RFID Technology Applications and Supply Chain Management: A Study on Manufacturing Sector in Malaysia

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Abstract— Radio frequency identification (RFID) is an emerging commercial tool for many different elements of company, including supply chain management (SCM). RFID is a wireless non-contact system that uses radio-frequency electromagnetic fields to send data from a tag attached to an object for automatic identification and tracking. This technique is ideal for product distribution and tracking. RFID technology can be utilized in a variety of supply chain applications, including warehouse management, inventory management, freight transportation, manufacturing, and retailing. The supply chain can achieve excellent performance and tracking with RFID technology. This study investigated how RFID technology applications can help to improve supply chain management process in Malaysia's manufacturing sector. The research findings suggested that there is a beneficial relationship between RFID technology applications and supply chain management. The study's practical contributions include increasing SMEs' knowledge of RFID technology applications and performance of supply chain systems in the Klang Valley manufacturing industry, as well as increasing their competitiveness in domestic and international markets.

Keywords— *RFID Technology Application, RFID System, Supply Chain Management, SMART Supply Chain Management System, Supply Chain Information System.*

1. Introduction

To strengthen business practices and to be relevant in today's complex and dynamic business climate, manufacturing firms must adapt their business processes to assure product customization, flexibility, and responsiveness to the needs of customers and business partners [3].

Globalization of the market, product growth varieties, shorter product life cycles, and increasingly sophisticated consumer requirements highlight the importance of integration with supply chain partners [64].

It becomes vital to lower manufacturing numbers and create products that meet the individual needs of customers. This can only be accomplished by deploying technologies such as enterprise resource planning (ERP) and radio frequency identification (RFID) technology to improve operational efficiencies and build stronger relationships with business partners [1]. Enterprises must combine information and communication technology in order to improve internal and external processes (with business partners in the supply chain) [7],[33].

ERP deployment in the organization gives managers with information and allows them to make informed decisions. Information on supply chain events, both internal and external, must be timely, accurate, complete, adequate, and dependable. It is vital to share real-time information and coordinate all business process activities. Inaccurate real-time information on production status from the shopfloor (e.g., Work-In-Process and inventory status) can have a negative impact on performance, particularly in just-in-time manufacturing (JIT) and supply chain planning. Using Radio Frequency Identification (RFID) technology, physical objects (raw materials, parts, products, equipment, shipments, and personnel) could be integrated in real time with the Enterprise Resource Planning (ERP) system and provide information visibility and sharing in a manufacturing digital enterprise by assigning an

identity (typically a number unique to each object) [8], [33].

Radio frequency identification technology is a fantastic business tool for a variety of applications, including supply chain management (SCM). RFID is a developing technology that enables supply chain participants to collaborate closely through real-time information visibility [1]. Manufacturing firms in developing nations such as Malaysia deal with quality issues related to production logistics, which is required to expand capacities for competitive responsiveness to market or supply chain partner demands. Malaysia is making significant efforts to gain access and cannot remain isolated from the environment's expanding globalization and digitization [5],[27].

Throughout the supply chain, enterprises tend to establish complementarities of inter-functional and inter-organizational integration and coordination. Because of the need for more effective and efficient internal and external supply chain management, we present a conceptual framework for integrating Radio Frequency Identification (RFID) with Enterprise Resource Planning (ERP) systems in manufacturing digital enterprises in this paper. One of the main aspects for strengthening competitive advantages is the rapid growth of information and communication technologies, such as Radio Frequency Identification (RFID) [6]. However, the benefits of RFID systems will not be realized if they are solely used within the organization, without the use of RFID systems by other supply chain partners [8],[27].

The implementation of RFID technology is in its infancy in most organizations within the manufacturing industry. The adoption of this technology is still not very apparent in the industry and it is mostly large foreign manufacturing companies that use it quite extensively. As a result of the low adoption of RFID systems in the manufacturing industry, companies experience problems such as lower product visibility [11], higher instances of out-of-stock items [14], increased warehouse costs [13], higher stock errors [14], higher instances of theft and shrinkage and a lack of efficiency when it comes to updating the logistics and inventory databases of the company [30].

The lack of RFID implementation in Malaysian manufacturing effectively prevents these companies from capitalizing on the true potential of their supply chain management initiatives, resulting inaccurate real-time information and overall lower process efficiency [30]. The lower visibility within the supply chain would result in slower inventory turns [31], higher shrinkage, higher labour and higher material flow through warehouse or distribution centres [32]. Lower efficiency means that the manufacturing processes would take more time and effort and cycle counting inventory would take a lot of time [37]. It is believed by the researcher that the implementation of RFID systems within manufacturing organizations in Malaysia would ensure that most of the problems described above are addressed effectively and the supply chain process of these organizations become more efficient and effective.

This research that is being carried about the SCM of Manufacturing companies in Malaysia and the potential use of RFID technology in order to enhance the efficiency of the supply chain of these companies. The main intention of the researcher is to examine the strategic role of RFID technology in creating greater SCM effectiveness within the companies in Malaysian manufacturing industry to ensure that these companies are able to pull themselves out of the outdated processes they currently use in their supply chain and to embrace newer technology in order to improve their performance.

Past research about industries in other countries have shown that RFID technology can bring a lot of benefits to the SCM of an organization[1]. There is a significant body of past studies which have shown that RFID is supposed to generate more effective SCM through producing more efficient demand management, manufacturing flow management, order fulfilment and returns management [47]. The researcher wants to study the role of RIFD in the SCM practices within manufacturing organizations in Malaysia and to find out whether it does bring about greater effectiveness of the SCM process in industries within this country, thereby resulting in greater overall efficiency of the manufacturing organisations within the industry [31].

