Internet of Things (IoT) Embedded Future Supply Chains for Industry 4.0: An Assessment from an ERP-based Fashion Apparel and Footwear Industry

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***Abstract*— In this competitive business world most of the supply chains are struggling to sustain competitively in the global supply chain due to its increasing complexity in each phase of the supply chain operations. Many companies are facing financial difficulties and some have shut down due to poor supply chain management practices. Companies have to be smarter by incorporating the necessary technologies to be more competitive and sustain in the global supply chain, that processes can be better managed and automated where necessary. Most companies fail due to poor integrations of technology in their supply chain. It is important that companies be smarter in order to strive hard to reduce cost, improve customer services and to increase return of investments throughout the supply chain. While a few industries are taking a major leap; it is vital for other companies to adopt to the changing nature of the digital supply chains and embrace industry 4.0, leveraging Internet of Things (IoT). The primary goal of this study is to improve inbound and outbound operations to better manage and optimize and automate operations in an ERP system through the use of RFID technology and Business Application Programming Interface (BAPI) technology in SAP®. The existing ERP system was thoroughly analysed using mixed method approach and was followed-up in assessing how transactions can be better executed in the system. The time taken to execute various process in inbound and outbound operation was measured in two iterations and was analysed to propose a means of improving inbound and outbound operations with the use of technology. The study derives a conceptual framework to enhance inbound and outbound operations in ERP for Fashion Apparel and Footwear Industry.**

***Keywords*—** *Supply Chain Management, Internet of Things, Industry 4.0, SAP, ERP. CRM, Fast Fashion Supply Chain, Apparel and Footwear, Fashion Management, Inbound Logistics, Outbound Logistics, Future Factories.*

1. Introduction

The world is constantly changing and evolving at a rapid rate, this has affected many companies and the entirety of their supply chain including all of its actors. This dynamic nature has put pressure on companies to innovate, collaborate and to redesign business processes that best fits their business, hence, this calls for incorporation of various technologies and integrated enterprise solution to manage complex and intricate processes. With the inception of Internet of Things (IoT) it is important to understand how Information and Connectivity will revolutionize tomorrow's supply chain in the context of industry 4.0 [1]. Radio Frequency Identification (RFID) is one of the technologies that offer various benefits in the aspect of automating various business processes and integration between various devices in the value chain [2].

RFID technology was introduced in the last 1940s however, due the relative high cost per unit compared to the widely used bar code, the implementation of this technology took place in the 1980 for tracking/ identification purposes and was limited [3]. By extensively streamlining data capturing procedures, RFID technology also helps to leverage process accuracy by reducing and eliminating conventional error-prone manual

International Journal of Supply Chain Management
IJSCM, ISSN: 2050-7399 (Online), 2051-3771 (Print)

processing, and helps to reduce labour costs and improve accuracy. RFID enables to capture and provide real-time and current information across the entire supply chain thus improving visibility which is crucial in the 21st century. RFID solutions can help organizations lower operational costs and increase throughput at different stages of the value chain [4].

2. Literature Review

2.2 2.1 Supply Chain Management

Council of supply chain management professionals (CSCMP) defined supply chain as "Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales product design, and finance and information technology" [7].

2.3 The Retail Supply Chain

"Retailing is the set of business activities that adds value to the products and services sold to consumers for their personal or family use" [5]. However, in the modern world retailing is not only about selling products and services in various retail outlets but through different channels (Omni-channel). Retailers work as an intermediate party between the manufacturer and the consumers who purchase product and services. Due to the dynamic nature in the retail world and unexpected consumer behaviour retail companies are facing many different challenges in the present world and with the evolution of the industry this poses a major threat to the existing business models. Due to various supply chain complexity business connectivity, collaboration, global sourcing and the use of various advance technology are areas where retailers will have to increase their focus on in order to be reverent, competitive and to better manage supply chain complexity in the digital era. Retail supply chain consists of the entities – suppliers, manufacturer, distributor, retailer and consumer as primary actors this is depicted in the figure 1 below [6].

Figure 1. Testing data- load current (amperes)

Source: Ref. [16]

2.4 Fashion and Life Style (Apparel and Footwear) Industry

One of the most profitable markets in the world is the fashion and lifestyle industry and it is defined to be a billion-dollar industry employing millions of professions all around the word. Fashion industry is one of the most dynamic supply chains in the modern world and due to this nature there are new challenges and many opportunities presented. With the fashion industry going global, consumers all over the world have been affected by this fast and constantly evolving industry [8] and this is disrupting consumer behaviour in the global market.

Over the years the fashion industry produces new products at a rapid rate and this has incorporated various new business operations for different types of products and is making supply chains more complex each year. With the removal of trade barriers in various countries the growth of the internet is growing and consumers use this means for purchasing merchandise online, this has disrupted the fashion industry making it a global competitive industry.

Demand for fashion is increasing and it requires quick responses from the supply chains, this enforces stakeholders to be more quick and

responsive to these demands hence, fashion industries are diverting their focus from forecasted demands to leveraging real-time data to better respond to customer needs due to this demanding nature of customers there is a requirement for fashion retailers to produce the right product at the right time, this is due to customers requirement for needing unique products in the market and has forced supply chain to react to these requirement really fast [9].

