A Review: Factors Affecting RFID Adoption on E-Commerce Supply Chain of Bangladesh

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Abstract: In Bangladesh e-commerce is getting more popular with the technological development like RFID. RFID is not a new technology but still Bangladesh can't utilize of this technology and even RFID based distribution system. RFID technology could make business value in different levels of supply chain management. Many world-famous brands established their production house in Bangladesh mainly readymade garments, leather goods, textile, and energy-related companies, for the low production and low labor cost. Bangladesh is a late candidate in the e-commerce industry, and it is getting tremendous popularity within a short period. Bangladesh is a growing technological nation and trying to implement innovative technology in every sector. RFID technology has an excellent opportunity to explore Bangladesh's business industry, especially for e-commerce based supply chain networks. All this literature examined the structure of RFID and its related factors. I this chapter, exiting literature associated with the factors affecting RFID adoption in e-commerce supply chain management in Bangladesh has been presented. Key elements such as technological, organizational, and environmental factors that influence RFID adoption are highlighted. The benefits and advantages of this technology implementation in the supply chain network in Bangladesh are also explained.

Keywords: About four key words or phrases in alphabetical order, separated by commas.

1. INTRODUCTION

This is an International reputed journal that published Radiofrequency identification (RFID) is a data collection and storage technology that utilizes radio waves to capture the information of products within a given range automatically. The commercial use of RFIDs has made sweeping changes in how organizations track goods in their supply chains. In the past, barcodes were used in the retail sector for identifying products, but major retailers (e.g., Walmart, Metro, and Tesco) are now requesting their suppliers to implement RFID as the new identification device. RFID has improved many business values such as efficiency, reductions in inventory and labor costs, prevention of inventory shortage or excess, and improved data accuracy and information visibility (e.g., Zhu, Mukhopadhyay and Kurate, 2012). The majority of initial scholarly and industry efforts have focused on understanding and overcoming technological shortcomings (Dwivedi et al., 2013). As RFID's commercial applications became widely deployed in the 1990s, RFID adoption should now proceed with how much it affects the organizational process, learning, customer satisfaction, and financial performance. Companies use RFID mainly for three purposes: to reduce cost, to better serve customers, and to support business growth through, for example, increasing market share (Hassan, 2008). In essence, most RFID projects in organizations explicitly or implicitly address one or several of these objectives.

Nowadays, e-business shows its enormous potentiality and worldwide acceptance (Kirs and Bagchi, 2012). E-business incorporates the latest communication technologies with its supply chain department and sells department via the internet (Turban et al., 2004). This technological knowledge helps organizations understand customer needs, customize products, adopt effective market solutions, and receive customer orders from wholesalers or retailers. The availability of internet service also has a significant impact on e-commerce business performance (L. Nicolas and M. Cerdan, 2011). The business process changes resulting from RFID need to fit the back-office or supply chain processes, promoting learning growth and customer satisfaction.

The research model shows that technological, organizational, and environmental factors affect RFID adoption, and these relationships are posited to be different in public and private organizations. The organizational factors encompass organizational readiness, size, and RFID adoption cost. The environmental factors are composed of

competitive pressure and external support. Hossain and Prybutok (2008) suggested that perceived security affects the technology acceptance of RFID. Privacy and security are some of the challenges that need to be faced in implementing RFID (Kumar et al., 2009). Organizational readiness, size, and RFID adoption cost are posited to be influential organizational factors.

Brown and Russell (2007) pointed out that organizational size and adoption cost is an influential factor in RFID adoption. A large organization can afford RFID's cost due to available resources for the high RFID implementation cost. The deployment of an RFID project demands a large amount of money (Yao, Chu and Li, 2012). The costs encompass the initial hardware and software purchase and training and the continuously high RFID infrastructure maintenance prices. An RFID infrastructure demands additional servers, databases, middleware, and applications, as well as tags and readers. RFID has an effect on learning and growth such as eliminating and reducing human error (Wen, 2010) and capacity expansion (Ferrer, Dew, and Apte, 2010); the performance of internal processes such as a faster response time/more significant speed/reduced cycle time (Tesoriero et al., 2010), inventory tracking and visibility/enhanced forecasting/reduced stock-outs (Ferrer, Dew, and Apte, 2010); customer performance such as customer satisfaction (Dwivedi et al., 2013). Many literatures that deal with new advanced technology adoption focused on a very particular sector in a company, to make an aggregate influencing factor. Though, the acceptance of innovative technology as RFID which is a global development. Moreover, e-commerce is a promising business trend in the current world. There is a need to find the factors affecting RFID implementation in the e-commerce supply chain network in the most promising country like Bangladesh.

This research explores the factors that affect RFID technology adoption by e-commerce sully chain management from the advantages of RFID uses in any organization by conducting open-ended questionnaire study in Bangladesh. This study also will examine the supply chain performance in e-commerce companies and the future business output using RFID in the country. Identifying the influencing factors, which is very crucial for adopting and implementing the new technology to establish smart RFID based e-commerce are also addressed for future research.

2. RELATED LITERATURES

Factors affecting RFID adoption

Factors affecting the RFID adoption acceptance willingly from the organization is very important, because the objective is to adopt a new technology that could be positively related to real performance in the technology (Ajzen, 1985; Davis, 2004). From a supply-chain network, manufacturer point of view, RFID technology and drivers have limited adaptation applications. So the government must give some incentives for the retailers and manufacturers for accepting new technology. It is not easy to calculate return on investment (ROI) is not easy from the management point of view for the new technology implementation. Low-cost RFID tags can be the initial solution to promote RFID adoption in supply chain network and the desire of buyers and suppliers. RFID is bit expensive than bar codes, and the high price issue can occur when using expensive metal objects' tags. Nowadays, the tag's size is reduced and integrated into the electric circuit due to minimizing the cost and size. Though, making compact in size can increase the initial production cost.

Further, RFID vendors do not have a strong idea regarding middleman business policy and their pricing. Lack of available expertise for implementing RFID, within the country, big organizations hire outside specialists, which is a cause of high price. Technological, organizational, and environmental factors are described for internet commerce adoption by Scupola (2003) used. In general, new technological innovation's adoption and implementation is affected by exiting technology, internal and external environmental of the organization (Tornatzky and Fleischer, 1990).

Technological factors

Comparative advantage has been observed to be a vital element in deciding the adoption of innovations. RFID technology has advantages directly and indirectly to organizations, which gives a positive perception and makes an incentive for the organizations to utilize the technology. It is expected that the comparative advantage of RFID innovation positively impacts the organization. Most of the studies confirmed that the organization had a positive relationship with new technology adoption (Alshamaila et al.,2013). For effective RFID adoption and implementation, this technology should be compatible with the company's existing technology infrastructure. Likewise, RFID innovation should be consistent with the necessities and the key objectives of the adopting firm. One of the most imperative

factors that influence the decision to adopt another technology is the full costs required for adoption within the firm. Organization's attempt to pick up advantages from adopting a new technology that would be proportionate with the expenses related to it. With regards to RFID, the costs are probably playing an essential role in the adoption decision. Therefore, RFID technology costs will have a fundamentally negative relationship with operators' intention to adopt RFID technology in the hospital application. Technological factor includes a few critical components such as appropriateness, effectiveness, and advantage. Schmitt and Michahelles (2009) explained that technology's suitability and compatibility are essential technology adoption tools.

An organization has to have higher state-of-the-art ability and knowledge exchange capability to better the company (Tsai and Ghoshal, 1998). Information exchange will influence factors as organizational, technological invention, which is determined organizational strength. New technology innovation usually follows an updated technological model in the organization (Teece, 1996). Using RFID adoption, an organization with vast experiences can increase its technology adaptability associated e-commerce supply chain network (Grant, 1996; Simonin, 1999). Therefore, with the continuous growth of technology, it is expected to influence RFID technology adoption in supply chain management. According to Alshamaila et al. (2013) and Tornatzky and Fleischer (1990), technological factors provide both restrictions and technological innovation opportunities and shape how a growing-businesses implement new technology.

Organizational factors

Top-level support shows senior management's eagerness towards resource allocation for advanced adoption and played a critical part in adopting and diffusion of innovation within associations. According to Prem kumar and Roberts (1999), top-level support is essential for verifying a supportive atmosphere for adopting new technologies. Therefore, Top-level support will have a fundamentally positive relationship with lower-level working peoples' intention to adopt RFID technology in the industry. Financial resources refer to the monetary assets accessible to pay for RFID advancement cost, the costs for implementing any following improvement, and the costs acquired on a progressing premise among utilization (Lian et al., 2014). Technical resources refer to the complexity of data systems utilization and the management's data systems management in an organization. Many reviews showed that organizational enthusiasm is a vital variable for development adoption. Therefore, organizational passion will have a fundamentally positive relationship with workers' intention to adopt RFID technology in their industry. Lai et al. (2014) performed a study regarding RFID adoption in the advance hospital system. Still, if there is a lack of finance, it won't be easy to adopt any new technology in the organization. An encouraging relationship have been shown between economical capability and technology adoption using several experimental works (Krasnova et al., 2008). The adoption of enterprise-level innovations depends largely on decision-makers' functional or emotional feelings, which reflect their attitudes, perceptions, psychographics, motivation, and other individual difference factors (Awa, Baridam, and Nwibere, 2015). On accounts of critical relevance in predicting enterprise adoption, we measure personal context in terms of social influence and hedonistic drives. TOE framework is an essential methodical tool for both the technical innovation adoption capabilities, facilities, and other adoption organizations' environmental circumstances (Eze and Chinedu-Eze, 2018). The ecological dimensions' focus on the business's size, competitors, macroeconomic perspective, and regulatory background (PR Newswire, 2019; Maclennan and Van Belle, 2014).

