



THE EFFECT OF SUPPLY CHAIN DIGITALIZATION ON INTERNAL SUPPLY CHAIN INTEGRATION OF CEMENT MANUFACTURING AND DISTRIBUTION FIRMS IN GHANA

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ABSTRACT

Purpose: The purpose of this study is to assess the effect of supply chain (SC) digitalization on the internal supply chain integration of firms with a focus on cement manufacturing and distribution firms in Ghana.

Design/Methodology/Approach: The study adopted the cross-sectional quantitative research design from 114 key players and administrative staff of cement manufacturers and distributors in Ghana using a purposive sampling technique and the use of a questionnaire for gathering the data.

Findings: The findings revealed a positive, moderate relationship between the drivers of SC digitization and internal SC integration; a negative, moderate relationship between the challenges of SC digitization and internal SC integration; a positive, strong correlation between the extent of SC digitization and internal SC integration. All the relationships were significant. Also, the drivers and inhibitors of SC digitisation revealed both positive and negative associations with the extent of SC integration.

Research Limitation: The selected firms are not fully representing the entire population of cement manufacturing and distribution firms in Ghana, which impact on the external validity of the findings.

Practical Implications: The results will help increase the performance of cement production firms and improve its SC integration. Firms invest resources in the digitalization of its SC to further improve internal SC integration.

Originality/Value: The study examines the relationship between supply chain digitalization and internal supply chain integration. While digitalization has been widely studied in supply chain management, the specific focus on how it impacts internal supply chain integration in the context of cement manufacturing and distribution firms in Ghana is relatively novel.

Keywords: *Digitalization. distributors. firms. integration. supply chain*



INTRODUCTION

Due to global disruptions, technology advancements, the complexity of customer demands and industry trends, the modern corporate climate requires more agile and adaptable supply chains. Digitalizing the conventional supply chain (SC) is one key differentiator for boosting (SC) management's flexibility and visibility. This is referred to as "digital transformation" (Aamer et al., 2021). According to a survey by McKinsey & Co., companies have already begun investing in digital transformation at a faster pace than they did before COVID-19 outbreaks. This is the truth despite the fact that the COVID-19 epidemic is still ongoing (LaBerge et al., 2020). Emerging technologies; cloud computing, artificial intelligence (AI), the Internet of Things (IoT), and mobile technology have had an impact on the digitalization of supply chains. This is achieved by providing factual data and openness, which enables exact forecasting of upcoming events and increases the adaptability, sturdiness, and resilience of the supply chain (Bienhaus & Haddud, 2018; Gunasekaran, Subramanian, & Papadopoulos, 2017).

Internal integration is achieved via the use of cross-functional teams, which can bring together a diverse group of professionals to exchange information and make choices about the development of products, and operations jointly and concurrently (Alexander, Anin, & Sarpong, 2016). Internal integration is the process of drawing in distinct functional aspects of the organisation to form a cohesive unit via inter-functional interaction, collaboration, coordination, communication, and cooperation (Flynn et al., 2010; Zhao et al., 2010).

Good supply chain management requires internal integration. In addition, organisations with a smaller extent of execution will exhibit a lower level of external integration, whilst those that have a high level of implementation will experience the highest levels of external integration. Before attempting to generate a greater level of external integration, firms must typically attain a decent amount of internal integration, by conventional wisdom.

It is upon these premises that this paper aims to evaluate the impact of SC digitalization on the internal SC integration of manufacturing enterprises, with a particular emphasis on cement manufacturers and distributors in Ghana. The research aims to: evaluate the critical drivers for a successful digital implementation at the firms, assess the impact of digitalization of the SC on the internal integration, and determine their obstacles to digital supply chain adoption.

LITERATURE REVIEW

Scholars (Frederico et al., 2019; Sahara et al., 2019) noted that despite the increasing attention on the digitalization of the supply chain, the discussion remains in its infancy, necessitating additional research into the critical success factors of SC digitalization. While researchers such as Hawes (2016) and Büyükoçkan and Gocer (2018) have extolled the advantages of digitalizing the supply chain, others such as Aamer et al. (2021) have outlined the obstacles that digitalizing the supply chain presents.



According to Büyükoçkan and Gocer (2018), advanced characteristics of SC digitization such as real-time capabilities, the use of information and communication technology (ICT) systems via vertical and horizontal integration, and interoperability are challenged with commercial hurdles. According to Erol et al. (2016), the digitization of the supply chain has improved company performance and increased the economic viability of firms. Lack of agreement on the drivers of SC digitization requires a comprehensive understanding of the notion.

Studies (Mielli and Bulanda, 2019; Radziwill, 2020; Saldanha, 2019) show that a substantial majority of digital transformation efforts in organisations fail during the execution and upgrading stages, with as much as 70% failing in certain polls. It is crucial to comprehend why certain digital transformation efforts failed during the transformation from the early stages to the comprehensive implementation and scaling phase of projects.

Leaders in charge of supply chain management (SCM) confront substantial obstacles when it comes to integrating supply chain-specific objectives with the entire corporate business plan. Hence, total synchronization is seldom accomplished in reality. The majority of SC integration difficulties stem from uncertainty or a failure to manage the many activities and people involved. Simultaneously, clients have become more intelligent, and demand greater quality, better service, and cheaper prices (Sweeney, 2011). Integration of supply chains has proven to be a tough objective for many businesses in satisfying these customers. According to studies, unlike other activities a business participates in, there is neither a blueprint for integration nor an aggregate measure of whole supply chain performance against which a firm's performance can be compared to that of its competitors. Also, the term "supply chain integration" may apply to several diverse concepts where there are insufficient resources available to address them.