2.5 Review on RFID

According to Thonemann, after the in implementation of RFID technologies, Wal-Mart and Procter & Gamble simultaneously reduced inventory level by 70% thereby improving their service levels from 96% to close to 99% which is a considerable amount in terms of revenue. This also helped to reduce various administrator expenditures by re-designing their supply chain processes [10].

Benefits of supply chain management can be achieved by integrating and the use of "information technology and the construction of integrated supply chain information systems" proves that it is important that supply chain adopts to the latest technologies available to be current in the global context [11].

Literature highlights that among the organizations which they investigated, those who exploit technology and integrate to their supply chain operations and redesign their business models where more successful compared to other companies [12]. This is evident that technologies that help to redesign and improve business process are vital for any organizations sustainability in the global supply chain.

Stadtler introduces the concept of "House of SCM" which states that coordination of information throughout the supply chain is one of the fundamental building blocks [13]. According to his study he stresses on the fact that information and communication technology is essential in the modern supply chain to efficiently manage and automate various tasks in the supply chain to better streamline the supply chain with reliable and efficient data. Finkenzeller discusses and gives a rudimentary idea and introduction to RFID as a technology that can be used to automate operations as well as sample applications such as container identification for the chemical industry or in the waste disposal and identifications in the automobile industry [14]. Which explains even at the time it was mainly RFID technology mostly was used for the purpose of identification purposes.

2.6 Introduction to Internet of Things (IoT)

As Internet of Things continues to develop day by day, further development to this is estimated by related technologies that would take it to the next level concepts such as Cloud computing, Big Data, robotics, Semantic technologies and services will help develop this even further and are in a way dependent. Main objective of IoT is to enable various electronic devices to be connected anytime and anywhere in the world with mealy an access point or service.

Internet of Things is known to be the new revolution of the Internet. Objects and devices are more intelligent and they make themselves recognizable and they obtain intelligence by making various decisions as per their configured process this is mainly due to the fact that they can communicate between them with a common understanding protocol. These objects and devices can access information that has been aggregated by physical objects, devices and sensors, or they can be components of an intricate network of services. This transformation is enabled with the emergence of cloud computing capabilities and the transition of the Internet towards IPv6 protocol with an almost unlimited addressing capacity which was lacking in IPv4.

The Internet of Things provides solutions based on the integration of various information technologies, which includes hardware and software used to store, retrieve, and process information and communications technology which includes electronic systems used for communication between individuals or groups of devices. The rapid development and convergence of information and communications technology is taking place at three layers of technology innovation: the cloud, data and

communication pipes/networks, and device [15], as presented in Figure 2 below.

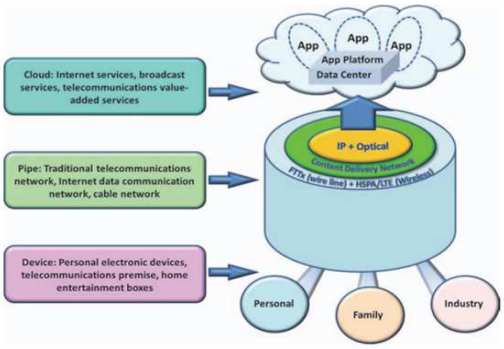


Figure 2. Factors driving the convergence and contribution to the integration and transformation of cloud. Source: Ref. [17]

2.7 Future factory concept with IoT

With the development and industry revolution taking place production will take place much more differently. Physical beings and machines will be more connected and will communicate with each other. In future factories humans will have to work with a complex world of processes, networks of processes, machines, sensors, robotics and devices. This system will require different operating concepts for a better human-machine relation operation. In the future quick, intelligent and self-adoptive manufacturing processes will be the measurement of success and a competitive advantage.

At present, majority of manufacturing and production facilities are configuring systems that will make devices and machines adaptive, fully integrated, and analytical and more efficient operating in a manner similar to real beings. These new manufacturing systems and devices will be the new industrial revolution, called factory of the future. This model will be the new era of smart manufacturing which will be based on fully automation and which will involve an increase use of technology in the manufacturing process. In the future factory model the convergence of mechanical equipment and systems with the digital era will be strong. Accumulation of data will be at a rapid rate and a proper analytical system will need to be set in place for processing these data.

The future factory concept is mainly oriented towards ensuring and enabling the availability of all relevant information for processing in real time this will be feasible through the connectivity that will be present between all elements that are in the value chain. The interaction between humans, objects and various other system dynamics, it is possible that the value chain can evolve to be real time, hence, this can help to adjust for different business aims such as to reduce cost, optimize resource consumption and high availability.

Manufacturers, plant workers and customers will have to understand and accept the future supply chain to be an increasingly complex one, which will include numerous processes, machinery and components which will operate in an integrated manner. This will require different operating concepts to optimize and bring synergy between human and machine to increase efficiency and reduce time-to-market. This will ensure manufacturers to compete in a way that it will reduce their operational cost and maximize resource utilization.