The main for successful SCM is written forecasting and execution of workflows among supply chain associates, which can be upstream or downstream. The manufacturer always look for the supplier; those are known as upstream. It isn't easy to achieve its business objectives Without working support from SCM department. Considering the consumer point of view, those are downstream members. For downstream members, internal connectivity is also needed among distributors and retailers. Since different of peoples are actively involved in a supply chain network, direction, and incorporation are very important, which is shown in Figure 2.1 and every member have to similar matched by the class of one another (Vanpoucke, E., 2017). For instance, suppliers of the raw materials and product manufacturers need to be cooperative, if the production stopped, the suppliers have to restock production materials instantly to the manufacturer. Moreover, producers and shipping agent also should be cooperative for the product shipment. SCI means the business processes and workflow information should be placed together to make necessary technology involvement decisions.

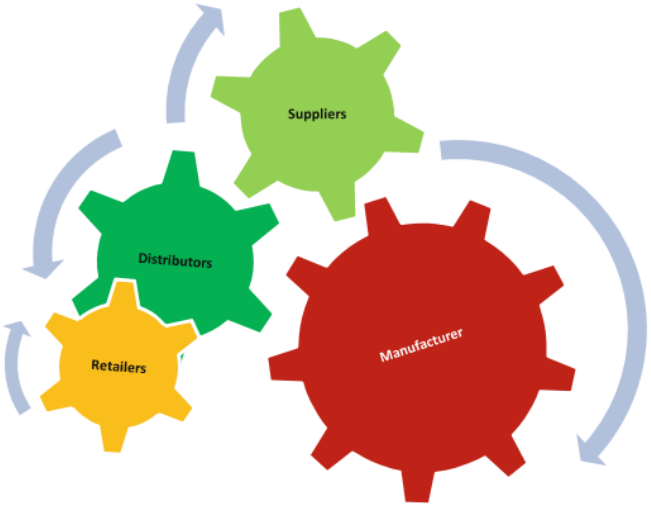

Figure 2.1: Supply chain integration workflow (Vanpoucke, E., 2017).

If the suppliers are unknown for the faulty product form the manufacturer, then it will make a problem in their relationship and retailers will call the suppliers. The RFID based vehicle tracking system provides instant location information to the distributor at the backyard as well as to the manufacturer. Otherwise, it will take time to find those vehicles that have already left the yard. Top management support is critical for creating a supportive climate and providing adequate resources for adopting new technologies (Lin, H. F.,2005). As the complexity and sophistication of technologies increases, top management can provide a vision and commitment to create a positive environment for adoption (Lee, S.,2007). There are two primary sources of influence in any professional organization from a managerial point of view. The first one is at the enterprise level, which mentions to top management. The second level refers to the organizational management unit. Generally, the top-level management level indicates the importance of technology to the company by investment and resource allocation and by strengthening and clarifying signals' significance (Lewis, W.,2003).

Environmental factors

Information intensity refers to the available information in an organization's product or service. Sometimes, information-intensive tends to be more complicated than others; customers require more information to specify their characteristics. RFID is a mandatory condition for supplying any products to Japan, UK, or EU countries. At the global level, several countries compete strictly to provide grocery items, vegetables and cattle products in the international marketplaces. Many farms that offer fresh and frozen items are RFID integrated traceability to compete with the global markets, which gains more profit.

Moreover, some advanced companies use RFID to classify the quality for wool or cotton items for their customers to enjoy an extra competitive authority in the market (Schmitt and Michahelles, 2009). RFID adoption is reliant on market pressure, and also the support for competitive market pressure (Zhu et al., 2006). Lee (2009) used an extensive survey using these two market pressure toward research and development on technology effects. The environmental approach provides evidence that market and competitive pressures exist simultaneously, and most of the time, it points to a single concern. According to Bradford and Florin (2003) models, there are some environmental issues when the outside competitor active outside the product marketplace. Poston and Grabski (2001) investigated that, when a company accepted the adoption a brand-new technology, maybe their competitors feel annoyed because they were worried about the possible benefit. The outcome of an external force that has been proved practically by many previous kinds of literature. Vanilla

Product Factors

RFID indicates that carrying technical information regarding an organization's innovation would build the inspiration toward improvement adoption. An RFID system is more complicated as compared to a bar code system. In this manner, RFID technologies in an organization will have a positive effect on the adoption decision. For example, if an

organization knows about RFID innovations through experience, adopting such designs would be high. Product quality, size, and user-friendly conditions are the factors for the adoption RFID in any organization.

Most corporations' units are facing challenges for provide moving stock, manage inventory management efficiency, sustain productivity, improvement of security, analysis of compliance needs, and emergency shipping prices. Many empirical studies highlight the unskillfulness and lack of responsiveness of ancient SCM systems (Zebra Technologies, 2011). Efficient foodservice response identified more than $800 million in savings available to the foodservice supply chain through more extensive use of RFID technologies (Zebra Technologies, 2011). Data assortment by RFID will facilitate forestall errors so as selecting and shipping that plague the foodservice trade. Despite surprising events and a lag within the economy, corporations still initiate offer chain improvement initiatives supported the growing recognition that excellent offer supply chain performance has the strategic price that may result in:

- Rapid financial payback, often within months.
- Improvements in productivity and profits.
- Improvements in customer positioning and product quality.
- Improvements in safety and security.
- Meeting compliance requirements.
- Enhancements in long-term relationships with suppliers.

There are some factors that is influencing RFID adoption in the SCN which is tabulated in Table 2.1. RFID is comparatively cheaper technology to track the supply chain network monitoring. Moreover, it is not driving technology but it can consider as a cost and man power savings opportunity.

Country	• Trade volumes • FDI • Wealth • Infrastructure of IT, logistics and legal system.	• Country's IT user • Global standards • Security law	• Quality of life • Rules of Law • User cluster towards IT
Industry	• Industry pressure • Government support • Organization benefits • Logistic growth	• Global standards • Regulation • Fulfillment • R &D • Path dependence	• Quality of life • Industry competitiveness • Regulation of privacy
Organization	• Customer service • Top management commitment • Training • Organizational size	• ROI • Customer awareness • Global standards • Technology complexity • IT provider	• Business model • Technology complexity • Data management • Service effectiveness
Stage >>	Preliminary	intermediate	Mature

Cost of adoption of RFID

The cost of implementation is considered as the critical influencing factor of RFID adoption by most of the researchers (Angeles, 2005). In addition, some others influencing factors of RFID adoption in supply networks. To classify the costs related in supply chain, Bunduchi and Smart (2010) developed a framework related to adopting process in supply networks simplifying the Thompson's (1965) model. Curtin et al. (2007) sketched an RFID "adoption dimension," including development, acceptance, and application, which is also reflected Thompson model. Bunduchi

and Smart (2010) acknowledged some others categories of innovation costs associated with the RFID adoption stages. The capital cost appears during the approval stage when a company is looking for principal investment in the new technology and it can extend up to execution stage.

Similarly, the development costs are considered as group investment for the technology development and this stage can be lengthy. The process of innovation adoption starts with the proposal and will result when fully implemented (Thompson, 1965). For the technology innovators, there are two categories such as generating innovation (developers) and acquiring others' innovation (Bunduchi and Smart, 2010). There are two types of costs: development costs, which are primarily incurred by developers, and launching costs which are acquired by acquirers. Development cost occur either in-house (interior) or collaboration with others. Research and development cost considered as internal development. External development costs of the company include other resources that are necessary to contribute for the organization's development where time and expert human resources are involved (Antonelli, 1994). Other activities, including learning about technology and suitability innovation for the organization's needs to adopt the new technology adoption (Damanpour and Wischnevsky, 2006). The process for and assessing alternative technology which is needed for organizations to identify the vendors and the available goods. During the approval stage of the RFID adoption, the organization have to provide strong support and permanent resources to accept this technology. In this phase, other costs such as switching costs and the cost of the capital where switching costs introduce the process to change that particular application have little effects on other applications (Shapiro and Varian, 1999). Exchanging or switching an existing organizational technology with new technology often cause of losing investment, which arise from mismatched technologies, are known as compatibility costs (Zhu et al., 2006). Mostly, cost of capital related to specific project investment, and the probability of risk rewand depends on the level of insecurity related to the new technology investment (Markus, 2000; Mata et al., 1995).