In their ASEAN study, authors reiterated this stance, noting a scarcity of empirical data on the degree to which supply chain digitalization is implemented. Moreover, Büyükoçkan and Gocer (2018) argued that few studies have been conducted on the role of digitalization in supply chain management within the existing literature, and suggested the need for further research into the impact of SC digitalization on supply chain integration. Therefore this research aims to fill a gap in the existing literature by evaluating the impact of SC digitization on the internal integration of cement manufacturers and distributors in Ghana.

The conceptual review of the research examined the terminologies and their relationship to the study. Digitalization of the supply chain: Legner et al. (2017) stated that digitalization refers to the process of converting analogue signals to digital models, as well as the impact these technologies have on acceptance and functioning. Due to the fact that digitization delivers more benefits to a number of enterprises, it has lately attracted a substantial level of attention from businesses throughout the world. The integration of digital technology across the supply chain enables the use of digital tools for organising and conducting commercial transactions, communications, and other operations (Sanders & Swink, 2020). Examples of SC digital



technologies include big data analytics (BDA), advanced robotics, 3D printing, sensor-enabled advanced manufacturing solutions, decentralised agent-driven control, augmented reality, advanced tracking and tracing technologies, and other digital technologies (Ivanov et al., 2018).

Cyber-physical systems (CPS)

CPS, according to Hofmann and Rüsç (2017), are digital systems that govern physical processes. The integration of interface tools and devices like sensors, actuators, and communication devices facilitates the execution of these activities (Jansen, 2016). Integrated systems such as MES (Manufacturing Execution System), ERP (Enterprise Resource Planning), and CRM (Customer Relationship Management) are examples of CPS (Kang et al., 2016). CPS is defined similarly to the so-called "Digital Thread," which "enables the collection, transmission, and exchange of data and information across systems throughout the product lifecycle rapidly, reliably, and securely." Some notions of industrial digitalization correspond to the definitions of CPS and "Digital Thread".

Internet of Things (IoT)

IoT refers to an internet-based technical infrastructure that supports the trade of products and services within a worldwide supply chain network. This is a relatively new paradigm of Industry 4.0 . IoT products provide new opportunities in terms of usage, cross-functionality, and greatly increased dependability, amongst many others. However, IoT also poses major risks to the privacy of a company's stakeholders and a threat to the firm's own security . Dealing with the threats presented by digitalization has become a major concern in both academic and industry of services: Smart factory: According to Hofmann and Rüsç (2017), the Smart Factory is based on the concept of a decentralised production system. According to Kagermann, Wahlster, and Helbig, "humans, machines, and resources are connected as naturally as in a social network" in this system (2013). The CPS, IoT, and the Internet of Services are combined to build the Smart Factory's base and provide its power. The increased complexity of a business's production processes helps the firm regain its controllability and profitability, which in turn helps secure the company's sustained success over the long term, and a fully integrated smart factory is capable of realising a substantial portion of its full potential.

Supply chain integration

External integration and internal integration are the two primary forms of supply chain integration. Internal integration refers to the divisions and operations inside a factory that are acknowledged as part of an integrated process. External integration, on the other hand, acknowledges the necessity to establish tight, interactive relationships with a company's logistical operations with those of its customers and suppliers beyond its geographical borders (Flynn et al., 2010). Internal integration in logistics and the supply chain refers to the collaboration, coordination, and integration of logistics with other functional areas. Recent



years have witnessed a rise in the amount of study that decisively indicate that internal integration is a precondition for outward integration. Studies have only focused on internal integration while disregarding outward integration demonstrates the relevance of internal integration. Enterprises with the greatest degrees of internal integration between logistics, manufacturing, and marketing were also able to attain the highest levels of external integration. This was shown by the organisations' ability to attain the greatest degrees of external integration.

According to the results of a research done by Germain and Iyer (2006) on more than 2,000 members of the Council of Supply Chain Management Professionals (CSCMP), external integration would only affect the performance of a firm if there is no internal integration occurring. Therefore, both theoretical reasoning and practical data support internal integration as the facilitator for external customer and supplier integration, indicating that pursuing internal integration is a successful approach for boosting external integration. This is due to the fact that both conceptual reasoning and practical data support internal integration as the enabling factor for outward customer and supplier integration (Errassaf et al., 2019). In other words, the integration of supply chains cannot be successful if there is not a substantial level of internal integration to IoT, web-based services offer new potential for enterprises and individual customers, all of which are easily accessible through online technologies (Hofmann & Rüscher, 2017). The word "service" refers to "a business transaction in which one party offers temporary access to the resources of another party in exchange for the performance of a defined function and the receipt of a connected reward." Human labour and skills, technological systems, information, consumables, land, and other forms of resources might be transferred in this type of transaction. According to Hofmann and Rüscher (2017), Web-based services features serve as the basis for concepts such as Service-Oriented Architecture (SOA), Software as a Service (SaaS), and Business Process Outsourcing (BPO).nd business circles (Jansen, 2016).

Theories Underpinning the Study

Resource-Based View (RBV)

Strategic management's overall objective is to strengthen a company's market position by maximising the value of its most valuable resources (Richard, 2000). According to the definition supplied by Boyd et al. (2010) RBV is coordinating the factors that influence customer satisfaction with the company's market standing. One of the basic ideas of the theory is that better corporate performance is built on firm-specific resources and competencies that cannot be readily copied by rivals. (Nwankpa and Roumani, 2016). According to Nath et al. (2010), RBV perceives an organisation as its resources and capabilities. To be more explicit, the RBV method defines in an efficient way how organisations establish and maintain competitive advantages (Lin & Wu, 2014). As a result, the RBV has evolved into a



comprehensive and effective theory of sustained exceptional performance in the field of strategic management (Barney & Arikan, 2001).

