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Supply chain visibility and integration in the age of the Internet of Things: a retail perspective

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Abstract

Purpose – This study aims to assess the use of the Internet of Things (IoT) in retail stores to improve supply chain visibility and integration.

Design/methodology/approach – This study employed a qualitative methodology with data collected using semi-structured interviews from a sample selected using purposive sampling. The population consists of 48 employees, of which 6 were selected for the sample as they worked directly with IoT and supply chain issues. Participants were from a SPAR franchise store (Samenwerken Profiteren Allen Regalmatig).

Findings – Thematic analysis was used to analyse the transcribed data from the interviews. The themes identified include supply chain visibility, supply chain integration and IoT. The findings indicate that the main IoT used is an organisational-wide system, the SIGMA (SPAR Integrated Goods Management Application) system. Other technologies that aid supply chain visibility and integration are geotags, the internet, WhatsApp social media applications, emails and scanners.

Practical implications – From the findings, this study recommends that IoT systems should be frequently updated to reflect current trends and that IoT systems should enable the integration of small and medium Enterprises (SMEs) suppliers.

Originality/value – The Fourth Industrial Revolution has ushered in new technologies that revolutionise business operations. Among these technologies is the IoT, which has ushered in a new connectivity area. However, there is little research on the use of IoT for supply chain visibility and integration in the South African retail sector. It provides sector-specific insights and recommendations for retailers, which might not be covered in general supply chain management literature.

Keywords Internet of things, Supply chain integration, Supply chain management, Supply chain visibility
Paper type Research paper

1. Introduction and background

To respond decisively to external economic disruptions such as the coronavirus disease 2019 (Covid-19) pandemic, market changes and changes in consumer demand patterns, retail outlets must have a capacity for supply chain integration and visibility (Kumar and Singh, 2022).

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The Internet of Things (IoT) is a key tool enabling retail outlets to achieve supply chain visibility and integration. The role of the IoT in businesses has been receiving much attention in both practice and academia as its value is becoming more appreciated in both business and everyday life (Attaran, 2020). One of the key drivers of the use of IoT was the Covid-19 pandemic, which led to more reliance on digital technologies as governments instituted lockdowns worldwide (Neger and Uddin, 2020).

Retail stores were not spared from the need to use digital technologies during the Covid-19 pandemic (Valaskova *et al.*, 2021). IoT was used by retail stores to manage issues related to inventory management and to mitigate the effects of supply chain disruptions (Yadav *et al.*, 2021). South African businesses have rushed to adopt IoT technologies to keep up with international competitors. According to the Industrial Development Corporation (IDC) (2022), the Covid-19 pandemic accelerated the realisation of the benefits of adopting IoT. South African IoT market was valued at US$2,167 million in 2019 and is expected to be valued above US$29,615 million by 2027 (The Insight Partners, 2021).

Oubrahim *et al.* (2023) investigated the impact of digital technologies, including IoT, on supply chain integration. Their findings suggest that IoT has a positive impact on supply chain integration. A study by Fatorachian and Kazemi (2021) concurs with these results, finding IoT and other Fourth Industrial Revolution technologies to enhance supply chain integration. According to a study by Ahmed *et al.* (2021), IoT can help enhance supply chain visibility. In their study, Kalaiarasan *et al.* (2022) found results suggesting that IoT leads to enhanced supply chain visibility. While there seems to be a consensus about the positive impact of IoT on supply chain integration and supply chain visibility, most of the studies have been done in the developed world or the Western world. There is a gap concerning research focused on developing countries in Africa. This gap is significant because the developing world has not fully adopted and diffused emerging technologies like IoT, especially in the retail industry, which is crucial to the development of these economies. Again, the few studies have been quantitative, mostly a cause-effect study. They are mostly limited to specific cases, which makes them too limited. A qualitative study that gives a broader perspective and in-depth insights is required to explore IoT use in the retail industry. As Kamble *et al.* (2019) alluded to, the use of IoT in retail stores, especially those in the food sector, is still nascent. This necessitates the need for further studies to understand the impact of IoT on retail supply chains. The study fills these gaps by investigating supply chain visibility and integration in the age of the Internet of Things with a focus on the retail sector in South Africa. With the rise of IoT in the South African context being a new phenomenon, a better understanding of its impact on supply chain management (SCM) is warranted. Specifically, this study explores the IoT technologies used in retail outlets, how retail outlets use IoT to improve supply chain integration, and how IoT enhances supply chain visibility. The findings of the study help in understanding the roles of IoT in developing nations and bring to light the use of IoT in the retail sector.

While studies have been undertaken in the developed world on IoT use in supply chains, the South African IoT landscape is markedly different from that of the developed world (Dlamini and Johnston, 2017). South Africa's IoT infrastructure development lags that of the developed world (Olaitan *et al.*, 2021). South Africa faces challenges such as poor internet bandwidth and erratic energy supply (Digiteum, 2019; Mitchell, 2022), challenges that hinder the use of IoT in the same way it is used in the developed world. South Africa faces challenges of high unemployment rates that result in trade unions being wary of new technologies, thus in some cases, there is resistance to the use of new technologies such as IoT (Mitchell, 2022).