When technologies like RFID are integrated to support the supply chain network, the partners' relationships influence adoption costs (Johnston and Vitale, 1988). The absence of trust affects the adoption of an inter-organizational either directly through its users (Allen et al., 2000; Gerst and Bunduchi, 2005), or indirectly through growing the business costs involved in switching new technology system (Chiles and McMackin, 1996; Dyer and Chu, 2003). Bunduchi and Smart's (2010) demonstrated a framework to identify six different categories of costs, though it is related to innovation process. Bunduchi and Smart suggest that the expenses will mostly be incurred in the implementation stage if some exiting setup costs are already there (Alison U,2008).

RFID is currently quite expensive to be implemented by SME sectors and various RFID components' cost remains a significant inhibitor to its adoption. It was agreed by both the vendor and the RFID sellers that initial setup cost was the most dominant barrier to the integration of RFID in a retail customer end. Besides, RFID was rejected in most cases as a possible SCM solution based on costly RFID readers and RFID tags. Though, RFID tags in a supply chain network solution involve continuous replacement. On the other hand, RFID readers have an initial expense, and later it requires little maintenance cost. In a long run, such as integration of RFID within a retail supply chain network, requires RFID tags with cooperation of all the entities in SCM.

Difficulties of RFID adoption in SCM

There are some challenges for expanding RFID application in the retail industry as an SCM solution and minimizing product reduction. These barriers are known as initial cost, lack of awareness regarding RFID technology, encouragement of the peoples. Investment cost or initial setup cost is a burden for the retailers. Though RFID technology has developed for mass user application over the last decade, still RFID components' cost remains a vital factor to its adoption for both retailer and vendors. Besides, RFID was dismissed as a possible SCM solution based on these factors. To convert itself as a well-established and user accepted easy to access technology, RFID needs more exposer from government and private sectors in Bangladesh.

Further, Bangladesh retailers' association have exiting well setup which is matured system and it would be difficult to convince them that RFID could improve those systems. To promote the retailers, the vendor is offering to different promotions on the legacy barcode systems. Retailers have invested a tremendous amount of money in moving their products from their whole sale outlet to their stores, and they doing impressive at this moment. The Barcode system is now spreading all over the country for each product. Moreover, the suppliers of RFID equipment are also limited

(Shris Hirur, 2018). The manufacturers of RFID are trying to improve this technology investing a huge amount of money. Day by day, market is getting better and expanding everywhere in the country with their price promotion.

On the other hand, RFID active readers has initial expenditure, but mostly, they need little looking after cost. For a big sales drive all over the country. RFID based integrated device for supply chain department, needs many RFID tags and the cooperation of all the entities in the value chain. The Systems Engineer from RFID Vendor in Bangladesh claimed that the tag's cost compared to barcodes is slightly higher. The price of an associate having RFID tag is relative to the law of economies of scale. Economies of scale discuss with the diminished per cost as the output will increase. In different words, once RFID tags may be created on a bigger scale with small input prices, economies of scale area units achieved. the most recent element technology and advancements in RFID, each unit to influence production volumes because of the lower prices of such materials. Recently, RFID tags' costs fall and become a lot affordable; the adoption of RFID can increase. As foretold, the industry's atomic number is ten cents a tag, Associate in Nursing retailers' area unit a lot of possible to ascertain an ROI with a systematically cost-efficient RFID resolution. Prospective customers conjointly have to be compelled to modification and earliest models specialize in cheaper price concept for surviving to the barcode. It's presumably that Associate in Nursing RFID resolution for retail provide chain would want to integrate a middleware application.

Another common barrier is the absence of awareness of RFID adoption and the reluctance that confuses the customers about RFID vision. Mostly, high authority can't understand the potentiality of RFID adoption in SCM which is a cause of loss reduction technologies. Due to lack of knowledge or technology adoption awareness regarding integrated solution, government agencies, technology providers, manufacturers should regular communicate to vendor.

The price of RFID is higher than bar codes, and main this cost issues will occur once metal body tags are considered. To reduce the total price of the RFID, the size of the RFID chip or tag size has to reduce. Furthermore, technology vendors should have a proper transparent plan for the RFID raw marketing. Finally, corporations usually hire their own permanent experts to implement RFID technology, and rent outside specialists may be tough and dearly-won. RFID is a special type of wireless technology with some potential security to users concerning the compromise of information throughout wireless transmission, short of storage, and sometimes security of memory places. Many protection problems are self-addressed by RFID vendors by using various querying protocols, jamming, and different techniques.

The uses of RFID have deep social impact without protections in everywhere. It has the potential application for consumer privacy but threaten in the public liberties. The main concern of come consumers the privacy that might create popularity problems for widespread its application. Governments around the world regulate the use of the frequency spectrum. There is virtually no part of this spectrum available everywhere in the world for use by RFID. This means that an RFID tag may not work in all countries. This ultimately hinders the use of RFID tags in a global environment

Structures of RFID Devices

In 1948, RFID technology was first inaugurated, initially for the radar and radio communication related research during World War II. However, RFID based real life application came after four decades to be fully commercialized user friendly prototype (Landt, 2005). It was started with integrated circuit in the microprocessor for commercial sell. Now, RFID has become sufficiently affordable and reliable for the widespread use and is thus considered a business solution for the industry (Roberts, 2006).

Experimental exploration started in 1948 and it was continued to 1950s which was published in the research papers. In the 1960s, RFID devices had gradually moved to the front, mainly when commercial systems with electronic article surveillance (EAS) were used to avoid high-value items theft. From 1970s to 1980s, RFID's research interest had been risen, from R&D department and academic institutions discovering in the various applications. (Landt, 2005). Since the year 2000, the RFID market has grown dramatically and total worth of USD 2.77 billion in 2006 to USD 10.1 billion by 2016 (IDTechEx, 2016). Mostly that amount from active RFID applications such as real-time location systems (RTLS), that enables users tracking and tracings movement in real-time.

Rest of the amount came from passive RFID applications, such as tagging consumer goods, medicine, and postal packages (IDTechEx, 2016). Over the past decade, development in the RFID market signifies that RFID technology has achieved a significant penetration level in commerce, mainly boosted by dynamic growth from retail apparel implementations (SMARTRAC, 2017). Significant advancements within the RFID trade have additionally competed for a job within the explosion of technology. For example, the business has removed technological obstacles, met ability needs, and worked on international standardization. It's provided adequate radio frequency RFID standards solutions, offered by a wide variety of market players serving all aspects of the way of life. RFID device consists of an RFID tag, an enquirer or antenna (which is used as a reader) that collect information from the tag, and a storage which will keep the information on its memory (Aguzzi et al. 2011). RFID readers will either be moveable on hand-held terminals positioned in numerous strategic places of the supply chain network. RFID tags, also referred to as transponders, are sometimes small items of fabric, usually comprising three elements. An antenna unit contains silicon chip memory storage explained in Figure 2.7. For the application, tags are often embedded in glass or epoxy resins or alternative materials. The tags have an electronic product code of ninety-six bits recorded at the time of manufacture. Tags are often classified in terms of knowledge access in read-only mode. The data cannot be modified or appended in a read-only tag, but I generally it can be read several times focusing on tracking applications.

According to EPC network model, RFID includes the following fundamentals such as RFID Tag, Tag reader, EPC, Expert server, Object name service (ONS), and Physical markup language (PML). An organization can consider renowned server application such as IBM, Oracle, and MS SQL for RFID. Some issues to be considered are whether the organization should treat RFID technology as one sensor-based service or focus on an RFID database that gathers RFID events.

RFID Tags

RFID tags save time and cost to keep record of each product with its label, putting back the level for the supply chain operation. RFID tag can read the data depending on the tag's memory size, the frequency ranges for it, and its assigned tag class. Tags work as long as it does not drop cases or pallets, is not affected by the offending materials, and it is evident during the transport. RFID Readers will also have difficulty detecting tags under the nylon belts, under the plastic bag for frozen meat packing application.

Commercially three types of RFID tags are mostly popular such as

Active tags – RFID active tag must have a power source (battery. In contrast to other tags, it offers long range coverage and larger memory. There are two types of' active tags as Transponders and Beacons. Depending on the functionality, RFID tags can be used for different applications, including road tolling, real-time location systems (RLTS), perimeter security functionality, and asset tracking.

Figure 2.2: Active RFID tag utilizing the 433 MHz frequency (Source: Telsor.com.au)

Passive tags – A passive RFID tag is quite different from active tags, comparing a microchip and an antenna. It has no internal power source and generally much smaller size than active tags, and frequency range few millimeters depending upon the application. Mostly uses for asset tracking, access control system. Figure 2.3 shows a picture one type of passive tag.

Figure 2.3: A picture of a UHF passive RFID label (Source: Aliexpress.com)

Semi-passive tag – It has an internal power source but not to hold an active transmitter. These tag uses for monitoring inputs from sensors, even it works surrounding electromagnetic fields without active tags presence from Figure 2.4. This quality makes it suitable for monitoring system and activating or deactivating objects remotely. It has some others applications such as clock alarms, seals, or thermostats. (Angeles, 2005).