After analysing past research about SCM and RFID technology, it seems that there is a lot of literature

about this topic but none specifically talking about this from a Malaysian perspective. There are no past studies done about SCM and RFID about Malaysia. Therefore, this study is being done to provide new literature about the strategic role of RFID technology in creating greater SCM effectiveness in Malaysian manufacturing industry. The research wants to contribute to the domain of SCM by performing this study and it is hoped that this study is able to close the research gap and can be used by other researchers who intend to research similar topics in the future,

With the reference to the Resource Based View (RBV), at present, there is lack of theoretical support that is able to explain the presence or the boundaries of SCM [31]. There are a number of authors, like [36] dan [54] who have provided theoretical foundations for various different parts that are related to the supply chain by using organizational theories that include the resource-based view. In essence, the RBV can be said to be the basis for the competitive advantage of an organization mainly in applying a set of valuable tangible or intangible resources at the disposal of the organization [16]. In order to transform a short-term competitive advantage into a sustained competitive advantage, there is a need for these resources to be heterogeneous and not perfectly mobile [39]. This translates into highly valuable resources which cannot be perfectly imitable or substitutable without putting in a very great effort [22].

The researcher aims to make a great contribution to the Malaysian manufacturing industry with this study and its outcomes. In essence, the researcher aims to show that RFID technology plays a very strategic role in creating greater SCM effectiveness within the Malaysian's manufacturing industry and that the use of RFID technology within the supply chain would result in greater SCM effectiveness [30]. In particular, the researcher aims to examine the role played by RFID technology in enhancing demand management, order fulfilment, manufacturing flow and returns management in Malaysian's manufacturing industry. The main objective of this research to identify and examine the relationship in between RFID technological applications such as demand management, Order fulfilment, Manufacturing flow management and Return management and Supply chain management in Manufacturing sectors.

2. Supply Chain Transportation

The term supply chain refers to various processes which are typically involved within the flow of goods from the organization's manufacturing process to the customer. It typically includes processes involved in the manufacturing, distribution and transportation of the finished product to the consumer [33]. Hence, the concept of supply chain management (SCM) covers all of these processes together with the marketing decisions and customer demand, according to the main corporate strategy and aims/goals of the organization [43] (Figure 1).

Figure 1: The supply chain management process

According to the literature and research by academics [34], there are a number of organisations that are starting to adopt new supply chain related technologies and innovations in order to achieve a competitive advantage, and to simultaneously automate important SCM processes internally or externally of the organisation [37]. These various implementations act as a strong tool which benefits the organisation and provides superior value in the supply chain [44]. Tools which facilitate data synchronisation, planning, real-time tracking, reporting and scheduling are particular facets of SCM that organisations are trying to automate and to address problems which presently plague conventional supply chains [50] (Figure 2).

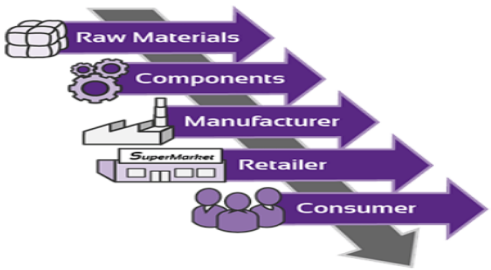

Figure 2: The steps in the supply chain process

The field of radio frequency identification (RFID) technology within SCM is one of the most innovative kinds of technology which has revolutionized SCM around the world [7]. It is noted here that RFID technology is not new and has been around since World War II, where countries involved in the war were using RFID technology as part of their radar operations [8].

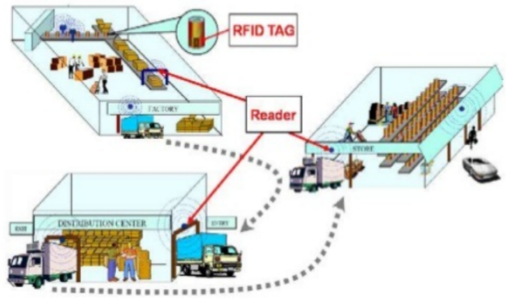

Figure 3: The role of RFID in the supply chain

RFID can be described as a kind of technology which is able to identify goods automatically [11](Figure 3). It is a kind of information system that can capture and store data in a way that is very up-to-date and highly accurate [1]. RFID technologies are widely used in many industries, which includes manufacturing, warehousing, medical devices, agriculture, pharmaceuticals, food and retailing [22]. The main function of RFID is asset management and the main activities that are involved include identification, monitoring, alerting and authentication [37]. Effective and comprehensive asset visibility helps to prevent losses because of spoilt perishables, theft as well as counterfeiting. In these present times, many organisations are enjoying the additional value which RFID brings to their business operations, the supply chain partnerships and also their customer service relationships [41].

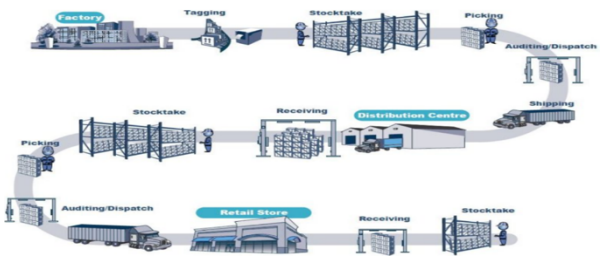

Figure 4: How RFID works in the supply chain process

The SCM functions of many organizations around the world have acquired a lot of benefits from the implementation of RFID technology. The use of RFID technology has become very widespread, and it has become an integral part of the SCM of many manufacturing companies [43] (Figure 4). RFID is not merely a replacement for barcodes but is used to accomplish many important purposes such as ensuring that the right goods are available in the right time and place without errors and discrepancies. RFID technologies have been credited for making the supply chain of the organization to become more efficient and reliability within the entire supply chain [45]. Also, RFID ensures that real-time information is always available to ensure smooth and flawless planning and administration processes. Presently, RFID has managed to generate a lot of academic research interest in terms of how technology can enhance the supply chain by saving time and costs. RFID has also been credited to helping manufacturing organisations achieve a strong competitive advantage via higher innovation [37].