The study zooms into one of the top 5 major retail outlets in South Africa, which is a SPAR franchise store. Shoprite, Massmart, Woolworths, Pick and Pay, and SPAR are the five biggest retail outlets in South Africa, (Das Nair, 2018), with Shoprite being the biggest in the sector, followed by SPAR and Woolworths (Labour Research Services, 2022). SPAR Group

has over 2,500 retail outlets in South Africa, with 6 distribution centres and an employee database of 10,280 nationwide. The retail sector contributes 12,5% to the economy's GDP and employs 20% of the South African workforce (Khatle *et al.*, 2018).

This study bridges the Gap in Retail SCM Research. While supply chain visibility and integration are extensively studied in the broader SCM domain, this research can fill a specific gap in the literature by focusing on the retail sector. It provides sector-specific insights and recommendations for retailers, which might not be covered in general SCM literature.

2. Literature review

This section presents a review of literature focused on supply chain visibility, supply chain integration and IoT. The theories underpinning the study are also presented in this section.

2.1 Theoretical framework

Two theories underpinned the study. The Technology-Organisation-Environment (TOE) framework and the Theory of Dynamic Capabilities. The TOE provides a framework to analyse the adoption of technologies, focusing on the organisation's resources and the environment (Tornatzky and Fleischer, 1990). Based on the TOE framework, before adopting a new technology, the organisation has to consider the environmental context, organisational context, and technological context it finds itself. The environmental context refers to the external environment in which the business operates. To be considered in the external environment are those things or entities that can influence how the organisation adopts technology (Abed, 2020). These may include the market structure, the industry, government policies, regulations and laws (AlKhoori, 2022). The organisational context focuses on the organisation's resources, the organisational structure and the relationships existing within the organisation. When looking at the organisational context, key considerations are organisational size, data management processes, organisational preparedness, employee skills and top management support (Ahmad, 2022). The technological context relates to the technologies currently used both outside and inside the organisation. It focuses on the ability of the organisation to assimilate new technologies into its current technological infrastructure. When looking at the technological context, key considerations are current technological infrastructure, compatibility of new technologies with current technologies, relative advantage and complexity (Al-Hujran *et al.*, 2018).

The use of the TOE framework in the study aligns with other empirical studies focused on adopting technology at the organisational level (Malik *et al.*, 2021). Some of the studies to have used the TOE framework in studies focused on technology adoption in organisations include Chweya and Ibrahim (2021), Tu (2018), and Ullah *et al.* (2021). However, a few, if any, studies have applied the TOE in the South African retail sector context. South African retail players are still lagging behind international players in technology adoption. It is important to apply it in the South African context as the South African technology sector still lags behind that of developed nations where the TOE has been applied in most studies. The organisational composition of the South African retail sector, while sharing similarities with those in the developed world, differs in some respects, especially in relation to trade union power which can hinder the adoption of technologies considered threatening to employees' job security. The South African environment differs from most developed nations regarding regulations and the infrastructure available for technology adoption.

The dynamic capabilities theory is linked to the resource-based view theory of firm growth. It posits that for a firm to succeed in a competitive market it needs to have dynamic resources and capabilities which the managers can put to use in a strategic way to enable the organisation to adapt to changes in the environment and to meet the needs of customers

(Monteiro *et al.*, 2017). In a world characterised by constant change at a fast pace and globalisation, a firm needs to have the ability to adapt to changes in technology and customer demand patterns. According to Teece (2007), dynamic capabilities can be put under three categories: sensing opportunities and threats, seizing the sensed opportunities, and managing the sensed threats while reconfiguring the organisation's resources.

The sensing (shaping) opportunities and threats dynamic capability are integral in the ability of the organisation to scan the environment, learn from developments in the environment, shape the organisation to take advantage of opportunities and reduce the impact of threats (Baden-Fuller and Teece, 2020). To build this capability, organisations need to make investments in research and development. The organisation also needs to actively and continually learn about customer needs, technological changes, supplier and competitor action, and industry and market (Kareem and Alameer, 2019).

The seizing opportunities capability is useful in allowing the organisation to take advantage of opportunities identified using the sensing capability (Kump *et al.*, 2019). The capability allows the organisation to create new products, processes and services. To build this capability, the organisation needs to adopt new technologies and design new business models. The managing threats and reconfiguration capability give the organisation the ability to react to threats by reconfiguring and recombining the structures and resources of the organisation in line with changes in the environment (Baden-Fuller and Teece, 2020). Organisational activities linked to this capability include redesigning business models, changing routines and processes, and realigning assets.

The theory of dynamics of capabilities can help explain how retail organisations sense the opportunities and threats IoT presents in SCM. It can further help bring to light the ways organisations are seizing the opportunities brought by IoT, managing threats and reconfiguring their resources to take advantage of IoT benefits in SCM.

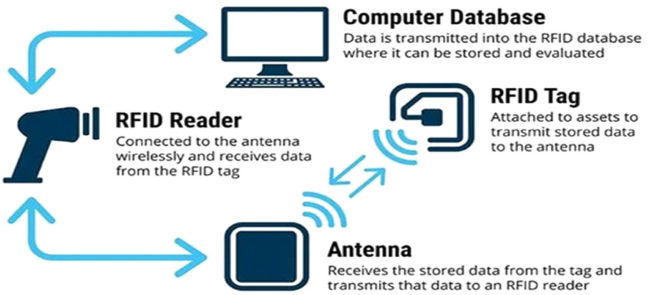
2.2 Internet of Things

The origin of the term IoT can be traced back to a Proctor and Gamble (P&G) presentation title in 1999 and is used to describe the interconnectedness of technological devices, processes, objects and information (Ashton, 2009). IoT technologies seek to enable the connection of the internet to various objects allowing for the objects to exchange information, to be tracked and monitored through radio-frequency identification (RFID), GPS, infrared sensors and other information sensing technologies and devices (Yan *et al.*, 2017). Among the capabilities of IoT is the ability to transmit, detect, auto-capture and share data both within organisations and with external parties (Ben-Daya *et al.*, 2019).

