position in the sector, the majority of the respondents were high level. Consequently, the respondents were appropriate to collect data about supply chain integration matters because they were in a suitable and critical job position. Besides, the study was incorporated participants from all levels to see their diversified perceptions towards the subject matters.

Table: 9 Position of the respondent in the organization

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
High level	134	55.4	55.4	55.4
Middle level	67	27.7	27.7	83.1
Low level	41	16.9	16.9	100.0
Total	242	100.0	100.0	

*Source; Survey Results and Own Computation, 2019*

#### **4.4.2 Respondents department**

The researcher requested respondents to indicate the departments in which they were working in the organization. Majority (62%) of the respondents were working at supply chain department, 19.8% were marketing department, 13.6% were management department while the rest 4.2% of the respondents were serving at other departments. This implies that all departments that were targeted by the study were involved and that the finding is reliable.

Table: 10 Respondents department

	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
SCM	150	62.0	62.0	62.0
R &D	9	3.7	3.7	65.7
Marketing	48	19.8	19.8	85.5
Management	33	13.6	13.6	99.2
Other	2	.8	.8	100.0
Total	242	100.0	100.0	

*Source; Survey Results and Own Computation, 2019*

#### 4.4.3 Education level of the respondents

As summarized in the table 11, majority of the respondents (65.7 %) were qualified in first degree and thirty seven (37) respondents i.e. 15.3 % were qualified in master degree. This is an indication that the majorities of the respondents have bachelor degree which enables them to provide more reliable information for this study and enable the respondents to have idea of the objective of the study.

Table: 11 Education level of the respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
Diploma or less	43	17.8	17.8	17.8
Bachelor	159	65.7	65.7	83.5
Masters	37	15.3	15.3	98.8
Doctorate	3	1.2	1.2	100.0
Total	242	100.0	100.0	

Source; Survey Results and Own Computation, 2019

#### 4.4.4 Experiences of the Respondents

Respondents experience is critical to obtain a wise and objective response. The table below depicts the experience of respondents in target organizations. The majority of the respondents were worked on the sector for 5 to 10 years, comprising 47.9 % (n=116) of the total participants. Seventy nine (79) respondents i.e. 32.6 % has been within the organization for 5 and less years, whereas only 5% (n=12) were worked for 15 and more years. Among the participants 14.5 % (n=35) were worked for 10-15 years.

Table: 12 Experiences of the Respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
<or equal 5	79	32.6	32.6	32.6
5-10	116	47.9	47.9	80.6
10-15	35	14.5	14.5	95.0
>15	12	5.0	5.0	100.0
Total	242	100.0	100.0	

Source; Survey Results and Own Computation, 2019

## **4.5. DESCRIPTIVE ANALYSIS**

This section explains and discusses the results of findings based on the analysis done on the data collected. The results of the study were discussed by triangulating the different source of results: questionnaire results, interview and document review results. Consequently, this section investigate and analyze the necessary assumptions for further statistical analysis and then present the results of descriptive analysis and ANOVA analysis. The discussion attempts to accomplish the objectives of the study and answer the research questions.

Descriptive statistics is the term given to the analysis of data that helps to describe, show or summarize data in a meaningful way. It is very important because if we simply presented our raw data it would be hard to visualize what the data was showing, especially if there was a lot of it (Kline 2010). Descriptive statistics therefore enable us to present the data in a more meaningful way, which allows simpler interpretation of the data.

Measures of central tendency describes the central position of a frequency distribution for a group of data (Kline 2010). The central position is described by using a number of statistics, including the mode, median, and mean. Measures of spread helps to summarize a group of data by describing how spread out the scores are. To describe this spread, a number of statistics are available to us, including the range, quartiles, absolute deviation, variance and standard deviation. The study was focused on mean and standard deviation to describe central position and data spreading pattern.

As indicated in the previous chapter, survey was the main strategy of inquiry adopted by the study to investigate the effect of supply chain integration on operation performance in WASH sector at government and non-government organizations. To this end, the results obtained from the survey were analyzed using Statistical Package for Social Sciences (SPSS Version 20.0) program through descriptive statistics and inferential statistics such as correlation and regression. The descriptive statistics part was analyzed using means, standard deviation, and percentage.

### **4.5.1. Descriptive Analysis of Supply chain integration practice**

To assess the effect of supply chain integration on operational performance, respondents were requested to rate the level of agreement using a Five-point Likert scale (1=Very strongly disagree, 2= Disagree, 3= neutral, 4= Agree and 5=Very high strongly agree. The mean statistical values of

the items were based on the 5 point Likert scale and illustrated through the following assumptions: if the mean (M) score is below 2.5 it implies that the respondents disagree with the statement, if the mean score is equal to 2.5 it indicates that the respondents prefer to stay Neutral, and finally if the mean score is above 2.5 it implies that the respondents agree with the statement.

A standard deviation of  $>0.9$  implies a significant difference on the supply chain integration practices of the variable among the respondents. The tables below summarized the mean scores of the variables of supply chain integration practices. Accordingly, the mean scores have been computed for all the three supply chain integration dimensions that includes external integration, information integration, internal integration and also the dependent variable operational performance by equally weighting the mean scores of all the items under each dimension. The average mean result of each supply chain integration dimension together with their respective variables was separately presented, analyzed and interpreted as follows.

#### **4.5.1.1. Internal integration**

Table: 13 summarizes respondents' level of agreement on internal integration practice of their organizations. Most of the respondents showed that, their organization departments involved in the development of production processes by a mean score of 2.52 and SD of 1.043 Which is the highest of all the other internal integration dimensions. The respondents were also agreed that their organization allow the employees to participate in solving the problems and internal conflicts and settlement (M=2.50 and SD=0.982). Most of the respondents were disagreed that their organization holds training program to increase the employee's competencies by a mean score of 2.26 and SD of 0.957 and their organization is keen to hold regular meetings with departments managers to coordinate the work (M=2.30 and SD=0.948). The issue of internal network for the exchange of information between the employee score M=2.27 and SD=0.896. The respondents were also agreed that their organization holds extensive meetings to increase the homogeneity among employees (M=2.36 and SD=0.858) and the uses of MRP system (to harmonize forecasting, procurement, production, and sales) with the mean of 2.41 and standard deviation of 0.831. Correspondingly, the respondents showed their disagreement on their organization to unify their culture with stakeholders (M=2.31 and SD=1.09 and on the involvement of the organization in different department during the preparation of strategic plan (M=2.35 and SD=0.904).

The findings indicated that, internal integration have been adopted at a lower extent as indicated by the composite (Mean=2.35 and standard deviation=0.49) with in WASH sector. This shows that the organizations have lacked in maintaining cross-functional cooperation and collaboration within the organization that intends to achieve organizational strategic goals. A research conducted by Binyam (2016, p.40) found a similar result on internal integration (M=1.96) in Ethiopian trading enterprise, the study states that, the poor data integration and lack of enterprise application are the critical factors which had been overseen by the management of the enterprise. Other research conducted by Daniel (2015, p.65) on chemical industry in Ethiopia also showed a low internal integration value with in the sector. The research done by Hamza (2015, p.57) on Jordanian pharmaceutical companies stated a similar result of the mean of internal integration items was between 1.76 and 2.4 with standard deviation between 0.69 and 1.04, which means that there were disagreement among JPM organizations on implementation of internal integration items.

Generally the sector need to be reconsider the issue of internal integration for its improvement because companies with low internal integration strategies will achieve low levels of external integration and companies implementing the full internal integration strategies will have the highest levels of external integration (Gimenez and Ventura 2005).

