5-2013

RFID For Document Management: Assessment of Scenarios Implementation: An Arab case study

Kamel Rouibah
College of Business Administration, Krouibah@cba.edu.kw

Khaled Al-Zanki
Ministry of Finance, ghallawy@hotmail.com

RFID For Document Management: Assessment of Scenarios Implementation: An Arab case study

Kamel Rouibah
College of Business Administration,
krouibah@cba.edu.kw

Khaled Al-Zanki
Ministry of Finance
ghallawy@hotmail.com

Abstract
Radio Frequency Identification (RFID) systems are used in a variety of applications to uniquely identify physical objects. The operation of RFID systems often involves a situation in which numerous tags are present in the interrogation zone of a single reader at the same time. Although RFID is currently a hot topic, many organizations are slow in adopting RFID to conduct more effective and efficient business processes. This study presents an analysis toward understanding the evaluation of business value and introducing RFID at a public ministry in an Arab country. This study propose a framework based of three phases for the assessment of RFID technology, hoping that a better understanding of the business value of RFID will encourage more organizations to implement it.

Keywords
Radio frequency identification (RFID), IT business value, business process reengineering, scenarios, total cost ownership, ROI

1. Introduction
The technology of Radio Frequency Identification (RFID) enjoys an enormous interest at the current time, not only from the standpoint of research but also from corporate practice. Since 2006, this technology is becoming widely discussed throughout scientific and non-scientific media, and rapidly gaining widespread growth and application (Reilley 2005; IDtechex 2012; Rouibah et al., 2011; Wamba and Chatfield 2011; Zhu et al., 2012; Chen et al., 2013; Dominguez-Péry et al., 2013; Feng et al., 2013). This increase was due to the 2006 survey of IT executives publication conducted by the Society of Information Management (SIM) and that revealed RFID was rated among the top 20 developments in application and technology (Luftman et al., 2006).

The RFID concept is not new and dated back to 1948 (Landt, 2005). It has its origins in military applications during World War II, when the British Air Force used RFID technology to distinguish allied aircraft from enemy aircraft with radar (Asif and Mandviwalla 2005). The increase focus t in RFID is highlighted by the interest of diverse technology providers (e.g. Texas Instruments), consulting firms (e.g. Accenture), infrastructure providers (e.g., HP, and Sun

Microsystems), enterprise software providers (e.g., SAP), and solution providers (e.g., IBM, 2003). And a number of large companies provide RFID technology solutions, such as SAP, Oracle, IBM, Microsoft, Hewlett Packard, and Sun Microsystems. This makes RFID more feasible, ease of use and practical to be widely deployed.

RFID is a generic term for technologies that use radio waves to automatically identify people or objects at a distance using an electromagnetic exchange. An RFID system (Figure 1) comprises three basic elements: (i) an RFID device (tag); (ii) a tag reader with an antenna and transceiver; (iii) and a host system or connection to an enterprise system.

Figure 1. Component of RFID system

RFID is seen as a means of enhancing data processes and is complementary to existing technologies overcome problems related to bar code technology (Roberts 2006). Operational RFID systems involve tags and readers interacting with objects (assets) and database systems to provide an information and/ or operational function.

RFID systems are emerging as a practical means of object identification in a wide variety of applications (Ilie-Zudor et al., 2012) such as Human tracking and control system (e.g. e-passport), assets and object tracking systems (e.g. luggage tracking in airports), contactless payment systems (e.g. RFID-tagged public transport cards), RFID-based information (e.g. enriched museum tours), supply chain management (e.g. product tracking), hospital management (e.g. tracking inventory), process control (e.g. vehicle parking access control). Unlike previous studies, this study aims to evaluate the potential application of this new technology for document management at a public ministry in an Arabic country (Kuwait).

RFID benefits have received extensive investigation (e.g. Roh et al., 2009). Thus the issue is not to assess the potential benefits of RFID but rather how to introduce the RFID and align it with organizational strategic objectives. One of the most important roles of IT is to evaluate capabilities of new technologies and match them with strategic business needs (Hussin et al., 2002; Chan and Reich 2007). For example Luftman (2003) has shown that the more successfully a business aligns its IT with its business goals, the more profitable will be. They also show that very few companies (only ¼ of the sampled firms) achieved alignment of IT with their business goals. Therefore, IT should focus on maximizing the organizations benefits by determining if adopting such a technology will improve internal business processes, and achieve cost reduction as past studies have shown costs as the key inhibitor of RFID widespread adoption and usage (Wamba and Chatfield 2011).