Several scholars have adopted a resource-based perspective to evaluate the influence of information technology on corporate performance (Haseeb et al., 2019). Due to the characteristics of newly produced technology and the use of resources, the adoption of digital technologies may result in fundamental and paradigm-shifting alterations (Han, 2017). Providing that the RBV demonstrates a direct link between resources and competitive advantage together with a well-explained dependent construct and the strategic importance of individual resources, The RBV gives insight into the contentious debate over whether or not IT resources may be employed for long-term performance enhancement. This is because the RBV demonstrates a direct link between resources and competitive advantage (Wiengarten et al. 2012),

According to Wu and Chiu (2015), both tangible and intangible IT resources, can be perceived as "valuable, rare, irreplaceable, and non-substitutable" in order to achieve performance superiority; these four characteristics are categorised as the RBV theory's four characteristics. The RBV theory is also considered one of the five pillars of strategic management. On the other hand, Wu et al. (2006) argue that when information technology (IT) is the only thing implemented, it may not meet the RBV criteria because there are relatively low barriers to imitation by other companies, which means that the opportunities associated with IT are likely to diminish relatively quickly.

This paper attempts to apply Industry 4.0 to the concept of SCM. On the basis of these considerations, it seems that the examination of Industry 4.0 might contribute to the advancement of SCM, especially SCI, which is organization-specific and difficult to replicate across businesses. The industry 4.0 construct in this dissertation refers to an organization's proficiency in IT exploitation. The RBV serves as the foundation for the development of this construct throughout this study. Sector 4.0, also known as the utilisation of modern technologies achieved via system-based thinking, provides a corporation with a continuing competitive advantage in their industry (Wu et al., 2006).

Relational View

Diverse inter-firm connections may be a source of competitive advantage, which is one of the most compelling arguments for the relational approach (Dyer & Singh, 1998; Chen et al., 2013). If the relational view is added to the RBV, it is possible to achieve a competitive advantage by focusing on dyads and networks of organisations as the fundamental units of analysis (Wieland & Wallenburg, 2013). Firms that emphasise collaboration with SC partners may realise greater financial returns than those that adhere to the conventional concept of a competitive advantage (Paulraj et al., 2008). Previous research studied how adding SCs may improve performance management by maximising the use of an organization's resources and skills (Prajogo et al., 2016; Sanders et al., 2011). According to Lee et al. (2014, p. 286),



information systems are an inter-organizational source and pioneer for integrating SCs. Information systems thus contribute to inter-organizational performance. Chen et al. (2013) investigate the effect of information technology integration inside companies and knowledge sharing with major suppliers on SCP.

According to Prajogo et al. (2016), the integration of supplier and buyer logistics operations gives a competitive advantage to businesses. This source of advantage involves the exchange of information and coordination of action between these two entities. Sanders et al. (2011) hypothesise that information exchange between buyers and suppliers, performance feedback, and investments in inter-organizational IT all play a crucial part in the performance improvement process. As mentioned earlier, an organization's internal and external resources, as well as the links between a company's SC partners, are all tied to the organization's competitive success. This research examines how digitization of supply networks impacts internal supply chain integration using the relational view theory as a theoretical framework. The present research adopts a relational view to analyse the network interactions in which organisations are embedded and a resource-based perspective (RBV) to evaluate the superiority of their performance from a resource perspective.

The Internal integration concept in Supply Chain internal integration is defined by Chang et al. (2016) as "the coordination and cooperation of information, procedures, and behaviour inside an organisation." Danese et al. (2013) define "internal integration" as the degree to which distinct divisions within a company may interact. This partnership's objective is to resolve differences and generate acceptable solutions. Departments inside a firm, according to Qi et al. (2017), must operate as part of an integrated system, and corporate structures, as well as organisational strategies, activities, and operations, must work cooperatively and synchronistically to satisfy the expectations of the company's clients (Silvestro and Lustrato, 2014).

Two key aspects that contribute to the internal integration of organisational processes are the exchange of information and collaborative decision-making across departments within an organisation (Chaudhuri et al., 2018; Jajja et al., 2018). Boonitt and Yew Wong (2011) found a favourable correlation between internal integration and customer delivery performance. According to the findings of the research, there is a correlation between internal integration and delivery performance, and this correlation may be strengthened by the use of information technology to enhance internal integration.

According to Silvestro and Lustrato (2014), a lack of internal integration results in subpar supply chain management effectiveness. Furthermore, research indicates that organisations should emphasise internal integration over external integration. This is due to the fact that internal integration is seen as the basis for supplier and customer integration (Delic et al., 2019; Chang et al., 2016; Sacristán-Daz et al., 2018). According to Sacristan-Daz et al. (2018), "the



function of internal integration is crucial for technical and social links via external integration efforts as a result of growing information, financial, and physical flows between partners." According to Cagliano et al. (2006), the primary reason why most firms fail at external integration is a lack of commitment to internal integration.

In addition, internal integration simplifies the process of "communication across all corporate divisions by removing functional boundaries" (Kim and Chai, 2016, p. 468). Consequently, internal integration focuses mostly on integrating a company's consistent operations, procedures, and strategy.

Despite the fact that Supply Chain Components (SCI) has been intensively researched over the last two decades, no concessions have been made in terms of concept measurement and operationalization (Alfalla Luque et al., 2015, p. 244). SCI may also be seen as a multidimensional phenomenon due to the fact that past study has analysed the concept in terms of several subcomponents (Liu et al., 2016, p. 14; Chang et al., 2016; Birasnav and Bienstock, 2019). Some academics have broken SCI into three components in order to examine it from a broader perspective: "supply integration," "internal integration," and "customer integration" (Zhao et al., 2015; Beheshti et al., 2014; Ataseven & Nair, 2017; Birasnav & Bienstock, 2019; Jajja et al., 2018; Lotfi et al., 2013). The most successful firms, according to this study, mix their customers, suppliers, and internal operations.