2.2.1 Technologies used in IoT. 2.2.1.1 RFID (radio-frequency identification). In the retail industry, products are scanned using RFID devices, relaying the information to an inventory database (Jones *et al.*, 2022). RFID technology has the following components microchipped RFID tags attached to a product/item, an antenna, a reader and the system software (de Boer, 2017). The following Figure 1 shows the components of RFID technology.

Retailers can use RFID technologies for SCM purposes. RFID has the benefit of retailers being able to track products as they move from one point to another on the supply chain. RFID also helps ensure goods transfer between supply chain partners at the right time (Chanchaichujit *et al.*, 2020). RFID also uses benefits supply chain synchronisation as it allows for the visibility of product movements (Drakaki and Tzionas, 2019).

2.2.1.2 Wireless sensor networks (WSN). Wireless sensor networks (WSNs) are designed as a network of sensors that can track and monitor the movements, location and temperatures of connected devices (Ben-Daya *et al.*, 2019). WSN sensors can be used when transporting products by attaching them to containers, trucks, items and shipping vessels to track their



Source(s): Shopify.com

Figure 1.
RFID technology

movements. WSN can also be linked to RFID technologies, magnifying the benefits of the two technologies on the supply chain (Xu *et al.*, 2017).

2.2.1.3 Cloud computing. Cloud computing consists of devices connected to the internet that can access, store and share information on demand (Ben-Daya *et al.*, 2019). IoT devices can generate massive amounts of data, which needs to be stored and cloud computing brings the benefit or ability to store this data. This leads to more efficient data sharing between IoT devices. Cloud computing also can cover all points in the supply chain, from the manufacturing process to the product getting into the hands of customers (Kittichotsatsawat *et al.*, 2021). Cloud computing helps cut data storage costs and enables real-time information sharing between supply chain partners (Attaran, 2020).

2.2.1.4 Bluetooth low energy (BLE) beacon. Bluetooth low energy (BLE) beacons can be described as IoT-enabled devices that can sense and communicate with smartphone devices and other devices (Stavrou *et al.*, 2019). Retail stores use BLE beacons to transmit information such as personalised product offerings and special promotions. Three components make up the IoT BLE beacon. These are the BLE beacon, server and smartphone components (Ofualagba, 2021). BLE beacons recognise smartphone devices, sending and receiving data from both the smartphone and server. The server stores the customer information and relays personalised customer information to the beacon (Alzoubi *et al.*, 2022). The smartphone component is the form of a dedicated application in the customer's phone. The application signals the presence of the smartphone device to the beacon (Ofualagba, 2021). The moment the BLE beacon recognises a customer device, it communicates the information to the cloud server, the cloud server, in turn, sends personalised information designed for the specific customer and the beacon relays the information to the customer device (Zaim and Bellafkih, 2016).

2.2.2 Benefits of IoT in supply chains. Several benefits arise for benefits due to the use of IoT in their stores and the supply chain. The first benefit relates to better customer experiences with 77% of retailers using IoT indicating so (I-Scoop, 2022). IoT also enables retail stores to gain more insights into customer behaviours, with 89% of retailers using IoT indicating so. IoT also enables greater collaboration among supply chain partners, with 77% of retailers using IoT indicating so (I-Scoop, 2022).

According to Maïzi and Bendavid (2021) the benefits of IoT also include automation which enables the creation of smart stores. Smart stores allow for self-service and are staffed by robots. They benefit from low labour costs for the retailer and time saved for customers (Durst, 2019). IoT also brings the benefit of price optimisation; IoT's ability to collect customer and product data enables better pricing (Yan *et al.*, 2021). IoT also helps retailers with staffing issues, information gathered through IoT can be used to better staff retail stores (Thomas and Whitfield, 2018).

IoT has the benefit of increasing production transparency in the supply chain. IoT enables tracking products through the supply chain (Thomas and Whitfield, 2018). In line with sustainability considerations, IoT also helps reduce resource wastage (Chander *et al.*, 2022). This is due to the ability to track products through the chain minimising losses. IoT also enables the promotion of sustainable and ethical production and delivery of products (Digiteum, 2022).

2.3 Supply chain integration

Supply chain integration refers to the extent an organisation collaborates with other members of the supply chain and to the inflow and outflow of resources and information among supply chain partners (Khanuja and Jain, 2019). Supply chain integration ensures the proper coordination of value-adding processes (Khan and Wisner, 2019). According to Pakurár *et al.* (2019), supply chain integration has two distinct categories: internal and external integration. Internal integration refers to the internal activities taken by the organisation related to the supply chain. Internal integration results from the resources, relationships and interconnections in the organisation (Khanuja and Jain, 2019). External integration is focused on the organisation's relationships with external partners and deals with inter-organisational procedures that enable the movement of products, resources and information in an orderly and coordinated way (Pakurár *et al.*, 2019).