Table: 13 Mean value of internal integration

	N	Mean	SD
There are multiple teams working with each other interactively	242	2.26	.986
The organization holds training program to increase the employees competencies	242	2.26	.957
There is an internal network for the exchange of information between the employees	242	2.27	.896
The organization is keen to hold regular meetings with departments managers	242	2.30	.948
The organization is constantly striving to unify their culture with stakeholders	242	2.31	1.090
The organization involves different department during strategic plan	242	2.35	.904
The organization holds extensive meetings to increase the homogeneity	242	2.36	.858
The organization uses MRP system	242	2.41	.831
The organization allow the employees in solving problems and conflicts settlement	242	2.50	.982
The organization departments share in the development of production processes	242	2.52	1.043
<b>Mean of Mean</b>		<b>2.35</b>	<b>0.49</b>

*Source; Survey Results and Own Computation, 2019*

#### 4.5.1.2. EXTERNAL INTEGRATION

The other dimensions of supply chain integration is external integration and it's defined as the degree of coordination between manufacturer and its downstream customers (Bowersox 1989; Narasimhan & Kim 2002; Frohlich 2002). External integration composed of supplier and customer integration. Table: 15 pinpoints the mean value of each item related to external integration with its aggregate average.

Table: 14 Mean value of External integration

	<b>N</b>	<b>Mean</b>	<b>SD</b>
There is follow up with major customer for feedback	242	2.01	.820
There is strong strategic partnership with major supply chain partners	242	2.21	.882
Computerized system for major customer ordering	242	2.21	.836
High frequency of period contacts with major supply chain partners	242	2.29	.964
There is strong IE with SC partners through information network.	242	2.29	1.246
There is linkage with customer through information network	242	2.33	1.017
Use of effective communication with major customer	242	2.33	1.010
There is stable procurement through network with major supplier	242	2.35	.983
There is quick ordering system with major supply chain partners	242	2.36	.911
Establishment of quick ordering system with major customer	242	2.40	.902
<b>Mean of mean</b>		<b>2.27</b>	<b>0.53</b>

*Source; Survey Results and Own Computation, 2019*

The table above depicts that the respondents deny the existence of strong information exchange with SC partners through information network and quick ordering system with major supply chain partners with the mean score of (M=2.29 and SD=1.246) and (M=2.36 and SD=0.911) respectively. Correspondingly, the respondents disagree on the adoption of strong strategic partnership with major supply chain partners and linkage with customer through information network with the score of (M=2.21 and SD= 0.882) and (M=2.33 and SD=1.017) respectively. The respondents also expressed their disagreement on the existence of follow up with major customer for feedback (M=2.01 and SD=0.820) and which is the lowest scores from all external integration dimensions. Finally, the respondents showed their disagreement towards the existence of stable procurement through network with major supplier (M=2.35 and SD= 0.983), computerized system for major customer ordering (M=2.21 and SD =0.836) and High frequency contacts period with major supply chain partners (M=2.29 and SD=0.964).But, the establishment of quick ordering

system with major customer (M=2.40 and SD=0.902) scored the highest value and the respondents expressed their agreement on the use of effective communication with major customer (M=2.33 and SD=1.010).

The average mean of external integration (M=2.27 and SD=0.53) showed the disagreement of the respondents to various external integration practice. External integration with customers is the degree of coordination between manufacturer and its downstream customers (Bowersox 1989). External integration involves strategic joint collaboration between a focal firm and its suppliers and suppliers in managing cross-firm business processes, including information sharing, strategic partnership, collaboration in planning, joint product development and so forth (Lai et al. 2010, p. 34; Wong, Boon-itt and Wong 2011, p. 68). The exchange of information with supplier through information network, quick ordering system, creation of good strategic partnership with supplier and the stability of procurement with supplier are critical issues but the issue neglected by WASH organizations. The company must work closely with suppliers and customers in order to improve the supply chain performance (Narasimhan & Kim 2002, p.39). The sector should focus to enhance external integrations because higher level of integration with suppliers and customers in supply chain, the greater the potential benefits (Frohlich & Westbrook 2001, p.48).

The research conducted by Biniyam (2016, p.44) showed that the disagreement of the respondents on the existence of follow up with major customer for feedback and the high frequency of contacts with customer with a mean score of (M=1.97,SD=0.760) and(M=2.01,SD=0.721) respectively. His study clearly showed that there is a problem of customer integration in Ethiopian trading enterprise. The same research found that, there is no strong integration with supplier and businesses are undertaken through traditional way of operation which in turn affects the operational performance of the enterprise. The extent of information sharing with supplier and quick ordering system in the enterprise are the functions that were neglected (Biniyam 2016, p.44).

#### **4.5.1.3. INFORMATION INTEGRATION**

The next independent variable on the study is the adoption of information integration in the WASH sector. Information integration refers to the free sharing of accurate and timely sharing of information across the members of the supply chain which is a key success factor for an organization. According to Lisa (1999, p.31), Supply chain management emphasizes on the flow

of information and products along the members of supply chain in an organization and also encompasses; suppliers, customers, producers, and service providers that integrates together the acquisition, purchase, manufacture, assemble and distribute products from suppliers to the ultimate users. Proper information utilization will lead to greater coordination in the chain and a better coordination in the flow of information between partner's results to growing impacts on the timely delivery (speed), accuracy, quality of products.

Table: 15. Mean value of Information integration

	N	Mean	SD
There is strong information sharing strategy	242	2.09	.771
There is specialized Information sharing department in the company	242	2.14	.962
Common Computerized data base system	242	2.17	1.065
Strong coordination in the flow of information among partners	242	2.17	.893
There is strong utilization of information among supply chain partners	242	2.28	.926
Timely sharing of information across the members of supply chain	242	2.28	.898
There is high level of free sharing of accurate information across members of SC	242	2.44	1.073
<b>Mean of mean</b>		<b>2.22</b>	<b>0.56</b>

*Source; Survey Results and Own Computation, 2019*

The table above depicts that the respondents deny the existence of timely sharing of information across the members of supply chain and strong coordination in the flow of information among partners with the score of (M=2.28 and SD=0.898) and (M=2.17 and SD=0.893) respectively. The respondents were also disagree on the presence of issues related to utilization of information among supply chain partners (M=2.28 and SD=0.926) and the existence of common computerized data base system (M=2.17 and SD=1.065). Correspondingly, the existence of specialized information sharing department in the company (M=2.14 and SD=0.962) and strong information sharing strategy (M=2.09 and SD=0.771) with in the organizations were the lowest scores with in information integration category.

Generally, the respondents were disagree on information integration with in the WASH sector partners with a mean score of (M=2.22 and SD=0.56). The result showed that, the adoption of information integration was very low and this affects significantly the operation performance of the sector because a critical emphasis on information technology without the interest of integrating information will not contribute to associate organizations together. Effective information

integration has the potential to develop supply chain partners in order to perform together for better delivery of products and services to consumers. A similar result was obtained by Biniyam (2015, p.74), which states the effect of information integration is reflected in various ways in ETE: the low level of accurate and timely sharing of information along the supply chain and poor utilization of information among Supply Chain partners. A similar research conducted by Daniel (2015, p.65) on Chemical Industry in Ethiopia also showed a low information integration value with in the sector. The research done by Hamza S (2015, p.57) on Jordanian pharmaceutical companies elaborated a similar result of the mean of information integration items is between 1.56 and 2.3 with standard deviation between 0.82 and 1.14, which indicated the inefficiency of information integration with in the pharmaceuticals companies.

