

## DETERMINANTS INFLUENCING ADOPTION OF RADIO FREQUENCY IDENTIFICATION (RFID) AT THE KENYA PORTS AUTHORITY

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### ABSTRACT

Radio Frequency Identification (RFID) is an emerging technology that has been increasingly used in logistics and supply chain management in recent years, particularly in the US and Europe. World's largest retailers including Kenyan based logistics firms are increasingly considering that their suppliers be RFID compliant. Despite many useful applications, there are major impediments to RFID adoption in the logistics and supply chain within Kenyan firms. Many Kenya ports authority have not fully embraced RFID use and those that have embraced it are yet to achieve optimum benefits that the technology promises. The study sought to examine the determinants influencing adoption of radio frequency identification at the Kenya ports authority by the Kenya ports authority. The guiding objectives of this study were to find out the influence of cost of capital, skills and competency, data sharing/data privacy and government policy on the adoption of radio frequency identification at the Kenya ports authority. The study employed the use of descriptive research design, which helped in the collection of relevant information from the Kenya ports authority. Key findings of the study shows that government policy is the key factor influencing adoption of radio frequency identification.

**Keywords:** *Determinants influencing Adoption of Radio Frequency Identification (RFID).*

## Introduction

Radio Frequency Identification (RFID) is one among the many technologies described under the general term Automatic Identification (Auto ID). This technology has been very useful in controlling information and material flow and has proven very useful in managing large production networks (Ilie-Zudor, Kemeny, Egri and Monostori 2006). The origins of use of RFID technology date back to World War II, when it was used to detect friendly aircraft. RFID like many other technologies have been adapted from their war context origins for use in a variety of useful applications in private and public sector settings (Federal Trade Commission, 2005). They could be found in such settings as hospitals, highways, warehouses, stores, highways among many other uses.

The RFID systems include tags, readers and software to process the data. Tags are usually applied to items, often as part of an adhesive bar-code label. Tags can also be included in more durable enclosures and in ID cards or wristbands (RFID Journal, May 2011). The RFID technology gathers data from an item without touching or seeing the data carrier through the use of electromagnetic waves. The data carrier uses a micro-chip attached to an antenna (also known as transponder or tag), enabling transformation of data to a reader within a given range of radio waves which can then forward the information to a host computer (Ilie-Zudor, et al, 2006). Some RFID tags can be read from several meters away and beyond the line of sight of the reader. The application of bulk reading makes RFID a convenient technology to be explored for its benefits in increasing efficiency.

## Statement of the Problem

According to Reports from the Republic of Kenya (R.o.K, 2013), lack of automation and use of modern cargo tracking mechanisms at the Port of Mombasa are blamed for increasing the cost of doing business by Sh1.64 billion. The 2013 Kenya overview report from the World Bank confirms that the Mombasa port offers weak operational services, which hinders logistical operations (World Bank, 2013). Even though a few Operations at the port of Mombasa employ RFID and EDI, data from the Institute of Trade Development (ITU) reports that logistic problems are so prevalent that to transport a 20-tonne container from Mombasa to Nairobi costs \$1,300 while a similar container from Mombasa to Kampala and Kigali costs \$3,400 and \$6,500

respectively (ITU, 2013). This is more than double the \$ 1,200 one would incur to ship the same goods from United Kingdom to Mombasa. Data from World Bank indicate that the inadequacies in the country's logistics supply chain have contributed in making Kenya's business environment unfriendly, sliding three positions to 109<sup>th</sup> as reported in the World Bank *Doing Business in the EAC 2012* rankings. The major losses due to these inefficiencies are a result of lost cargo due to non-monitoring, corruption deals at the port and borders as well tampering with goods in transit. According to reports from KRA, the Kenyan government does lose millions in lost taxes due to these inefficiencies (R.o.K, 2010)

Adoption of RFID and growth in EDI capability is becoming a requirement for effectively servicing many large business customers (Furst & Nolle, 1998). Even then, their adoption and implementation is still problematic and complex for organizations (Ngai & Gunasekaran, 2004). The adoption and application of these invaluable technology by most logistics firms has not been embraced, hence it has been mostly limited to a few large organizations both in Kenya and its neighbors (Power, 2002).