Supply chain integration has the benefits of helping retailers cut costs linked to supply chain inefficiencies and synergistic benefits arising from sharing skills across the network (Mukhtar and Azhar, 2020). Supply chain integration also benefits customers through improved customer service as products are delivered on time (Phengchan and Thangpreecharparnich, 2018; Wang and Huo, 2018). The benefits of IoT are based on studies in developed countries, with a dearth of studies focused on supply chain integration in the South African retail sector. The study will help understand if these benefits are found in the South African retail sector.

2.3.1 IoT and supply chain integration. Supplier chain integration can help retailers avoid challenges such as failure to meet customer demands in a timely manner and other supply chain bottlenecks (Jiang, 2018). According to Mathu (2018), the use of information technology in supply chains has improved information sharing among supply chain partners and has improved collaboration between supply chain partners. An empirical study by Shafique *et al.* (2018) found results indicating that IoT has a positive and significant effect on supply chain integration. According to De Vass *et al.* (2018), IoT improves supply chain integration through improved customer, internal and supplier-related processes. While these studies provide results indicating a positive relationship between IoT and supply chain integration, none of them was undertaken in the context of the South African retail sector; hence, the need to conduct a study focused on this sector.

2.4 Supply chain visibility

Supply chain visibility deals with the ability of organisations to track products as they move from one point to another on the supply chain. Supply chain visibility contributes to supply chain performance and the supply chain's resilience (Hohenstein *et al.*, 2015). Lack of visibility in a supply chain can lead to thefts, stockouts and waste (Alshurideh *et al.*, 2019; Noor, 2021). According to Bvuchete *et al.* (2018) supply chain visibility in SCM leads to better management of demand and supply, avoiding wastage and product shortages. Product shortages can negatively impact customer loyalty, especially when a customer can find the product from another store (El Haddou-Yousfi *et al.*, 2020).

2.4.1 IoT and supply chain visibility. IoT enables supply chain visibility and helps retailers track products as they move through the supply chain (Shiralkar *et al.*, 2021).

According to de Boer (2017), IoT in supply chains leads to high visibility, thus reducing delivery delays, theft, stockouts and waste. Findings from a study by Ahmed *et al.* (2021) indicate that IoT positively and significantly affects supply chain visibility. Al-Talib *et al.* (2020) indicate that the use of IoT has the benefits of improved productivity as time used for traditional supply chain activities is now used for other things, better communication in the supply chain and better tracking of products. These benefits are all linked to supply chain visibility.

While studies have been undertaken in developed nations on IoT adoption in retail stores, extrapolating the findings to the South African situation can be misleading due to South Africa considerably lagging developed countries in IoT development and adoption. For example, some of the IoT technologies considered novel and innovative in developed nations have been in use in developed countries for some time (Akpan *et al.*, 2020). Culture also plays a role in the adoption of technologies (Asir and Manohar, 2023), with South African culture differing from that of developed nations it can be argued that IoT adoption in South Africa differs from that of developed nations. South Africa seems to lack the financial resources needed for the development of technological infrastructure (Olaitan *et al.*, 2021) that can enable the majority of retail stores and their supply chain partners to adopt IoT. Initial investments into IoT can be prohibitive for South African retailers (Dlamini and Johnston, 2017). There is a lack of use of IoT systems by some members of the supply chain of retailers resulting in South African retail stores not making full use of IoT systems in the same way they are used in the developed world (Dlamini and Johnston, 2017). Poor power supply in South Africa also has the effect of hindering the effect use of IoT technologies (Mitchell, 2022; Olaitan *et al.*, 2021). This can be exacerbated by poor internet bandwidth (Digiteum, 2019). IoT adoption in South Africa is slowed down by the presence of activist trade unions that fear that their members will lose their jobs to technology, in light of the high levels of unemployment in South Africa this is an important concern (Mitchell, 2022). These differences ensure that the South African retail landscape differs from that of the developed world.

3. Design/methodology/approach

The study employed a qualitative research methodology. Qualitative methodologies focus on collecting non-numerical data that provide insight into a phenomenon under study (Babbie, 2016). Qualitative methodologies use techniques that seek to decode, explain and gain insight into the meaning of phenomena (Leedy and Ormrod, 2015). An interpretivism paradigm guided the study. The interpretivism paradigm views reality as subjective and knowledge as arising from the subjective experiences of people (Creswell and Creswell, 2017). An exploratory research design was chosen for the study. A research design provides a systematic and logical plan of how a study is undertaken (Nayak and Singh, 2021). An exploratory design is suited for a study designed to explore a new phenomenon, as in the case of the use of IoT in the South African retail sector; thus, the design was considered suited for the study.

3.1 Interviews and data collection

Data were collected using semi-structured interviews conducted by the researcher. Purposive sampling was used to select the participants. Purposive sampling entails the researcher using discretion to select participants with characteristics suited to the study (Saunders *et al.*, 2019). Thus, the sample frame for the study was employees of SPAR who dealt with issues linked to SCM and IoT. The interviews touched on supply chain visibility and integration and were conducted with employees of a SPAR retail outlet working in areas requiring IoT

technologies and dealing with SCM issues. The SPAR retail outlet had 48 employees. However, only 6 indicated they knew about SCM and IoT use. These included a store manager, two-floor managers, a merchandiser and a supply chain manager.