Generally the issue of information integration in the WASH sector is low and this affect the sector order capacity because Rai et al. (2006, p.23) found that integrated information technology infrastructures enable a firm to develop the higher-order capacity of supply chain process integration.

#### **4.5.1.4. OPERATIONAL PERFORMANCE**

Table: 17 showed that the average mean of dependent dimensions is between 2.14 and 2.91, with standard deviation between 0.75 and 1.22, which indicate that there is a disagreement among WASH sector organizations on the implementation of the three dependent dimensions.

The table below depicts that the respondents were agreed only to the practice of the organizations towards reducing defective in output (M=2.91 and SD=1.22) but the respondents disagreed on the existence of supplier choices on the basis of high-quality (M=2.45 and SD=0.955). The respondents were provided the least scores for the existence of commitment of the organizations to provide the service according to standard with a mean scores of (M=2.351 and SD=0.79).

Table:16 Mean value of operational performance

<b>Operational performance</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>
<b>Flexibility</b>			
Amend the characteristics of the service according to customer's needs	242	2.14	0.93
Chooses suppliers who are flexible in responding to requests of the company	242	2.15	0.75
The organization has the ability to respond to changes in service volumes	242	2.41	0.93
Possesses the ability to respond rapidly to changes in the work Environment	242	2.47	0.97
<b>Average mean of Flexibility</b>		<b>2.29</b>	
<b>Time</b>			
The organization is committed to provide fast service to its customers	242	2.48	0.943
Committed to deliver orders to customers within the agreed delivery times	242	2.40	1.006
Suppliers are committed to supply orders by the agreed timetables	242	2.33	0.798
<b>Average mean of Time</b>		<b>2.40</b>	
<b>Quality</b>			
Committed to provide the service according to standard	242	2.35	.791
The organization chooses their suppliers on the basis of high-quality	242	2.45	.955
The organization is seeking to reduce the wasteful use or resources	242	2.44	.896
The company is working to reduce defective in output	242	2.91	1.22
<b>Average mean of Quality</b>		<b>2.53</b>	
<b>Average mean of Operational performance</b>		<b>2.41</b>	

*Source; Survey Results and Own Computation, 2019*

The flexibility practices were the other dimensions assessed by the study and the respondents have expressed their disagreement on amendment of the characteristics of the service according to customer's needs (M=2.14 and SD=0.93) and the existence of ability to respond to changes in service volumes (M=2.47and SD=0.97). The respondents were also disagreed on the existence of ability to respond rapidly to changes in the work environment and flexible suppliers choice who are flexible in responding to requests of the company (M=2.47and SD=0.97).

Time is the other dimensions under operational performance and focused on time elapsed that is required by the organizations to provide the product or and services to the customer according to agreed timetable. The respondents were disagreed on the commitment of the organizations to provide fast service to its customers and deliver orders to customers within the agreed delivery times with the score of (M=2.48 and SD=0.943). Finally, the respondents disagreed with a lower score on suppliers commitment to supply orders by the agreed timetables (M=2.33and SD=0.798).

The overall mean of the three dimensions is 2.41 with standard deviation, which mean there is a disagreement among WASH sector organizations on implementation of the operational performance variable. According to the respondents perception about the existence of dependent variable dimensions implementation and based on the mean of each dimension, the existence is ranked as the following: quality, flexibility and time (Speed). This result shows the operational performance dimensions are ignored or neglected by the sector organizations. Consequently, its impact on the lives of human being (Customer) are significant. Flexibility has also a lower value and comes in the second level, which means that all the organization haven't the ability to match the fluctuation in demand to the customer's requirements. At the end, time is ranked the in third level and this indicated that less emphasis was given for time dimensions.

The research study conducted by Biniyam (2016, p.45) was also showed that the respondents disagree on the dimensions of operational performance such as on the issue of on time delivery record to customer by the company with a lowest mean score of (M=1.92).

#### 4.5.1.5. SUMMARY OF DEPENDENT AND INDEPENDENT VARIABLES

Table 17: Summary of Dependent and independent variables

	N	Minimum	Maximum	Mean	SD
Internal Integration	242	1.30	3.90	2.3533	.49522
External Integration	242	1.20	3.40	2.2781	.53210
Information Integration	242	1.00	3.86	2.2220	.56516
Operational performance	242	1.55	3.27	2.4110	.39693

*Source; Survey Results and Own Computation, 2019*

Table 17 depict that the overall calculated mean scores of all the three supply chain integration and operational performance dimensions that have discussed above. The mean of all dependent and independent variable were below the average and the dimensions of internal integration scored the highest score and in contrary information integration tilts to the disagreed side more. It is evident that SCI has been considered as a means to reduce operations costs and supply chain inefficiencies, and improve the service level in an organization. Lack of integration between

members of a supply chain results in operational inefficiencies and hinders the performance of the supply chain (Lambert 2004, p.51).

#### 4.6. CORRELATION ANALYSIS

The bivariate Pearson’s coefficient of correlation is a measure of the degree of relationship between two variables and is denoted by  $r$ . Basically, a Pearson product-moment correlation attempts to draw a line of best fit through the data of two variables, and the Pearson correlation coefficient was conducted to examine the relationship between variables,  $r$ , indicates how far away all these data points are to this line of best fit (how well the data points fit this new model/line of best fit). The Pearson correlation coefficient,  $r$ , can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables (B.Burns & R.Burns 2008, p.69).

Interpretation of correlation coefficient ( $r$ ) size is as follows: if the correlation coefficient falls between 0.1 to 0.20, it is slight correlation or small; if it is between 0.20 to 0.40 is low correlation or weak relationship, if it lies between 0.40 to 0.70 moderate; if it falls along 0.70 to 0.90 high correlation or substantial relationship and if it is within 0.90 to 1.00 it is very high correlation or very strong correlation between variables (B.Burns & R.Burns 2008, p.69).

Table: 18. Pearson’s coefficient of correlation

		<b>Internal Integration</b>	<b>External Integration</b>	<b>Information Integration</b>	<b>Operational performance</b>
<b>Internal Integration</b>	Pearson Correlation	1	.620**	.428**	.755**
	Sig. (2-tailed)		.000	.000	.000
<b>External Integration</b>	Pearson Correlation		1	.656**	.633**
	Sig. (2-tailed)			.000	.000
<b>Information Integration</b>	Pearson Correlation			1	.521**
	Sig. (2-tailed)				.000
<b>Operational performance</b>	Pearson Correlation				1
	Sig. (2-tailed)				

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

Source; *Survey Results and Own Computation, 2019*

Hence, in the study Bivariate Pearson Coefficient ( $r$ ) was used to examine the relationship between the three supply chain integration dimensions and operational performance by using a two-tailed test of statistical significance at the level of 99% significance,  $P < 0.05$ . The correlation coefficients on the main diagonal are always 1.0, because each variable has a perfect positive linear relationship with itself.

The results of the analysis showed that there is moderate correlation between, External integration and internal integration with a value of 0.620. A research conducted by Huo (2012, p.75) also showed that internal integration improves external integration and that internal and external integration directly and indirectly enhance company's performance. Besides, the research conducted by Rai et al. (2006, p.64) indicated a strong correlation between internal and external integration with a Pearson coefficient of 0.75. Further, a number of recent studies such as Baofeng Huo, (2012), Das et al., (2006); and Koufteros et al., (2007) have found a positive relationship between internal and external integration.