This study focuses on the following research question "How RFID can be introduced to ease document management and how total cost ownership is determined?".This study focuses on the analysis of the RFID technology and its potential integration and extension with an in house

developed document management in the Ministry of Finance (MOF), a public ministry in the state of Kuwait, which is an Arabic country. This study is motivated by the following facts:

- There is high correlation between perceived potentials of RFID and CIOs' intention to invest in RFID (Leimeister et al., 2009).
- After finding that perceived strategic benefits of RFID varies across culture, Knebel et al., (2006) and Leimeister et al., (2009) called for future research that addresses strategic benefits, risks, success factors and potential application of RFID in other cultures; and more in-depth insights about factors that lead to leverage the potentials of RFID and its applicability.

2. **Literature review**

The number of studies that focused on potential advantages and benefits of RFID application is increasing (Reilley 2005; Knebel et al., 2006 ; Fung et al., 2007 ; Ngai et al., 2008 ; Roberts 2006, O¨ztaysi et al., 2009; Roussos and Kostakos 2009; Roh et al., 2009; Leimeister et al., 2009; Rouibah et al., 2011; Wamba and Chatfield 2011; Zhu et al., 2012; Chen et al., 2013; Dominguez-Péry et al., 2013; Feng et al., 2013). For example the survey done by Reilley (2005) found that 69% of respondents plan to evaluate, pilot, or implement RFID in 2005. Roberts (2006) projected that the market for RFID tags will grow to over $10 billion in sales by 2015, while the cumulative sales up to 2005 was 2.4 billion, and $5.56 billion in 2009. IDTechEx (2012), a market research organization specializing in RFID, estimates that 2012 the value of the entire RFID market will be $7.46 billion, up from $6.37 billion in 2011. In the retail sector, apparel tagging alone demands 1billion RFID labels in 2012, with 1.35 billion tags forecast for 2013. RFID in the form of tickets used for transit will demand 500 million tags in 2012. IDTechEx (2012) also found that 3.98 billion tags will be sold in 2012 versus 2.93 billion in 2011. And the RFID market will grow steadily over the next decade, rising four-fold in that period to $26.19 billion (including tags, readers, services etc) in 2022. These statistics revealed that RFID applications are growing very fast.

We observed that most previous RFID studies focused on factors that affect intention to adopt: Use and intention to use (e.g. Roh et al., 2009; Rouibah et al., 2011; Kim and Garrison 2010), RFID development of application software solution and protocol (e.g. Chow et al., 2006; Tzeng et al., 2008). Despite the increase focus on RFID, and that cost justification and feasibility analysis of new technology is proving to be a popular research topic (Gunasekaran et al., 2006; Yusof et al., 2008). However assessment of RFID for document management implementation is missing and did not receive the due attention and which scenarios to introduce RFID. The existing research is largely focused on the conventional applications of RFID, such as supply chain management warehousing, retail and animal field. Economic analyses are highly advanced for these operations. Brown and Russell (2007) presented an explanatory study on the adoption of RFID technology on the South African retail sector. Chow et al. (2006) proposed a RFID case-based resource management system for warehouse operations. Other studies focused of RFID application in food traceability (Regattieri et al., 2007), service sector applications (Lee et al., 2008); impact of RFID technology on warehouse process innovation (Wamba and Chatfield 2011); case study of RFID application in the supply chain management (Chen et al., 2013); review of RFID technology and its managerial applications in different industries (Zhu et al., 2012), case description of RFID implementation in jewellery supply chain retailer (Dominguez-

Péry et al., 2013), RFID usage for animal tracking and food traceability (Rouibah et al., 2011; Feng et al., 2012).

With regard to the review of past studies, it is surprising to note that RFID for document management are lacking, except few studies which focused on different issues than the one investigated in this study (e.g. Yu 2007). Also for economic analysis there is a need to differentiate between the premises of RFID in document management and the acknowledged benefits of RFID in this field. Scenarios to introduce RFID technology and the total cost ownership of its implementation in document management are yet to be clarified and researched.