Figure 2.4: A picture of a UHF semi-passive RFID tag with a temperature probe (Source: Veryfields.net)

Antennas

Antennas orientation, position, proximity, and reading zone are the most essential part of RFID antenna, and all are related to each other. None can be isolated without considering the other two. RFID chip antenna is not the same as the reader or conveyor antenna. These antennas have a read rate of up to 1000 tags per second and a long read range of up to 30 feet. The reader cannot communicate with a label that is oriented vertical to the high gain antenna. Minimum one High Gain UHF RFID antenna is needed for located in selected zone. Although several antennas enable more accurate tag positioning, but is can cause for improper positioning due to reflections from different barriers which affect the device batteries.

Figure 2.5: Invengo XC-AF26 High Gain UHF RFID Antenna (Source: RFID Solutions,2020)

RFID Readers

There are four types of RFID readers' handheld, vehicle-mount, post-mount, and hybrid. The first three are dedicated to the reading of the tags, active or passive. The last one has the active/passive mode allowing it to switch from the inactive to active mode and vice versa. Future RFID readers offers less power consumption and voltage requirements capabilities. Passive RFID readers only can create a RF field when they are switched on. These types of tags generate

their power from the radio frequency field and battery power source is not mandatory. Because they have no battery, the passive tags have the advantages for smaller size, weight and not battery required even lighter weight than barcode system.

Figure 2.6: UHF RFID reader for smartphone (source: RFID & Wireless IoT, 2021)

Active tag acts as an energy source included into a tag and passive tags obtain energy from the readers' magnetic field. RFID readers can be classified based on portability and device components. When an antenna sends or receive radio frequency, it encrypted the data generated from tag.

RFID uses in different standards

The main modules for RFID integrated supply chain network are RFID Tag, Interrogator, Reader, Antenna, Sensors, Controller, Software System (ERP/MRP), Communication Set-up, and Actuators. Therefore, RFID follows automated identification tagging method within the range of RFID tag and it stores and retries data, which are attached to its microchip and an antenna, explained in Figure 2.7.

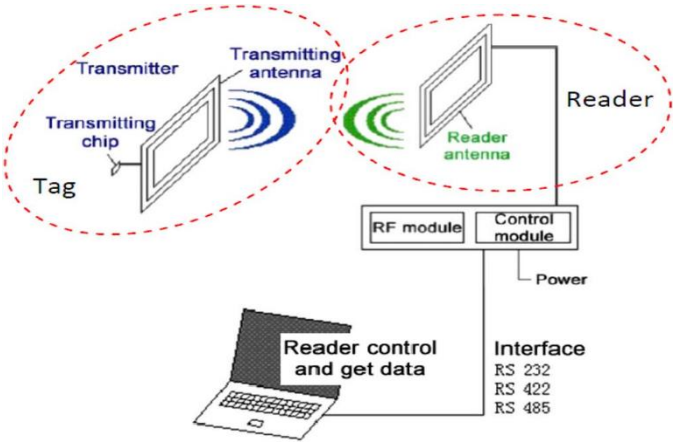

Figure 2.7: Working principal of RFID (Li.Wang, 2014)

If there are many tags in a same area, there will be a chance for the data collision. For an example, in a shopping mall when a customer takes full of grocery items in to the basket and it can be a cause for data collision. To reduce this data redundancy chance, efficient anti-collision algorithms have to use. Each RFID tag can read the data only one time at a time.

RFID technology vendors have to follow the list of standardization. Air interface device item is under at UHF ISO/IEC 15961 and 15962. American National Standards Institute/International Committee for Information Technology Systems (ANSI/INCITS) 256:2001 and the European Article Numbering Association Uniform Code Council Global Tag is (EAN.UCC GTAG). The application standard for the use of RFID in the macro supply chain is ANSI MH10.8.4. Application standard for RFID on reusable containers ISO/IEC 18000. ISO 18185 Electronic Seal Tags for Containers Automotive Industry Action Group (AIAG). The most popular RFID frequency usage is 900 MHz, 13.56 MHz, 860 MHz–930 MHz for Logical Communication Interface Specification. Short-range passive tags are inexpensive but,

many readers and antennas are required for long coverage, and multi-tag can cause of slow communication. Combined of two-active tags system is quite expensive but have more highly reliable transmission service and better support for additional memory and sensors.

RFID Tag life cycle

RFID uses radio frequency to communicate between transmitter and receiver which is movable tagged. RFID data model can be classified into two groups, which are event data and the master data. The event data is real time and it keeps current data about RFID tagged stuffs such as materials handling equipment, vehicles, textiles containers, pallets, animals tracking etc. Therefore, master data offers previous information and verification about the event data which is time-dependent, it changes dynamically large volumes. RFID application is needed a big support such a huge sequential data made by RFID readers. Moreover, they want to have an automatic method to convert the original observations from RFID readers into derivative data used in RFID-integrated applications. This is a significant view of information capturing techniques for different data items such as fresh food items, medicines etc. The Transaction time (TT) is already on the base, denoting the time when the transaction took place. Besides, Valid Time (VT) and Availability Time (AT) are known time-based dimensions concerning our RFID Application.

There are four periods in the RFID life cycle which are unknown, detected, captured, and expired. These four different steps are event detection at the beginning, event disappeared, then event captured when the tag is seen for a certain period and its timestamp is attached, and finally event is expired which is explained in Figure 2.8. (Tyagi.S, 2011)

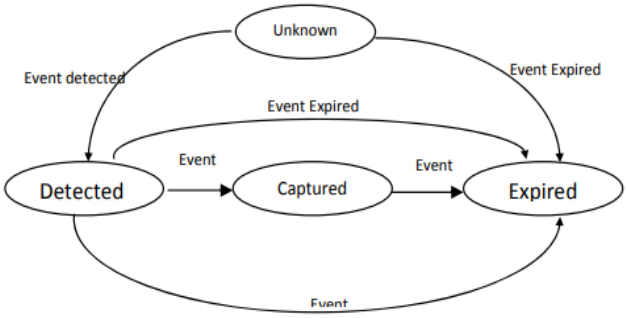

Figure 2.8: Life-cycle of RFID Tag (Abdul Kaiyum Ansari, 2011)

U.S. company DoD and Wal-Mart have taken the advantage using RFID tag to supply their products on cases and pallets as it saves costs and time in better inventory and item tracking management (R. Angeles, 2005). Although the suppliers are finding ways to implement the technology, the active RFID technology market continues to grow. Initially, passive RFID products are developing faster than the active RFID products because passive products are small in size and user friendly to handle it. The storage capacity for active tags is much larger to allow multiple larger-sized files on the server database via a laptop. For both RFID technologies, the readers can be either mounted on a surface and it has more flexibility in orientation than the barcode technology. Moreover, the data transmission rate for active RFID device is much quicker than inactive RFID products. RFID tags can be programmed for sending, receiving data and it contain the data identifying protocols using RF. The degree of programmability is also measured for transmitted power to the tags. The more power from the tags can have or receive, the more possibilities for a reader's programming read/write capabilities. Inactive tags, data may be secured, and only specific individuals assigned passwords to read them.

Passive RFID tags draw their power from the microchip from radio waves mirrored by Associate in Nursing RFID reader inside the radiofrequency field's short scanning vary. Once the tags square measure outside the RF field, they're going to inactive. The facility to the chip should meet the minimum voltage threshold required to show on the chip. Once the chip is turned on, it will challenge data on constant oftenest wave. Except passive or inactive tags, active tag receives a weaker signal from the RFID antenna or reader at a more comprehensive field frequency that varies significantly. Once it activated, these tags get their power or energy from the batteries or the sources and this facility of the tags boost the signal. These tags have to vary anywhere from tens meters to more. However, the value is quite the passive and semi-passive sorts due to the quality of the electronic equipment. Combination of semi or full

active RFID device, to find environmental changes that might lead to, for example, spoiled chicken or broken computers. A causes for slower development of active RFID device square measure that the batteries could unexpectedly out for long before the battery life is regular to drop. A minimum of one antenna should be set in the one zone and using many antennas are set of a correct tag positioning, reflected signal from walls to put incorrect tag position and instrumentation will adversely affect the transmission from the batteries. The tags that aren't situated within the correct position in buildings which affect transmission quality. Though most industrial, retail, and provide chain sectors need solely the best, lowest-cost tag, the potential worth of a lot of difficult tags justifies their multiplied value in specific industries. For example, the food trade might want to feature temperature trailing by adding a temperature device on tags. Suppose one or a lot of tags find an increase in temperature throughout cargo or different suggests transport. In this case, the tag can send an Associate in Nursing alert concerning the surprising mechanical breakdown of cooling throughout the transport or during a warehouse via a set, portable, or perhaps Palm-mounted reader to a manager. Once obtaining Associate in Nursing alert, the chief or manager will remotely activate the backup system during a warehouse, direct a moving vehicle to the closest offer chain location or send an Associate in Nursing emergency crew to mend the cooling.