Of the six participants chosen through purposive sampling for the study, one could not participate due to being dismissed before the interviews were conducted therefore, five employees participated. According to Creswell (2007) and Saunders (2012), using five participants can be considered appropriate for qualitative studies where the participants can provide in-depth information through interviews. The study participants were able to provide in-depth information as they dealt with matters of SCM and IoT daily.

An interview schedule was prepared and used for interviews (Husband, 2020). The interview schedule had questions pertaining to issues of supply chain integration, visibility and IoT. Questions on supply chain integration sought to gain insights on the IoT technologies made use of in the retail store, and to understand how communication was used to enhance supply chain integration and foster a good working relationship internally and externally throughout the supply chain ecosystem. Questions on supply chain visibility focused on the IoT systems used to ensure supply chain visibility, including the movement of products from the suppliers/head office and internally in the store. The researcher asked predetermined open-ended questions and follow-up questions where necessary. Semi-structured interviewing technique afforded the participants an opportunity to share their lived experiences and elaborate further when prompted (Flick, 2018).

3.2 Data analysis

The study made use of thematic analyses for data analysis. Thematic analyses seek to identify themes in the data collected qualitatively (Kiger and Varpio, 2020). The recording was first transcribed, and to ensure reliability, the researcher listened to the recordings while reading the transcripts. The researcher then coded the data, organising the responses under identified key themes. The researcher then reread the transcripts to check if all the coded information aligned with the context of the responses. The themes identified were organised accordingly and the themes dealt with the issues of IoT, supply chain visibility and supply chain integration.

3.2.1 Measures of trustworthiness. In the study, credibility was ensured by undertaking member checks, where participants were asked to verify certain information from the transcripts to ensure it was in line with what they said (Candela, 2019; Motulsky, 2021). Furthermore, the transcripts were presented verbatim to ensure the participants' voices were not diluted by the researcher's bias or own interpretation. The trustworthiness of the study was ensured by fully informing the participants of the purposes of the study and by building an honest relationship with participants, which allowed them to give truthful answers (Amin *et al.*, 2020).

3.2.2 Ethical considerations. A study needs to abide by research ethics from the formulation of research questions up to the data storage point (Nayak and Singh, 2021). Ethical clearance for the study was sought and granted by the relevant authorities before the data were collected. Permission to collect data was also sought and granted by SPAR Retail X. Participants were informed of their right to participate voluntarily, and the necessary steps were taken to protect the identities of the participants.

4. Result/findings

The study focused on the issue of supply chain integration, supply chain visibility and IoT. Under each key issue, themes were identified from the collected data.

4.1 Supply chain integration

Two themes linked to supply chain integration were identified in the data collected. These were technology and communication. Participants noted that to ensure supply chain integration, they used technology. Technological gadgets identified by participants included computers, scanners, modems, the internet, emails, phones and WhatsApp applications. The use of technology such as scanners was noted to be useful in ensuring the head office was aware of the stock levels in Retail X. The participants noted that the head office was responsible for the purchase of most goods thus Retail X had to ensure that the head office was aware of its stock levels for purchases to be done timely. The scanners were used to record stock purchases in the store with the information transferred to computers which would relay the information back to the head office which was linked to the store computer system.

4.1.1 Participant X1 explained it as follows.

> We order through the modem, computer handheld scanners to our computer system, and then it goes directly into our head office system. And then they pick up and send us stuff. So, the head office they buy from all the suppliers. A computer links us; we have scanners we are ordering from and a computer system that gives us stock on hand. So, much technology is supplied from our head office (Participant X1).

Participant X2 indicated the following about the use of scanners to place purchases at the head office:

> So, we basically will place orders that we scan and then it goes to the Distribution Centre (DC) or DC, then what is the stock that we get billed after that. And then we have 18 days to pay our DC (Participant X2).

Participants who used the social media application identified WhatsApp as helping supply chain integration by allowing for fast communication with supplier representatives. The participants indicated that WhatsApp groups were created comprising store supply chain managers, head office employees responsible for product delivery and representatives of suppliers. These groups allowed for quick communication in case of supply chain issues such as products not arriving on time or products needing to be returned. As indicated by Participant X2:

> So, generally, I have many guys on WhatsApp. So, there is a problem with a product if I don't have to find DC, with a direct supplier, I can just say, hey, whoever, we have a problem here, we haven't received this or this needs to be returned. I mean, we just check what's happening (Participant X2).

This tool, WhatsApp, was seen as helping build relationships between stores and suppliers, thus helping stores to be made aware of key information such as discounts and loan offers. As mentioned by Participant X5 in the following way:

> WhatsApp is a beautiful thing. It's a beautiful thing there's like groups that have been created . . . with all of the owners and store managers along with the buyers and along with the advisor for DC and then they will inform us of big loans that are going to be on deals and things like that (Participant X5).

Participants also mentioned the importance of emails and the internet to ensure supply chain integration. The internet was used to search for product information while emails were used as a communication tool with suppliers, customers and the head office. Participants noted that using these tools gave them information such as catalogues, delivery times, pricing and service. As noted by Participant X3:

> . . . have simplified the whole process; now you get all your information, your catalogues, pricing, service, delivery times via the internet, just pop an email customer sends back all the relevant information (Participant X3).