3. Research methodology

Deciding about how to introduce RFID in an organization is an ill-structured and not adequately understood. While the current situation is known (organization without RFID), the target or ideal situation with RFID is unknown. Surveys (collecting large amounts of data followed by testing hypotheses) are not appropriate for helping managers in this situation. Therefore, the chosen methodology used to perform this research is the "engineering research" (Rouibah & Ould-Ali 2002), which is close to design science (Walls et al. 1992). It is an on-site methodology useful for expanding knowledge about complex and ill-structured processes, such as interpreting weak signs, and helping managers to progress.

This research methodology has three characteristics: Engineering activities: the researcher is not an observer, but is a part of the problem solving process. He acts as an engineer who develops a conceptual model, builds a guideline, acts as a facilitator and evaluates his construction on site in the organization, in this case the authors play the role of engineers who help the organization to decide about the most attractive scenario to introduce RFID and estimate the cost associated. (ii) Exploratory research: due to the lack of structure the problem can be approached by exploratory research in modeling, building, or/ and evaluating. (iii) Creation of procedural knowledge: the objective is to build the knowledge that helps to act and to reason. This takes the form of a prototype represented in a guideline in our RFID case.

The main results expected from this methodology include: Ability to stimulate interest of stakeholders since most senior managers or executives needing to be interviewed are not always able to express clearly either their difficulties or their requirements. Therefore, it is useful to support them with "something" in the form of a guideline in order to attract them and motivate their meeting with researchers. This guideline can be used as a support for training and learning of users how who will learn faster by doing rather than by talking.

4. Background information about document management at MOF

4.1 Overview of efforts to address document management

The MOF pursue its objective to achieve competitive advantages, streamline its business processes, and use the latest technologies in order to achieve these objectives. Automated document management has been one of the lacking areas in the Ministry Of Finance (MOF). Over the past, the ministry has made two attempts in order to implement a Document

Management System (DMS). Unfortunately, both projects have failed and the outsourcing companies involved have been terminated.

The first attempt was made in the early 1990 with a local and famous IT company (www.its.ws). This company introduced a DMS package that was complex to use which turns into failures. MOF initiated customization efforts in order to simplify the system. However, those efforts did not materialize or ended into a working system and the project was abandoned. The second attempt was made in 2001, and astonishingly enough, the developed system was criticized as being very simplistic. As a consequence, the company was forced to add many features which the information and technology department at MOF thought it was necessary for the system's success in order to meet high usability and end-user satisfaction. The added features consumed a very long time and affected the overall stability of the system, yet causing this project to be terminated too, and not led to its usage.

4.2. Current situation without RFID

In 2007, the IT department took the responsibility of filling this gap and addresses the usability and end user satisfaction of systems for data management. It implemented a DMS in-house on two phases. In phase 1, the decision was made early to have a gradual approach (i.e. using an incremental approach, prototyping) in which to start with a basic set of features and extending those features based on user requests and perceptions. In addition, several platforms were evaluated as a basis to build this DMS. And, finally Microsoft's Share Point Server was selected as the ideal platform. The selection was based on several features such as versioning, extensibility, easy management, and ease of use. The MOF now have implemented phase one of its DMS that covers the areas of: Archiving, indexing, retrieval, and correspondence. And this system was adopted and is currently under use. In phase 2, the IT department is in the process of determining the features that would be included in the DMS.

4.3. Potential contribution of RFID to DMS

The IT department was approached by RCS, an American company (http://rcsapps.net) to provide RFID solutions (Figure 2) that could enhance its current DMS. The RC company promises that its RFID technology would offer the following features:

- Offer comprehensive solutions for document folder management and file tracking that streamlines business processes.
- Eliminate manual tasks and increase control, helping to implement best practices and document usage compliance to best practices.
- Optimize locating and processing files in and out of the central file room, where all document files are managed.
- Equip file rooms with Check In/Check Out computer stations to record daily transactions and movement.
- Track files by location, department, subject, user, date of creation, etc.
- Enable staff offices to control inventory tracking and audits.