The result showed that internal integration and information integration with a Pearson coefficient of value of 0.428. This result are also supported by other research conducted by Biniyam (2016, p.47) and the result showed a positive and significant association between information integration and internal integration ( $r = .356$ ,  $p < 0.01$ ). .

The results indicated that internal integration and operational performance with a Pearson coefficient of value of 0.755. A similar research conducted by Daniel (2015, p.67) on chemical industry in Ethiopia also showed that a magnitude of correlation coefficient 0.449 and this also indicates that there is the good positive relationship between internal integration and operational performance. The result is also supported by previous empirical studies (e.g. Das et al., 2006; Koufteros et al., 2007; Petesen et al. 2005) and the resource based view theory. Many literatures assured a great importance of supply chain integration for achieving operational performance (Frohlich and Westbrook 2001, p.32). However, some authors found no direct relationship between internal integration and operational performance (Koufteros et al. 2005 and Gimenez 2003). But large number of authors clearly identified a positive relationship between internal integration and operational performance and the positive effect of internal integration on cost,

quality, delivery, flexibility, innovation, process efficiency, time-based performance and logistics service performance (Koufteros et al. 2007 and Petesen et al. 2005).

The table above depict that external integration and information integration with a Pearson coefficient of value of 0. 656. It was found that information technology was supporting supplier integration and customer integration as well. Similarly, the research conducted by Biniyam (2016, p.47) found that, supplier integration has a positive relationship with information integration and statistically significant with a confidence of 95 percent.

In addition, it was found that external integration and operational performance with a value of 0. 633 and Similarly, Frohlich and Westbrook (2001, p.78) found that the highest levels of integration with both suppliers and customers had the highest correlation with high levels of an organization's performance.

The correlation analysis was also indicated the Pearson coefficient of operational performance and information integration with a value of 0.521. Froehlich and Westbrook (2001, p.79) also found that operational performance and information integration had a positive correlations.

#### **4.7. REGRESSION ANALYSIS**

Regression analysis is concerned with the distribution of the average value of one random variable as the other variables which need not be random are allowed to take different values. A linear regression model was applied.

##### **4.7.1. MULTI-COLLINEARITY**

Multicollinearity is the extent to which a particular construct can be explained by other constructs in the analysis (Hair et al. 2006, p.42). It occurs when the variables that appear distinct and unrelated actually measure the same thing.

Table: 19 Multi-Collinearity

	Collinearity Statistics	
	Tolerance	VIF
Internal Integration	.615	1.626
External Integration	.429	2.329
Information Integration	.569	1.757

a. Dependent Variable: Operational performance

*Source; Survey Results and Own Computation, 2019*

Table 19 indicated that the VIF values are less than 10 and the tolerance values are more than 0.2. This indicates that there is no multi-collinearity within the independent variables of the study.

#### 4.7.2. REGRESSION MODEL

The table below depict that when regressing the three independent variables of supply chain integrations dimensions against dependent variable operational performance.  $R^2$  shows the fitness of the model for multiple regressions and explains the variance of independent variable on dependent variable.

Table 20: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.793 <sup>a</sup>	.629	.625	.24316

a. Predictors: (Constant), Information Integration , Internal Integration, External Integration

*Source; Survey Results and Own Computation, 2019*

Table 21: ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	23.898	3	7.966	134.730	.000 <sup>b</sup>
Residual	14.072	238	.059		
Total	37.970	241			

a. Dependent Variable: Operational performance

b. Predictors: (Constant), Information Integration , Internal Integration, External Integration

*Source; Survey Results and Own Computation, 2019*

Since  $R^2$  is 62.9% then the independent variable can explain 62.9% of variance on dependent variable, since ( $R^2=62.9$ ,  $F=134.73$ ,  $Sig.=0.000$ ). Consequently, the null hypothesis is rejected and the alternative hypothesis is accepted, which states that Supply chain integration elements have direct impact on operational performance in WASH interventions Organizations, at ( $\alpha \leq 0.05$ ).

Table 22 Multiple Regression Analysis

Model	Unstandardized Coefficients		Standardize d Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.777	.083		9.304	.000
Internal Integration	.468	.040	.584	11.601	.000
External Integration	.122	.045	.164	2.716	.007
Information Integration	.115	.037	.164	3.126	.002

a. Dependent Variable: Operational performance

*Source; Survey Results and Own Computation, 2019*

The regression model specifically connects the average values of Y for various values of the X-variables. A regression equation is in no way a mathematical linking two variables but serves as a pointer to questions to basically, the regression analysis is used in two distinct ways; (1) as a means of considering data taking into account any other relevant variables by adjustment of the random variable; and (2) to generate mathematical forms to be used to predict the random variable from the other (independent) variables. The regression model was as follows:

$$Y = 0.777 + 0.115X_1 + 0.122X_2 + 0.468X_3$$

**Where: Y:** is the dependent variable (operation performance),

**X<sub>1</sub>:** is Information sharing

**X<sub>2</sub>:** is External integration

**X<sub>3</sub>** is internal integration

According to the regression equation established, taking all factors (Information integration, external integration and internal integration) constant at zero, operational performance in the

WASH sector will be 0.777 as a result of these independent variables. The data findings analyzed also showed that taking all other independent variables at zero, a unit increase in information integration will lead to a 0.115 increase in operational performance in WASH sector. Similarly, Hult et al. (2002, p.71) mentioned that IT and process innovation can contribute significantly to operational performance.

The regression analysis indicated that a unit increase in external integration will lead to a 0.122 increase in operational performance in the WASH sector. Likewise, Wheelen and Hunger (2012, p.81) indicated that supplier network resources have a significant impact on firm's performance. Besides, Alam, et al. (2014, p.64) concluded that logistic integration has mediating effect on operational performance. Bowersox et al. (2000, p.21) and Croxton et al. (2001, p.61) said that the use of external linkage performance metrics leads to the creation of end-customer value through integrating activities and communication with other member firms along the supply chain. Forslund and Jonsson, (2009, p.59) found that supplier relationship obstacles (lack of trust, different goals and priorities and lack of parallel communication structure) significantly hindered performance management process integration.

The result showed that a unit increase on internal integration will lead to a 0.468 increase in operational performance in the WASH sector. Previous studies have found that components of internal integration such as cross-functional collaboration and integrative inventory management systems have positive impacts on a firm's performance (O'Leary-Kelly and Flores 2002; Rosenzweig et al., 2003 and Vickery et al., 2003).

This therefore implies that all the three variables have a positive relationship with organization goal and contributing more to operational performance in the WASH sector, while level of information integration contributes the least to operational performance in the WASH sector.

#### **4.8. HYPOTHESIS TESTING**

Table 22 specified that there is a positive direct impact of external integration on operational performance, since (Beta= .122, t=2.716, sig. 0. .007,  $p < 0.05$ ), the null hypothesis is rejected and the alternative hypothesis is accepted, which indicates that the external integration has a significant effect on operational performance at ( $\alpha \leq 0.05$ ). Similarly, Peterson (2005) found that supplier

involvement has a positive impact in new product development and made significant improvements in financial returns as well). Supplier integration has a significant influence on operational performance of the sector which aligns with the finding of cheeyew et al. (2011, p.78) and Petersen et al. (2007, p.81).