The global smart factory market is expected to total nearly USD 67 billion by 2020, increasing at a compound annual growth rate of 6% from 2014 to 2020 [16]. Communication, automation, robotics and virtual simulation will change the product sector as we know it today. Vendors such as SAP plans to accelerate innovation in its IoT solution portfolio, increase sales and marketing, scale service, support and co-innovation, and grow its ecosystem of partners and start-ups in the IoT market, which is estimated to reach €250 billion by 2020 [17].

2.8 Industry 4.0 and the revolution

According to platform industry 4.0 the term “Industry 4.0” stands for the, forth industry revolution. It is also understood as a new level of organization and control over various supply chain industries and their product life cycle, as it is more optimized towards individualized customer needs. The cycles begin from the point where the idea is generated, order generation through to the development and manufacturing of the product and finally deliver for the end consumer. Also it

ensures the recycling and all post delivery services. The basis for the fourth industry revolution is to ensure the availability of current information in real time by integrating and connection all parties involved in the value chain. In industry 4.0 it is vital to derive the optimal value- added flow at any time in the process. The connection between people, things and various networks of systems creates a dynamic, organized, and optimized and value adding streams across all companies in the supply chain in real time. Below figure 3 depicts the progression and the distinct pivotal stages of the evolution of the industrial automation.

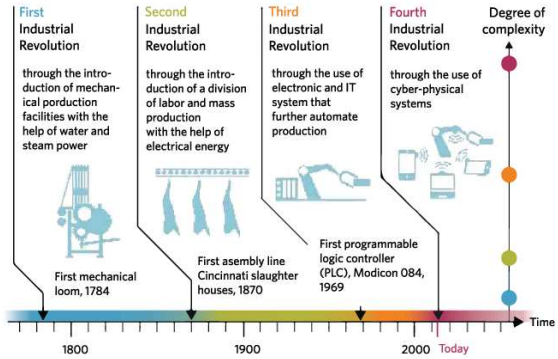


Figure 3. Industry revolution

Source: Ref. [18]

During the first industry revolution humans used mechanization, water power and steam power for manufacturing. Following the second revolution where mass production took place there were assembly lines in the manufacturing plants and electricity was the primary requirement for the operations. In the third revolution computerize automation evolved and some of the process in the manufacturing flow was automated with technology. The fourth industry revolution was the inception of cyber physical systems. The information and communication technology in the production and manufacturing space in the past was widely adopted too, however, at present with the emergence and adaptation of sophisticated systems is obscuring the boundaries between the real world and the digital world which is known as the cyber-physical production systems (CPPSs).

3. Data Collection Process

In order to better understand users existing knowledge on the subject matter few interview questionnaires were formulated related with RIFD. The data gathered was then analysed so that the question regarding the SAP process could be formulated and data regarding how exiting manual operations in the ERP system. Once the direct interviewing was completed data was gathered for different processes in the inbound and outbound operations executed in the SAP ERP environment. Information such as average time spent on the process to complete, no of screens to iteration/ steps taken to perform the operation, Average documents created per day and complexity was captured. The data that was gathered at this point was done by myself through observation on how they perform each task. Below table summarizes data captured during 10 observations made.

3.2 Sampling and Response Rate

A survey was conducted with a sample size of 30 SAP consultants who are experienced in both areas technical and functional and 10 SAP users who works in the Apparel and Footwear industries directly involved in executing operations in the SAP ERP environment. Using this sample size, a questionnaire based data collection and 15 direct observations data on using the SAP ERP system to execute transactions were gathered for analysis. In order to increase the response rate of the survey questionnaire was printed on paper and distributed among the individuals while direct observation was also self-administered. There was an 86% response rate from in house SAP consultants and 40% response rate from external SAP Users giving us a total of 30 valid samples to work with.

3.3 Questionnaire Method

In order to understand the users existing knowledge on RFID and to obtain a general idea about the importance of using RFID in the retail supply chain following questionnaire was conducted and data was gathered accordingly. In order validate various areas the questionnaire was broken down in to several sections as mentioned in the below table 1:

No	Question	Answer	
RFID Knowledge section			
1	Do you have any idea what an RFID is?	Yes	30
		No	0
2	From your understanding can RFID be a technology diver for the future of supply chains?	Yes	18
		No	2
		Maybe	10
3	In your opinion can RFID replace technologies such as barcode?	Yes	24
		No	0
		Maybe	6
4	Have you implemented any SAP solutions for companies who use RFID for efficient process optimization?	Yes	0
		No	30

Compelling reasons to implement RFID in a retail environment						
5						
Product Visibility	Improve stock out	Improve Inventory Management	Improve Demand Visibility	Improve Inventory Shrinkage	Automate Processes	Real-Time Information
23	22	22	17	25	27	30

Key Drivers for implementing RFID			
6			
Benefits	Security	External Forces	Improved cost per tag
24	2	1	3

