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# Review of the Strategic Importance of RFID data Concept for Examination Management Process

By Hamza Danladi, Dr. G.K. Viju Professor & Dr. Abdalrahman Mohammed Alamin

*Sudan University of Science and Technology*

*Abstract-* This paper investigates and conceptually established the relevance of adopting Radio frequency identification (RFID) data concept in the management of higher education examination. Through the collected of several eminent authors in the area of RFID data concept, and based on Resource-based view (RBV) theoretical framework, the paper analyzes the strategic importance of RFID data concept in the management of examination process. These RBV was used to indicates the different ways that the strategic relevance of RFID data concept in the examination management could be assessed. The paper thus provides better understanding and conversation of an Automatic Identification and Data Capture Technology (AIDCT) like RFID data as well as the benefits of adoption to improves examination management process. It also improves capabilities to evaluates and learn how to look into the strategic areas of applying appropriate identification technologies, tools and techniques to a specific examination management solution. The study concludes with direction for further research.

*Keywords:* *strategic importance, examination, management, RFID data concept, process improvement, conceptual review.*

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# Review of the Strategic Importance of RFID Data Concept for Examination Management Process

Hamza Danladi [α], Dr. G.K. Viju Professor [σ] & Dr. Abdalrahman Mohammed Alamin [ρ]

*Abstract-* This paper investigates and conceptually established the relevance of adopting Radio frequency identification (RFID) data concept in the management of higher education examination. Through the collected of several eminent authors in the area of RFID data concept, and based on Resource-based view (RBV) theoretical framework, the paper analyzes the strategic importance of RFID data concept in the management of examination process. These RBV was used to indicates the different ways that the strategic relevance of RFID data concept in the examination management could be assessed. The paper thus provides better understanding and conversation of an Automatic Identification and Data Capture Technology (AIDCT) like RFID data as well as the benefits of adoption to improves examination management process. It also improves capabilities to evaluates and learn how to look into the strategic areas of applying appropriate identification technologies, tools and techniques to a specific examination management solution. The study concludes with direction for further research.

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## I. Introduction

Advocate of process improvement approach are of the view that process improvement tools and techniques can be used to increase effectiveness, efficiency, agility and sustainability of a particular process under a condition of scarce resources (Khosravi, 2016; Zemguliene & Valukonis, 2018; Shafique, Khurshid, Rahman, Khanna & Gupta 2019). One possible reason for this submission is that, organizations that implement an end-to-end processes improvement can improve the quality of their products and services thereby achieving a significant cost reduction and make their business process more reliable and efficient (Khosravi, 2016). Hence, the age of information technology such as the use internet, mobile devices and other computing platforms have made it possible for organisations to collect data, store and share this information within and outside the organisations boundary for effective decision making (Wang, Gunasekaran, Ngai & Papadopoulos, 2016).

One popular tool or technique of doing such process improvement is the Radio Frequency Identification (RFID). Identification technology such as RFID data enables every item to possess a special symbol that identifies a body of data which can be read far-off place, enabling automatic, "real time identification and tracking of individuals objects" (Mirza & Brohi, 2016). It also has the capacity to provide mechanical devices with the means to recognize items, understand condition, exchange information and where required, get into action, construct "real time awareness" (Akpinar & Kaptain, 2010). RFID data enables the use of radio signals rather than wires in the act of storing data as well as automatic recovery of data (Pala & Inanc, 2009). The most important or essential of RFID data system are grouped into three major parts: 1) device for sending and receiving radio waves known as antenna, 2) RFID reading device that is, RFID reader and, 3) a small piece of cloth, paper, plastic, or other material attached to object as a label or means of identification which is regarded as RFID tag (Akpinar & Kaptain, 2010; Abugabaha, Nizamuddina & Abuqabbeh, 2020).