From the literature review, it is evident that past research done remains limited regarding this emerging area in Kenya. This study will therefore focus on the determinants that influence the adoption of RFID.

## Objectives of the Study

### General Objective

To establish the determinants of Radio Frequency Identification (RFID) Adoption at the Kenya ports authority.

### Specific Objectives

- i. To establish how cost of capital influences the adoption of RFID by Kenya ports authority.
- ii. To determine how skills and competences influence adoption of RFID by Kenya ports authority.
- iii. To find out how the firms' Data sharing and Data Privacy influences the adoption of RFID by Kenya ports authority.

- iv. To determine the influence that government policy and concerns have on the adoption of RFID by Kenya ports authority.

## Literature Review

### Pecking order Theory

In 1958, Modigliani and Miller developed their invested theory, which considered that in a perfect market condition, assuming that there are no taxes, bankruptcy and other cost, a firm would always finance its operations using its internal sources (Murray and Vidhan, 2003). In 1961, Donaldson modified the theory to now the pecking order theory, which states that the cost of financing a firm increases with the asymmetric nature acquiring information. Considering that the acquisition of information is cheaper with internal means, a firm would first prefer this financing method; then explore external debts such as loans, and finally opt for equity financing as the last resort. Pecking order theory elucidates satisfactorily the financing behavior of firms, which experience constraints that makes them lack the capacity to borrow or secure funds using equity financing. Categorically, the theory explains how firms organize their financing means in an order or hierarchy starting with the most safe, internal finance sources to the risky external finance sources.

Psillaki & Daskalakis (2009), in his study established that firms that enjoy the economies of large-scale production are able to utilize internal financing options as opposed to small firms. With regard to the theoretical explanation proposed by Psillaki and Daskalakis (2009), it is assumed that most Kenya ports authority have a weak financial base or do not enjoy the benefits of large-scale production. For this reason, they have failed to adopt the use of RFID technology in monitoring their production and distribution activities because the risk-free internal finances are not enough to manage the implementation of RFID. Furthermore, the cost of accessing external finance and the time taken discourages many logistics firms in Kenya to realize their dreams of managing their operations using RFID applications. In his Survey conducted in 2012, firms in developed countries, Attaran (2012) confirms that only large firms, which can raise more than \$25 million internally, are able to implement the use of RFID. The rationale behind it is explained by the Pecking order theory of hierarchical modes of raising capital for firms. Ngai (2007) also holds the same view as Attaran (2012). The former contends

that the risk involved in accessing external capital makes it hard for some logistics firms to invest in acquisition, installation, and maintenance of RFID technology.

### Quality Management theory

The term quality management has a specific meaning within many business sectors. This definition does not necessarily mean or assure “good quality” from the general definition, but ensure that an organization or product is consistent with the set requirements. Notably, the management should have four main components namely: quality planning, quality control, quality assurance and quality improvement (Rose, 2005) Quality management is focused on not only product/service quality, but also the means to achieve it. Quality management therefore uses quality assurance and control of processes as well as products to achieve more consistent quality. Quality assurance (QA) refers to the planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled (ASQ Definition). It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention (MASB). This can be contrasted with quality control, which is focused on process outputs.

Two principles included in QA are: "Fit for purpose", the product should be suitable for the intended purpose; and "Right first time", mistakes should be eliminated. For instance, in adopting the use of RFID in logistics firms, Ngai (2007) postulates that the tags mounted on the goods on transit should be 100% readable and intact such that even a fast-moving conveyor belt can still identify the information from the tag. He adds that quality assurance of such an initiative requires sufficient processes of putting checks and balances to ensure smooth operations of RFID system using RFID tags. QA includes management of the quality of raw materials, assemblies, products, and components, services related to production, and management, production and inspection processes. Suitable quality is determined by product users, clients or customers, not by society in general. It is not related to cost and adjectives or descriptors such "high" and "poor" are not applicable. For example, a low priced product may be viewed as having high quality because it is disposable where another may be viewed as having poor quality because it is not disposable.