Using RFID with SAP ERP for AFS/ FMS			
7	Do you have knowledge about the SAP BAPI technology?	Yes	30
		No	0
8	Will RFID help as a means to capture data and send the BAPI and automate processes?	Yes	21
		No	0
		Maybe	9
9	What would you say about the process time improvement with RFID integration for data capturing?	Low	0
		Medium	8
		Significant	22
10	How long does it take to create a sales order (fixing and correcting errors if any)?	1Min	0
		2Min	0
		3Min	18
		5Min >	22
11	Roughly how many transactions would you execute pertaining to IBD and OBD n a production system a day (imaging you are a SAP user for your organization)?	10	0
		20	0
		30	0
		40	8
		More	22
12	If you were told to create 100 sales orders will it have a constant time for each sales order creation?	Yes	0
		No	30
13	Can processes in an IBD or OBD cycle be automated?	Yes	21
		No	0

		Not Aware	9
14	In order to be more efficient in creating and performing transactions does experience matter?	Yes	30
		No	0
15	How would you rate SAP transaction complexity	Low	0
		Medium	18
		Significant	12
16	From the following operations what would you weight mostly to have RFID automate various sub tasks?	Inbound	5
		Outbound	7
		Both	18
		None	0
17	How important do you think real time data is to improve process efficiency?	Low	0
		Medium	2
		Significant	28

Table 1. Questionnaire

3.4 Direct Observation Method

Table 2. ERP Process 1

Process – Run 1		Average time spent on the process (Sec)	SAP Process	Possibility for automation with RFID	Automation by other means	Apparel and Footwear Specific	No of screens to iterate/ Steps	Average document created/ day	Complexity
Outbound Operation	Customer Purchase orders	0	-	-	X	X	-	40	0
	Purchase requisitions	32	X	-	X	X	5		2
	Sales Order Creation	100	X	-	X	X	14		2
	Allocation Run	30	X	-	X	X	6		2
	Picking	25	X	X	X	X	7		2
	Packing	20	X	X	X	X	6		2
	Outbound Delivery Creation	20	X	X	X	X	4		2
	Shipment Consolidation	25	X	X	X	X	6		2
	Send ASN	10	X	X	X	X	2		2
	Post-Goods-Issue	10	X	X	X	X	3		2
	Billing	25	X	X	X	X	9		2
		296							
Inbound Operation	Purchase order	50	X	x	x	X	4	25	2
	Inbound delivery	20	X	x	x	X	5		2
	Goods receipt	20	X	x	x	X	2		2
	Transfer order	15	X	x	x	X	7		2
	Transfer order confirmation	10	X	x	x	X	5		2
	Incoming invoice	30	X	-	x	X	5		2
	Payment	100	X	-	x	X	8		2
		245							

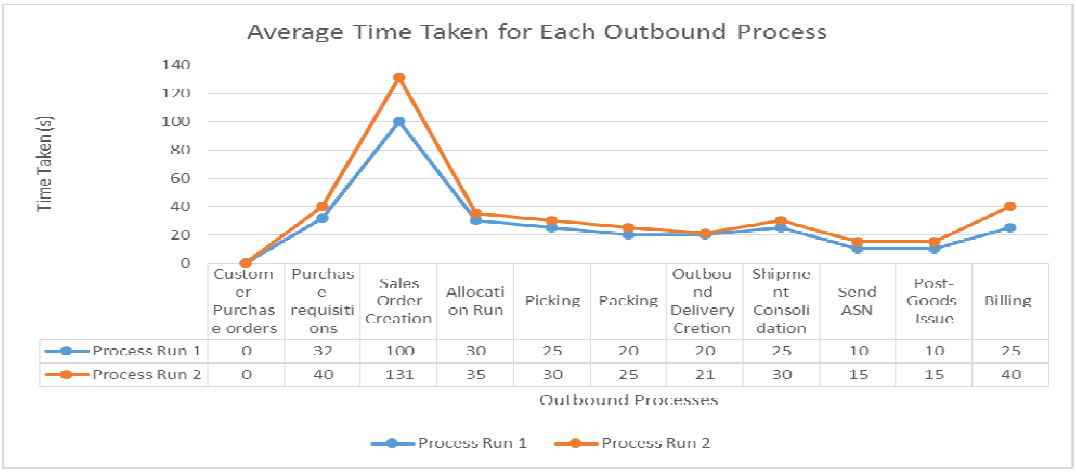
Process - Run 2		Average time spent on the process (Sec)	No of screens to iterate/ Steps	No of errors occurred
Outbound Operation	Customer Purchase orders	0	-	-
	Purchase requisitions	40	5	6
	Sales Order Creation	131	14	10
	Allocation Run	35	6	2
	Picking	30	7	3
	Packing	25	6	3
	Outbound Delivery Creation	21	4	2
	Shipment Consolidation	30	6	2
	Send ASN	15	2	0
	Post-Goods-Issue	15	3	0
	Billing	40	9	3
		381		
Inbound Operation	Purchase order	60	4	5
	Inbound delivery	30	5	2
	Goods receipt	25	2	1
	Transfer order	20	7	0
	Transfer order confirmation	15	5	0
	Incoming invoice	40	5	4
	Payment	109	8	3
		300		