Although, the RFID technology experienced a significant acceptance in the retail outlets (Reyes et al., 2016), transportation (Fu et al., 2015), in footwear and apparel industry to improve the visibility of the several of products (Mohammed & Wang, 2017; Majeed & Rupasinghe, 2017), as well as within the charitable organisations for humanitarian food supply chain and networks (Biswal et al. 2018). But little attention has been given to education industry particularly the examination management process which has been a lingering issue in the developing countries due to low infrastructure, corruptions and mismanagement of the entire process (Ogunji, 2011; Kawugana, & Woyopwa, 2017). This predicament resulted in the reduction of quality of education and students' outputs (Kawugana et al., 2017) and integrity of the entire process. Some of the causes of re-occurring cases of examination malpractices in those institutions include things such as lack of proper monitoring of the entire process, student teacher alliance (Dusu et al., 2016), lack of sound moral values and attitude toward education excellence (Kpangban et al. 2008). Thus the question is can RFID data concept be used to address some of the problems?

There is general assumption that the implementation of RFID data technology in the student's check- in process can led to enhanced and significant

*Author α σ ρ: Management Information System Department, Sudan University of Science and Technology.*
*e-mails: hamzachances@yahoo.com, vijugk2005@gnail.com, abdosh_21@yahoo.com*



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process transformation thereby eliminating problems such as student's impersonation and other malpractices thereby improving the credibility and integration of entire process. However, when technology is first been adopted to deal with a very sensitive issue such as student verification, there are several other vital factors that need to be taken into account that include the cost of acquiring and management of such technology, its operational reliability, ethical and other legal considerations (Raj et al., 2018). Because, the privacy and confidentiality of the candidate are equally important, this study was set to investigate and conceptually establish the relevance of adopting RFID data concept in examination process improvement and suggest some possible limitations of RFID in the higher education sector.

## II. The Concept of RFID Data Technology

RFID data technologies are now considered as one of the recent technologies that have been labeled as a major enabling technology for automating and making a process to be contactless and data driven collection. But little is known about it perceived strategic importance of RFID data among stakeholders. The system has three basic components that include a reader, a tag, and back office data-processing capability. In most applications, chips are used to store information about objects, products, or transportation that the company needs to follow. The reader tracks the physical movement of the tag, thereby tracking the physical movement of the object followed. (Zhu et al. 2012). However, recently cloud base technology has been incorporated in the RFID data concept in order to ensure the reliability and analytical capability of object identification and categorization of an object. According to Moselhi and Montaser (2012), "RFID is wireless communication of data through radio waves." Compared with manual recording and routine tracking of items on construction sites, RFID can bring more improvements in terms of Lower costs and enhanced features that meet the needs of the construction industry. These authors, proposes the utilization of RFID data technology that involves RFID fixed reader, RFID encapsulated and labels tag printer in near real time as an automatic technique for tracking earthmoving operations to capture data during construction.

Robert (2006) gives an explanation of the concept of Radio frequency identification (RFID) data technology. This study believes that the concept of RFID data technology is similar to the concept of bar code, and bar code technology is considered to be a means to enhance data processing capabilities and is a supplement to existing technology. The study describes RFID as a data transaction system through the RFID tags on top of objects or useful things along with readers to gather the tag information. The study explains tag data as read only memory (ROM), write once or read many memory (WORM), and random access memory (RAM). ROM is used to store security data, the data is a unique device identifier, operating system instructions, data storage (volatile or non-volatile) and electronic product code (EPC), while RAM is used for storing data at some stage in transponder examination and response. The study concluded with the consideration of privacy and security concern of RFID as regards to the increasing use of the technology. This is in line with other scholars' submission (Shafique, et al. 2018). RFID technology is similar to barcodes because they both use tags and scanners to read tags, and use background software to store data for retrieval and subsequent use.

## III. Review of Empirical Studies on RFID Data Concept

The effectiveness of an RFID data application in dealing with the most wanted process is reliant on quite a lot of significant factors that incorporate the issue of sourcing power – that is, whether the RFID tag source it power "passively" via an RFID reader or from an inbuilt power source. Even though, due to the cost considerations, nearly all application is passive system in nature. The next factor considers the read range, because most RFIDs are passive in nature. As a result, "restrict the utility of the application to the application where assets, commodities, people or animals must be in close proximity to the reader". The last factor is the storage capacity in such that, the limited amount of storage capacity (read only) normally associated with the lowest cost of tags (Hunt, Puglia & Puglia, 2007).