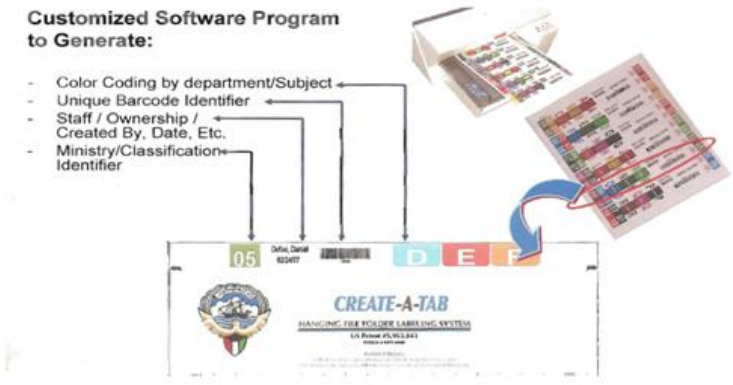

Figure 2: RFID for document management

The RCS Company has shown lot of experience in the field of DMS based RFID and has already implemented its solutions in many US agencies like the US Department of Labor, the US Department of Justice, the Central Intelligence Agency, and the National Institute of Standards and Technology.

5. The RFID evaluation process

The proposed RFID solution from RCS was being considered for evaluation, which raises several issues. Most of the normal software selection criteria taken from known theories such as TAM (Davis 1989), or innovation diffusion theory (Rogers 1983), didn't apply on our case for several reasons. *First*, the technology and its usage in document management are relatively new and very few companies could be approached to have a comparable offering. *Second*, very few people from the IT department are involved in the RFID evaluation who are highly motivated and convinced about the benefits of RFID, but have little experience on how to start introducing it. *Third*, although RCS Company had shown several success stories abroad, there is no local Kuwaiti company that had adopted and yet implemented such RFID solution. *Fourth*, the current DMS solution implemented by the MOF is still in an early stage where focus on gaining user acceptance is very important for the top management. If the RFID additional features turned out to be a failure, this could endanger the DMS implementation and its overall acceptance.

Taking all the previous points into consideration, we started a process of three stages to conduct the RFID evaluation (see Figure 3).

- Define scenarios for potential introduction and their characteristics and identify which department is responsible about incoming and outgoing documents
- Identify factors of the total cost of ownership (TCO)
- Make decision about its adoption.

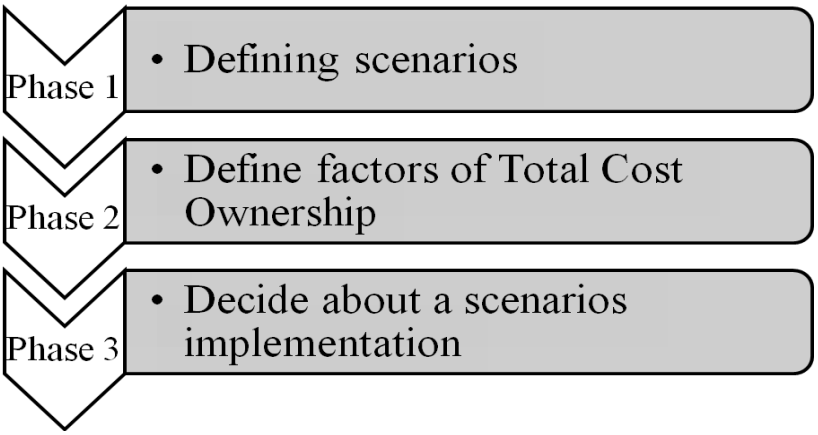

Figure 3. Proposed evaluation process

The following sections describe in details those stages.

5.1. Defining scenarios

The first stage was concerned with identifying departments where the RFID technology will be potentially used in the MOF environment. After extensive analysis of the MOF structure, two scenarios were identified that may benefit from such a technology.

5.1.1. Scenario 1: MOF public registry department

This department is responsible to all external correspondence of the MOF. Every incoming and outgoing document gets to be registered, stamped and photocopied. The original incoming document will be forwarded to the appropriate department while the original outgoing document will be sent to the appropriate external agency, during which a copy will be archived for future inquiries. This scenario has the following characteristics:

High volume: Incoming and outgoing document handled by MOF are characterized by high volume. The MOF received an average of 70 documents per day. On the other hand, it sends an average of 102 documents per day. Taking those statistics into consideration, the total annual external correspondence would accumulate to almost 44892 documents assuming 261 working days in a regular year.