The second theme of communication was identified as key in ensuring supply chain integration. Participants noted that communication was essential in emergencies where the store required inventory to be delivered outside of the normally scheduled times, as the store supply chain manager could contact representatives of suppliers directly rather than going through the head office. Participants also indicated that communication ensured supply chain integration through communication continuously with all involved in the supply chain, from the suppliers to customers. This was seen as ensuring the store had the right products at the right time. Participants X1 and X3 put it as follows:

> With that, so that we have who is calling at the store, say the lady by the name of Lerato who is calling at our store from Coca-Cola, we have the direct telephone number for Lerato. So we would find that Lerato is only coming to our store on Wednesday, but we need the stock on Monday. Yes, we would find the representative Lerato directly. Then she would place the order for us to get an emergency order. So, we do not deal directly with the company (Participant X1).

> You have got to make sure you have got the right product at the right time at the right place. So it is ordering the correct products, like I said for our store, make sure our pricing is competitive and correct. Liaising with the DC liaising with staff on the floor, communicating on prices, new products, merchandising is quite important. And then our day-to-day liaising with customers on the floor, speaking to customers seeing if they're happy with service, obviously, pricing people are not happy with because everything is going up daily. Okay, that is basically how we do it. It is very simplified (Participant X3).

4.2 Supply chain visibility

To ensure supply chain visibility computer systems, scanners, people skills, geotags, the Sigma SPAR Integrated Goods Management Application) system and Goods Receiving Voucher (GRV) were used. Participants indicated that they used computer systems to ensure they were aware of the location of products while they were in transit. People skills were noted to be important in the case of smaller suppliers who did not have computer systems.

Some of the participants also pointed to possession of knowledge of the rate of sale of products helping them make better decisions when it came to ensuring supply chain visibility. This knowledge helped SPAR Retail X employees make decisions that were intuitive and, in some cases not in line with the computer systems, with participants noting in most cases they would be right due to their experience and knowledge.

Geotags were used by the distribution centres when making the delivery to the store. Through the geotags the store can track the location of the truck making deliveries while it is in transit. Another way used by the distribution centres to ensure supply chain visibility is the use of SMS messages to notify the store of delivery times and the type of goods being delivered. The GRV process or system was also identified as a key tool in ensuring supply chain visibility. The process is such that, upon receipt of goods the receiving manager logs the goods in the system, using scanners at till points the goods are tracked as they pass through the store. For example, upon the sale of a product, it is recorded in the computer system and those responsible log the details such that they are always aware of the inventory levels.

The computer system was considered the main tool used to ensure supply chain visibility. Using the system, the store can track products from when they are delivered to when they are in the hands of customers. The computer system was noted to be of use in generating a rate of sales of products. Participant X1 indicated the following:

4.2.1 Participant X1.

> We have a computer system, which gives you the sale rate. So we can track everything in the store that comes into the store. So when we receive the order, the first process, the order will go to the Data Capturer, and the data capturer will capture that order and call it GRV. The order has gone into the system received 24 coca cola on the system. When we sell a product through the store and scan the product, each stock you sell comes off your stock card, so there is a computer system. And that is linked to SPAR. It is quite a sophisticated system; we can track every product that comes in the store rate of sale, how much stock we sell, and how much stock should be left on the shelf, at any given time (Participant X1).

Participant X2 also described the importance of the computer system in the following way:

> So once it is scanned through, it automatically goes to our system once it is captured whatever we need back. We know we worked 100 maize meals, for example. And then from the back they are still even if they are taken to the store soon as it scans on my till. I can go check. Okay, we sold today. We should have so many in stock (Participant X2).

The dedicated system used by the store and other SPAR franchises is called the SIGMA system, Participant X3 described this in the following way:

> In our Sigma system, whenever we place orders, it has a stock on hand with a sales rate sold per week. And then, when the ladies the office ladies GRV the invoice, the new quantity is placed in the Sigma system. So it always updates how much stock has been sold and what is left. Our Sigma system gives us a rate of sales, you can pull a daily rate of sales, the monthly rate of sales and a yearly rate of sales and a weekly rate of sales. So, that gives us an idea of how much stuff we should have per month per week that we know to order enough and not overstock (Participant X3).

The Sigma system was noted for its ability to capture information when new products were delivered automatically. Participant X4 indicated the following:

> And then the system that I am telling you about is called Sigma and automatically captures when things go through checks. And there is a printout at the end of the day, when we take the receipt in the morning, we can sit down. Okay, we had five things, three short ones, and there is one left on the shelf (Participant X4).

People skills were also identified as a key theme in relation to supply chain visibility. While participants appreciated the impact of technologies, people skills were viewed as still key in ensuring supply chain visibility especially when dealing with small suppliers who did not have computer systems. Of note to participants were the discrepancies which emerged in some cases between information from technology and their assessments. For instance, participants noted that technological systems could indicate that a product was a fast seller indicating the need to source more of the product from suppliers. However, this would be erroneous if considerations of why the product was a fast seller were not made. One example was of products being fast sellers due to promotions, meaning if the store purchased more of them, they would suffer losses at the end of the promotion. Participant X1 noted the importance of people skills in complimenting technology in supply chain visibility in the following way:

> In addition to technology, technology can help you to a certain point. But after that, you have to rely on people skills as well. So, we use both. The system can also generate its order. So what happens is that you can set up a system when the stock comes down to say six units out of 24. The stock can be automatically reordered. But we do not use that system because we also depend on people's skills. Yes, in our particular market. So, it comes from the knowledge of the person who is doing the order. Yes, the clerk. And the retailer, that is, doing the ordering (Participant X1).