There is substantial evidence in both conceptual, empirical and simulation analysis (Chanchaichujit, et al. 2020; Lee, Cheng & Leung, 2004; Zemguliene & Valukonis, 2018) suggesting that RFID data has the potential to automate, enrich and accelerate, automate a particular process. Brock, Allen, and Schuster (2007) conducted a study on the Global RFID: the value of the electronic product code (EPC) global network for supply chain management. The study believes that the most important concept of RFID data involves attaching radio frequency identification tags (RFID tags) to physical objects, allowing information to be exchanged between the object and the reader. The study further found that RFID tags provide the potential for seamless, continuous two-way communication for items to pass through the supply chain-this means that when a tagged object passes through the reader field, two-way communication starts to be used for objects and reading Exchange information between devices. The study concluded that object bearing an RFID tag can be converted into a network with no human involvement or manipulation by computerized device as in case with other identification technologies like



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barcodes. This has been supported in various studies (Shafique et al. 2018; Zemguliene & Valukonis, 2018; Raj et al. 2018; Iluore, et al. 2020).

Lopes (2010) carried out a study on RFID and the internet of things in freight and handling operations. The study described RFID data as an automatic identification technique, relying on holding data and remotely restoring it by means of devices called RFID tags or transponders which allow the remote identification of items, whereas the Internet of Things are "things with identities and virtual characters that operate in a smart space through smart interfaces to connect and communicate with society, the environment, and the user environment." The study believed that RFID tags can be fixed into a product, animal or person allowing for identifying and tracking them through radio waves, and the reader can read from several meters away without line of sight. The study goes on to identified two parts of RFID tags: the first part involves an incorporated path for holding and processing information, modulating and demodulating radio frequency signal as well as other operations, while the second part contains an antenna for receiving and broadcasting the signal. The study concluded that this technology will have an essential role in the very near future of freight and handling operation through the efficiency improvement of the involved stakeholders during the deterrence of ground handling operation errors tightening to the control of the process (Abugabah et al. 2020).

Hodes and Mccarlane (2004) found that RFID data technology relies on radio frequency communication, so that the reader releases energy in the form of radio waves of a specific frequency, and uses this to power the tag and communicate with it. The process described in the study does not require a direct line of sight like bar code technology, because the communication system is supported by radio wave transmission – this means that even if the level of attachment or even the entire item is missing, it is possible to identify the tagged object in the reader's directly in sight. For example, they can be located behind other objects in a covered area or out of sight. The research further demonstrated and clarified that the ability of an RFID system to operate without a line of sight can make "eavesdroppers" very simple and undetected, but the indicator that originate from the tag are extremely not strong, and therefore, an "eavesdropper" would require to be somewhat lock in. Even though, this can be secure through the design of an RFID system, where information that communicated is converted into a code (key), but this will impact the cost of the tags and the performance of the system as well as the range and communication speed. Despite these, the study believed that once the tag gets nearer into the closeness with the RFID reader; the reader will discover the tag's presence and can read its data and can also hold its data, but with little amount of memory capacity. The study concluded that there is a certain distance between the RFID reader and the tag to be able to pick up enough signals to operate reliably. This depends on many factors, including the radio frequency used for communication, the power released by the reader, radio intrusion sources and items in the environment that absorb radio waves.