Single document repository: Is a single document repository appropriate to handle all incoming and outgoing documents? A copy of all original outgoing documents that need to be send to other agencies and companies are kept in MOF for future reference. In addition, although the MOF *public registry* handles all incoming documents, it has an obligation to distribute the original documents to the appropriate departments. A previous attempt by the MOF *Public Registry* to retain the original documents and distribute only copies was rejected by many MOF departments. Another attempt to request departments to return those documents to the *Public Register* for safe keeping also faced a similar rejection. Many departments have argued that it is very important for them to receive and retain those original documents, mainly due to legal issues and easy retrieval. By interviewing the head of the Taxation Department it was found out that it is a necessity for them to obtain the original documents. The head of the department stated that: "*Most of the time those documents are used as basis for administrative use or legal actions against other companies. The department must have all of its documents in place in case of*

disputes being solved in a court of law". This will lead us to a situation where no single repository is responsible for holding all MOF's documents. Instead, we have distributed files rooms each located in the premises of the owning department.

High circulation steps: Many of the documents involved in MOF take a long procedure and cross many steps until they are handled to their appropriate destination. If an attempt is taken to automate those procedures "as-is" without reengineering would add a tremendous overhead to the administrative staff responsible for this lengthy procedure. Recording each Check In/CheckOut will be very tedious unless work procedures are restructured to benefit from the advances of the new technologies such as RFID.

Document based tags: MOF's *Public Registry* handles the incoming and outgoing correspondence and merely passes them to the appropriate department (or agency). Implementing RFID technology would require the *Public Registry* to tag each document that gets passed through.

4.1.2 Scenario 2: MOF Departmental Level Approach

This approach tries to look for departments in the MOF that would benefit most of the RFID technology and have a departmental level implementation that would satisfy the requirements of those selected departments. This approach will most likely include external and internal correspondence. This scenario has the following characteristics:

Low volume: A survey conducted on seven departments showed that the average volume of circulating documents is very low and ranges between 10 and 25 daily documents, compared to the more than 172 documents handled by the public registry.

Tight ownership: Each department will have its own repository and equipment setting to handle its documents. This scenario should provide the required control and convenience for the selected departments.

Low circulation: Those documents usage patterns are expected to be inter-departmental where Chek In/Check Out will be made by employees belonging to the selected department. Other departments will not be granted access to those documents to be checked out, but rather provided with copies as needed to prevent loss or misplace.

Folder based tag: Selected departments for this scenario can categorize their documents and issue folders corresponding to their business entities (Figure 4). For example, the human resources department would designate a folder for each employee. In this case each document will be added to this folder and only the folder will be tagged by RFID. A Check In/ Check Out would be on the folder level rather than on the document level. Similar argument would apply to the taxation department, where each company would have a profile including all related documents to this company, and the profile would be tagged by RFID and not each single document.

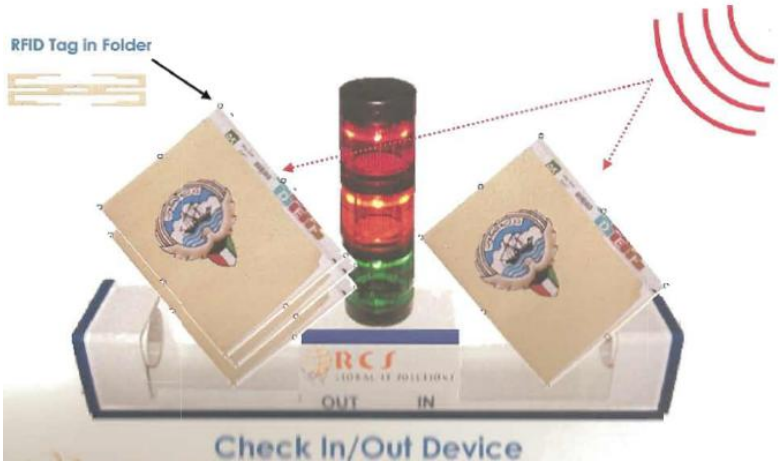

Figure 4. RFID tag based folders

5.2. Identify factors of total cost of ownership (TCO)

While identifying factors of TCO, it is necessary to gather all issues that would affect costs associated with adopting the new RFID technology. The major issues would be the cost of site preparation, hardware, maintenance, training, tagging, and control. As with our previous discussion, the TCO for each of the proposed scenarios will be estimated.