2.1 Malaysian Manufacturing Industry

Malaysia's industrial sector is critical to the country's economic development. Despite global economic difficulties, its contributions to export earnings and employment creation ensured the country's progress. More high-value-added, diversified, and complex products will be prioritised, with a focus on the catalytic sub-sectors of electrical and electronics (E&E), machinery and equipment (M&E), and chemicals and chemical products. The other two high-growth sub-sectors, aerospace and medical devices, will also be pursued [12]

Talent pool development and Industry 4.0 continue to be the primary focal areas of Malaysia's manufacturing sector, revitalizing various ageing industries and providing new doors for other sectors. Companies are encouraged to boost productivity by speeding automation and innovation, doing R&D, implementing green and sustainable manufacturing processes, and collaborating with industry associations to share best practices [12].

Malaysia has taken steps to embrace the Fourth Industrial Revolution (4IR) in order to maintain the manufacturing industry competitive in terms of

productivity, innovation, and talent, while also producing the jobs required for long-term development. The Indus-try4WRD initiative was developed in 2018 as a catalyst to assist the manufacturing and manufacturing-related services sectors in successfully transitioning into Industry 4.0[12].

The industry 4WRD Intervention Fund, for example, is a financial support facility that assists Malaysian SMEs in the manufacturing and related services industries in integrating Industry 4.0. The Malaysian government predicts that the number of enterprises embracing digital business practices would grow in the future. The Malaysia Digital Economy Blueprint, or My DIGITAL, encapsulates the country's ambition to become a digitally driven, high-income nation and regional digital economy leader. The National Fourth Industrial Revolution (4IR) Policy, Industry4WRD, a Digital Investment Office, the National Digital Network (JENDELA), and Malaysia's Lighthouse Programme are among the other significant projects [12].

These attempt to expedite digital transformation and improve industrial transition to the future of manufacturing by deploying technology, altering the workforce, and growing an end-to-end supply chain. We continue to welcome investors with expertise in 4IR-enabling technologies such as artificial intelligence (AI), robots, virtual reality, big data analytics (BDA), the Internet of Things (IoT), and software engineering. MIDA is eager to assist these companies in putting their suggestions into effect in the country [12].

3. Literature Review

3.1 Supply Chain Management

The literature review will now focus on discussing literature pertaining to SCM. Essentially speaking, SCM plays a very important role when it comes to effectively managing business organisations because SCM focuses on all the main business operations of the organization [41]. According to [43], SCM can be defined as the process of planning, implementing, and control-ling various supply chain operations and the main aim is to satisfy customer requirements in the most effective way possible. [1] defines SCM as an integrative philosophy which is designed to manage the flow of a distribution channel right from the supplier to the final customer. [30] states that SCM plays the role of controlling all the movements and storage of the raw materials, the work-in-process inventory as well as finished goods from point to point. Hence, SCM is a very important part of the competitive and logistics strategy of large organizations [31]. According to [55] claims that SCM involves the managing of operations that include the delivering of raw materials, the designing of products, the manufacturing of products and the delivering of the products right to the end user.

Over time, SCM has evolved greatly from a manual, logistical and mechanized optimization process to a contemporary, digital and automated integration of various elements of the supply chain [54]. As such, SCM plays a very important part when it comes to addressing the increasing complexity of the present day international supply chains. SCM involves facilitating and optimization of the efficient flow of products, data and finances, thereby permitting companies to create greater relationship value as well as to enhance operation effectiveness and overall business efficiency [11].

Before the 1960’s, the main focus of the SCM included logistics enhancement, mechanization as well as maximization of warehouse space [20]. The process of information management was said to be highly manual in nature and freight transportation was described as intermodal [7]. However, after the 1960’s, trucks started to become a popular method of transportation, and this was particularly so when it came to products that were time-dependent [22]. It is this particular trend which generated the concept of physical distribution, and this was done with the aim of facilitating effective confluence of freight transportation, materials handling and warehousing [31]. However, the process of supply chain data management continued to be mainly paper based [30].

During the 1970’s, the process of computerization commenced [22]. After a number of years, the supply chain planners started to gain access to computers and this permitted them to enable further logistics optimizations and to achieve greater innovation [33]. Starting in the 1990’s, the internet began making a prominent presence in the business world and this coupled with other technological advancements resulted in changes to the supply chain networks of many companies across the

world [34]. An increasing number of businesses started to show an interest in the concept of SCM and they began to invest in SCM solutions like Enterprise Resource Planning (ERP) in order to overcome information silos within the organization and to ensure greater levels of data accuracy and availability, as well as to effectively integrate all main functions of the supply chain [34].

In these modern times, an increasing number of companies are starting to modernize and digitize their supply chain network in order to be able to competitively operate competitively [44]. Such a supply chain face lift would typically require a set of strategies that are able to go way beyond only logistical enhancement and mechanization, to ensure that organizations are able to address the problems relating to the supply chain [45]. Research by [52] shows that supply chain challenges are starting to become increasingly taxing because of the changing and unpredictable demands of the consumers of these present times. According to [53], implementing state of the art and efficient SCM through the use of effective SCM initiatives and solutions would permit the organization to be able to achieve effective optimization in three main flows within the supply chain and these include the product flow, financial flow and also the information flow [60].

The concept of time to consumer is said to be a very important indicator of the product flow efficiency within the organization [43]. According to [46] believes that the lower the amount of time it would take for the products to arrive to the end customer, the greater the efficiency of the product flow. Nevertheless, there are a number of other factors that are to be considered and these include material quality, balance of supply and demand, shipment options and costs as well as inventories [51]. The use of effective SCM allows organizations to enhance their product flow through very accurate demand and sales forecasting as well as to enhance inventory management within the organisation with the aim of suppressing the bullwhip effect as well as top prevent underproduction [56]. In addition, SCM is also said to reduce the amount of delays and to permit total traceability and visibility when it comes to the movements of goods from the suppliers to customers [57]. The use of SCM would allow for the creation of effective working strategies which are able to accelerate the time to market as well as to improve overall business speed, while making sure of high levels of product quality [58].