Hakala (2014); Tsao, et al. (2017); Werthmann, et al. (2017) studied the feasibility of RFID technology in the supply chain of ABB's medium-voltage products, and realized that RFID data technology can capture data and then integrate it into a required database (e.g. ABB medium voltage products). The study conceived RFID as a means of communication device that can read while object is moving. And this to the study does not need a direct line of view since the identification is based on radio waves, and is also feasible to read numerous labeled objects simultaneously. The most important idea behind RFID data here as determined by the study is its ability to read and write information in the RFID tag via a radio transmission, and the indicator is released by means of the reader and data exchange occurs as soon as the tag is close enough to the reader. The study went further to discovered a link between RFID tag and antenna as an important area that can effects on reading range and durability especially on ultra-high frequency (UHF) antennas due to their shorter wavelength. The study concluded that the RFID-based identification system makes it possible to achieve moderate inventory, faster and more accurate tracking of goods, reduce operating costs, more effective warehouse management, and improve the traceability of work-in-process (product and inventory) and more understanding of supply chain activities.

Aggarwal and Han (2013) are engaged in the investigation of RFID data processing. This research inspired the definition of RFID technology, in which they described a technology that enables sensors (readers) to be read remotely without line of sight, while at the same time associating a unique product identification code (EPC) with the tag. Research has found that this tag can be used to track the movement and location of a large number of items in a low-cost manner, which is useful in inventory and logistics management. The research further identified two types of data contained in RFID data processing: 1) static data and 2) dynamic data. They treat static data as data related to profitable objects, such as location information, product level information, and sequence information. The dynamic data is divided into two types: the first type communicates with occurrence data, such as serial numbers and production dates, and the second type communicates with time data, such as location observations and time changes in object accommodation. Similarly, the second type of temporal data is recorded through EPC tag readings and is related to the movement of the product. These



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processes together influence RFID technology to identify objects.

Guinard et al. (2011) conducted a study on cloud computing, representational state transfer (REST) and Mashups to simplify RFID application development and deployment. This article first observes the application of the Electronic Product Code (EPC) network, which is the RFID standard framework, which aims to enable "interoperability" and application development, as well as the process of communication between tags and readers, reader configuration, monitoring, translation of tag identifiers, filtering and aggregation of RFID data, and continuous storage of application events. The paper also pointed out how the successful use of blueprints on the web can help make the adoption of EPC less difficult. Finally, this article specifically discusses how cloud computing, "RESTful interfaces, real-time Web, (Web sockets and Comet), and Web 2.0 mashups" can facilitate application development, deployment, and maintenance in general RFID applications. The findings of this paper indicate that RFID and EPC network applications are excellent playgrounds for web of things technology (Wang et al., 2016).

Recently, Chanchaichujit et al. (2020) studied the advantages and driving factors of RFID data concept implementation in the supply chain and organizational competitiveness. The research results show that the implementation of RFID can bring huge benefits and impetus to customers and enterprises. The "2 C" classification of profit-driven factors is novel and should provide practitioners with more motivation to utilize RFID. In addition, the link between the benefits of RFID-driving force and competitive advantage is also conceptually established. Finally, it focuses on some future research approaches, so it can be used as a starting point for current and other academic research.

In the same vein, Derakshan et al. (2007) did an examination on RFID data management: challenges and opportunities. The authors begins with the concise synopsis of RFID technology where they found numerous techniques of identification, but for the most part is to store a serial number that identifies a person or item, and possibly other information on a microchip that is affixed to an antenna, and the antenna allows the chip to broadcast the detection information to the reader, and the reader translates the broadcasting signals reproduced back from the RFID tag into digital information so as to be able to transfer on to computers with the aim of making use of it. The authors started with a concise introduction of RFID technology. They found many identification technologies, but in most cases it is to store a serial number that identifies a person or object and possibly other information on a microchip attached to the antenna. The antenna allows the chip to detect information to the reader, and the reader converts the broadcast signal reproduced from the RFID tag into digital information so that it can be transmitted to the computer. The authors believed that the chip and antenna together are called RFID tag or transponder. The author continues to summarize some of the challenges related to the various layers of the RFID data management recommendation system architecture, and proposes to overcome these problems. These layers include: capture layer, process layer and enterprise applications.

Although some studies believe that in the early stages of the entire system, they often travel in large numbers in groups (Gonzalez et al. 2009), but they also believe that these observations will bring to the traditional relational and data warehouse technology. This method may include restoring and reasoning a large number of "interrelated tuples" through various levels of item movement. The study concluded that techniques should be develop for reviewing and cataloging data as well as methods for processing a range of queries (Gonzalez, et al., 2009).