The above table also depict that there is a positive direct effect of information integration on operational performance, since (Beta= 0.115, t=3.126, sig. 0. .002, p<0.05), the null hypothesis is rejected and the alternative hypothesis is accepted, which indicates that the information integration has a significant effect on operational performance at ( $\alpha \leq 0.05$ ). Furthermore, Frohlich and Westbrook (2002, p.69) reported that firms that embrace high levels of internet-based supply integration and demand integration experience the highest levels of performance.

The result also indicated a positive direct impact of internal integration on operational performance, since (Beta= 0.468, t=11.60, sig. 0.00, p<0.05), the null hypothesis is rejected and the alternative hypothesis is accepted, which indicates that the internal integration has a significant effect on operational performance at ( $\alpha \leq 0.05$ ). Previous studies conducted by Alexis Uwamahoro (2018, p.81) indicates that there is a direct relationship between internal integration and a firm' s operational performance and stated that there is a relationship between internal integration and performance of manufacturing firms in Rwanda

From the above table 22, the researcher concludes that all supply chain integration variables have an impact on operational performance at WASH sector organizations. The internal integration was holding the highest impact (Beta= 0.468, t=11.60, sig. 0.00, p<0.05), followed by external integration (Beta= .122, t=2.716, sig. 0. .007, p<0.05) and then information integration variable hold the least impact (Beta= 0.115, t=3.126, sig. 0. .002, p<0.05). The study clearly indicated the importance of internal, external and information integration with in the sector for the improvement of operational performance. Previous studies also found that supply chain integration (Internal, strategic, and external integration) was affecting the operational performance (Al-Shaar 2010, p.67). Besides Wong et al. (2011, p.78) found that there is a positive relationship between supply chain integration dimensions and operational performance dimensions as well .

Table 23. Overall outcome of the research hypothesis

<b>Hypothesis</b>	<b>Result</b>	<b>Reason</b>
<b>H<sub>0</sub></b> : External integration has no significant influence on the operational performance.	H <sub>0</sub> :Rejected	$\beta=0.122$ $p<0.05$
<b>H<sub>1</sub></b> : External integration has a significant influence on the operational performance	<b>H<sub>1</sub>:Accepted</b>	
<b>H<sub>0</sub></b> : Information integration has no significant influence on the operational performance	H <sub>0</sub> :Rejected	$\beta=0.115$ $p<0.05$
<b>H<sub>1</sub></b> :Information integration has a significant influence on the operational performance	<b>H<sub>1</sub>:Accepted</b>	
<b>H<sub>0</sub></b> : Internal integration has no significant influence on the operational performance	H <sub>0</sub> :Rejected	$\beta=0.468$ $p<0.05$
<b>H<sub>1</sub></b> :Internal integration has a significant influence on the operational performance	<b>H<sub>1</sub>:Accepted</b>	
<b>H<sub>0</sub></b> : Internal integration, External integration and information integration are negatively related to one another.	H <sub>0</sub> :Rejected	$r >0.4$
<b>H<sub>1</sub></b> : Internal integration, External integration and information integration are positively related to one another.	<b>H<sub>1</sub>:Accepted</b>	

*Source: Survey Results and Own Computation, 2019*

## **CHAPTER FIVE: SUMMARY,**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 INTRODUCTION**

This chapter presents the summary of the data findings on effects of supply integration on operational performance of WASH sector in Ethiopia, besides conclusion and recommendation are drawn there to. The chapter is therefore structured into summary of findings, conclusions, recommendations, limitation of the study and areas for further research.

#### **5.2 SUMMARY OF FINDINGS**

Ethiopian National WASH Program undertaken by rural and urban communities throughout Ethiopia and supported and facilitated by governmental agencies, civil society organizations, the private sector and international donors. The objectives of this study were to determine supply chain integration approaches adopted by the WASH sector organizations in Ethiopia and to determine the effect of the supply chain integration dimensions on operational performance. The study also clarified the relationship that exists between the operational performance and supply chain integration dimensions and also along the dimensions of supply chain integration with the intent of knowing the strength of the relationship of the dimensions in this particular case. In order to achieve these objectives, secondary and primary data were collected from the employees of the sector at different organizations located at different levels and processed in both quantitative and qualitative approach of descriptive approach and also used regression analysis.

##### **5.2.1 Internal Integration**

The analysis result depicts that, the first and highest level of integration is related to internal integration with a mean score of 2.35 but the result are under the category of disagreement. But internal integration has a significant contributions towards operational performance because it's impossible to achieve either supplier integration or customer integration without internal integration.

The result showed that there is moderate correlation between, External integration and internal integration with a value of 0.620 and the result was supported by prior research conducted by Huo

(2012, p.75) and Rai et al. (2006, p.64). The result also showed that internal integration and information integration correlate with a Pearson coefficient of value of 0.428. Similarly, the findings pointed out that internal integration and operational performance associate with a Pearson coefficient of value of 0.755. The result is also supported by previous empirical studies (e.g. Das et al., 2006; Koufteros et al., 2007 and Petesen et al. 2005), and the resource based view theory. The result also indicated a positive direct impact of internal integration on operational performance, since (Beta= 0.468, t=11.60, sig. 0.00, p<0.05), the null hypothesis is rejected and the alternative hypothesis is accepted, which indicates that the internal integration has a significant effect on operational performance at ( $\alpha \leq 0.05$ ).

### **5.2.2. External Integration**

The analysis result depicts that the mean of mean of external integration was 2.27 and it's the highest result next to internal integration but the result was below the average value and in the category of disagreement. Consequently, the results clearly showed that, there is ineffective customer and supplier integration with in the sector. The results showed that there is moderate correlation between, External integration and internal integration with a value of 0.620 and a positive relationship between internal and external integration. The findings also depict that external integration and information integration with a Pearson coefficient of value of 0.656 and supplier integration has a positive relationship with information integration and it is statistically significant with a confidence of 95 percent. In addition, it was found that external integration and operational performance correlate with a value of 0.633 and both suppliers and customers had the highest correlation with high levels of an operational performance.

The regression analysis indicated a positive direct impact of external integration on operational performance, since (Beta= 0.122, t=2.716, sig. 0.007, p<0.05), the null hypothesis is rejected and the alternative hypothesis is accepted, which indicates that the external integration has a significant effect on operational performance at ( $\alpha \leq 0.05$ ).

### **5.2.2. Information Integration**

The result indicated that information integration scored the lowest result (M=2.2.2 and SD= 0.565) compared to external and internal integration and it's below the average. Which really indicates

information integration of the sector are ineffective. The result revealed that internal integration and information integration correlate with a Pearson coefficient of value of 0.428. Besides, external integration and information integration associate with a Pearson coefficient of value of 0.656. It was found that information technology was supporting supplier integration and customer integration as well. The result was also depicted that there is a positive direct effect of information integration on operational performance, since (Beta= 0.115, t=3.126, sig. 0.002, p<0.05), the null hypothesis is rejected and the alternative hypothesis is accepted, which indicates that the information integration has a significant effect on operational performance at ( $\alpha \leq 0.05$ ).

The study showed that there are moderate inter-relationships and interactions among the three components of supply chain integration and between them and operational performance. High correlation between external integration and information integration with a value of  $r=0.686$ . Finally, the results showed that the respondents believed that there is a moderate relationship between supply chain integration dimensions and operational performance. These results are going with line with the most of previous studies, such as Wong et al. (2011) who showed that there is a positive relationship between supply chain integration dimensions and operational performance dimensions as well. Jin et al. (2012) also revealed that the supply integration dimensions are positively related to operational performance and firm performance.