3.2 Effective Supply Chain Management

Effective SCM would typically need an integration of material flows as well as an integration of information flow within the supply chain [55]. In these present times, consumers are always demanding for real time responses as well as ease of access of the product as well as other kinds of supply chain content, and hence it is essential that information flow must not be uninterrupted [54]. The presence of an intermittent and insufficient flow of information because of the presence of a fragmented supply chain would typically result in a lack of proper supplier and customer relationships as well as the incurring of high costs [48],[63].

[20] states that organizations having effective SCM are the ones who are able to remove obstacles and bottlenecks when it comes to information flow within the supply chain. It would also assist them in making an evaluation of the level of quality when it comes to information sharing, and to introduce solutions to solve the problems [28]. Effective SCM would help create best practices in order to facilitate various different kinds of supply chain information which typically come in different forms and structures [41],[61].

According to [44], SCM allows for greater accuracy, timeliness, greater relevance and a more complete flow of information in order to take advantage of present opportunities and to avoid risks. The presence of effective and seamless flow of information would help to solve the problem of information distortion and miscommunications and more significantly, it would help to promote greater collaboration and relationship value with the main stakeholders of the supply chain [45], [62]. SCM would also help enhance visibility of the various transactions within the supply chain and to accelerate the creation of supply chain insights via the creation of past reports [19], [60].

Another main issue that is faced by supply chain managers is how to enhance the cash flow within their value chain [43]. The level of unpredictability and variability pertaining to financial inflows/outflows is high and it is likely to create greater complexity within an already com-plicated financial flow process in the supply chain [48].

Essentially speaking, the main challenges relating to financial management within the supply chain include slow processing be-cause of manual and/or silo processes [55]; lack of reliability and predictability of cash flows due to lack of timely information [58] expensive processes because of compliance and inefficient empowerment of employee [53] and a lack of optimal credit decisions because of manual processes involved in establishing optimal limits [42]. The use of SCM can help organization solve these various cash flow challenges, hence permitting them to make a proper evaluation of their present processes, to make an identification of weakest links within the supply chain which slow down the financial flow and to come up with the most effective solutions in order to solve these kinds of problems [45].

3.3 FRID Technology

RFID technology is a form of technology that is said to play a role in improving the effective-ness of the SCM processes in an organization [2]. [5] states that RFID has a very strong potential in various parts of the firm's operations, like manufacturing, product life cycle management and after sales support. An advanced RFID system is capable of being used to make an identification of all kinds of objects, like manufactured products [8]. [11], RFID technologies are known to provide support to a vast range of applications, and these can include things such as asset management and tracking, manufactured products and customer services, access controls as well as automated payments [21]. Every RFID system does have very different components and customizations which can help it provide effective support to certain business process with-in the organization [29]. A RFID system could be very complex, and its implementations can differ greatly [43].

Essentially speaking, RFID systems can be comprised of three main subsystems and these are RF subsystems (performs identification and various other related transactions via the use of wireless communications, enterprise subsystems (have computers that run special software which are able to easily store, process, and analyse the information collected from the RF subsystem transaction in order to transform the data so as to become useful in supporting business process) and inter-enterprise subsystems (links enterprise subsystems when data is needed to be shared across the organization's boundaries)[33].

Each RFID system has an RF subsystem, and this consists of tags and readers [53]. In most modern RFID systems, the RF sub-system is usually supported by an advanced enterprise sub-system which is comprised of middleware, networking services and analytic systems [35]. However, within a supply chain application, it can be said that a tagged product would usually be tracked all through the product's life cycle, right from the manufacture to the final purchaser [32]. Hence, RFID systems are known to share information across the boundaries of the organization. RFID systems that support the supply chain applications also possess an interenterprise subsystem [50]. Within the supply chain, the RFID systems can be used effectively in processes such as demand management, order fulfilment, manufacturing flow management, and return management [57]. In the section below, these four supply chain management processes are discussed in detail and the role of RFID in enhancing these processes are highlighted using past literature.

3.3.1 Demand Management

Literature about the role of RFID in improving demand management is discussed. According to [19], a very significant challenge in the sphere of demand planning is the absence of reliable data. [22] states that the use of RFID is likely to result in very accurate information that is related to the inventory of finished goods, work in progress as well as in-transit stages with highly reliable due dates. The information that is acquired from the RFID systems are helpful in removing inaccuracies and errors in the data because of human errors or a lack of information [24] (Figure 5).

Figure 5: Main components of demand management

[32] states that customer demand for lower price coupled with higher quality are said to be the main

driving forces for a firm to create an effective and efficient supply chain. The presence of timely data at the item level and in aggregate pertaining to the market demand for any products and/or service will assist in creating winning strategies when it comes to production, marketing and distribution [34]. [43] states that RFID helps create forecast that are accurate and which provide the necessary inputs to match demand with supply in the form of aggregate planning. The aggregate planning process is capable of being enhanced with the presence of accurate data with the use of RFID technology, hence avoiding the very costly buffer stocks when engaging in the process of demand planning [44].

3.3.2 Order Fulfilment

Literature about RFID and SCM shows that RFID does play a very important role in enhancing the effectiveness of the order fulfilment process [43]. This is very important for SCM effectiveness as it is proven that order fulfilment is a very important process which helps in satisfying customer requirements and improving supply chain effectiveness [46].RFID technology would be able to facilitate process automation especially when it comes to picking, cross docking, shelving, implementation of consolidation operations and lowering expensive logistical mistakes like transporting a product to the incorrect destination and not being able to dispatch the correct item at the right time [55]. These kinds of process changes would lower operational costs [56] (Figure 6).