In the field of education, Shahid (2005) conducted a study to explore the use of RFID technology in libraries: a new method for library material circulation, tracking, inventory and security. The research first regards RFID data technology as a combination of radio frequency technology and microchip technology. The study went on to consider RFID tag, reader or sensor, antenna and a computer system as the components of RFID system. According to the study, tag is the heart of RFID system which is an automatically programmed with unique information and can be attached to an objects in library like books, or compact discs (CDs) plates or videos allowing for identification of the objects. While the reader or sensor is used to query the tag passing the reader field or area, the information stored in the tag will be read by the reader and sent to the computer system, and the computer system will then communicate with the integrated library system and the antenna is the communication method between the tag and the reader.

Even so, the research observes the readers in the RFID library in the following ways: 1) Switching stations, writing library data into tags. 2) Recycled employee workstations are used for loading and unloading library materials. 3) There is a self-service sign-in desk, and library materials can be checked out without human intervention. 4) There is a self-service check-in desk, which allows you to check in library materials without personnel support. 5) The exit sensor is used to confirm that all materials leaving the warehouse have been checked out. 6) Book reader, used to automatically release library materials and reactivate security. 7) Sorters and conveyors are suitable for automated systems that return materials to appropriate areas of the library. 8) The handheld reader can be used to take inventory and verify whether it has



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been properly shelved. The study concluded that the use of RFID in the library can tackle both the security and materials tracking needs of the library as well as to speeds up borrowing and inventories in addition to requiring no staff to perform more user-service jobs. Similarly, Mishra and Mishra (2010), concluded that application of RFID in baggage handling will ensure effective management of baggage tracking or delivery and providing the airport or airline security and premium customer services (Li et al. 2017).

Similarly, Yu and Wang (2011) studied product quality inspection that combines structured lighting systems, data mining and RFID technology. The research uses RFID data and quality inspection systems for production tracking and tracing. The research believes that RFID data is a technology that uses a radio signal system to identify objects and transmit data from tags attached to movable objects to readers. This technology is fast, reliable, and does not need a line of sight or contact between reader or scanner and the tagged objects. The research continues to believe that transmitting RFID tags to each inspected component can identify the product type and write the quality inspection results determined by the data mining classifier for real-time quality query. Research has concluded that these processes can improve the traceability of product quality.

As can be seen, RFID data has observed substantial adoption in the different sectors (Mohammed & Wang, 2017; Mejjaouli & Babiceanu, 2018). For instance, RFID enables end to end supply chain management through traceability of particular items sourced from different destination (Tsao et al., 2017). Other scholars are of the view that, without RFID technology tracking a particular object; it becomes difficult to swiftly locate the source of particular items for information for accurate decision making (Chanchaichujit, et al. 2020). Apart from medicine and foods processing sector, RFID also witnessed a rising acceptance in industries/sectors such as footwear and apparel (Majeed & Rupasinghe, 2017), automobile (Werthmann et al. 2020), manufacturing sector (Liukkonen, 2015; Tsao, Linh & Lu, 2017), transport and logistics management (Fu, Chang, Lin, Du & Hsu, 2015). Strategic asset management (Iluore, Angela & Emetere, 2020), healthcare related sector (Chanchaichujit et al. 2019b).

## IV. Theoretical Relevance of RFID Data Concept

The theoretical foundations of the current study is based on Resource-based View (RBV) Theory of the firm competitiveness which suggested that organisations that possess resources and capabilities that are valuable rare, imitable and no substitutable can be used to enhance performance (Barney, 1991). Therefore, Since RFID data technology represents the resources and capabilities of an organization that are meant for process improvement (Shafique, at al. 2019). Hence, RBV theory is suitable for the conceptual assessment of the relevance of RFID data technology on examination management process. That is, RBV theory higher education institutions in Nigeria can used RFID data technology to improve the efficiency of student's check in during examination processes. This is in turn, address the issues of impersonation and other examination malpractices.