The study depicted that the internal integration was having the highest effect on OP, followed by external integration and finally information integration. The research studies conducted by Zhao, et al. (2013) showed that supplier, internal, and customer integration affects the competitive performance and related to the firm's performance as well. Lack of integration between members of supply chain results in operational inefficiencies and hinders the performance of the supply chain.

The study result shows that all the supply chain integration dimensions have an impact on operational performance at WASH sector in Ethiopia. Different prior research studies also confirmed this result such as Hamad (2013) and Huo (2012) found that there was a significant impact of supply chain integration on business and organizational performance as well. Xu, et al. (2014) showed that top management support and information technology are two vital enablers of supply chain integration. Besides, Huo (2012) showed that internal integration improves external

integration and that internal and external integration directly and indirectly enhance company's performance and that goes directly with the study result about the most important role of internal integration. Thus, this research reinforces the importance of supply chain integration practices in improving operational performance.

### **5.3. CONCLUSIONS:**

The study sought to find out the effect of supply chain integration practices on operational performance of WASH sector in Ethiopia. Based on the findings in relation to specific objective, the study concluded that: Correspondingly, the issue of external integration and information integration with in the sector were discouraging and below the expectations level.

- The sector organizations are implementing internal integration ineffectively and only an encouraging results obtained on two internal integration practices such as; the participation of organization employees in solving the problems and internal conflicts settlement and the involvement of departments in sharing production processes but a little emphasis were provided on unifying the culture of the organizations, involvement in strategic plan and interactive working. The findings indicated that internal integration has a moderate relationship with external and information integration and significantly influences organization operational performance in WASH sector. It was therefore concluded that to improve organization operational performance in respect to quality, flexibility and time there is need to enhance the internal integration in respect to type of skills, the level of knowledge, the mode of communication and the problem solving skills.
- The dimensions of information integrations were rated below the average mean value of 2.5 and therefore it gives a clue for the poor existence of information integration in the sector. The finding of the study also revealed that information integration significantly influences organization operational performance in WASH sector. It was therefore concluded that to improve organization performance in terms of quality, flexibility and time, there is need to enhance the information integration practice in respect to timely sharing, accuracy of information, mode of sharing, level of collaboration and the level of information utilization.
- The WASH sector organizations are implementing external integration ineffectively and the finding of the study also revealed that external integration significantly influences

organization operational performance in WASH sector. It was therefore concluded that to improve organization performance in terms of quality, flexibility and time, there is need to enhance the external integration practice in respect to customer follow up, stable procurement, computerized ordering system, frequent contacts, establishment of quick ordering system with major customer.

- The three dimensions of supply chain integration are positively relate with each other and interlinked significantly with operational performance.
- The regression analysis indicated that supply chain integration is necessary and inevitably for all the processes and activities from supplier to customer and vice versa.
- Results indicated that the WASH sector organizations at the source and distribution level are well organized systems since supply chain department are available at each organization and they are aware about the concept of supply chain integration. But in contrary the issue is more worsen at the downstream of the chain.

#### **5.4. RECOMMENDATION:**

Based on the study research findings, the researcher recommends the following:

- In order to improve operational performance in Water and Sanitation organizations in Ethiopia, information sharing, coordination of supply chain operations and user customer integration need to be improved specifically, the problems encountered in the supply chain integration as well as the level of information integration. Supply chain integration also needs to be aligned with other channel members across WASH sector. The sector organizations should make sure that all the respective bodies have full and clear information on time to enhance easy decision making, using the latest model of software and hardware available in the market, training of staff, adopt real time solutions in ICT and increase external linkages with customers
- External integration also needs to be improved through increasing information network, strategic partnership, computerized system, level of collaboration and the level of support among the stakeholders. Measures to enhance the level of customer relationship management, the level strategic partnership and the level of customization of customer

needs as well and segmentation of service are necessary to ensure user customer integration.

- Regulations on policy and practice governing the adoption of supply chain integration in business should be introduced in a bid to improve the firm efficiency as well as coordination of effort to build long term relationships with stakeholders. In this regard, the government could introduce supply chain software in all government institutions so as to ease the procurement cycle and to enhance service delivery time.
- It is advisable to pay more attention to the strategic relationship with suppliers through enhancing joint programs and activities to increase the coherence and harmony.
- The integration of internal function within the organization is a primary activity in any organization. The sector organizations should have to give a critical emphasis on alignment among departments through better data integration & creating continuous interdepartmental contact among internal functions. Besides, the sector organizations should have to equip itself with modern technologies like enterprise resource planning systems which benefits the company through better integration. It is recommended to pay greater attention to the internal integration through the involvement of various departments in formulating the strategic plans.

The study recommends the following areas for further study;

- This study is dedicated to the WASH sector, so it is advisable to study the supply chain integration on other sector organizations.
- It is recommended that to restudying the same topic on the same sector over a period of time to evaluate the progress resulting from the application of supply chain integration.
- It is advised to conduct similar studies by categorizing in to different livelihood
- Moreover, the framework of this study consisted of three constructs, each of which included several significant dimensions that were deemed capable of improving operational performance. In future studies in this field, additional factors related to operational performance could be tested, in order to assess their significance.

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## Appendix 1: Thesis Questionnaire

Online Questionnaire link

[https://docs.google.com/forms/d/1VJmcB6PUKBaesXddDbEhm1jN9Ct\\_yz\\_y5fpKx9Q155U/edit](https://docs.google.com/forms/d/1VJmcB6PUKBaesXddDbEhm1jN9Ct_yz_y5fpKx9Q155U/edit)

### ADDIS ABABA UNIVERSITY

### SCHOOL OF COMMERCE

#### Dear Participants,

I would like to extend my deep appreciation for your time in responding to the research questions provided below. I'm a postgraduate student at Addis Ababa university school of commerce under the department of logistics and supply chain management. The title of my thesis is: **THE EFFECT OF SUPPLY CHAIN INTEGRATION ON OPERATIONAL PERFORMANCE IN ETHIOPIAN WASH SECTOR** . We ask your kindly cooperation in answering the questions as truthfully as possible and your response will be highly confidential. This questionnaire will only be used for a student thesis work purposes only. Your participation in this survey is completely voluntary.

#### SECTION A: Demographic information

1. Gender:             Male                     Female
2. Age (years):      25 – 35       Between 35 – 45      Between 45 – 55      above 55
3. Education:      Diploma or less      Bachelor      Master                    Doctorate
4. Position:         High level                    Middle level       Supervisors
5. Division:         Supply chain mgt      R&D       Marketing       Management      Others
6. Years of experience:  Less or equal 5      Between 5 – 10       Between 10 – 15      Above 15

## SECTION B: THE EFFECT OF SUPPLY CHAIN INTEGRATION ON OPERATIONAL PERFORMANCE IN ETHIOPIAN WASH SECTOR

The following 38 items tap into supply chain and its effect on operational performance. Please, answer these questions based on actual and current situation and not on beliefs.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree] based on how you feel about the statement.