The multimodal nature of SCI, according to Zhao et al. (2015), makes it challenging to determine the relationship between SCI and performance. According to Beheshti et al. (2014), the supply chain strategy should comprise internal integration operations inside the business and a framework for integrating these activities with supply chain partners to achieve substantial integration benefits. According to Ataseven and Nair, internal integration refers to intra-organizational features, while customer integration and supplier integration examine linkages that firms enhance in their upstream and downstream processes (2017). According to Jajja et al., information sharing, shared decision making, and collaboration between partners and internal departments inside enterprises are essential qualities for evaluating effective integration through SCs (2018). However, integration with both suppliers and customers is often considered external integration (Chaudhuri et al., 2018, Danese et al., 2013; Willis 2016). In order to demonstrate external integration, this dissertation applies similar supplier and customer integration concepts.

The five primary integration strategies, known as "arcs of integration," represent "inward, peripheral, supplier, customer, and outward-facing groups." Other studies using diverse methodologies identify the characteristics of SCI (He & Lai, 2012;Tsanos et al., 2014). Campbell and Sankaran (2005) enhance their framework by basing it on enterprises' experiences and perspectives on SCI, and they classify their SCI components as "internal



integration," "forward integration," and "reverse integration." On the basis of an organisational structure, their inductive model focuses on numerous internal integration aspects, including backward SC activities and forward SC activities.

Cagliano et al. (2006) concentrate specifically on upstream supply chain dynamics with the aim of integrating production and logistics. Using a lean paradigm, the two key components "integration of information flows and physical flows" were evaluated. Factors that motivate supply chain digitization: It is essential to have a thorough understanding of the reasons that inspire manufacturers to adopt digital technologies, since these variables may considerably affect adoption behaviour and consequences (Fernando et al., 2018; Hanninen et al., 2018). In addition, businesses must link their actual adoption operations with the drivers so that the results are more closely aligned with their original business goals (Correani et al., 2020). There is a greater than ever before the urge to reduce expenses and increase productivity in procurement, manufacturing, storage, and transportation (Bienhaus and Haddud, 2018; Baruffaldi et al., 2019).

Numerous organisations in the industrial sector have conducted research on how to replace inefficient outdated management systems with faster and more precise digital management solutions. These companies have also investigated methods to use the Internet of Things (IoT) and large amounts of data to enhance lean and agile operations and supply chain activities. Typically, operational challenges and goals are straightforward to comprehend (Hanninen et al., 2018). Additionally, strategic orientations have a substantial effect on the adoption of digital technology. Internet companies such as Amazon, Alibaba, and Google were among the first to adopt digital technology-based business methods. According to the findings of several studies, client expectations are a crucial impetus for manufacturing companies to use digital technology (Chen et al., 2015; Seethamraju, 2014).

There is a growing market need for digitalized goods, techniques, and services across a variety of business types. Consequently, businesses must use digital technology to better meet the requirements of their customers and manage their relationships with those customers (Chen et al., 2015). Numerous businesses use it as a marketing strategy since it helps to portray businesses favourably. Innovative and digital. One organization's digitization efforts have an effect on the other supply chain participants. When one of the significant actors in a supply chain decides to use a particular digital system, the other participants in the supply chain are frequently put under pressure to adapt to the new system (Holmstrom and Partanen, 2014), resulting in a variety of power positions throughout the supply chain. Strong supply chain partners are driving digital innovation, therefore this is the case. Many companies' decisions to embrace digital technologies are driven by a desire to stay at the forefront of technology advancements and to retain a tight relationship with supply chain partners.



Competition is another external factor that may be investigated (Adamson et al., 2017; Büyükoçkan and Gocer, 2018). Adopting digital technology may assist industrial businesses boost their competitiveness, particularly if their rivals are already doing so. According to Chong and Chan (2012), the majority of companies will embrace digital technology if their rivals are already using it. They feel that this is the direction of the whole industry. Therefore, they have an irrational worry that if they do not do it, they will be overtaken by competition and fall behind.

Supply chain digitization and supply chain internal integration

Moreover, a number of studies suggest that the use of digital technology across the supply chain may be a crucial factor in the rise of integration inside the organisation (Gautr, 2020). Implementing electronic data exchange (EDI) delivers enormous benefits, as it simplifies the incorporation of information into the supply chain process and significantly reduces the number of failed shipments. Using enterprise resource planning (ERP) and customer relationship management (CRM) digital transformation technologies, Rai et al. (2006) demonstrated how an IT infrastructure may facilitate the integration of supply chain processes. This results in long-term improvements in the performance of the company.

Gautr (2020) adds that digital technologies are believed to provide integration across the different departments of a firm (such as material management, planning, and scheduling). The use of digital technology enables SC integration, resulting in enhanced financial performance. Despite the undeniable significance of digitization in the process of supply chain integration, the actual statistics are confusing. SC integration is essential to achieving a competitive edge since the rivalry is increasing across supply chains and not between individual businesses (Song et al., 2019). Implementing OCR thus requires not only the internal integration of merchants but also the coordination of activities with other firms participating in the whole supply chain (Cai et al., 2020).

The term "supplier integration" refers to a strategic partnership in which merchants and suppliers interact on all aspects of manufacturing (such as jointly deciding on inventory levels) (Delic et al., 2019; Song and Song, 2021). Retailers are responsible for managing their pull-based supply chains and are required to continually provide consumers with added value (Vishal et al., 2019). Customer integration refers to the process of acquiring information about each individual customer. Few scholars have performed exploratory research into the relationship between digitization and SCI. Shi et al. (2020) and Feyissa et al. (2019) showed, for instance, that digitalization can coordinate complicated activities within a supply chain by fostering enhancements in a company's cooperation and communication abilities, as well as its level of SCI. This was accomplished via digitalization's potential to enhance supply chain intelligence (SCI). Yu et al. (2020), supported by the resource-based approach and



organisational capability theory, found that supplier and customer IT systems greatly enhance supplier and customer system and process integration.