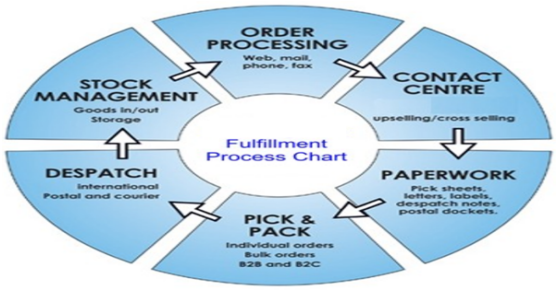

Figure 6: The process of order fulfilment

[57] states that RFID technology would allow the suppliers to make an accurate determination of the precise location of a pallet, to effectively track its journey within the supply chain as well as to make instantaneous routing decisions. For example, RFID portals that are placed in strategic parts of the distribution centre would help in the process of reading tags and to automatically update the inventory quantities as tagged cases/pallets make an entry into the centre [50]. In coming merchandise are matched against the correct purchase order and discrepancies would be identified very easily [52]. [54] claims that RFID would help to free up labour-intensive parts of the organization that are involved in the process of quantity check in and receiving.

3.3.3 Manufacturing Flow Management

Within the sphere of manufacturing, it is understood that assembly line operations can become streamlined with the use of RFID [56] . Such kind of automation within the process of production would result in reduction of overall recycle time and it would result in increased production throughput [58] (Figure 7).

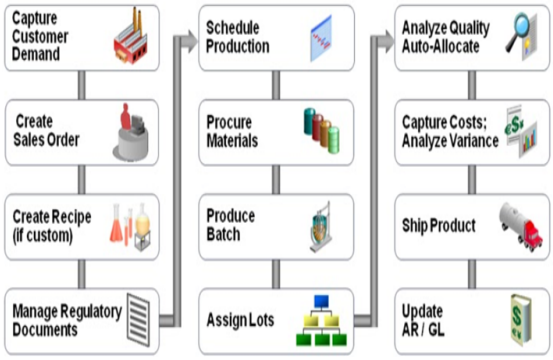

Figure 7: Manufacturing Flow Management process chart

RFID technology is able to provide improved process automation and tracking capabilities and as such, the overall velocity and visibility of the products within the organization's supply chain would achieve improvements [37]. Such a process would assist manufacturers with just-in-time assembly lines [45]. It is believed that RFID technology is able to help an organization track where the items are within the process of manufacturing and supply chain [47]. There can be a lot of cost saving in terms of inventory carrying costs with the use of RFID [52], [63].

3.3.4 Returns Management

RFID technology is also said to play a very important role in enhancing the process of returns management within the organization [54]. The process of reverse logistics, that is, product re-call and return relating to defective products, is said to

be quite common when it comes to an organization's supply chain operations [50]. Using RFID, it is possible for the return track to be traced easily within the return process [33]. Using applications like the Electronic Security Marker (ESM), RFID technology is able to facilitate return management by assisting retailers in a way so that they have knowledge about items which they have sold but are being returned [7] (Figure 8).

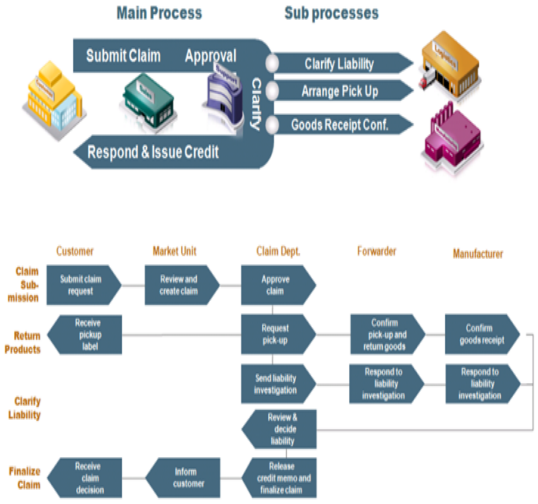

Figure 8: Returns Management process

The ESM would help link the relationship of a product in question to a sale and then to the re-turn. The organization would benefit because it would prevent fraudulent products from being returned to the retailers by putting the item level RFID tags on high-end products and components [20]. The customer returns would add to the inventory pile and not to deplete it [33]. Such returns are viewed as RFID technology providing downstream visibility relating to negative demands [31].

3.4 Framework and Hypotheses

In this study, there would be an analysis of the effectiveness and efficiency of supply chain management in using RFID. There was an examination of the appropriate business processes that are affected by RFID technology. Using four major supply chain processes, it was discussed as to how RFID technology is able to increase SCM effectiveness. More precisely, the research-er wants to show that the use of RFID technology can improve SCM by enhancing demand management, order fulfilment, manufacturing flow management and returns management (Figure 9).

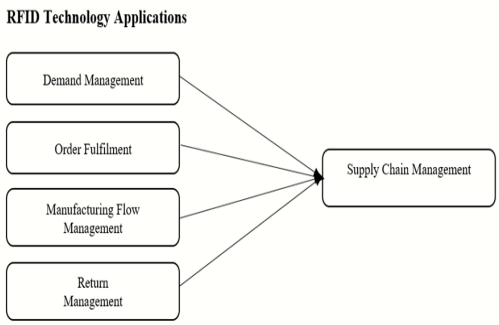

Figure 9: Research framework

Based on the above discussion and literature findings the following hypotheses are proposed accordingly.

H1: There is significant and positive relationship between Demand Management (DM) and Sup-ply Chain Management (SCM).