RFID implementation in different SCM

During the first commercial uses of data processing, material requirements planning (MRP) regarding automated inventory, and production planning processes in the early 1970s (Joshi, 2000). Because the user data is limited, and the manufacturing system is not integrated with the company's financial system, MRP's concept was extended. It is needed to integrate technology and digitalized working environment across the firm which will help to make enterprise resource planning (ERP) systems and this information system drives the competition in the subsequent development of enterprise information systems.

Supply Chain Management (SCM) has several applications in logistics aspects, such as pertains to any supplies that can be bought, managed, and transported from one point to another in the supply chain. Examples include hospital supplies, pharmaceutical supplies, clothing supplies, aircraft supplies, subsistence (food), vehicle part supplies to field troops overseas, clothing supplies, office supplies, computer supplies, furniture, and shoe supplies. SCM covers the integration with ERP Systems, Web Services, loyalty cards, handheld devices, smart shelves, and POS terminals for the management aspects.

As adopting RFID technology within the supplying service method may be thought-about as technological innovation for the supplying business, it might be expected that there's a positive relationship between RFID technology adoption and provide chain performance for supplying service suppliers. Moreover, RFID technology may be a very important resource for a firm to get competitive benefits. A firm ought to develop a viable strategy to marshal resources to provide superior performance (Grant, 1991). potato and Poist (2000) argued that supplying services capabilities, together with economical reposition, transportation, and freight bill payment, area unit drivers for superior provide chain performance. RFID technology will facilitate item-level identification and expeditiously characterize every item among the complete provide chain (Davis and Luehlfing, 2004). it's useful to advance the aptitude of a fast response. As service capabilities like responsiveness and suppleness will enhance performance, supplying firms with higher service capabilities could attain higher service performance (Lai, 2004; Zhao et al., 2001). In building a supplying management system, the costs, schedules, and necessities area unit tracked. Controls area unit necessary to stop unauthorized changes to the method, practices, and policies. For the management, the total system integrates with ERP Systems (e.g., Oracle-PeopleSoft), Web Services, handheld devices (e.g., The METRO Group Future Store), smart shelves (e.g., Chain Pharmacy Operations).

The retail e-business represents one of the most important industries within the world economy which is one of the largest selling platform in terms of variety, the number of staff, and the number of institutions for doing business worldwide (Vargas, 2017). The increasing economic process has exaggerated distributor competition, motivating firms to realize higher performance (Koh et al., 2006). Major retail sellers in U.S, European union, and Middle East-Asia allow the various opportunities in different application of RFID technology. In the USA, Wal-Mart was the primary distributor to appreciate the attainable price savings that would be created attainable by the victimization of RFID technology in its provide chain and outlet centers. In Europe, retail sellers like Tesco, Marks, and philosopher, and subway cluster have enforced RFID technology in their SCM. Most retailers expect to learn from group action RFID practices across company lines apart from China in Asia. Chinese retailers would like to use RFID inside their

company boundaries in transportation and private tagging to observe the geographic point. In distinction, Japanese retailers take many integrated approaches and use RFID tags to monitor and manage distribution and sales of women's shoes and attire in stores because of anticipated business edges (Fish and Wayne, 2017). Rogers's theory of department of the inner technology reception model, technology, institution, and surroundings frameworks is most popularly employed in RFID adoption (Adhiarna et al., 2011). The central theoretical perspective used because the foundation during this study is Rogers's theory of the Department of the Interior. It explains the adoption method progressing in many stages. It's the major referred theory in new technology adoption because of its well-developed ideas and many experimental results (presently and Gutierrez, 2010). Most of the present RFID adoption research targets adoption problems at a private level, especially sensible observations.

RFID Technology uses in Bangladesh

In the Shipping and Distribution industry, RFID enables suppliers to determine a pallet's location accurately, track its journey through the supply chain, and make instantaneous routing decisions. The tag mechanically determines loading/unloading activities area is required for crew movement the truck at the service center maintaining world standard (Intermec, 2004). RFID technology leads an advantages over bar-coding all over the world. In Bangladesh, some big organizations as Arong and Sailor's took the initiative and moved in RFID technology to lead crucial technology development for retailers. RFID tags regularly gather information about the product stocks in the shelves to the checkout. This technology supports the retail merchant scale back labor and manual prices, curbs thieving and boosts store productivity (Gogoi, 2005). The tags already facilitate Arong and Sailor with rearrangement, stocking, and keeping purchases record. Manufacturing Sector has been finding alternative ways to derive price out of this technology. As an example, the production department will use RFID products to make sure their accuracy.

The elements are labeled and half-tracked individually throughout the producing method, whereas on the assembly line. Once the finished products are received from the assembly plant, they'll be half-track throughout the assembly method. Tags containing instrumental specifications and connected to a database that is used for sample upgrading. Similarly, tags are wont to track usage, convenience, location, and fabric handling instrumentality maintenance. RFID tags is using to keep tracking personal vehicles in the Dhaka city as they can track from anywhere. This technology will help to reduce the working labor expenses involved in decreased record expenses, and ensure faster order.

Apparel Industry - during this business, RFID technology will address the vital challenges of gaining larger management of merchandise flow. The technology can facilitate the garment industry to boost turnover and increase complete profitableness. RFID can modify attire makers and retailers to appreciate fewer operational errors throughout the provision chain, confirm what stock is within the store, and luxuriate in automatic replacement that has taken things. The garment industry's foremost vital advantages will gain by holding RFID technology, to increase visibility into client needs, correct and timely quality services, reduction in inventory prices, stock-out and holding prices, and better quality product traceability. The system will assist employer in rising inventory super vision and security.

Agriculture, and Food regrowth: Uses of RFID technology in U.S and European Union (EU) started in 2005 for adjustment traceability of customers' needs. This technology is employed for trace toxic, bacteria, and annoying particles in the food and food products. RFID will facilitate these traceability needs at an affordable value. The technology is proving additional helpful and is enjoying a broader strategic role during this business. So, it's conjointly a crucial scope for the food sector in Bangla Desh to boost this sector.

Health Care sectors – This radio frequency based technology is progressively being employed in health-care industries to boost the quality and dependability of health-care service delivery. RFID tags are accustomed to determine and track people in health-care contexts. Examples are worker identification cards, patient identification cards, mortise joint and wrist joint bracelets, and small chip less RFID tag. RFID tags are accustomed to determine patients and update their standing mechanically. RFID tags also are familiar to use in the hospital blood samples collection to patients. Medical Centers are also used RFID tag to trace and manage assets, like medical devices, wheelchairs, and surgical instrumentation. Moreover, technology is employed to look at its samples and laboratory outcomes. It is useful if used utterly in the hospital application in Bangladesh (Md. Mahadi Hasan, 2019).

Bus Ticket System- Offline ticket booking is easy and convenient for customers' choice based on their travel condition (Gayathry, 2013). When internet was not available (offline era), bus ticket booking during was difficult for the instant

customers. Moreover, for the bus companies it was much more difficult to monitor their seat capacity. Some small and medium bus operators are started to use RFID based monitoring and tracking system for their own operation. It also gives customers the power to make a ticket booking through bus operators 'popularity, performance, and ranking. This high-speed Internet-based ticket booking system allows full control of the ticketing inventory. Recently, Bangladeshi mobile operators like Robi, Grameen phone, and other software companies are providing online ticketing system service worldwide.

In recent technology developments, chipless RFID tags have been developed and offered on the affordability level of customers, which will result in a higher level of the drug market. RFID tags that do not contain a silicon chip are called chip fewer tags - some of which can be printed on thin plastics and specially manufactured papers or the products at a unit price of 0.1 cents or less and replace ten trillion barcodes yearly [8]. In recent years, various types of chipless RFID tags were developed. The researchers face a challenge in designing chipless RFID transponders/tags during data encoding without a chip. RFID transponders can be identified as time domain reflectometry (TDR)-based and spectral (frequency) based chip less RFID tag. Figure 2.10 below indications the types of chip less RFID tags (A.sultana, 2013).

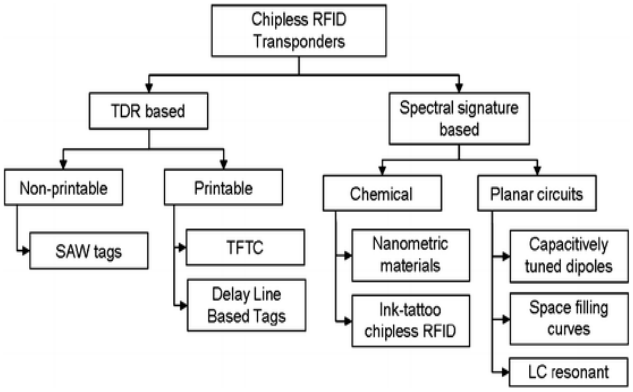

Figure 2.10 Classification of chip less RFID

(Stevan Preradovic, 2012)

From Figure 2.10 chip less RFID transponders are mainly two typed: TDR-based chip less RFID transponders and Printable TDR- based chip less transponders (A.sultana, 2013). TDR-based chip less RFID transponders can be classified as printable and non-printable and printable is divided in to Thin Film Transistor Circuits (TFTC) and delay line based tag. TFTC transponders are printed at high speed and on low-cost due to their small size and low power consumption. Spectral signature based is divided by chemical itching based and planer circuits.