Table 3. ERP Process 2

4. Results and Data Analysis

4.2 Quantitative Data Analysis

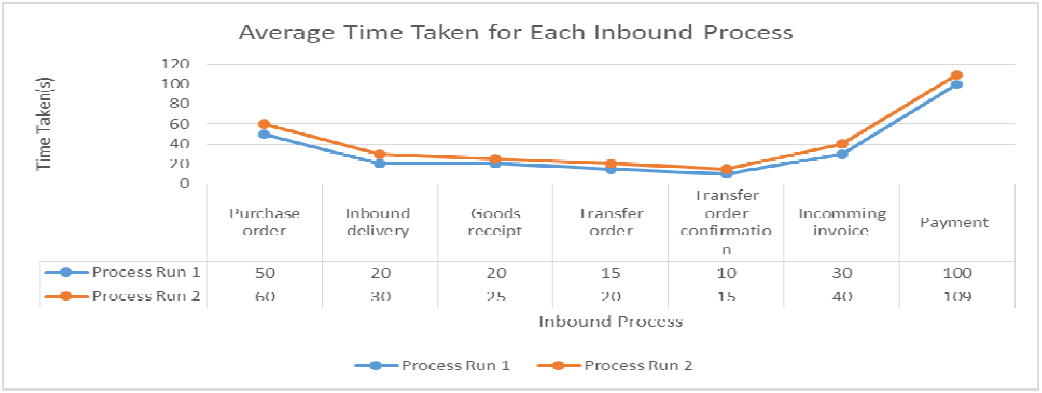
Average time taken for each process in outbound operation



	Customer Purchase orders	Purchase requisitions	Sales Order Creation	Allocation Run	Picking	Packing	Outbound Delivery Cretion	Shipment Consolidation	Send ASN	Post-Goods Issue	Billing
Process Run 1	0	32	100	30	25	20	20	25	10	10	25
Process Run 2	0	40	131	35	30	25	21	30	15	15	40

Figure 4. Average Time Taken for Each Outbound Process

If we compare each outbound process in each of the two direct observations done in process run 1 and process run 2 as per figure 4 we can clearly identify that there are variations on the time taken to execute each process. While executing various transactions in an ERP system, it is known that time is a concerning factor when there is a complex supply chain to manage especially daily transactions needs to be entered so that data is consistent and current throughout the enterprise, the efficacy however, is directly dependent on people how accurate information is entered to the system in a timely manner. While the above was tested for only 2 scenarios the reality is that the number of transactions executed is more than this. From this it is evident that there is a direct impact on the efficiency of executing transactions on an ERP environment. Average time taken for each process in inbound operation.



	Purchase order	Inbound delivery	Goods receipt	Transfer order	Transfer order confirmation	Incomming invoice	Payment
Process Run 1	50	20	20	15	10	30	100
Process Run 2	60	30	25	20	15	40	109

Figure 5. Average Time Taken for Each Inbound Process

If we compare the inbound process it shows the similar type of variance on the time taken for each process run. The data gathered through observation as per the above table 2 and table 3 shows that for each transaction executed there is a considerable time taken to complete the process. While this scenario considers to be on a small organization where there is limited amount of inbound and outbound documents created a day, however, if we consider a large enterprise where there are different companies running on the same ERP system this number increases drastically. In order to process such bulk transactions, the company have to employee many resources just for data entry purposes, this increase the cost the company has to bare.

The first process however, took place in a smooth and less stressful scenario where users were told to ensure the data was properly inserted during the execution of the transaction and it was just once. Then later the users were told there were many inbound and output process to be completed for various sales orders and purchases orders, this however, was on a stressful scenario and the users were told to run each process again for the subsequent new documents. As expected there was a significant increase in the time for each process run as per the above analysis. Compared to the first run where each process was executed while ensuring there was no errors in the documents created however, the number of errors increased in the second observations:

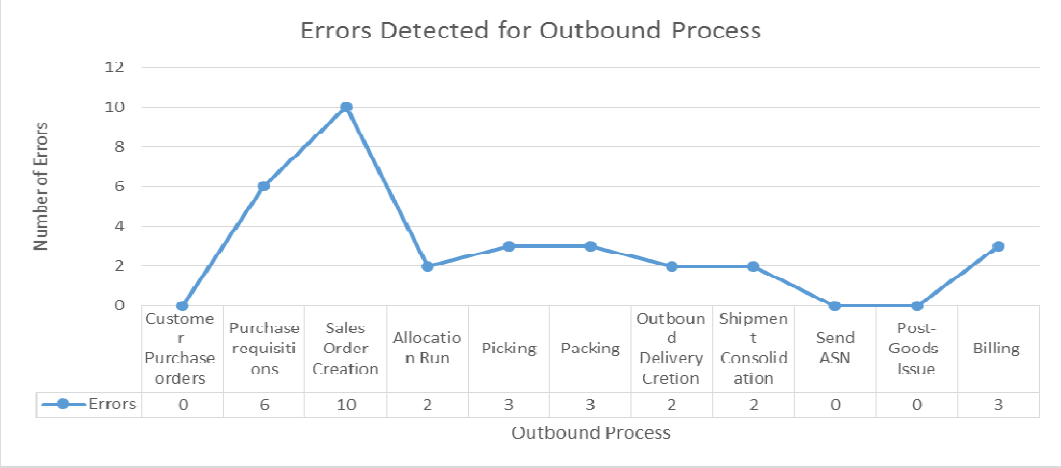


Figure 6. Errors Detected for Outbound Process

This was the same for the inbound operations as well. While the no of errors increased the time taken to finish one transaction also increased as a result of the errors made during this phase due to fatigue and lack of concentration. So if we look at a scenario where there is limited resources in an organization to process many documents (with minimum resource minimum cost) the efficiency will reduce resulting in various other delays which could have a significant impact on the supply chain as a whole resulting on negatively on the profits for the organization. If we take a scenario where the enterprise employees many resource to distribute these operations, then it will incur more cost to the organization not only for employees' payments but also for increased number of users the licensing cost to use the ERP system will also be more. When the organization grows and when operations become more complex the necessity to automate the less value adding operations is vital especially when industry is moving towards a digital era.

4.3 Quantitative Data Analysis

Main drivers for the utilization of RFID technology

In order to understand the mind-set of the users with regards to implementing RFID for supply chain the following data was acquired. As per the below pie chart it's evident that most of the users are having a fundamental knowledge on the benefits of RFID.

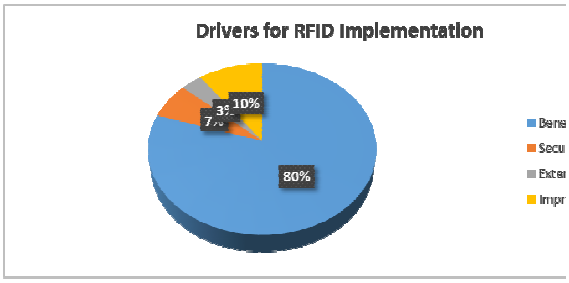


Figure 7. Drivers for RFID Implementation

If we analyze figure 7 it is evident that majority of the users are aware of the benefits of the RFID implementations. With 80% agreeing on the benefits that a supply chain can acquire from this technology we can understand that it is without doubt this technology will help in numerous ways especially in the context of an ERP system.

Compelling Reasons to Implement RFID in a Retail Environment

While there are many benefits that we can obtain from an RFID enabled supply chain it was understood that getting real-time information was weighted to be more importance among rest this we can observe in figure 8 below. In order to execute various business transactions and to get information real time will be a vital aspect in the future of supply chains hence, most agreed that RFID to obtain real-time information will be an advantageous aspect and most compelling reason to implement RFID in a retail supply chain.

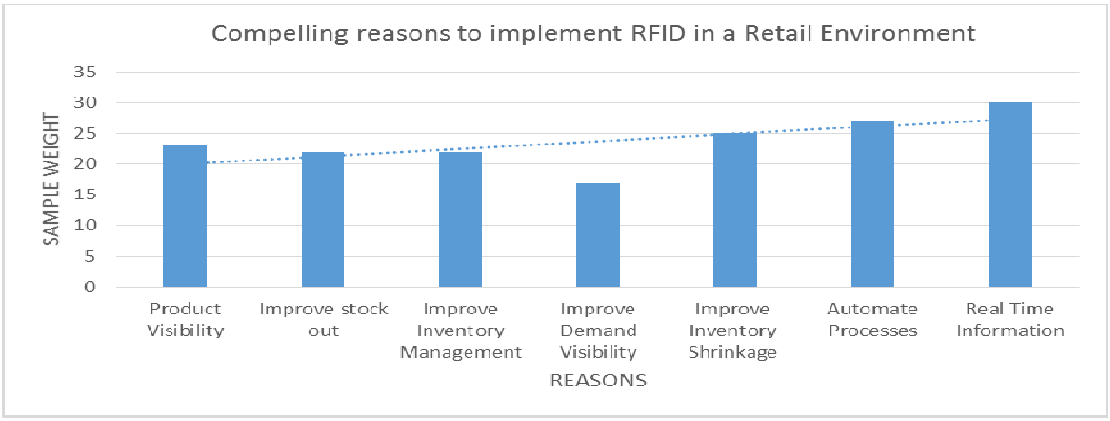


Figure 8. Compelling Reasons to Implement RFID in a Retail Environment

Challenges for RFID Implementation

Implementing RFID into a supply chain will not be easy due to various complexities and challenges in figure 8 we can note that among the questioned cost of implementing is the highest concern when integrating this technology for existing and future supply chains. Without a proper framework and global standards set in place implementing RFID will be costly despite its benefits.