H2: There is significant and positive relationship between Order Fulfilment (OF) and Supply Chain Management (SCM)

H3: There is significant and positive relationship between Manufacturing Flow Management (MFM) and Supply Chain Management (SCM)

H4: There is significant and positive relationship between Return Management (RM) and Supply Chain Management (SCM)

4. Research Methodology

The researcher used the survey method for this research and the survey was performed with the help of a questionnaire. It is the opinion of the researcher that using the survey method does help in the collection of the quantitative data needed for this analysis. In this study, the questionnaire was created by adhering to guidelines about best practice questionnaire designs. There were several considerations which were taken into account during the creation of the questionnaire, and these were to ensure that the questionnaires were uncluttered, neat and well-presented and that the English language that was used was not complicated and was easy to comprehend by the respondents. Besides that, the questions were presented in a way that made the respondents comfortable in that the easier questions about the respondent's demographics were asked in the first

part whereas the difficult Likert scale questions were asked in the second part of the questionnaire [8]

The research population for this study comprised of the entire group of individuals that the researcher wants to generalize the conclusions. The research population for those study is those who are employees working in the marketing departments of manufacturing organizations in Malaysia. The sampling frame can be defined as the list of items within the research population from which the research sample is obtained. The sampling frame consists of those people who work in supply chain management of manufacturing SMEs in Malaysia.

The sampling designed that was used for this study was the probability sampling technique, which is a sampling method where all the people within the research population have an equal chance of being selected to represent the sample [41]. The type of probability sampling method utilized for this research is the simple random sampling technique. This sampling method in-volves the random selection of research participants [42]. It means that everyone in the research population would have a chanced of participating in the survey. The main advantages are that the research sample would be low in bias and it would also be more representative.

The sample size can be described as a very important factor which should be considered in a study like this one where there is an inference that needs to be made about the research population. Practically speaking, the sample should be huge enough to ensure that it has high statistical strength and power, and the rationale here is so that it is able to generate higher precision [42]. As a general rule, for this kind of social research, the sample size which is adequate and desirable would be a sample that consists of more than 100 respondents. Therefore, the researcher created a sample consisting of 150 respondents to ensure high statistical strength.

The researcher pre-tested the reliability and validity of questionnaire. In order to ensure reliability, the survey questions have to be answered in the same way by the respondents each time. The researcher assessed the reliability of the questionnaire by comparing the answers given by the respondents in one pre-test with answers that were given in another pre-test. The questionnaire's validity was determined by the effectiveness at which it is able to measure the concepts which it intended to measure [41]. The convergent and divergent validity can be determined by making a comparison of answers to another question that is measuring the same kind of concept, and then by measuring the answer to the response from the participants to the question which requests for the exact opposite answer.

5. Results

5.1 Response Rate

In total, 450 sets of questionnaires were distributed to the SMEs. Two versions of the questionnaire, English and Bahasa Malaysia, were sent to every SME to achieve the estimated sample size, which was 200 units. Out of the 450 sets of survey questionnaires sent, only 150 sets were returned, thereby, achieving a 75% response rate. Following table 10 shows overall summary of response rate.

Table 10: Summary of Response Rate

Questionnaire Response	Frequency	Rate (%)
Number of distributed questionnaires	450	100
Returned questionnaires	150	49
Estimated sample size	200	100
Returned questionnaires (compared with the estimated sample size)	150	75
Usable questionnaires	150	75

5.2 Response Rate

Table 11 lists the details of the descriptive statistics of all the examined factors. The variables' mean value ranged between 3.6472 and 3.3.9566, whereas the standard deviation ranged between 0.69602 and 0.99602. Based on the results, a satisfactory level of acceptance for each variable was achieved.

Table 11. Descriptive statistics of the constructs

Construct	Mean	Std. Deviation
Demand Management (DM)	3.6472	0.78092
Order Fulfilment (OF)	3.9394	0.99602
Manufacturing Flow Management (MFM)	3.8588	0.80654
Returns Management (RM)	3.7870	0.71893
Supply Chain Management (SCM)	3.9566	0.69602

5.3 Reliability Analysis

The questionnaire was pre-tested using the chosen respondents. A suitable sample size of 30 was selected to carry out the pilot study and to test the instrument's reliability. This size was chosen because past studies have proposed that a range of 30–40 samples would be sufficient for the pilot study [42]. Based on the pilot study results, a more systematic review of the reliability and validity of all the latent variables and their associations was achieved (Table 12).

Table 12: Cronbach's alpha score for latent variables (n = 30)

Variable	Items	Cronbach's Alpha
DM	5	0.871
OF	5	0.735
MFM	5	0.817
RM	5	0.761
SCM	6	0.767

Reliability analysis showed the consistency of the data gathered from the distributed questionnaire. The reliability analysis can be conducted by testing consistency and stability. Consistency implies how well the items measure the constructs together as a set and is computed via the split-half technique in the Statistical Packages for Social Sciences (SPSS). The current investigation examined the instrument's reliability through internal consistency, whereby Cronbach's alpha was 1.0. A reliability value lower than 0.60 was deemed weak, whereas a value of 0.70 was acceptable an alpha value of more than 0.80 was good [42]. A reliability test was beneficial to make sure that the instrument provided consistency of data for proper management decisions, as listed in Table 12.

5.4 Factor Loading

Table 13: Factors Loading

Variable	Item	Loading	Cronbach's Alpha	CR	AVE
DM	DM1	0.791	0.962	0.966	0.653
	DM2	0.844			
	DM3	0.774			
	DM4	0.767			
	DM5	0.786			
OF	OF1	0.738	0.877	0.904	0.575
	OF2	0.771			
	OF3	0.735			
	OF4	0.717			
	OF5	0.814			
MFM	MFM1	0.799	0.858	0.898	0.638
	MFM2	0.859			
	MFM3	0.768			
	MFM4	0.775			
	MFM5	0.789			
RM	RM1	0.807	0.874	0.909	0.666
	RM2	0.804			
	RM3	0.793			
	RM4	0.862			
	RM5	0.811			
SCM	SCM1	0.781	0.905	0.925	0.639
	SCM2	0.857			
	SCM3	0.805			
	SCM4	0.736			

Note: Demand Management (DM); Order Fulfilment (OF); Manufacturing Flow Management (MFM); Returns Management (RM); Supply Chain Management (SCM)

Table 13 lists the external loadings and AVE for the exogenous and endogenous variables. The AVE surpassed the recommended value of 0.50 for all the latent variables [20]. Hence, more than half of the variance observed was the variance generated from the loading items.