Integration of RFID in the supply chain network

Supply chain integration is a close alignment and coordination within a supply chain using management information systems. A supply chain is made up of all parties involved in fulfilling a purchase, including raw materials, manufacturing the product, transporting completed items, and supporting services (S LeMay, 2017). Moreover, integrated supply chain management refers to an enterprise resource planning approach to supply chain management. A business facilitates relations with all of its suppliers and manages all distributors and logistics activities by a centralized system. An E-commerce business platform can support supply chain integration (Cagliano et al.,2005). Despite the potential benefits of e-commerce solutions, organizations in the private and public sectors are still careful about implementing RFID (Elmer Bakker, 2007). Adopting RFID is to take action or make acquainted or enable the users with the new technology. RFID adoption should continue to improve the organizational process, culture, customer satisfaction, and financial performance. For instance, a company adopting an RFID system may need to change its business processes and procedures and check whether the RFID system can be integrated with the existing office system. TOE framework (Tornatzky and Fleischer, 1990) offers a relatively complete study of RFID adoption issues. To examine the differential effects of technological, organizational, and environmental variables on RFID adoption, public organizations are quite different from the private sector in competition from industry. Though it has several benefits, its adoption has not been popular because of its high cost of implementation and integration issues (Irani, Gunasekaran, and Dwivedi, 2010).

SCI is defined as the activities within a company where suppliers, customers, and other supply chain members are involved to execute final process (Flynn et al., 2010; Stonebraker and Liao, 2006). SCI links a firm with its customers, suppliers, and other network members by integrating their relationships, actions, procedures, and sites (Naslund and Hulthen, 2012). This supply chain integration has two working stages such as internal collaboration and external integration among the business partners. Internal integration creates close relationships between shipping and raw material management (Trkman and Groznik, 2006). Under external integration products deliveries between manufacturers, whole sellers, and customers and backward flow of data from customers, to main manufacturers (Schoenherra and Swink, 2012). E-commerce business applications contain three different types of groups such as retail consumers, E-procurement, and e-collaboration. E-commerce retail business starts when a buyer places an order. Than a supply chain gets the information to process the order through the supply chain network. To complete the order process, RFID technology can be involving with this trade such as orders tracking, recording performance.

SCI is outlined because the extent to all activities inside a corporation, including its suppliers, customers, and alternative supply, provide members square measure integrated with this process (Flynn et al., 2010; Rai et al., 2006). SCI makes relationship among a firm, its customers, suppliers, and others supply chain members by integrating their activities, roles, processes, and positions (Naslund and Hulthen, 2012). It includes internal integration and external integration with organization's partners. Internal integration establishes locked relationships between tasks like shipping and inventory or getting raw material (Trkman and Groznik, 2006). At a same time, external integration has two: forward directions (integration flow of delivery item from suppliers to the customers and backward direction which is flow of technological knowledge from customers to suppliers (Schoenherra and Swink, 2012). E-commerce or e-business applications generally include three teams. They're E-commerce (e.g., retail consumers), E-procurement (e.g., RFID tags, readers, so on), and E-collaboration (e.g., cluster data sharing). E-commerce starts once a client places associate order online. Once a provided information gets by the supply chain within the back-end data systems to make business transactions throughout the supply network. The RFID technology infrastructure should method must use and record performance measures that square measure coupled to the provision supply chain to complete the order. Many industries have electronic marketplaces to handle the complexity better or procure items to buy and sell products over the Internet.

RFID in the Garments industry

RFID technology is based on RF (Radio frequency), and it has recently have been started to use in garments industries, point-of-sale (POS) machine, continuous information about its production in Bangladesh. This technology is also profitable for customers to create options within the best quality to increase the services' quality and reduce difficulties in delivery time. In retail outlets, the RFID tag uses modern clothes and canceled customer orders to make stock at each order. Several problems within the textile business are more than regular problems in chain interventions to beat issues. Short item life cycle, long-creating time interval, and high anticipating errors are basic problems found within the textile trade (Lam & Postle, 2006) and to manage these problems, RFID technology is usually recommended by previous studies (Chow et al., 2005; Chow et al., 2006). RFID technology expands operations and productivity within the distribution center and reduces operational expenses in the company. Generally, it can boost up the accuracy of product traceability. These cases show that RFID technology helps ever-changing items and up overall revenues at every supply chain part. Therefore, RFID is one of the systems supporting info-communication technology and enhances the delivery system and worker's services quality to spread up chain operation. The Electronic Product Code Information Services (EPCIS) provides information-sharing within the availability supply chain. The RFID-based intra-supply chain's framework style is partitioned off into four stages: the RFID access, info coordination stage, intra-supply chain info understanding stage, and electronic stage (Keung Kwok & Wu dialect, 2009).

RFID adoption in Hospital

Using radio wave frequency, RFID is more user friendly, fast-developing technology for collecting and transferring data without any human interaction (Yao.W., 2012). Usually, bar codes were used in the hospital to recognize the patients and to ensure the accurate medicines were delivered to the correct person. In the traditional system, the barcode needs a line-of-sight between scanner (reader) and wristband and also there are some difficulties if the patient tore or remove any part of barcode is not clearly visible.

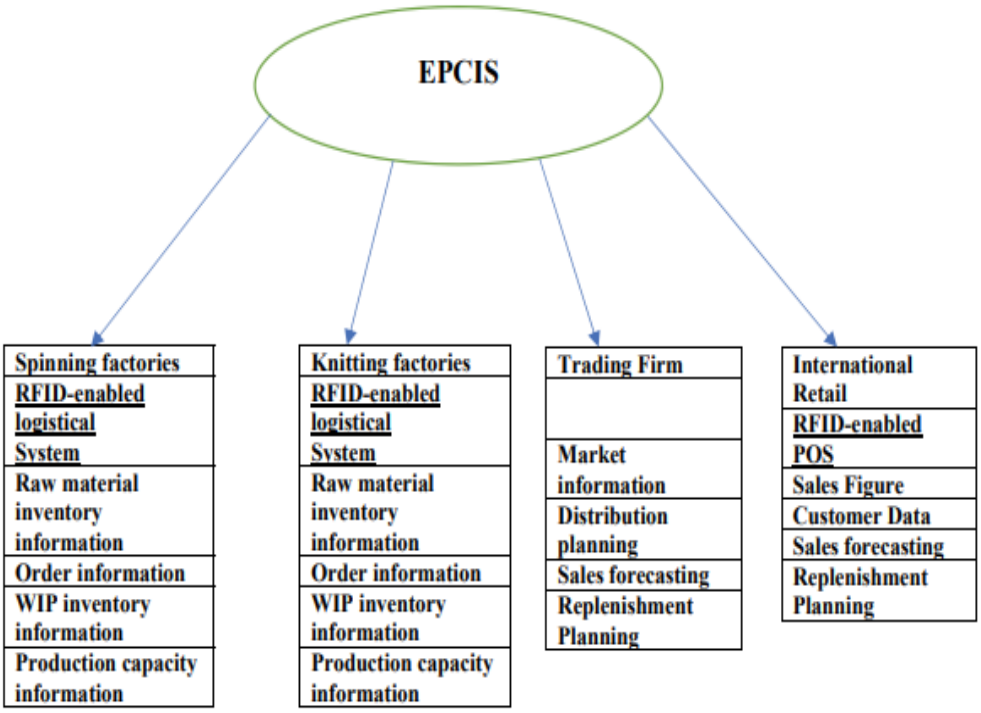

Figure 2.11. Radio frequency identification (RFID) technology is a newly emerging technology for the apparel industry based on information communication technology (ICT) [source: Keung Kwok and Wu, 2009)]

If the barcode scanner faces any difficulties to read the barcode, when it becomes dirty and the wrong patient can be identified. RFID don't have these kind of isues and does not require a line-of-sight to be read. Although RFID costs more than bar codes, it has many advantages over the older technology, making it a good alternative (Suhaiza Zailani,2014) (Yu, Y. C., 2012). Initially, bar codes can be fade when it is printed and uses for long time, and line-of-sight also required for barcode. On the other hand, line-of-sight is not essential in between RFID tag and RFID reader and also it is not a problem if the tag is muddy.

RFID reader can read hundreds of RFID tags at once. Hawrylak et al. categorized its application in the healthcare industry into three areas, namely tracking and managing inventory, finding assets, patients, official staffs, doctors attendance and developing the quality of patient (Hawrylak, P. J.,2012). The inventory tracking ability of RFID system permits hospitals to reduce extra inventory complexity before it expires and inform to the supplies (Healthcare Purchasing News, 2006). Locating assets, patients, and staff ability enables hospitals to monitor staff and patient location, making it possible to contain diseases better and implement effective quarantine and isolation areas (Wang, S. W.,2005). RFID can also improve patient care quality through its treatment scheduling system for the patients. RFID technology in the hospital or health sectors which is relatively new than other sectors such as libraries, logistics, retailers, manufacturing industries, and supply chain network. The adoption of RFID is considered as "next disruptive innovation in healthcare" in the healthcare. (Crooker, K.,2009).