Quality management is a recent phenomenon. Advanced civilizations that supported the arts and crafts allowed clients to choose goods meeting higher quality standards than normal goods. In societies where arts and crafts are the responsibility of a master craftsman or artist, they would lead their studio and train and supervise others. The importance of craftsmen diminished as mass production and repetitive work practices were instituted. The aim was to produce large numbers of the same goods. The first proponent in the US for this approach was Eli Whitney who proposed (interchangeable) parts manufacture for muskets, hence producing the identical components and creating a musket assembly line (Thareja, 2008).

According to Thareja (2008), several people including Frederick Winslow Taylor a mechanical engineer who sought to improve industrial efficiency promoted the next step forward. He is sometimes called "the father of scientific management." He was one of the intellectual leaders of the Efficiency Movement and part of his approach laid a further foundation for quality management, including aspects like standardization and adopting improved practices. Henry Ford was also important in bringing process and quality management practices into operation in his assembly lines. In Germany, Karl Friedrich Benz, often called the inventor of the motor car, was pursuing similar assembly and production practices, although real mass production was properly initiated in Volkswagen after World War II. From this period onwards, North American companies focused predominantly upon production against lower cost with increased efficiency. From this humble background, the influence of quality thinking has spread to non-traditional applications outside of walls of manufacturing, extending into service sectors and into areas such as sales, marketing and customer service (Selden, 1998).

### **Privacy and Information Security theory**

Information security means protecting information and information systems from unauthorized access, use, disclosure, disruption, modification, perusal, inspection, recording or destruction (Chad, 2012). The terms information security, computer security and information assurance are frequently used interchangeably. These fields are interrelated often and share the common goals of protecting the confidentiality, integrity and availability of information; however, there are some subtle differences between them. These differences lie primarily in the approach to the subject, the methodologies used, and the areas of concentration. Information security is

concerned with the confidentiality, integrity and availability of data regardless of the form the data may take: electronic, print, or other forms (Spagnoletti, 2008). Computer security can focus on ensuring the availability and correct operation of a computer system without concern for the information stored or processed by the computer. Information assurance focuses on the reasons for assurance that information is protected, and is thus reasoning about information security.

Information Security is a field that has a long history. Since the early days of writing, politicians, diplomats and military commanders understood that it was necessary to provide some mechanism to protect the confidentiality of correspondence and to have some means of detecting tampering. Julius Caesar is credited with the invention of the Caesar cipher ca. 50 B.C., which was created in order to prevent his secret messages from being read should a message fall into the wrong hands, but for the most part protection was achieved through the application of procedural handling controls (Stanford, 2003). Sensitive information was marked up to indicate that it should be protected and transported by trusted persons, guarded and stored in a secure environment or strong box. As postal services expanded governments created official organizations to intercept, decipher, read and reseal letters (for instance the UK Secret Office and Deciphering Branch in 1653).

### Legal-political Environment theory

The Legal and political environment of a business determines whether it may or may not adopt various strategic initiatives. According to Weinberger (1991), the Legal Political environment theory explores a company's vulnerability to risk of loss of assets, earning power, or managerial control due to politically based events or actions or policies by host governments. The author elucidates that businesses must deal with unfamiliar political systems when they go international as well as with more government supervision and regulation. Some of the major legal, political concerns affecting international business are political risk, political instability and laws and regulations.

A company's political risk is defined as its risk of loss of assets, earning power, or managerial control due to politically based events or actions by host governments (Weinberger, 1991). Political risk includes government takeovers of property and acts of violence directed against a firm's properties or employees. In Mexico, business executives and their families is a prime target for gangs of kidnappers many of which are reportedly led by state or local police.

Estimates are that big companies in Mexico typically spend between 5 to 15 percent of their annual budgets on security. Companies operating in other countries also formulate special plans and programs to guard against unexpected losses. Executives at Tricon, which owns KFC and Pizza Hut restaurants monitor events through an international security service to stay on top of potential hot spots. Some companies buy political risk insurance and political risk analysis has emerged as a critical component of environmental assessment for multinational organizations (La Porta et al., 1998). In order to reduce uncertainty organizations sometimes also rely on the Index of Economic Freedom, which ranks countries according to the impact political intervention has on business decisions, and the Corruption Perception Index, which assesses 91 countries according to the level of perceived corruption in government and public administration.