Conceptual framework

The conceptual framework of the study which highlights the relationship between the dependent and independent variables of the study is presented in Figure 1.

Independent Variable

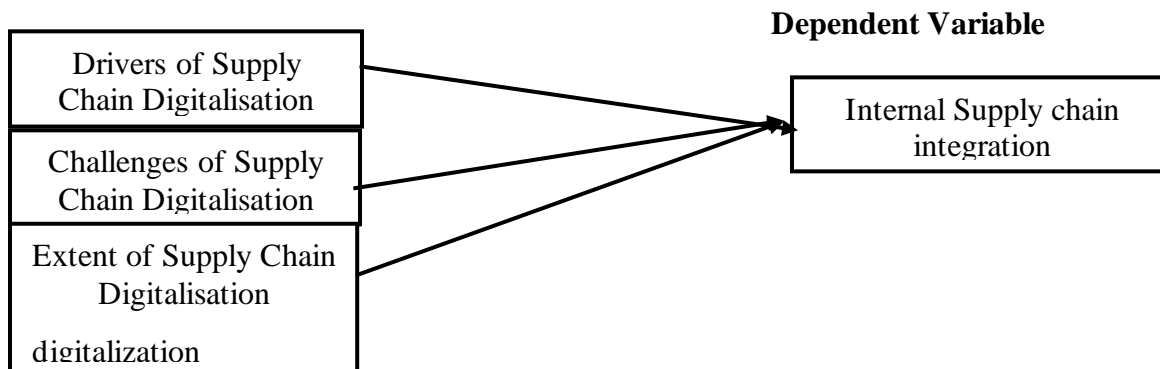


Figure 1: Conceptual framework

Various studies have indicated that digitalization in the supply chain could play a key role in building integration in the organization (Gautr, 2020). For example, in a field study on the logistic operations at the assembly centres of Chrysler Corporation, Srinivasan et al. (1994) found that the adoption of electronic data interchange (EDI) brings substantial benefits by facilitating the integration of information into the supply chain process and sharply reducing shipment errors. Rai et al. (2006) have shown that the IT infrastructure through the application of ERP and CRM digital transformation tools enables supply chain process integration, which in turn yields sustained gains in firm performance. Gautr (2020) has further supported this contention, indicating that digital technologies are believed to enable integration across the various functions of a firm (e.g., material management, planning, and scheduling) to ensure that teams move forward in unison toward common goals. These studies have suggested that the application of digital technologies facilitates supply chain integration for improved firm performance. Although the important role of digitalization in the SC integration process is quite certain, the empirical evidence is unclear. Therefore, it is posited that SC digitalization has a positive influence on internal integration.

METHODOLOGY

The study adopted the quantitative cross-sectional research approach (Rahi, 2017). A purposive sampling technique was used to select respondents from renowned cement manufacturing and



distribution firms in Ghana, Data were obtained from participants at a single moment in time using a structured questionnaire. The study adopted a confidence level of 95% and a margin of error of 5% with a total population of 160 administrative staff of cement manufacturers and distributors in Ghana. The total sample size for the study was 114 administrative staff and key players in the industry including Shipping and Logistics staff. Adopting the purposive sampling technique, data was collected and analyzed using Jamovi version 2.2.5. Descriptive statistics were deployed. Furthermore, the researcher used the Spearman rank order correlation to establish the effects of SCdigitalization and SCintegration.

A sample is a subset of a population (Schutt, 2011). Kothari (2004) postulated that the sample size for a study should not be too large or too small. Researchers Diamantopoulos & Schlegelmilch 2000; Woldemichael, 2012; Qayyum et al., 2013) postulated that for a quantitative study, the sample size should not be less than 30 participants. The study adopted the Krejcie & Morgan (1970) formula for known population size which is stated as

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

Where:

n = sample size

N = Population size

e = acceptable error of sample size

χ^2 = Chi – square *df* = 1 and reliability level of 95% ($\chi^2 = 3.841$)

ρ = population proportions (assumed at 0.5)

Based on the above, the calculated sample size is presented as

$$n = \frac{(3.841)^2 (160) (0.5) (1 - 0.5)}{(0.05)^2 (160 - 1) + (3.841)^2 (0.5) (1 - 0.5)}$$

$$n = 114$$

To account for non-responses, the researcher added 25 percent to the projected minimum sample size, bringing the total sample size for the study to 114.

Data Sources

Researchers use two types of data sources while doing research: primary and secondary. The phrase "primary source" is used to refer to any source that is unique. A primary data source is an original data source, which means that the data was acquired directly by the researcher for a specific study purpose or project (Salkind, 2010). There are several methods for gathering primary information. The most common methods are interviews, self-administered surveys, field, experiments and field observation. Primary data collection is more expensive and time-consuming than secondary data collection. Nevertheless, for some types of research, original data collection may be the only realistic choice. The majority of the data used by the researcher is primary data collected through a standardized questionnaire. The questionnaires were targeted at directors, managers, supervisors and officers in various departments.



Data Collection Methods

The study relied on the use of a structured questionnaire to collect primary data for further analysis. The questionnaire was in five sections. Section A was on the demographic variables of the respondents. Section B to E was on the study objectives. The questionnaire was on a five-point Likert scale with 22 items where 5 means strongly agree and 1 means strongly disagree. The questionnaire was administered to respondents via google forms. The researcher uploaded the questionnaire on google forms and shared the link with the respondents. This was done to easily track responses and also save time on printing and distribution of hard copies.

Data Analysis

Field data was edited, coded and entered into the SPSS version 25 software. The completed questionnaires were edited to ensure consistency and completeness in the responses from the participants. The data were analyzed using simple descriptive statistics and inferential statistics (spearman rank order correlation) to assess the effect of supply chain digitalization on internal supply chain integration.