E-commerce supply chain network in Bangladesh

The supply chain ensures the timely delivery of goods and services to end-users (Chen, 2009), subsequently enjoying associate degree advantages among alternative management approaches. The abundant analysis was conducted on SCM in developed countries (e.g. Dubey et al., 2017; Wang and Dai, 2018), however the analysis on SCM within developing countries like the southeast Asian countries has received very little attention. Bangladesh was involved in SCM activities before four decades, and SCM practices were started in Bangladesh when growing the RMG sector (Hossain and Roy, 2016). SCM practices aren't enough in different sectors in Bangladesh because of national and international market data availability and undeveloped infrastructure for supply chain system in Bangladesh (Nuruzzaman, 2015). Haque and Islam conducted a study on the supply chain in the pharmaceutical business of Bangladesh (Haque and Islam, 2018). They found a positive relationship between knowledge sharing and collaboration with customer satisfaction, leading to Bangladesh's overall SCM practices. However, cost factors (e.g.

labor, raw materials, etc.), efforts to improve the business environment, services, and facilities development foster an advantageous Bangladesh for SCM position. It is critical to understand the drivers, practices, and outcomes of SCM practices of Bangladesh. As SCM practices are increasing in Bangladesh, it is crucial to gauge various aspects like SCM's influencing factors, SCM practices, and SCM consequences. SCM's upstream and downstream partners will be benefited, knowing the multiple issues of SCM practices in Bangladesh. Moreover, there is a dearth of research conducted on SCM issues in a developing country like Bangladesh (Aloini et al., 2015).

Trust could be a behavioral side of each party during a relationship and build up step by step among each party (Su et al., 2008), and mutual trust creates a strong belief between the partners that they won't go against the others. Formation of partnership to form price needs trust as a vital antecedent in enterprise investment. There's forever an occasion of the opposite party's timeserving behavior in which all ambiguity will ne'er be removed during a provide chain relationship (Blome et al., 2014). Individual companies measure their operation expenses, income returns with their expectations, and therefore the total strategic relationship system is evaluated under partnership (Williamson, 1979, 1985). Co-operative governance shows supply chain interchange, which has large relationship-specific assets shared with a high trust (Bloome et al., 2014).

Most e-commerce organizations in Bangladesh don't have a supply chain management format to convey items or restore their item from the client. Customers are not fulfilling enough to purchase more items from that organization because of its business fall. E-commerce deals with online selling and buying and plays a vital role in supply chain management. Apparel manufacturing organizations are suffering enormous issues regarding receiving materials on time. Consequently, owners have to pay more for airing goods due to an inadequate supply chain. The SCM is the backbone and a critical component of E-commerce. Supply chain efficiency has the right product at the right place at the right time, which can save money or reduce costs. E-commerce plays a vital role in inventory management to keep the record electronically to avoid any information breach. A supply chain is a network of facilities and distribution options for the entire network of companies to work together to design, produce, deliver, and service products. RFID adaptation is significant to change the situation for any e-business software. Agility will become a necessity for any e-business infrastructure software. In Bangladesh, the apparel manufacturing organizations struggle to survive in the competitive market since labor cost increases day by day. Bangladesh government has been imposed a rule over the entire garments manufacturing industry that wages must be increased every five years of recess. The government does not provide any particular facility to the industrialist to cut their overhead cost through some options to be considered in the power supply (Kurpad, M.R., 2014).

E-commerce future platform in Bangladesh

Chaffey (2009) defines “e-Commerce as the exchange of information across electronic networks, at any stage in the supply chain. Where the exchange would be within an organization, between businesses, between businesses and consumers, or between the public and private sector, whether paid or unpaid”. Similarly, according to Fellenstein & Wood (2000), “e-Commerce is the use of online facilities for doing business. Bangladesh is a developing country comprised of 185 million people. It is a business opportunity country, but there are many e-Commerce adoption problems, and there has not been much research to investigate. Implementation of innovative technology and its practices are crucial from the view of academicians and practitioners. The Internet, intranets, extranets, private networks, and any other networking facility that enables buyers to communicate with sellers are components of online facilities. Doing business can be defined as a set of buying and selling activities of goods and services that make up a business transaction.” Several related factors on e-commerce adoption are as follows considered as typical factors on e-Commerce adoption.

RFID benefits in e-commerce SCN

In general, RFID technology might generate business opportunity in the supply chain network. It can be instant where RFID tag reader can read multiple tags at the same time, while not requiring line of sight or human participation. This system can cut internal control, and some operating cost. In the short-term, RFID tag reader can improve supply chain performance through quality, product tracing, and merchandising support. The organization can be benefited getting supply chain product information provide by RFID data in a long run. By which the authority can identified the right item need to place in right place at the proper time and for the proper value. Product fulfillment systems will be linked into inventory management system which is also connected to logistics department (Intel Corporation, 2004).

Sabbaghi and Hindu (2008), explored the effectiveness and potency of RFID applications where RFID device performed best value for available supply chain network. It will make “Supplier- partners relationship” between business partners and the peoples those are related in the supply chain process. So major five advantages of RFID integration have been explained here

Demand Management - one of the main challenging part is product demand planning on time with previous experience. RFID can give correct and timely information associated with the current stock inventory, in-transit products, and finished products which is ready for shipment. If the management can get the accurate information on time related to production, shipment and product marketing strategies. A detailed calculation provides the main contribution with the supply with demand and produce total profitable forecasting.

Order Fulfillment – RFID permits automation processes like choosing, shelving, and product rearranging. These processes are combined with logistics, proper distribution channels and suitable customer selection from marketing department by using RFID. RFID adoption can provide more visibility along with the supply chains, providing accurate products location tracking for fulfillment of customer order.

Production Management – With the help of using RFID device, production line performance can be enhance reducing delay times and improving production quantity. Moreover, RFID technology will be helpful to makers with just-in-time (JIT) final production lines.

Return/Recalls Management - RFID will help the process of returning the defective product or recollection the product which is referred to reverse logistics. RFID technology enables to return the goods to purchase and increased product tracking capabilities. On the other hand, enabled by RFID, organization can remove the fraudulence being refund back to retailers and reduce product handling charges and extra manpower burden. Improvement of the reverse process can ultimately cause of sustained economic advantage for the company allowing active monitoring capability.

Supplier Connection - Good relationship between suppliers and manufacturers is very important for business forecasting, future planning and Partnership among partners. The accuracy of forecasting will be improved by having the customer demand, order and sales promotion which can be improved by the better quality of services, better supply chain planning and on time information flow to the management. To achieve these purpose, RFID technology can be the better and automated solution by its integrated system for SCM. Moreover, the implementation of this technology can provide better visibility and sharing facilities to the supply chain partners.

Theories of Technology Adoption

Constant technological change simultaneously creates threats to established business models. Leading firms often seek to shape technological applications' evolution to their advantage (Lovelock, 2001; Lai, 2007). With the advanced and dynamic growth of technologies, how fast the consumers accept these technologies depends on some factors such as availability of technology, convenience, consumers’ need, security, etc. Many researchers have addressed the consumers’ adoption of new technologies (Dapp, Stobbe, and Wruuck. 2012; Lai and Zainal, 2014, 2015; Lai, 2016). Therefore, this section presents theories leading to the development of new technology adoption models and theories leading to the theoretical framework for an integrated RFID based supply chain management system. These included the Theory of Diffusion of Innovations (DIT) (Rogers, 1995) that started in 1960, the theory of Reasonable Action (TRA) (Fishbein and Ajzen, 1975), theory of Planned Behavior (TPB) (Ajzen, 1985, 1991), the Technology Acceptance Model (TAM) (Davis, Bogozzi and Warshaw, 1989), theory of Task-technology fit (TTF) (Goodhue, and Thompson, 1995), Decomposed Theory of Planned Behaviour, (Taylor and Todd, 1995), Final version of Technology Acceptance Model (TAM) Venkatesh and Davis (1996), Technology Acceptance Model 2 (TAM2) Venkatesh and Davis (2000), Unified Theory of Acceptance and Use of Technology (UTAUT), Venkatesh, Morris, Davis and Davis (2003) and Technology Acceptance Model 3 (TAM3) Venkatesh and Bala (2008).

Rogers’ (1995) diffusion Model

Rogers (1995) proposed the theory of ‘diffusion of innovation,’ which established the foundation for research innovation acceptance and adoption. Rogers synthesized research from over 508 diffusion studies and developed the ‘diffusion of innovation’ theory to adopt innovations among individuals and organizations. The theory explicates “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1995, p. 5). The process of the members of a social system communicated an innovation

through certain channels over time, known as diffusion. The Rogers' (1995) diffusion of innovation theory explained the innovation and adoption happened after going through several stages including understanding, persuasion, decision, implementation, and confirmation that led to the development of Rogers (1995) S-shaped adoption curve of innovators, early adopters, early majority, late majority and laggards as shown in Figure 2.13.