To attain the research objectives and evaluate the measurement and structural models, PLS-SEM data analysis method was used. The convergent validity was analysed, comprising indicator loadings, AVE, and CR. Findings in Table 13 reveal that the loading of indicators for all the variables was above the minimum value of 0.708 recommended by [21]. Next, the AVE value of the items ranged from 0.504 to 0.735, above the recommended 0.50 value. Meanwhile, the CR value ranged from 0.876 to 0.956, which was greater than the recommended value of 0.70 by [21]. As such, this present research ensured that convergent validity existed.

5.5 Discriminant Validity

The HTMT ratio was employed to check the discriminant validity of the model. [21] have explained that in comparison to other approaches such as the Fornell-Larcker criterion [20], the HTMT ratio is better. They have proposed two different HTMT threshold cut-off values i.e. 0.85 and 0.90 for discriminant validity. This analysis utilised 0.90 (i.e., HTMT.90) criterion to determine the model's discriminant validity. Table 5.5 demonstrates that the model has discriminant validity; all the constructs' HTMT value was below the critical value of 0.90. There were ample convergence and disparity in the measuring model.

Table 14: Discriminant validity (HTMT.90) results

Construct	DM	OR	MFM	RM	SCM
DM					
OF	0.775				
MFM	0.623	0.816			
RM	0.78	0.786	0.73		
SCM	0.749	0.785	0.701	0.722	

Note: Demand Management (DM); Order Fulfilment (OF); Manufacturing Flow Management (MFM); Returns Management (RM); Supply Chain Management (SCM

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5.6 Collinearity Evaluation

First, the structural model was evaluated with the tolerance and VIF for collinearity assessment [20]. The tolerance level recommended for PLS-SEM predictors is more than 0.2 and for VIF is lower than 5.0. This is to confirm that no collinearity problem is present in the structural model. If collinearity is found in the structural model, the structures taken out must be merged or removed from the research model (Table 15).

Table 15: Collinearity evaluation of the structural model

Construct	SCM
	VIF
DM	3.583
OF	4.112
MFM	3.504
RM	3.872

Note: Demand Management (DM); Order Fulfilment (OF); Manufacturing Flow Management (MFM); Returns Management (RM); Supply Chain Management (SCM)

5.7 Structural Model Analysis

The structural model was tested using the path coefficient. The magnitude of the path coefficient was calculated by contrasting the t-values with significance levels of 0.01, 0.05, and 0.10. The empirical t-value of path coefficient was calculated using 1,000 subsamples. The path coefficients derived from the analysis (Table 16) were then used to estimate the statistical significance in the structural model.

As proposed in H1, DM had a positive relationship with SCM with a beta value of 0.199 and p-value of 0.000 ($p > 0.001$). Hence, H1 is accepted. Next, OF also had a positive relationship with SCM with a beta value of 0.125 and p-value of 0.018 ($p > 0.05$). Therefore, H2 is accepted. H3 proposed that MFM has a positive relationship with SCM. This relationship was proven beta value = 0.099 and p-value = 0.049 ($p > 0.05$)]. Hence, H3 is accepted. Meanwhile, RM had a positive relationship with SCM with a beta value of 0.127 and p-value of 0.007 ($p > 0.05$); H4 is accepted.

Table 16: Results of the structural model analysis

Hypothesis	Path	Std Beta	Std Error	t-value	p-value
H1	DM -> SCM	0.199	0.049	4.06	0.000
H2	OF -> SCM	0.125	0.06	2.093	0.018
H3	MFM -> SCM	0.099	0.06	1.653	0.049
H4	RM -> SCM	0.127	0.051	2.476	0.007

Note: Demand Management (DM); Order Fulfilment (OF); Manufacturing Flow Management (MFM); Returns Management (RM); Supply Chain Management (SCM)

6. Discussion

The findings that made in this study which are very similar with the literature review. In this study, the researchers have shown that SCM plays a very important role in effectively managing business organizations and is an integral part of the competitive and logistics strategy of large organizations. The findings show that SCM facilitates and optimizes the efficient flow of products, data and finances, which in turn creates greater relationship value enhance operational effectiveness. The same findings were made in the study by [23] and [12]. In the same study [18] it was also shown that best practices in SCM allows the organization to achieve effective optimization in product flow, financial flow and information flow [60]. This finding was also apparent from the data analysis carried out in this research.

The finding show that RFID tools help to produce very accurate information relating to the inventory of finished goods, work in progress as well as in-transit stages with highly reliable due dates. In the study [29], it was also shown that RFID systems provide help in removing inaccuracies and errors in the data due to human errors or lack of information [27]. This was also a very important finding that was made from the data analysis. Next, the data analysis finding showed that RFID helps to create forecasts that are accurate and provide necessary inputs to match demand with supply in the form of aggregate planning [48]. Besides that, the findings of the data analysis showed that aggregate planning is enhanced with the presence of accurate data with the use of RFID technology, and this helps avoid costly buffer stocks in the process of demand planning [32].

There are many similarities between the findings made in this research and the past studies by academics on the relationship between RFID and order fulfilment. This research has proven that RFID plays a very important role in enhancing the effectiveness of the order fulfilment process. This research also has proven that RFID technology facilitates process automation especially when it comes to picking, cross docking, shelving, implementation of consolidation operations within the firm. The RFID technology helps to lower expensive logistical mistakes like transporting a product to the incorrect destination and not being able to dispatch the correct item at the right time [58].

In this research, the researcher also made the same finding from the descriptive mean analysis. Another finding made in this research is that RFID technology allows suppliers to make an accurate determination of the precise location of a pallet, to effectively track its journey within the supply chain and to make instantaneous routing decisions. The researcher [50] also made the same finidngs. Another finding that is made in this paper is that RFID would help to free up labour-intensive parts of the organization that are involved in the process of quantity check-in and receiving [35].