5.2.1. Scenario 1: RFID at the public registry department

Site preparation: *The Public Registry* department would be restructured and rebuilt all over in order to adopt RFID technology. After consulting with the implementing company, MOF was informed that the existing steel cabinets installed will interfere with RFID technology and reduce the scanning capabilities and reading accuracy. An accurate estimate of such reconstruction indicates a minimum of $83000 for fiber or reinforced plastic based cabinets.

Hardware: Due to the high volume circulation nature of documents in the *Public Registry* department, RFID scanner, tag printers, and antennas should be provided in large numbers to streamline the inner workings of the Public Registry. Unfortunately, this will also translate into higher costs on the MOF's part. The hardware provided should be fault-tolerant and offer high availability. Any problem associated with the usage of RFID would have a ripple effect on the overall MQF daily work.

Maintenance: Given that the *Public Registry* department will be the focal point and the main repository of the MOF, all efforts should be taken to avoid making it a single point of failure. A downtime period with more than one hour would be problematic, and maintenance procedures should be done in a preventive manner to ensure the continuous availability at the system. It is a well known fact that new technology is always daunted by challenges caused by lack of experience from both sides (vendors and consumers) especially during the early phase of implementation and deployment.

Training: The *Public Registry* department consists of more than 40 employees who are still undergoing training on current implemented DMS. Daily work load of those employees are very high, and with the complexity of the RFID technology and hardware, it is believed that it will be

an additional challenge to yet upgrade the skills of those employees to RFID without disturbing their daily tasks. Also, given that most documents would be owned by the departments with only a slight percentage being sent back to retention. This would cause most documents to be marked as Checked Out.

5.2.2 Scenario 2: RFID at the departmental level approach

Site preparation: The departmental level approach will allow for less expensive preparation cost. Smaller rooms will be equipped with special shelves that accommodate file storage without interfering with RFID transmission. A challenge may arise if the current storage space is small. Many departments have noted a shortage in space which prevents them from having a dedicated file storage area.

Hardware: Given the low volume nature of individual departments (only seven), some of the equipment that will be provided to them will be underutilized. The specification and equipment, provided to each department should be reviewed to provide the optimal number of scanners, antennas, and Check in/Check Out stations. Additional hardware could be provided on lending basis when workload increases and should be returned afterwards.

Maintenance: Having multiple repositories would require more efforts on maintenance teams. Each location would be assigned to a coordinator from the technical team and maintenance records should be kept to track each location's performance and availability.

Training: Each department should elect the administrative staff that would handle the process of filing and Check-In/ Check-out operations. Based on current situation of MOF department and work habits, it should be expected that this staff would be less computer knowledgeable. Therefore efforts should be made in order to ease the training process by providing instructors based sessions which handles day-to- day common usage scenarios. In addition, these proposed sessions should include hands-on experience to get the staff familiar with RFID scanners and Check ln/Check Out stations. Such sessions should be offered to accommodate new employees and to introduce new features.

5.3 Decision making about RFID scenario adoption

Taking into account the two proposed scenarios, and after a rigorous review process these were the decisions:

The scenario 1 has a centralized approach that would utilize the MOF's *Public Registry* staff to enforce the single repository as the means to safe keep all of the MOF's documents. It has been realized that the high volume, single repository concept is considered risky and expensive if one document come to be lost. This approach is risky because it would be a new technology while having a potential of single point of failure. It is also expensive due to the fact that it requires a complete restructure and requires tagging each and every incoming and outgoing document. In addition, the majority of departments will challenge this approach due to responsibility issues and convenience, and thus will cause such an approach to fail. For such an attempt to succeed, top officials in the ministry should be committed to such approach and should assign the *Public*

Registry department the responsibility to safe-keep the MOF's document repository and provide them with all the facilities and support to accomplish this task.