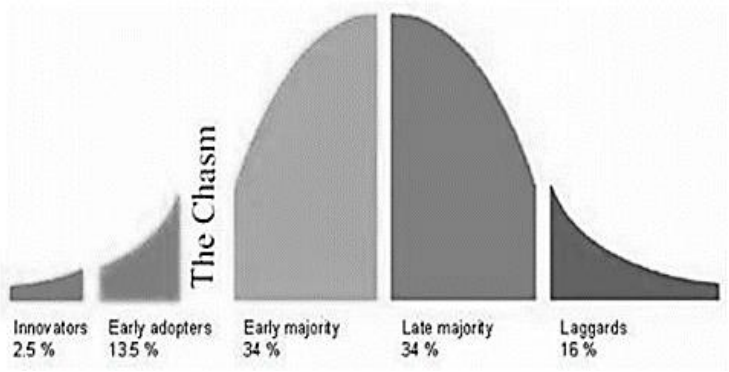

Figure 2.13: Innovation adoption curve (Roger,1995)

Based on Rogers's theory of DOI, Mithu Bhattacharya (2014) proposed a modified four-stage model using knowledge, persuasion, design, decision, and implementation as specified in Figure 2.14.

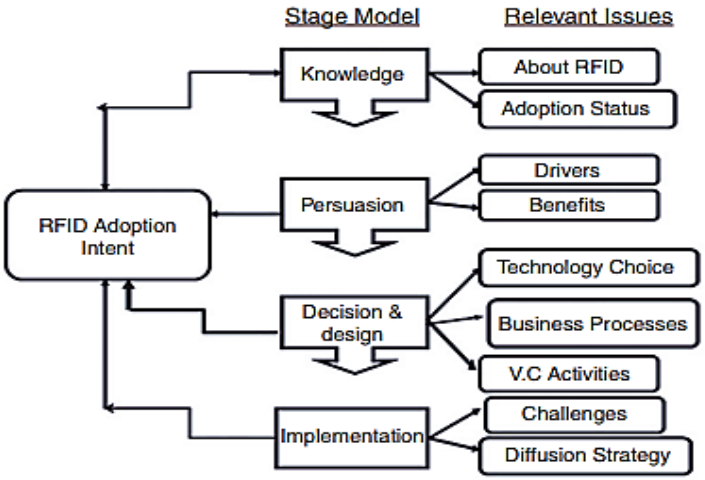

Figure 2.14. Proposed RFID stage model and propositions (Mithu Bhattacharya, 2014)

The custom-made four-stage model is selected over basic two-stage model with initiation and implementation to classify related problems through stages. This e model recommends to achieve specific knowledge in the particular field than need encouragement with its benefit for the future decision making. Finally, new design using new technology can be easy to implement in the organization.

Right hue and Thompson Model

Task-technology match (TTF) model emphasizes individual impact which refers to improved productivity, effectiveness, and better quality. Goodhue et al. (1995) expected that the wonderful match between task and technology is to extend the chance of utilization and increase the performance control since the technology meets the customer needs.

As shown in Figure 2.15, this model is suitable for investigating the technology's actual usage, mostly new technology testing, to get feedback. The task-technology fit is suitable for measuring the technology applications already release in the marketplace, like in the google play store or apple store app (iTunes) (Pc Lai, 2017).

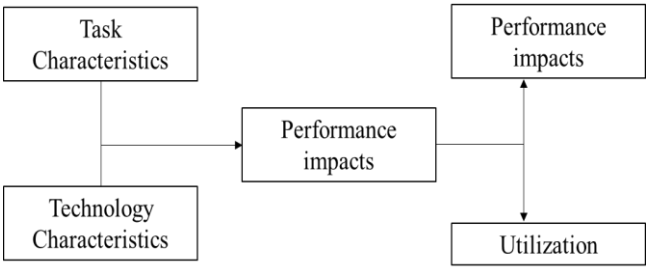

Figure 2.15: Task-technology fit (Goodhue and Thompson,1995)

2.12.3 Theory of Reasonable Action (Fishbein and Ajzen, 1975)

Low-cost action theory (Fishbein and Ajzen, 1975) is one of all the expected standard theories. It's regarding one issue that defines the behavioral intent of the person's attitudes toward the behavior, as shown in Figure three. Fishbien associate degreed Ajzen (1975) outlined "attitude" because the individual's assessment of associate to project object and quality, and selected "activities" as a result of intention. Attitudes area unit affectional and primarily based upon beliefs regarding the item of behavior. A second issue is that the person's subjective norms of what they understand their immediate community's perception precisely.

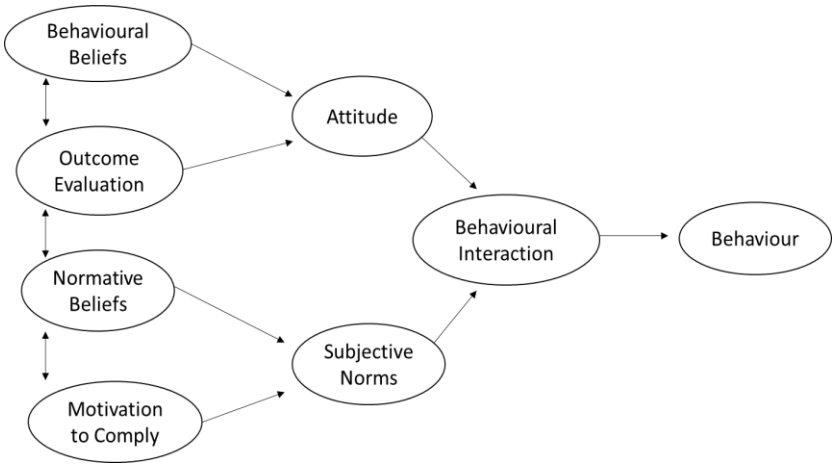

Figure 2.16. The theory of Reasonable Action (Fishbein, 1975)

Theory of Planned Behavior (Ajzen, 1991)

Ajzen (1991) developed a Theory of Planned Behavior, which is about one factor that determines the behavioral intention of the person's attitudes toward behavior, as shown in Figure 4. The first two factors are the same as Reasonable Action theory (Fishbein and Ajzen, 1975). The third factor, known as the perceived control behavior, is the control that users perceive to limit their behavior.

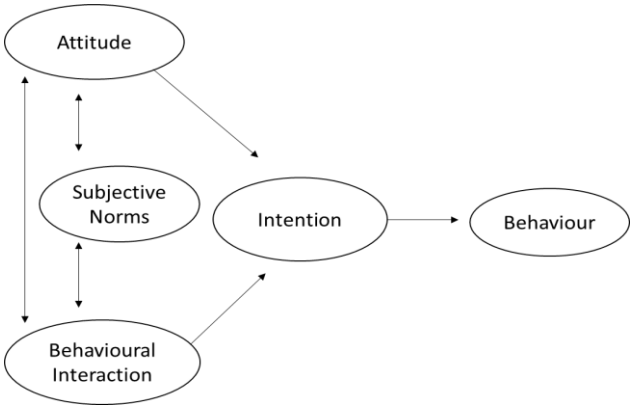

Figure 2.17: Theory of Planned Behavior (Ajzen, 1991)

Decomposed Theory of Planned Behavior (Decomposed TPB) was introduced by Taylor and Todd (1995). This TPB model (see in Figure 2.17) involves three main factors that influence intention, such as angle, subjective norms, and perceived behavior management. Shih and Fang (2004) examined the adoption of web banking exploitation by the TPB and decomposed TPB.

RFID Implementation Success Factors

Some studies have been done to identify factors that contribute to the success or failure of RFID adoption. For example, Vatanasombut and Gary (1999) identified some success factors contributing to data warehousing projects' success or failure. Sammon and Finnegan (2000) commend ten instructions for data warehousing. A multidimensional computing model was introduced to separate the different success categories (DeLone & McLean, 2003). Ten critical implementation factors have been chosen to represent RFID adoption's prominent influencing factors (Attaran, 2011a; Visich, Li, Khumawala, and Reyes 2009; Waters and Rahman, 2007). Some of the popular factors are a) Clearly defined business needs/benefits b) Top management involvement c) Proper planning/scoping d) Return of Investment (ROI) e) Satisfactory funding f) Technology provider partnership g) Incorporating RFID technology into an existing IT organization.

3. CONCLUSION

Many world-famous brands established their production house in Bangladesh mainly readymade garments, leather goods, textile, and energy-related companies, for the low production and low labor cost. Bangladesh is a late candidate in the e-commerce industry, and it is getting tremendous popularity within a short period. Bangladesh is a growing technological nation and trying to implement innovative technology in every sector. RFID technology has an excellent opportunity to explore Bangladesh's business industry, especially for e-commerce based supply chain networks. exiting literature associated with the factors affecting RFID adoption in e-commerce supply chain management in Bangladesh has been presented. Key elements such as technological, organizational, and environmental factors that influence RFID adoption are highlighted. The benefits and advantages of this technology implementation in the supply chain network in Bangladesh are also explained.

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