Validity and Reliability Tests

When substantiated by evidence, validity is the quality of being correct or truthful. Messick (2006) defines research validity as the extent to which empirical evidence and theoretical rationales support the appropriateness of interpretations. In this study, both criterion and construct validity were used. Criterion validity is established when the study results gained through one measure are equivalent to those obtained from a more direct or previously validated assessment of the same phenomenon. When there are no evident validation criteria, construct validity is used. The factors of the study were obtained from existing knowledge and research.

According to Fraenkel and Wallen (2013), a study is considered accurate if it can be used by a variety of researchers under highly consistent conditions, with predicted findings and predictable outcomes. The dependability of a study over time reflects its consistency and duplicability. According to Fraenkel and Wallen (2013), dependability refers to the absence of measurement errors in a test result. The accuracy of the test decreases as measurement errors grow. Cronbach alpha was used to establish the reliability of the scale, which was modified from Karimi and Rafiee (2014).

Ethical Implications

According to Leedy and Ormrod (2010), the majority of ethical issues fall into one of four categories: informed consent, secrecy, security, and honesty. All participants were given a concise explanation of why the study was being done, granting them full consent to participate. The researcher maintained the nature and quality of the participants' performance strictly



private. There was no data linking respondents to their responses. The participants were not exposed to any additional stress, shame, or loss of self-esteem, and the researcher reported his findings openly and honestly.

Ghana cement firms and Digitalization

They have implemented digitalization in its supply chain in order to increase efficiency, reduce costs and improve customer experience. The company has been able to improve its supply chain management by integrating digital solutions such as the use of digital tools, automation and IoT to improve its supply chain visibility, cost reduction and improve its inventory management. In recent years they have channelled considerable energy into several digital technologies with the aim of improving work and satisfying customers as follows:

- A self-serve mobile application has been developed in-house for customers to be able to remotely order and pay for cement without needing to be physically present at various selling points.
- Tracking systems available to customers for cement hauled from the plants to various destinations to follow the delivery and get information on delivery time.
- An ERP software package provides information on stock and replenishment levels.
- Microsoft SharePoint and Power Automate are currently used for the inter-departmental liaison to automate manual operations and make work easier and faster.
- Expert systems are in place to control portions of raw materials in the milling system during manufacturing. The firms have not stopped there but have continued to advance digitally in operational areas.

RESULTS AND DISCUSSION

This section presents the results of the analysis carried out using Jamovi version 2.2.5. Data were collected from 114 sampled employees. The data were analyzed using descriptive statistics and Spearman rank correlation.

Demographic Characteristics: The demographic features of respondents; age, gender, department, level of education, and years of experience of respondents were assessed and the results of the descriptive statistics depicted in Table 1 indicate that the administrative staff consisted of fairly younger people with males out-numbering females. Also, most of the respondents worked in the shipping and logistics department, followed by IT, then Maintenance, Technical support and finally Production and Quality Assurance departments.



Table 1: Demographic Characteristics

| Demographic | Characteristic | Frequency (<i>n</i> = 114) |
|-----------------|---------------------------------|-----------------------------|
| Age | 20-30 years | 44.7% |
| | 31-40 years | 34.2% |
| | 41-50 years | 15.8% |
| | 51-60 years | 5.3% |
| Gender | Male | 64.9% |
| | Female | 35.1% |
| Department | Shipping & Logistics | 22% |
| | Commercial | 10.5% |
| | Accounts | 10.5% |
| | Maintenance & Technical Support | 13.2% |
| | IT | 14% |
| | Production & Quality Assurance | 13.2% |
| | EHS & HR | 8.8% |
| | Procurement | 7.9% |
| Education Level | First Degree | 53.5% |
| | Masters' Degree | 37.7% |
| | Doctoral Degree | 4.4% |
| | Professional Certification Only | 4.4% |
| Experience | 0-5 years | 44.7% |
| | 6-10 years | 31.6% |
| | 11-15 years | 18.4% |
| | 16-20 years | 3.5% |
| | 21 years and above | 1.8% |

Drivers of Supply Chain Digitalization

The respondents were asked to submit how much they agreed to statements seeking to assess their opinions on the drivers of supply chain digitisation. A large proportion of the respondents strongly agreed with the statement, Digital Supply Chain (DSC) tools are helpful for internal and external communication and collaboration; DSC increases the transparency and traceability of processes at the organization; DSC helps to automate and speed up transactions and processes; Digital Supply Chain (DSC) enables the organisation to operate with full remote access; and A common user interface enables the organization to work more efficient and effective were all ranked very high, with mean scores of 4.63; 4.62;4.58;4.57 and 4.49 respectively. This is in agreement with Büyüközkan, and Göçer, (2018) that managers and companies opting for digitally enabled organizations and fully transformed Digital Supply



Chain operations to achieve productivity. These findings show that the respondents acknowledge that Digital Supply Chain helps them improve the organisation's processes and that these serve as factors leading to the adaptation of digital technologies as shown in Table 2.