There are many findings made in this study about the relationship between RFID and manufacturing flow management and many of these findings bear very close similarities with academics and researchers that were featured in the literature review [36]. For example, the research showed that assembly line operations can become streamlined with the use of RFID and this was also the finding made [47]. Next, the data analysis findings showed that automation within the process of production results in reduction of overall recycle time and would result in increased pro-duction throughput. The RFID technology provides improved process automation and tracking capabilities, and this means that the velocity and visibility of the products within the supply chain would improve [62]. In the literature review, reflecting that RFID technology would assist manufacturers with just-in-time assembly lines [63]. From the data analysis carried out by the re-searcher, this finding was supported and confirmed. The data analysis in this

project shows that RFID technology helps an organization track where the items are within the process of manufacturing and supply chain [45].

About the relationship between RFID and returns management, the findings of the data analysis show that RFID technology plays a very important role in enhancing the process of returns management within the organization. The next finding made by the researcher in this project is that the process of reverse logistics is facilitated by RFID, thereby enhancing supply chain operations. Once again, this finding was supported by the past research carried out by [8]. The study reflecting that RFID technology can facilitate return management by assisting retailers to acquire have knowledge about items which they have sold but are being returned.

This is a finding that was confirmed by the researcher in this project. The researcher also found that organizations benefit from the use of RFID because it would prevent fraudulent products from being returned to the retailers by putting the item level RFID tags on high-end products and components [62]. This was the same finding which [13] made in their research. The data analysis also showed that RFID technology provides downstream visibility relating to negative demands.

7. Conclusion

The research findings are very relevant to the research questions and the research problem. In essence, the findings have highlighted the importance of Malaysian manufacturing companies to start implementing measures to pave the way for the introduction of RFID technologies [60],[62]. The research findings have shown a strong relationship between RFID use and supply chain effectiveness. The findings have shown that RFID brings many benefits to the supply chain of the manufacturing company and these include creating better demand management, better order fulfilment management, better manufacturing flow management and better returns management.

RFID, or radio frequency identification and data capture technology, can be used to improve corporate efficiency. In terms of management, the integration of ERP with RFID enables better decision-making while taking into account client expectations and making efficient use of business resources. The result of a literature research and the authors' experience with RFID use in organisations, this paper provides an overview of the present stage of development of RFID technology and its application in practice. The chapter will help researchers, practitioners, and other interested parties understand the value of real-time visibility in supply chain management in order to improve operational performance by applying RFID in manufacturing and supply chain. RFID based identification and data capture is suitable for solving problems in production and other business processes caused by manual identification and data collection [35]**.** The combination of an ERP system and RFID technology can allow real-time tracking of work orders, parts, and goods, as well as data accuracy and information exchange across internal and external supply chains [58].

7.1 Implications

The first implication is that RFID technology plays a critical role in improving demand management in Turkmenistan's industrial industry. This means that if supply chain managers in these companies wish to improve demand management, they must employ RFID technology that aid in successful demand management [45]. The second implication of these findings is that RFID technology is crucial in improving order fulfilment in Malaysian's manufacturing industry.

Hence, to ensure effective order fulfilment, it is very important that supply chain managers users RFID applications to create better efficiency within the order fulfilment process [34]. The next implication that is derived from this study is that RFID technology is very important in enhancing manufacturing flow management in Malaysian’s manufacturing industry. Due to this, it would be very essential for supply chain managers to ensure that they use RFID in the operations at the company so that the manufacturing flow can be improved [54]. Another important implication of the research findings is that RFID technology helps improve returns management in Malaysian’s manufacturing industry. The results have shown that by using RFID tools and appliances, it is possible to generate better returns management within the supply chain [55].

7.2 Limitations

Firstly, the study was carried out on a small segment of the target population who were working

in management and executive departments of large and medium size Malaysian manufacturing companies. To generalize the results to a large group, a larger sample would have been desirable. The second limitation is the fact that the respondents might not have provided genuine and fully thought through answers while filling out the questionnaire. This can be due to the respondents answering the questionnaire hurriedly without giving proper focus to each question or errors when answering the questionnaire. This can result in data that is inaccurate, and which can produce imprecise findings that do not reflect the real perceptions and views of the respondents. The third limitation involves not using a qualitative research instrument (i.e., interviews). Because of the quantitative nature of the study, the researcher only used the questionnaire method. The use of a qualitative method like interviews could have resulted in more focused and elaborate data that can provide very detailed and comprehensive answers to the research questions.

7.3 Recommendation

The main recommendation to be made here is for the wide scale adoption of RFID technologies in manufacturing companies in Malaysia. At present the use of RFID in this industry is relatively low and confined to a small number of international companies. It is recommended that RFID be implemented at a wider scale to ensure that the manufacturing industry is able to enjoy the benefits of this technology. To ensure maximum effectiveness of implementation, it is very essential for a number of critical success factors to be taken into account while creating a framework for the implementation of RFID in these organizations. There are three main dimensions which supply chain managers must take into account when designing the RFID implementation framework. The first of these is the technological dimension and this involves steps being taken in order to choose the proper RFID hardware and software for the implementation according to the requirements of the organization.

Next, there must be effective testing carried out to ensure that the RFID system is able to perform the necessary functions. Besides that, it is also very important for supply chain managers to ensure that sufficient technical support is provided to ensure the smooth running of the system. It is recommended for the company to deploy a technician or expert to ensure that the system is deployed effectively. There must also be very precise performance measures for the system so that it is possible to measure the progress being made in reaching the main target. The next dimension is the managerial dimension and recommendation is for these companies to ensure that there is good management to ensure the successful implementation of the system.

There are a number of success factors with regards to this and these include managers having a clear vision, having good project management skills, and good risk management skills. The next dimension is the social dimension and this involves the management being sensitive to social issues that are involved in the implementation of the RFID system. It must be ensured that there is adequate teamwork and effective communication during the process of implementing the system. This is very important to ensure that there is proper organizational wide support for the implementation of RFID and there can be continuous improvements being made to the system to ensure maximum effectiveness

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