4.3 The Internet of things

Participants were also asked to indicate the kind of IoT technologies they used in SCM. The main IoT technology indicated by participants to be used by the store was the Sigma system. The Sigma system is designed to link the store and other stores in the SPAR franchise network to the head office and distribution centres. The Sigma system tracks the products from the moment they are delivered from the distribution centre and when the products are sold when they are recorded using a scanner this information is transmitted to the system thus notifying the head office of the rate of sales. The Sigma system is also used by the staff in the store to find out the stock levels.

The participants also indicated that another IoT technological tool used was tags. The store used tags in the form of security tags which were put as anti-theft labels on products. The tags can emit magnetic signals relayed to a system put on the door exits of the store. In cases where a customer tries to walk out with a product without paying, the system is triggered, resulting in an alarm being set off to notify security.

Participants were also required to indicate if they were satisfied with their current IoT technologies. Participants indicated satisfaction with the Sigma system as it helped streamline some SCM-related processes. However, it was also felt that the system needed to be updated since it has been in use for over 20 years. Participants also noted that they were unsatisfied with the lack of systems dedicated to small suppliers.

The technology component of the TOE framework alludes to companies making use of new technologies that are compatible with the current technologies used in the firm. The findings suggest that this is the case in the retail stores, as participants pointed to the use of technologies such as WhatsApp, internet and scanners which are compatible with the current computer and communication systems in the store.

The retail store made use of scanners and the internet was based on resource availability within the organisation, in line with the assertions of the TOE framework that indicates that organisations adopt technologies based on the available resources. The use of WhatsApp is due to the wide use of the technology in the South African environment. The TOE framework points to environmental factors such as the widespread use of certain technologies playing a role in the adoption of technologies.

The dynamics capabilities theory identifies three important dynamics namely, sensing opportunities and threats, seizing the sensed opportunities and managing the sensed threats while reconfiguring the organisation's resources. Based on the findings of the study, the retail store has indeed used its capability to sense opportunities and threats in the marketplace. The opportunities are the ability to improve customer service and to cut costs. The threats emanate from competitors adopting new technologies and from lost stock through theft and wastage. The retail store has managed to adopt technologies such as tags which ensure the threat of losing stock is minimised. In line with the dynamics capabilities theory, the use of the Sigma system allows for the reconfiguration of resources, with those workers who would have been needed for stock taking, moving to other roles.

5. Discussion of findings

The study sought to understand the impact of IoT on SCM with a focus on supply chain integration and supply chain visibility. The emerging themes from the data analysis suggest that using technologies to ensure supply chain integration is considered necessary for a retail store. Several technologies are put in use, these include the internet, WhatsApp application, emails and scanners. The use of technologies such as scanners is considered essential as it allows for the recording as well as tracking of products within the store (Abdel-Basset *et al.*, 2018). Connecting the scanners to the head office, like a branch or franchise store, also helps ensure supply chain integration by providing real-time information.

Social media applications such as WhatsApp also play a role in ensuring supply chain integration. The participants noted the importance of WhatsApp groups in allowing for the quick dissemination of important information and helping create relationships with suppliers that were essential in emergencies. The use of WhatsApp for communication in business is seen as essential in the retail industry, with many adopting the application to ensure easy communication and better collaboration (Misuraca, 2022). WhatsApp for supply chain integration can help resolve any snags in the supply chain (Tungande *et al.*, 2020).

The findings from the study indicate that technological tools, such as computers, and people skills are essential to ensure supply chain visibility. Participants indicated that technological tools such as scanners, geotags, GRV and computers were used to ensure supply chain visibility. Some of the tools are used at specific points in the supply chain. For instance, geotags are used to transport goods from the distribution centre to the store. While scanners are used in the store. Scanners play an integral role in ensuring that the store records movements of goods within the store, thus allowing for accurate record keeping of stock levels. The use of scanners as indicated by participants is in line with retail industry trends whereby scanners are increasingly used for inventory and SCM (Kjellberg *et al.*, 2019).

The participants also indicated that they used the GRV system for supply chain visibility. The GRV system records goods when they are delivered from the head office or the distribution centre. The GRV process also tracks the movement of goods within the store with detailed data on the goods from the purchase point to the sales point (Messele and Tefera, 2020; Verma, 2018). Geotags were used to track products as they were being transported from the distribution centre. They enhance supply chain visibility by informing the store of the location of goods thus allowing for the receiving manager and his/her team to be ready to receive the goods. Tags in the form of security tags were also used as anti-theft devices. The tags were put on goods to allow for the tracking of goods. An alarm would sound when a customer steps out without paying. Using such tags is becoming an industry practice as they cut security costs and losses due to theft (Sullivan, 2022). Another tool identified by participants was the Sigma system. The system is designed for SPAR stores and franchises and connects them to the head office. The system allows for goods delivered from the head office to be recorded and for tracking the movement of the goods until they are purchased by the customer, thus allowing the head office to have real-time information.