Table 2: Drivers of Supply Chain Digitalisation

| Item | Total | Mean | Std. Deviation | Rank |
|--|-------|------|----------------|------|
| DSC tools are helpful for internal and external communication and collaboration | 528 | 4.63 | 0.789 | 1 |
| DSC increases the transparency and traceability of processes at the organization | 527 | 4.62 | 0.812 | 2 |
| DSC helps to automate and speed up transactions and processes | 523 | 4.58 | 0.777 | 3 |
| Digital Supply Chain (DSC) enables the organization to operate with full remote access | 521 | 4.57 | 0.855 | 4 |
| A common user interface enables the organization to work more efficient and effective | 512 | 4.49 | 0.967 | 5 |

Challenges of Supply Chain Digitalization

Most of the respondents disagreed that the "Existing infrastructure in the organisation cannot handle digital transformation". There were similar responses to the statements, "Employees in my organisation do not have the appropriate capabilities for the digitalization of the company." "My organisation has implemented digital self-serve technologies for employees, business partners, and customers to use "; "My organisation has uncertainty and fears about supply chain digitalization"; "Leadership management within my organisation does not support creative freedom for creativity and innovation" and Suppliers of the company are not included in the process of digital transformation. The results are in agreement with the study of Saarikko, Westergren, and Blomquist, (2020) that indicated that firms are feeling the pressure not just to alter their existing business models but also to operate a portfolio of different business models in order to cope with increasingly indecisive customers. Cement firms' ability to adapt digital systems is relatively streamlined due to the relative lack of infrastructural and company cultural challenges. However further discussions with IT heads in the company revealed that financial constraints and cyber security concerns limited the extent to which digitalization was implemented, as shown in Table 3.



Table 3 Challenges of Supply Chain Digitalisation

| Item | Total | Mean | Std. Deviation | Rank |
|---|-------|------|----------------|------|
| Existing infrastructure in the organisation cannot handle digital transformation. | 231 | 2.03 | 0.989 | 1 |
| Employees in my organisation do not have the appropriate capabilities for the digitalization of the company | 222 | 1.95 | 0.776 | 2 |
| My organisation does not have a clear digital transformation strategy. | 213 | 1.87 | 0.967 | 3 |
| My organisation has uncertainty and fears about supply chain digitalization. | 204 | 1.79 | 0.893 | 4 |
| Leadership management within my organisation does not support creative freedom for creativity and innovation. | 202 | 1.77 | 0.912 | 5 |
| Suppliers of the company are not included in the process of digital transformation. | 201 | 1.76 | 0.878 | 6 |

Internal Supply Chain Integration

In order to assess the implementation of supply chain integration in the respondents' organisations, they were asked for statements that measured the variable. An analysis of the responses revealed that a greater proportion of the respondents agreed that their organisation had integrated information systems among different departments/channels. Most of the respondents also submitted that their organisation shared real time operational data among departments or channels. When asked to respond to the statement, "My organisation creates a network of cross-functional teams to corporate decision-making mechanism"; "My organisation has developed mechanisms for internal information sharing and confidentiality" many of the respondents agreed and strongly agreed while a few of them disagreed. Exactly half of the respondents strongly agreed while a significant proportion of the remainder agreed that their organisation implements process integration, such as integrated warehousing and distribution.

These findings corroborated that of Munir, Jajja, Chatha, and Farooq (2020) emphasized that the relationship between internal integration and operational performance fully mediates the association between supplier and customer integration and the operational performance of firms. Ghana cement firms have been relatively successful in implementing an internal integration of their supply from the perspective of the administrators. This is a relevant finding since it can help understand other metrics the company operates under. This is in agreement with many studies which have found relationships between internal supply chain integration



and firm performance. The findings can provide key insights to future studies on firm performance indicated in Table 4.

Table 4: Internal supply chain integration

| Item | Total | Mean | Std. Deviation | Rank |
|--|-------|------|----------------|------|
| My organisation has integrated information systems among different departments/channels | 513 | 4.50 | 0.780 | 1 |
| My organisation creates network of cross-functional teams to corporate decision-making mechanism | 509 | 4.46 | 0.722 | 2 |
| My organisation has developed mechanisms for internal information sharing and confidentiality | 508 | 4.45 | 0.767 | 3 |
| My organisation shares real-time operational data among departments/channels | 501 | 4.39 | 0.791 | 4 |
| My organisation implements process integration, such as integrated warehousing and distribution | 495 | 4.32 | 0.753 | 5 |

The final variable of interest was the extent to which the respondent's organization, Ghacem had an integrated internal supply chain. The proportion of respondents who strongly agreed that their organisation, "has clear digital goals and specific investment for digital strategy in its annual budget" constituted the majority. Also, most of the respondents agreed that their organisations have implemented digital self-serve technologies for employees, business partners, and customers to use" while the respondents admitted that their "organisation has implemented digital self-serve technologies for employees, business partners, customers to use". These findings reflect the relative success that the cement firms have in the integration of their internal supply chain, as indicated in Table 5.



Table 5: Extent of supply chain digitalization

| Item | Total | Mean | Std. Deviation | Rank |
|--|-------|------|----------------|------|
| My organisation has clear digital goals and specific investments for digital strategy in its annual budget | 508 | 4.45 | 1.885 | 1 |
| My organisation has standard operating processes which are modified to include new digital technologies | 514 | 4.51 | 0.902 | 2 |
| My organisation has implemented digital self-serve technologies for employees, business partners, and customers to use | 492 | 4.32 | 0.931 | 3 |

Relationship between SC Digitalisation and Internal SC Integration

In order to fully achieve the study objectives, the effect of supply chain digitalisation on internal supply chain integration was assessed using spearman's rank correlation. The results of the analyses represented in Table 6 showed the following relationships between the variables.

Table 6 shows a positive, moderate relationship between the Drivers of Supply Digitalisation and Internal Supply Chain Integration, significant at $p < 0.001$, a negative, moderate relationship between the Challenges of Supply Chain Digitalisation and Internal Supply Chain Integration, significant at $p < 0.001$, and a positive, strong correlation between the Extent of Supply Chain Digitalization and Internal Supply Chain Integration, significant at $p < 0.001$. These results show that digitalisation has a positive impact on internal supply chain integration at Ghacem Limited.

The negative relationship between the challenges of supply chain digitalisation and internal supply chain integration is due to the fact that challenges to digitalisation hinder an organisation's ability to successfully adapt digital systems thus limiting their ability to integrate their supply chains (Gupta et al., 2022).