If tertiary institutions desire to transformation some of the examination process such as student's check in process, diffusion of innovations theory (DIT) can be used to complement the assumptions of RBV theory. DIT is based on five identified attributes of innovations that are said to influencing their adoption and utilization of a particular technological solution to address business problem (Roggers, 1995). These features include compatibility, relative advantage, complexity, observability and trialability of IT solution (Roggers, 1995). So the strategic importance of RFID data in management some part of examination process is explains by these theories.

## V. Discussions of Findings

Analysis from the literature review shows that RFID data is an effective technology that can be used to identify objects and allow information to be exchanged between the identified objects and the reader that reads the objects. The effectiveness and usefulness of RFID data was shown in some literature from which significant thought emerged. In a review by (Lopes, 2010), two areas of RFID tag have been identified that appraised RFID data, the first area involves an integrated path for holding and processing data, modulating and demodulating radio frequency signal as well as other operations. The second area contains an antenna for receiving and broadcasting the signal. This implies that the effectiveness of RFID data depends on RFID tag and reader since the tag result is very appropriate if connected with the reader in identifying object.

In addition, even if there is a certain distance between the RFID reader and the tag, it can allow adequate and reliable signal distribution. This depends on many factors, including the radio frequency used for communication, the power released by the reader, the source of radio intrusion, and items in the environment that may reflect or absorb radio waves. Nevertheless, the most important idea behind the appraisal of RFID data concept as noted in the research work of (Hakala, 2014) is its ability to read and write information in the RFID tag via radio transmission, and the indicator is released by means of the reader and data exchange which occurs as soon as the tag is closer to the reader. This is therefore important in designing, implementing and evaluating examination processes.



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However, despite the effectiveness of RFID data in identifying objects, it associated with some challenges. As noted in a review by Derakhshan et al. (2007) which outlined three categories of challenges related to the diverse layers of system architecture for RFID data management. This includes the following:

- Capture layer
- Process layer
- Enterprise application

In addition to these challenges, there were also discoveries on the challenges of analyzing massive RFID data sets. Gonzalez et al. (2009) identified these challenges based on two observations: The first observation is that objects often move collectively in large collections in the early stages of the system (for example, in the distribution center), and only in later stages (for example, stores), they move in smaller groups. The second observation is that, though RFID data is recorded at the initial stage where data analysis typically takes place at a higher generalization point. However, the research work of (Bai et al., 2006) recommended further research to develop various effective techniques for filtering RFID data as well as noise removal and duplicate elimination in order to achieve the goal of RFID data appraisal in identifying, locating, tracking and monitoring physical objects with no line of sight.

## VI. Conclusion

The study has provided a background for understanding and appraising RFID data concept from a strategic point of views. The analysis has considered the different thoughts of authors that appraised RFID data concept within the context of substantial adoption in different sector. Findings of the analysis revealed a better understanding and conversation on the topic of an Automatic Identification and Data Capture Technology (AIDCT) like RFID data is an effective and useful technology in identifying objects. Even though, some of the findings were concerned with the challenges of RFID data in the areas that include for example, privacy and security concern as regards to the increasing use of the technology. It also involves filtering RFID data and eliminating noise and repetitive elimination to achieve the goal of the technology's effectiveness and practicality in identifying, locating, tracking, and monitoring physical objects without line of sight. This paper believes to have extends knowledge and ideas on the effectiveness and usefulness of RFID data which can lead to process accuracy and integrity of the adopting organisation.

In the future, the researcher will look at how other AIDCTs like biometric, cloud base and analytical computing can be used to address these issues and to examine the relevance for adoption in the management of higher education examination. This can thus be useful to organizations in making an appropriate decision on whether to utilize or apply to a particular situation. For instance, the object driven elements of RFID concept focused on the ways on which traceability of an objects through RFID technology adhere to meeting process requirement, while the strategic driven adoption of RFID data concept focused on how object identification and traceability can lead to process accuracy and integrity of the adopting organisation.

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