	Please indicate the extent of integration of your enterprise. (1=strongly disagree;2=disagree;3=neutral ;4=agree;5=strongly agree)	1	2	3	4	5
<b>Internal Integration</b>						
1	The organization is constantly striving to unify their culture with stakeholders ( mission and vision)					
2	The organization involves different department during the preparation of strategic plan					
3	The organization uses MRP system ( to harmonize forecasting, procurement, production, and sales)					
4	There is an internal network for the exchange of information between the employees					
5	The organization holds training program to increase the employees competencies					
6	The organization is keen to hold regular meetings with departments managers to coordinate the work					
7	The organization holds extensive meetings to increase the homogeneity among employees					
8	The organization allow the employees to participate in solving the problems and internal conflicts and settlement					
9	The organization departments share in the development of production processes					
10	There are multiple teams working with each other interactively					
<b>External Integration</b>						
11	There is strong information exchange with supply chain partners through information network.					
12	There is quick ordering system with major supply chain partners					
13	There is strong strategic partnership with major supply chain partners					
14	There is stable procurement through network with major supplier					
15	There is linkage with customer through information network					
16	Use of effective communication with major customer					
17	Computerized system for major customer ordering					
18	Establishment of quick ordering system with major customer					
19	High frequency of period contacts with major supply chain partners					
20	There is follow up with major customer for feedback					
<b>Information integration</b>						

21	There is high level of free sharing of accurate information across members of supply chain					
22	Timely sharing of information across the members of supply chain					
23	Strong coordination in the flow of information among partners					
24	There is strong utilization of information among supply chain partners					
25	There is specialized Information sharing department in the company					
26	Common Computerized data base system					
27	There is strong information sharing strategy					
	<b>Operation performance</b>					
28	The organization is to amend the characteristics of the service according to customer's needs (without conflicting with the regulations and instructions)					
29	The organization has the ability to respond to changes in service volumes					
30	The organization possesses the ability to respond rapidly to changes in the work Environment ( internal and external changes)					
31	The organization chooses suppliers who are flexible in responding to requests of the company when needed					
32	The organization is committed to provide fast service to its customers					
33	The organization is committed to deliver orders to customers within the agreed delivery times					
34	Suppliers are committed to supply orders by the agreed timetables					
35	The organization is committed to provide the service according to local and international standard like GPM					
36	The organization chooses their suppliers on the basis of high-quality					
37	The organization is seeking to reduce the wasteful use or resources (electricity, water, raw materials)					
38	The company is working to reduce defective in output					

## APPENDIX 2: LIST OF SAMPLE ORGANIZATION

Supply chain level	Type of organization	Name of the organization			Number of Respondents
Source	Donor	African Development Bank World Bank WHO DFID UNICEF			10
	Government	Ministry of finance			2
Distributor	Government	Ministry of health Ministry of water Resource			6
	NGO	CARE Ethiopia ICRC OXFAM GB WATER AID CRDA SNV Netherland			12
Retailers	Regional	Oromiya Tigray Afar Gambela Harari Diredawa Addis Ababa			6
	Afar districts	Awash Fentale-Wereda	Dawe-Wereda	Awra-Wereda	13
		Gewane-Wereda	Dalifage-Wereda	Ewa-Wereda	
		Dulacha-Wereda	Hadele Ele-Wereda	Teru-Wereda	
		Bure Mudayitu-Wereda	Yalo-Wereda		
		Argoba Liyu-Wereda	Amibara-Wereda		
	Tigrai districts	Mereb Lehe-Wereda	Laelay Maychew-Wereda	Alaje-Wereda	21
		Ahiferom-Wereda	Tahtay Maychew-Wered	EndamehoniWereda	
		Were Lehe-Wereda	Nader Adet-Wereda	Raya Azebo-Wereda	
		Adwa-Wereda	Kola Temben-Wereda	Alamata-Wereda	
		Seharti Samre-Wereda	Dega Temben-Wereda	Ofla-Wereda	
		Enderta-Wereda	Tanqua Abergele-Were	Maychew -Wereda	
		Hintalo Wajirat-Wereda	Abi Adi /Town/-Wereda	Korem / Wereda	
	Oromiya Districts	Ginde Beret-Wereda	Nono-Wereda	Adama-Wereda	127
		Jeldu-Wereda	Tikur Enchini-Wereda	Lome-Wereda	
		Ambo Zuria-Wereda	Dendi-Wereda	Gimbichu-Wereda	
		Midakegn-Wereda	Ejere-Wereda	Ada A-Wereda	
Cheliya-Wereda		Wolmera-Wereda	Dugda-Wereda		
Bako Tibe-Wereda		Ada Berga-Wereda	Adami Tulu Jido		
Dano-Wereda		Meta Robi-Wereda	Bishoftu/Town/-Wereda		
Mieso-Wereda		Ambo/Town/-Wereda	Bora-Wereda		
Doba-Wereda		Abuna Gindeberet-Were	Liben-Wereda		
Tulo-Wereda		Toke Kutayu-Wereda	Akaki-Wereda		
Mesela-Wereda		Jibat-Wereda	Ziway/Town/-Wereda		
Chiro /Town/-Wereda		Elfata-Wereda	Arsi-Zone		
Anchar-Wereda		Holeta Town-Wereda	Bale Gasegar-Wereda		
Guba Koricha-Wereda		North Shewa-Zone	Merti-Wereda		
Habro-Wereda		Were Jarso-Wereda	Aseko-Wereda		
Daro Lebu-Wereda	Dera-Wereda	Gololcha-Wewreda			