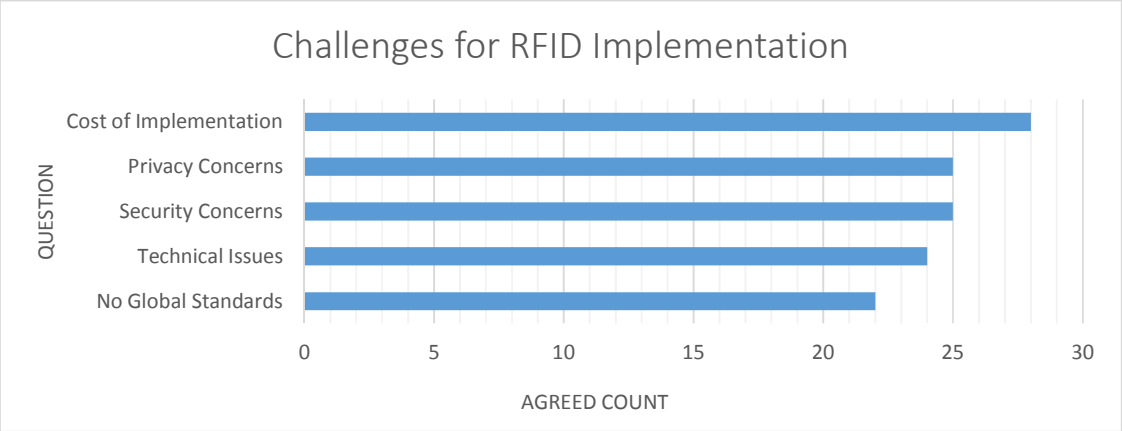


Figure 9. Challenges for RFID Implementation

Use SAP BAPI Technology in Conjunction with RFID for Process Automation

RFID will be used as a primary technology to gather information at different points in the value chain. However, the gathered information needs to be identified appropriately so that different transactions in an ERP system can be executed. This is where SAP BAPI technology will be most helpful so that various operations can be automated to improve efficiency in an enterprise system to improve overall profitability. Figure 10 depicts that a majority of the users agreed on the fact that BAPI technology can be used to automate transactions in a SAP ERP environment.

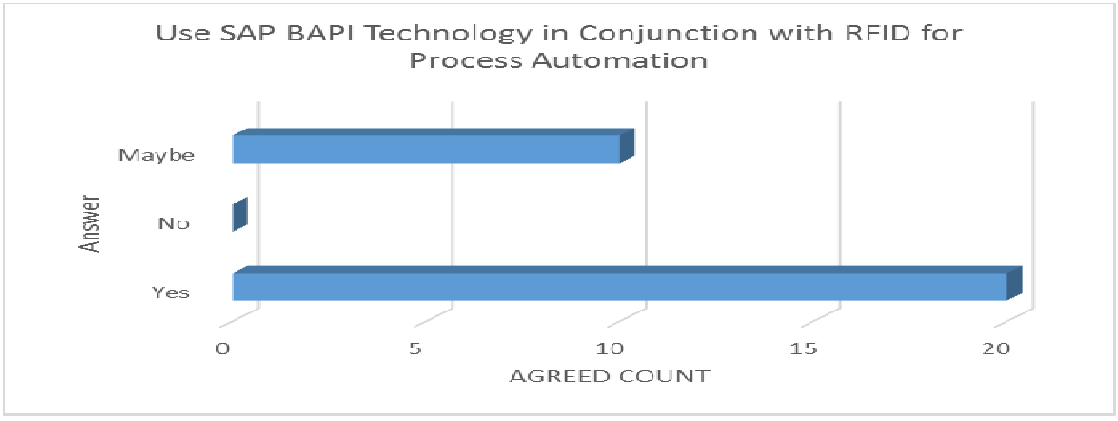


Figure 10. Use SAP BAPI Technology in Conjunction with RFID for Process Automation

Time concerning factor in Executing Transactions in an ERP Environment. While ERP systems has their benefits such as centralizing an enterprise operation in one system it also has concerning factors such as complexity to execute certain transactions specially when there is 100 of transactions that needs to be executed. From the questionnaire complied if we look at question 10 in the above table 4 if we take the process of a sales order creation process on average it takes close to 5mins per transactions. This could be less significant in a smaller operation however, in a large organization this number increases and then it could cause a significant impact on the efficacy of the process and can cost in terms of money or a huge amount of backlogs to clear. This was also validated during direct observation method where SAP ERP transactions were executed pertaining to inbound and outbound operations. It was also evident that when we have more transactions to execute it was understood that not all can have the same time question 12 in table 4 clearly shows that there was a 100% agreement on the fact that each

transaction executed can have different duration however, with the help of SAP BAPI technology this can be handled and 'n' number of transactions could be executed at a higher speed.

ERP applications need to leverage the smart devices and technology so that it also can be smarter. Current implementations of SAP ERP for the apparel and footwear industry does not have this capability where RFID technology is incorporated into it. With manual entry to the ERP system there are various issues such as time consuming, prone to human errors, lead times and gaps. With the use of EDI various operations that cannot be automated with RFID can be automated. In order to trigger an EDI, we can use RFID tags in conjunction with EDI technology which presents a more flexible and viable scenario to integrate RFID to the system.

4.4 Proposed Improvement for ERP System with the Use of RFID in Conjunction with BAPI Technology

While many companies are investing and moving towards a smarter digital supply chain it is vital that existing ERP users look into options of digitizing their supply chain as well. This will be a competitive advantage in the time to come as reducing lead times, processing time will be vital for fast fashion industries specially when there are unexpected demands to cater for. Fast fashion supply chain is one of the most volatile industries and with time things get even complicated specially when there are many retails to supply for. Process like order fulfillment and purchase order management can be improved with the use of technologies such as IoT and RFID.