### Empirical Review

In a Study titled Mobile Commerce Integrated that was published in 2005, Ngai and Cheng concluded that the biggest challenge companies faced with RFID is that it is the high cost of implementation. According to the researchers, one of the key challenges a company faces with the introduction of RFID technology is whether the business really needs the technology and how to justify the investment in the implementation. Cost-benefit analysis is critical to the successful adoption of an RFID project. At present, the cost of RFID adoption is the major investment in hardware, application software, tags and the cost of integrating RFID-based system with the legacy systems, consultancy fees and employee training (Ngai, 2005).

Ngai 2005) postulates that with RFID, not all partners will use it and those who do may require it for only their RFID-ready distribution centers. Furthermore, not all the items or packages will be tagged. This creates a requirement for a dual system when the system is first introduced. Another need for dual systems arises when dealing with small and medium businesses that cannot afford RFID systems. Such a scenario necessitates the assumption that exceptions to the “all or nothing” ideal will always exist and be prepared to deal with this challenge from a technical and operational standpoint. Needless to say, running a dual system enhances operating costs and may serve as a bottleneck to achieving the full range of benefits of RFID use.

As postulated by Ngai (2005), companies need to be aware of the security risks, such as profiling, eavesdropping, denial of service attacks and inventory jamming. Education and

training is the best way a business can ensure it understands the limitations and risks associated with RFID adoption. Businesses should not assume that the risks associated with RFID adoption are small because the RF footprint of current generation tags is constrained. Understanding the mean time to crack—access, alter or deny the use of—the tags is a prerequisite to ensure that tag selection embodies the objectives of the company's corporate security policy.

## Data Analysis/Findings

### Regression analysis

The researcher conducted a multiple regression analysis so as to investigate the influence of the various variables on adoption of RFID by Kenya ports authority. The researcher applied the statistical package SPSS, to enter and compute the measurements of the multiple regressions for the study. The findings are presented below.

**Table 4.1: Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.730 <sup>a</sup>	.841	.774	.97631

### Source: Research, 2014

R is the correlation co-efficient which measures the strength of relationship between variables. The four independent variables which are cost of capital, Skills & competency, Data Privacy & sharing and government policy contribute 84.1% in the adoption of RFID by Kenya ports authority which is represented by  $R^2$ . Therefore further research should be conducted to investigate the other factors that contribute 15.9 % in the adoption of RFID.

Table 4.8: Multiple Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	8.866	.974		8.214	.000
Cost of capital	.374	.127	.280	4.412	.005
Skills and competences	.410	.158	.035	5.185	.004
Data privacy and sharing	.417	.139	.248	6.165	.003
Legal/Government Policy	.487	.170	.288	7.189	.001

The regression equation ( $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4$ ) was interpreted to mean  
 $Y = 8.866 + 0.374X_1 + 0.410X_2 + 0.417X_3 + 0.487X_4$

$X_1$  is Cost of capital  $X_2$  Skills and Competency,  $X_3$  is Data privacy and sharing and  $X_4$  is the Legal /Government policy.

According to the equation, taking all factors (Legal /Government policy, Skills and Competency, Cost of capital and Data privacy and sharing) constant at zero, overall Adoption of RFID technology will be 8.866. The data findings also show that a unit increase Cost of capital will lead to a 0.374 increase Adoption of RFID technology; a unit increase Skills and Competency will lead to a 0.410 increase in Adoption of RFID technology; a unit increase in Data privacy and sharing, will lead to a 0.417 increases in Adoption of RFID technology and a unit increase in Legal /Government policy Will lead to a 0.487 increase in Adoption of RFID technology. This means that the most significant variable is Cost of capital followed by Skills and Competency.

At 5% level of significance and 95% level of confidence, Cost of capital influences had a 0.005 level of significance; Skills and competences influences showed a 0.004 level of significant, Data privacy and sharing influences showed a 0.003 level of significant, and Legal/Government

Policy influences had a 0.001 level of significant; hence the most significant factor is Cost of capital.

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