These findings are also consistent with the findings of Liu and Chiu (2021) who posit that digitalisation increases the efficiency within supply chains inevitably leading to an internally integrated supply chain. Iddris (2018) also notes from an extensive systematic review that information sharing, which is a key feature of digital supply chains, breaks down barriers between departments leading to successful internal integration.

According to Yang et al. (2021), the desire of an organisation to solve operational problems or further improve processes is a significant driver of digitalisation. This conclusion provides some background for understanding how the drivers of supply chain digitalisation positively impacted internal supply chain integration. The drivers assessed reflect the motivations of the administrative staff within Ghacem Limited. In theory, these motivations would lead them to



adapt digital technologies hence contributing to their successful internal supply chain integration.

In addition to this, the drivers of supply chain digitalisation and the challenges to supply chain digitalisation had positive and negative relationships with the extent of supply chain digitalisation. Yu et al. (2016) findings show that both IT and marketing capacity have a strong beneficial influence on Supply chain integration. Agrawal et al. (2019) also indicated that lack of support from top management, organisational structure, lack of strategic orientation, and lack of digital skills and talent, are barriers to supply chain digitalisation which are consistent with the findings of this study.



Table 6: Spearman's Rank Correlation

| Item | | Drivers of Supply Chain Digitalisation | Challenges of Supply Chain Digitalisation | Internal supply chain integration | Extent of Supply Chain Digitalisation |
|---|----------------|--|---|-----------------------------------|---------------------------------------|
| Drivers of Supply Chain Digitalisation | Spearman's rho | - | | | |
| | p-value | - | | | |
| Challenges of Supply Chain Digitalisation | Spearman's rho | -0.520 | - | | |
| | p-value | <0.001 | - | | |
| Internal supply chain integration | Spearman's rho | 0.622 | -0.602 | - | |
| | p-value | <0.001 | <0.001 | - | |
| Extent of Supply Chain Digitalization | Spearman's rho | 0.606 | -0.524 | 0.777 | - |
| | p-value | <0.001 | <0.001 | <0.001 | - |



Table 7: Validity and Reliability of Scale Items

| Scale | Cronbach's α |
|---|---------------------|
| Drivers of Supply Chain Digitalisation | 0.745 |
| Challenges of Supply Chain Digitalisation | 0.928 |
| Internal supply chain integration | 0.856 |
| Extent of supply chain digitalization | 0.894 |

All scales had Cronbach's alpha values above 7.0 which is an indicator of an acceptable level of reliability, or internal consistency, of a set of scale or test items as shown in Table 7.

CONCLUSION

The study investigated the relationship between the drivers of supply chain digitalisation, the challenges of supply chain digitalization, and the extent of supply chain digitalisation as the independent variables and internal supply chain integration as the dependent variable. The findings revealed a positive, moderate relationship between the drivers of supply chain digitalisation and internal supply chain integration; a negative, moderate relationship between the challenges of supply chain digitalisation and internal supply chain integration, a positive, strong correlation between the extent of supply chain digitalization and internal supply chain integration. All the relationships were significant. Furthermore, the drivers and challenges to supply chain digitization revealed both positive and negative associations with the extent of supply chain digitalisation. These findings show that the firms have successfully adapted digital tools and have a well-integrated supply chain. The associations reveal that the digitalisation efforts led to a well-integrated supply chain.

Practical Implications:

1. The findings of the study provide insights into how digitalization initiatives can improve supply chain efficiency within cement manufacturing and distribution firms. Implementing digital technologies and solutions can streamline processes, automate tasks, and enable real-time visibility across the supply chain. This, in turn, can lead to improved inventory management, reduced lead times, optimized production scheduling, and increased overall operational efficiency.
2. Digitalization efforts that improve internal supply chain integration can contribute to cost reduction and improved financial performance for cement manufacturing and distribution firms. By eliminating manual processes, reducing errors, and improving coordination and communication across the supply chain, firms can reduce operational costs, increase productivity, and achieve better financial outcomes.



3. Embracing supply chain digitalization and achieving high levels of internal supply chain integration can provide a competitive advantage for cement manufacturing and distribution firms in Ghana. Firms that effectively leverage digital technologies and integrate their supply chain activities can respond quickly to market demands, adapt to changing customer preferences, and differentiate themselves from competitors. This can help secure market share, attract new customers, and enhance their overall competitiveness.

Social Implications:

1. The digitalization of the supply chain may lead to job transformations and changes in the skills required for certain roles. As firms adopt digital technologies, some traditional job functions may be automated or modified, requiring employees to acquire new skills related to technology utilization, data analysis, and process optimization. Providing training and upskilling opportunities can help employees adapt to these changes, fostering professional growth and increasing their employability in the digital era.
2. Supply chain digitalization can contribute to environmental sustainability within the cement manufacturing and distribution sector. By optimizing transportation routes, reducing excess inventory, and enabling efficient demand forecasting through digitalization, firms can minimize energy consumption, carbon emissions, and waste generation. This can have a positive impact on the environment and contribute to the broader sustainability goals of Ghana.
3. Digitalization and enhanced internal supply chain integration can facilitate closer collaboration among various stakeholders in the cement manufacturing and distribution sector. By sharing real-time information, fostering transparency, and enabling collaborative decision-making, firms can strengthen relationships with suppliers, distributors, and customers. This collaboration can lead to improved supply chain coordination, increased trust, and the development of mutually beneficial partnerships.
4. The adoption of supply chain digitalization practices can contribute to economic growth and development in Ghana. Increased efficiency and competitiveness within the cement manufacturing and distribution sector can attract investment, create job opportunities, and stimulate economic activity. This can have a positive ripple effect on the overall economy, leading to improved living standards and societal well-being.

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