Traditional ERP will have to make a major leap in order to cater for the future of smart devices and machineries. With the increasing usage of IoT machinery, sensors and devices ERP should provide necessary interfaces to enable a strong link between these smart objects. Manufacturing flow process can be further improved with the use of such technology enabling a maximum utilization on the floor. Using these technologies companies can capture data whenever merchandise leaves or enters the facility and use the smart data necessary processing can be done in order to identify what should be executed in the next step and transfer these data to the ERP.

While RFID is of great importance for data capturing and communications in order to automate various transactions in a SAP ERP system we need to utilize Business Application Programming Interface technology provided by the vendor. Below figure 9 depicts a detail framework on the proposed solutions for better inbound and outbound process automation in an ERP environment.

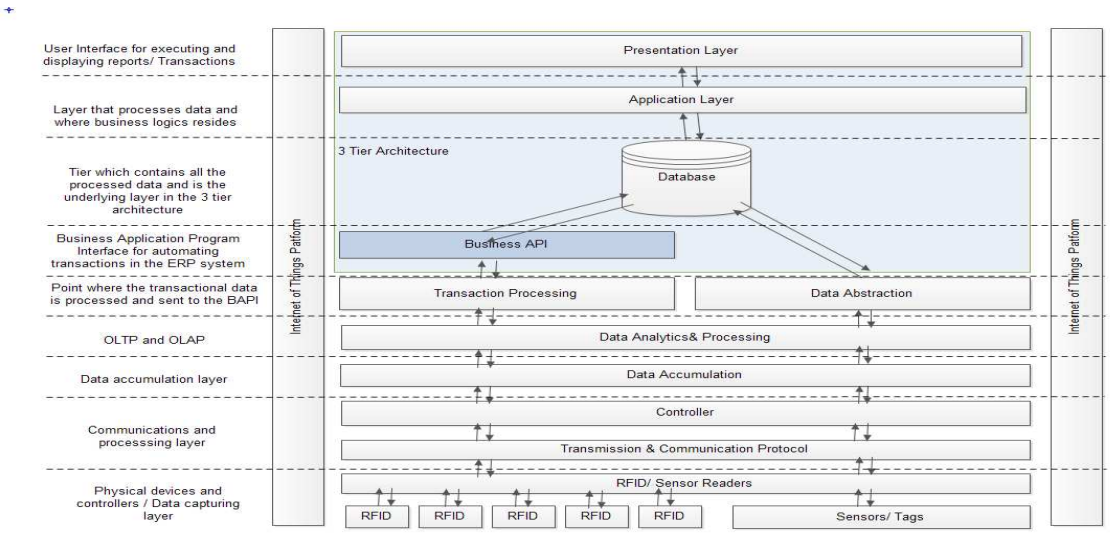


Figure 11. Conceptual Framework for Process automation through RFID and BAPPI

Validity of the proposed framework

The framework that is depicted above in figure 11 is designed in conjunction with "The IoT Reference Model" depicted in figure 6 above where each layer is explained and how each layer communicates with one another. The IoT reference model proposed by Cisco is a sold underlying framework and is something that can be considered for the context of industry 4.0 and integrating the exiting three tier architecture of the ERP landscape is credible for the proposed framework in order to address the question in hand. Using this technology only thing that needs to be taken into considerable is the network and processing delay. With a powerful IT infrastructure, we can consider them to be very less considerate while technology has already taken its next step to shape up the digital

supply chain. While the use of RFID will continue to grow with its technological improvements it is vital and a necessity for ERP vendors to transform these sophisticated enterprise applications to adopt to the next industry evolution

5. Discussion

From the time of inception, RFID and various other technology has been used in various supply chains due to its unique capabilities it is widely adopted by many industries specially in particular the fast fashion supply chain. RFID technology has received this attention from the beginning of the industry because of potential for innovation in different processes such as manufacturing, in-bound logistics, out-bound logistics, transportation, distribution process, inventory and after sales services. While the benefits of RFID are different from one industry to another the appreciating for this technology is mainly from the fashion industry because of its advantageous capabilities it offers. The thesis contributes and explains a framework that could be used to automate various transactions in an ERP enabled supply chain whereas presently, RFID is mostly used primarily for item level tagging and inventory management compared to the current literature, where information is just retrieved. However, proposed solution enables to use the data captured from RFID at different points in the value chain to trigger various transactions and execute operations in an ERP system which would increase the efficiency significantly. This is especially important due to the industry evolution taking place and fashion companies need to make quick decisions on how their IT infrastructure should change along with the change that is occurring in the global market.

6. Conclusions

The Time has come for RFID to be adopted by almost all of the supply chain manufactures and it is important that the cost of RFID tags come lower in cost as it should be more affordable if item level tagging to be ubiquitous in fashion stores. In order for companies to sustain their business in the digital era and industry 4.0 it is vital that they restructure their IT landscape to incorporate technologies discussed in this study as it is vital if they want to compete with the major players in the market providing the best of services to their customer and increase consumer shopping experience to fit the digital era.

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