Participants were also asked to identify the IoT technologies used within the organisation. The main tool identified was the Sigma system. The Sigma system, not to be confused with the Six Sigma tool, is designed by SPAR as a SCM tool. The system is used for tracking products as they move from distribution centres to stores. The Sigma system is an organisation-wide system thus it is in line with retail industry trends whereby organisation systems are being developed by retail companies (Mesirow, 2019). As noted by participants the system needs to be updated as well to make the system available for small suppliers. Another tool identified was geotags used when transporting products from the head office to the store. The geotags with the ability to transmit information on the location of trucks enabled better planning of delivery and receiving of goods. Geotags are also in line with industry trends whereby geolocation tags are increasingly used for transport and logistics (Pégulu, 2022; Stapleton, 2019).

Studies have, however, shown that the more businesses adopt and implement technological tools to improve their processes, the greater the impact on the human aspect of the business. Moreover, like any other technological transformation, the IoT, with its positive attributes such as improved and increased productivity, visibility, and integration of supply chain systems (Kamble *et al.*, 2019; de Vass *et al.*, 2018), Yu *et al.* (2023), are of the assertion that the adoption of these technologies could potentially have a negative impact on employment and employability. This might be due to automating certain processes, which renders certain employees useless, and/or the need for more skilled personnel to understand

the complexity that is brought by technological transformation. For instance, the IoT accentuates process effectiveness through automation and integration of business processes (Lu *et al.*, 2018), and thus limiting human interaction in the physical stock control process within the store.

6. Recommendations

From the study findings, several recommendations can be offered for both practice and academia. The participants were satisfied with the current IoT technologies as they streamlined SCM processes. However, they also noted that the system has been used for a very long time and thus needs updating. It is therefore recommended that retail organisations be in a position to always update their systems to align with current trends. In line with this recommendation, these updates need to be made with input from low-level workers who use the systems daily as they might have insights on the best way to put the IoT tools to good use. Another point of dissatisfaction with the system for participants was its lack of capability to integrate small suppliers. It is, therefore, recommended that SPAR and other retail chains work towards developing their systems so they can cater to small businesses.

Participants also noted the lack of systems designed to curb product theft. It is recommended that retail stores develop such systems as product theft can put a serious dent in the profitability of stores and negatively impact the supply chain as stores will now be inconvenienced to change delivery schedules due to the need for missing products.

A look at the industry trends in South Africa shows that retail chains are scrambling to adopt technologies as much as possible. For example, Shoprite through its checkers subsidiary is designing stores unmanned by till operators giving the customers the capability for self-service. Therefore, SPAR should follow suit in designing its own IoT solutions that cater to its specific clientele.

The current study used qualitative methodologies therefore, it used a small sample. It is recommended that future studies make use of larger samples incorporating several stores to gain a broader perspective of IoT use for the supply chain. Studies can also be broader by looking at the entire supply chain from suppliers to customers. It is recommended that future studies also focus on the human aspect of IoT adoption. These are issues such as employment, worker satisfaction and income adjustments due to the use of IoT in the retail sector. Studies can also focus on customer experience to investigate if IoT enhances customer experiences.

7. Managerial implications

The implication for management from the findings is that they should be at the forefront of pushing for IoT use in the supply chain as it helps streamline supply chain-related activities. It is recommended that managers initiate training programmes for employees to acquaint them with IoT technologies in the supply chain. Management should also work towards creating employee positions focused on IoT: that is, employees whose sole responsibility is learning, adopting and implementing IoT solutions in retail stores. This is especially important in an era where technological changes are happening quickly. For example, checkers took the majority of the on-demand delivery business due to being at the forefront of innovating technological solutions (Moneyweb, 2022). Thus, it is recommended that managers push for innovation-led from within. It is also recommended that managers push for including small businesses in the IoT systems. This helps create long-term relationships with these small businesses and helps to integrate the supply chain. With small businesses making up the majority of businesses in the country, a reputation for integrating small businesses can make the retail chain attractive to reputable suppliers and other businesses.

8. Conclusion, limitations and further study

The study sought to explore the use of IoT for supply chain integration and supply chain visibility. The study found that technological tools and people skills are considered essential in enhancing supply chain visibility. Tools such as scanners and the GRV system were used for supply chain visibility, while people skills were considered effective in enhancing supply chain visibility when dealing with small suppliers who lacked technological tools that could be integrated with the retail store. The study sought to assess the ways retail outlets enhanced supply chain integration through the use of IoT. Technological tools were identified as leading to supply chain integration. These include scanners, WhatsApp, the internet and emails. The use of technology like WhatsApp was identified to lead to faster resolutions to problems in the supply chain and to form relationships that helped suppliers and retailers to work together more synchronously.

The study had some limitations. Firstly, the study made use of qualitative methodologies meaning the data collected was subject to the interpretation of the researcher. All efforts were made to ensure the researcher stayed faithful to the responses of the participants. The study focused on one organisation. Thus, the findings may not apply to other retail stores in South Africa. The study was also limited in that it used a relatively small sample. The use of a larger sample could lead to more generalisable findings. Thus, it is recommended that future studies use a large sample and, if possible multiple organisations. Studies can also be broader by looking at the entire supply chain from suppliers to customers. It is recommended that future studies also focus on the human aspect of IoT adoption. These are issues such as employment, worker satisfaction, and income adjustments due to the use of IoT in the retail sector. Studies can also focus on customer experience to investigate if IoT enhances customer experiences.

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