The scenario 2 seems to be more approachable since the management issues would have less negative effects. The low volume and low circulation factors fail to provide a cost-effective approach having multiple installations with redundant equipments. Although technical support would be challenging once in case of multiple installations of such a RFID system. A unified view of the MOF's repository would be lost and individual performance would be hard to compare and replicate.

ROI have proven to be very hard to quantify since most MOF's objectives are at an intangible nature. Any effective measurements would require extensive research and surveys, both being out at scope.

During a departmental survey, taxation department was identified as a major entity that needs restructuration of its entire repository of company profiles. Therefore, this study suggests that the RCS vendor designs a pilot project targeting the taxation department. The input generated from such a project will surely unveil many aspects regarding the use of FRID, and it successful would pave the way for a wider adoption by other departments in the MOF

6. Conclusions

This is an ongoing study that focuses on evaluating the introduction of RFID at the ministry of finance in Arab country (Kuwait). The main contributions of the study stem from the development of a framework that is based on three phases: (i) Define scenarios for potential introduction of RFID; (ii) Identify factors of the total cost of ownership (TCO); (iii) deciding about the RFID adoption for a specific identified scenario.

This framework is new and useful for any kind context organizations (profit or none profit) willing to invest and introduce RFID for document management, and not only organizations in the Arab world. This study are contributions go beyond major studies that focus merely on intention to adopt and provide stakeholders with means to act and move forward toward RFID use. However, to fully grasp the real value of RFID, investments are not sufficient without complementary investments such as investing on time and organizational change.

References

Asif, Z. and Mandviwalla, M. (2005) "Integrating the supply chain with RFID: A technical and business analysis", Communications of AIS, 15(24), pp. 393–427.

Brown, I. Russell, J. (2007) "Radio frequency identification technology: an exploratory study on adoption in the South African retail sector", International Journal of Information Management 27, pp. 250–265

Chan, Y.E and Reich, H.B. (2007) "State of the Art: IT alignment: what have we learned?" Journal of Information Technology 00, pp. 1–19

Chen, J.C., Cheng C., and Huang, P.B. (2013) "Supply chain management with lean production and RFID application: A case study", Expert Systems with Applications (forthcoming)

Chow, H.K.H., Choy, K.L., Lee, W.B. and Lau, K.C. (2006) "Design of a RFID case-based resource management system for warehouse operations". Expert Systems with Applications, 30(4), pp. 561-576
Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", MIS Quarterly, 13, pp. 319-39
Davis, F.D., (1989) "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly 13, pp. 319-339
Dominguez-Péry, C. Ageron, B. and Neubert, G. (2013) "A service science framework to enhance value creation in service innovation projects. An RFID case study", International Journal of Production Economics, 141(2), pp. 440-451
Duroc, Y. and Kaddour, D. (2012) "RFID Potential Impacts and Future Evolution for Green Projects Energy", Procedia, 18, pp. 91-98
Feng, J. Fu, Z. Wang, Z. Xu, M. and Zhang, X. (2013) "Development and evaluation on a RFID-based traceability system for cattle/beef quality safety in China", Food Control, 31(2), pp. 314-325
Fung, L.C. Chan, K.H., Lam, W.K., Leung, S.W., Wong, Y.F., Wu Paul, W.K., Tang, C.K., (2007) "Electromagnetic assessment on human safety of RFID system at Hong Kong international airport. Microwave and Optical Technology Letters, 49, pp. 924–927
Gunasekaran, A., Ngai, E.W.T., and McGaughey, R.E. (2006) "Information technology and systems justification: A review for research and applications", European Journal of Operational Research, 173(3), 16, pp. 957-983
Hussin, H., King, M., & Cragg, P. (2002), "IT alignment in small firms". European Journal of Information Systems 11(2), 108-127
IDTechEx (2005). RFID tag sales in 2005: how many and where? Web: www. IDTechEx.com. accessed June 2009
IDTechEx (2012). RFID Forecasts, Players and Opportunities 2012-2022 www.IDTechEx.com/forecasts.
Ilie-Zudor, E., Kemény Z., Blommestein F., Monostori L., Meulen A., (2011), "A survey of applications and requirements of unique identification systems and RFID techniques", Computers in Industry, 62(3), pp. 227-252
Kim, S., and Garrison G., (2010), "Understanding users' behaviors regarding supply chain technology: Determinants impacting the adoption and implementation of RFID technology in South Korea". International Journal of Information Management, 30(5), pp 388-398
Knebel, U., Leimeister, J. M., and Krcmar, H. (2006), "Strategic importance of RFID: The perspective of IT decision makers in Italy", Journal of Information Technology Management, 17(4), pp. 1–11
Landt, J. (2005), "The history of RFID", IEEE Potentials, 24(4), pp. 8–11.
Lee, L.S., Fiedlera, K.D., Smith, J.S., (2008) "Radio frequency identification (RFID) implementation in the service sector: a customer-facing diffusion model". International Journal of Production Economics 112, 587–600
Leimeister, S., Leimeister, J.M.; Knebel U., and Krcmar, H., (2009), "A cross-national comparison of perceived strategic importance of RFID for CIOs in Germany and Italy", International Journal of Information Management, 29(1), pp. 37–47
Luftman, J (2005), "Key issues for IT executives 2004". MIS Quarterly Executive, 4(2), pp. 269-285