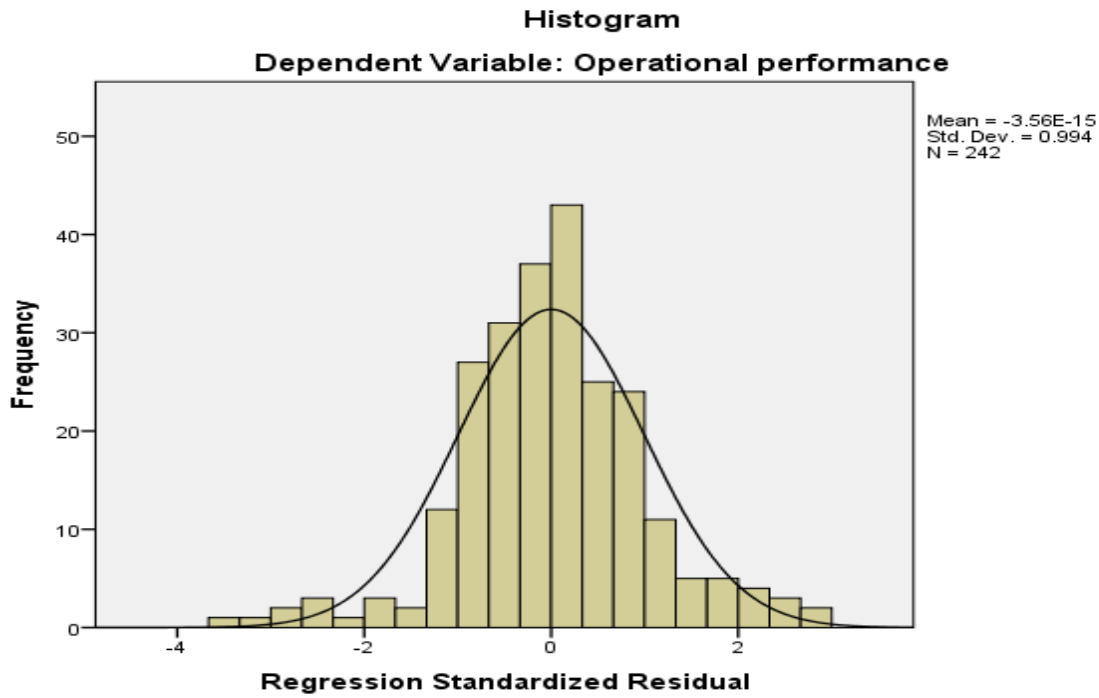
		Boke-Wereda	Hidabu Abote-Wereda	Jeju-Wereda	
		Kuni-Wereda	Kuyu-Wereda	Dodota-Wereda	
		Gemches-Wereda	Degem-Wereda	Ziway Dugda-Wereda	
		Chiro Zuria-Wereda	Girar Jarso-Wereda	Hitosa-Wereda	
		Bedesa/Town/-Wereda	Debere Libanos-Wereda	Sude-Wereda	
		East Hararge-Zone	Wuchale-Wereda	Chole-Wereda	
		Zone Total	Abichuna Gnaa-Wereda	Amigna-Wereda	
		Kombolcha-Wereda	Kimbibit-Wereda	Seru-Wereda	
		Jarso-Wereda	Bereh-Wereda	Robe-Wereda	
		Gursum-Wereda	Sululta-Wereda	Tena-Wereda	
		Babile-Wereda	Fiche/Town/-Wereda	Shirka-Wereda	
		Fedis-Wereda	Yaya Gulele-Wereda	Digluna Tijo-Wereda	
		Haro Maya-Wereda	Jida-Wereda	Tiyo-Wereda	
		Kurfa Chele-Wereda	Mulo-Wereda	Munesa-Wereda	
		Kersa-Wereda	Aleltu-Wereda	Limuna Bilbilo-Wereda	
		Meta-Wereda	Sendafa/Town/-Wereda	Guna-Wereda	
		Goro Gutu-Wereda	East Shewa-Zone	Sire-Wereda	
		Deder-Wereda	Zone Total	Lude Hitosa-Wereda	
		Melka Belo-Wereda	Fentale-Wereda	Deksis-Wereda	
		Bedeno-Wereda	Boset-Wereda	Enkelo Wabe - Wereda	
		Midga Tola-Wereda	Horo-Wereda	Moyale-Wereda	
		Chinaksan-Wereda	Shambu/Town/-Wereda	Dire-Wereda	
		Girawa-Wereda	Guduru-Wereda	Teletele-Wereda	
		Gola Oda-Wereda	Hababo Guduru-Wereda	Abaya-Wereda	
		Bule Hora-Wereda	Abey Chomen-Wereda	Dugida Dawa-Wereda	
		Yabelo-Wereda	Jima Genete-Wereda	Miyu-Wereda	
		Arero-Wereda	Jima Rare-Wereda	Amuru-Wereda	
		Jardega Jarte Wereda			
	Addis Ababa	Akaki Kaliti-Sub City	Gulele-Sub City	Kolfe Keraniyo-Sub City	4
		Nefas Silk-Lafto-Sub City			
	Gambela districts	Abobo Wereda	Jor Wereda	Gambella Town Wereda	
		Gog Wereda	Dima Wereda		
	Private companies	Afro Consulting	Addis Geo system Co. Ltd	WARYT international PLC	23
		Akakon Consultancy	East Africa drillers PLC	TELTAF PLC	
		AWS consulting	RAEY construction		
		Breakthrough consultancy	Royal Bore hole Drillers PLC	Abulkhasse PLC	
		CARE consultancy	SABA engineering PLC	TECHNOMAX engineering PLC	
		DH consult	TECHTRA Engineering PLC	Bruh Tesfa water technology PLC	
		Dynamic Consult	TANA water well drill	Emu General importers PLC	
		SAICA Ethiopia trading PLC	YASRAT Engineering PLC		
	<b>Total</b>				<b>215</b>

### Appendix 3: Skewness and Kurtosis value

	N	Mean	SD	Skewness		Kurtosis		Fisher skewness Coefficient	Fisher Kurtosis Coefficient
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error		
II1	242	2.45	1.159	0.417	0.156	-0.657	0.312	0.359793	-0.56687
II2	242	2.4	0.845	0.349	0.156	-0.046	0.312	0.413018	-0.05444
II3	242	2.42	0.895	0.501	0.156	0.053	0.312	0.559777	0.059218
II4	242	2.43	0.877	0.57	0.156	0.347	0.312	0.649943	0.395667
II5	242	2.42	0.983	0.325	0.156	-0.262	0.312	0.330621	-0.26653
II6	242	2.45	0.981	0.418	0.156	-0.144	0.312	0.426096	-0.14679
II7	242	2.33	0.849	0.706	0.156	0.858	0.312	0.831567	1.010601
II8	242	2.56	0.937	0.532	0.156	0.042	0.312	0.567769	0.044824
II9	242	2.61	1.126	0.52	0.156	-0.538	0.312	0.461812	-0.4778
II10	242	2.39	1.07	0.97	0.156	0.365	0.312	0.906542	0.341121
EI1	242	2.21	1.356	0.753	0.156	-0.808	0.312	0.55531	-0.59587
EI2	242	2.41	0.948	0.885	0.156	0.156	0.312	0.933544	0.164557
EI3	242	2.39	1.022	0.705	0.156	-0.199	0.312	0.689824	-0.19472
EI4	242	2.49	1.067	0.383	0.156	-0.514	0.312	0.35895	-0.48172
EI5	242	2.49	1.079	0.292	0.156	-0.722	0.312	0.270621	-0.66914
EI6	242	2.58	1.087	0.108	0.156	-0.682	0.312	0.099356	-0.62741
EI7	242	2.3	0.93	0.59	0.156	0.337	0.312	0.634409	0.362366
EI8	242	2.5	1.011	0.473	0.156	-0.305	0.312	0.467854	-0.30168
EI9	242	2.21	0.946	0.881	0.156	0.654	0.312	0.93129	0.691332
EI10	242	2.02	0.797	0.907	0.156	1.397	0.312	1.138018	1.752823
III1	242	2.44	1.073	0.315	0.156	-0.649	0.312	0.293569	-0.60485
III2	242	2.28	0.898	0.672	0.156	0.682	0.312	0.74833	0.759465
III3	242	2.17	0.893	0.436	0.156	-0.174	0.312	0.488242	-0.19485
III4	242	2.28	0.926	0.308	0.156	-0.441	0.312	0.332613	-0.47624
III5	242	2.14	0.962	0.56	0.156	-0.229	0.312	0.582121	-0.23805
III6	242	2.17	1.065	0.663	0.156	-0.22	0.312	0.622535	-0.20657
III7	242	2.09	0.771	0.453	0.156	0.305	0.312	0.587549	0.39559
OP1	242	2.14	0.939	0.361	0.156	-0.684	0.312	0.384452	-0.72843
OP2	242	2.41	0.939	0.541	0.156	-0.046	0.312	0.576145	-0.04899
OP3	242	2.47	0.977	0.349	0.156	-0.274	0.312	0.357216	-0.28045
OP4	242	2.15	0.758	0.722	0.156	1.238	0.312	0.952507	1.633245
OP5	242	2.48	0.943	0.356	0.156	-0.336	0.312	0.377519	-0.35631
OP6	242	2.4	1.006	0.52	0.156	-0.094	0.312	0.516899	-0.09344
OP7	242	2.33	0.798	0.024	0.156	-0.518	0.312	0.030075	-0.64912
OP8	242	2.35	0.791	0.564	0.156	0.466	0.312	0.713021	0.589128
OP9	242	2.45	0.955	0.805	0.156	0.586	0.312	0.842932	0.613613

OP10	242	2.44	0.896	0.506	0.156	0.166	0.312	0.564732	0.185268
OP11	242	2.91	1.228	0.18	0.156	-1.007	0.312	0.14658	-0.82003

Annex 4: Normal probability plot



Annex 5: Mahalanobis distance by cases