Luftman, J., (2003), Competing in the information age: Align in the sand, Oxford University Press, USA, 2 edition (August 2003).
Ngai, E.W.T., Moon, K.K.L., Riggins F.J., and Y,i C.Y., (2008) "RFID research: An academic literature review (1995–2005) and future research directions". Int. J. Production Economics 112, pp. 510–520
O¨ztaysi B., Baysan S., and Akpinar F., (2009). Radio frequency identification (RFID) in hospitality. Technovation 29, pp. 618–624
Regattieri, A., Gamberi, M., Manzini, R., (2007) "Traceability of food products: general framework and experimental evidence". Journal of Food Engineering 81, 347–356
Reilley, K. (2005), AMR research survey finds 69% of respondents plan to evaluate, pilot, or implement RFID in 2005, viewed February14, 2010. http://www.amrresearch.com/Content/View.asp?pmillid=18470 .
Roberts, C.M. (2006) "Radio frequency identification (RFID)", Computers & Security, 25(1), pp. 18-26
Rogers, E. M. (1983) Diffusion of Innovations, (3rd ed.), New York: The Free Press
Roh, J.J. Kunnathur, A., Tarafdar, M., (2009) "Classification of RFID adoption: An expected benefits approach", Information & Management, 46(6), pp. 357–363
Rouibah K. and Ould-Ali S., (2002). "PUZZLE: a concept and prototype for linking business intelligence to business strategy". Journal of Strategic Information Systems 11(2), pp. 133-152
Rouibah, K. and Ateeqi M., and Rouibah, S., (2011), "Does the Introduction of RFID Technology Improve Livestock Subsidy Management in Kuwait? A Success Story from an Arab Country". Journal of Cases in Information Technology (JCIT), 13(1), pp. 15-36
Roussos, G., (2008), "Computing with RFID: Drivers, Technology and Implications", Advances in Computers, 73, pp. 161-217
San Francisco Business Times (2004). Surging Market for RFID security predicted. San Francisco Business Times, 24 March 2004
Tzeng S., Chen W., Pai F., (2008), "Evaluating the business value of RFID: Evidence from five case studies", Int. J. Production Economics 112, 601–613
Walls, J.G., Widmeyer G.R., and El Sawy, O.A., 1992. "Building an information system design theory for vigilant EIS", Information System Research 3 (1), 36-59
Wamba, S. F., and Chatfield, A.T. (2011), "The impact of RFID technology on warehouse process innovation: A pilot project in the TPL industry", Information Systems Frontiers, 13(5), pp 693-706
Yu, S., (2007, "RFID implementation and benefits in libraries", The Electronic Library, 25(1), pp. 54-64
Yusof, M.M., Papazafeiropoulou, A., Paul, R.J., Stergioulas, L.K. (2008), "Investigating evaluation frameworks for health information systems", International Journal of Medical Informatics, 77(6), pp. 377-385
Zhu, X., Mukhopadhyay, S. K., Kurata, H. (2012) "A review of RFID technology and its managerial applications in different industries", Journal of Engineering and Technology Management, 29, (1), pp. 152-167