IS Change and RFID Deployment Protocol: A Collaboration of Two Models

TOLGA PUSATLI\textsuperscript{1}, EUGENE LUTTON\textsuperscript{2}, BRIAN REGAN\textsuperscript{2}

\textsuperscript{1}Department of Information Systems Engineering
Atilim University
Kizilcasar Mahallesi, Incek Golbasi, Ankara
TURKEY

\textsuperscript{2}School of Design, Communication and IT
The University of Newcastle
University Drive, Callaghan, NSW
AUSTRALIA

eugene.lutton@newcastle.edu.au http://www.newcastle.edu.au/school/design-communication-it

Abstract: - This paper presents our approach to explain information systems (IS) change in organisations and its applicability in the RFID (radio frequency identification) application management. It aims to investigate collaboration of these two models: an IS change model (Information System Maintenance/Replacement Model (ISMRM)) and RFID deployment model. Similar to other changes in business process and IT infrastructure, RFID deployment requires a business commitment, combined with a thorough analysis, planning and control to enable the organisation to obtain an optimal solution. To assist and guide an organisation in this activity a RFID Rationale and Deployment Methodology was developed, recently. As reported in the literature, this methodology is divided into three phases and has phase transitional motivators that are utilised to support the decision making during the possible deployment of RFID technology. Meanwhile, the ISMRM model lends support and extends the decision making process, within the RFID Rationale and Deployment Methodology, so that decision to implement such technology can be approved with additional factors of productivity, error/failure rate, available support facilities, user feedback, system specialisation and maintenance. This exploratory research concludes that there is a considerable potential for further research including implementation, testing and validation of the true linkages and purpose of the melding of these models.

Key-Words: - information system, change request, IS Maintenance/Replacement Model (ISMRM), radio frequency identification deployment methodology, RFID rationale and Deployment methodology

1 Introduction and Background

A recent work [1] has found evidence that there is a potential to explain IS changes via an IS change model, IS Maintenance/Replacement Model (ISMRM), which recommends a model with such a potential as shown in Figure 1.

One of the purposes of ISMRM is to provide a tool to explain the replacement/maintenance decision i.e. by this model the decision maker will have to say something more concrete than, for example, "it is simpler to maintain the system instead of replacing it".

Meanwhile, the RFID deployment model (Figure 2) aims to assist organisations through its three phases, namely business, infrastructure and deployment. This model aims to guide organisations in answering "is it really better to implement RFID than what is currently in place?"

In the following section, we explain both models but avoid getting into too much detail as this paper's aim is to focus on the motivation to collaborate both models to create future work avenues in guiding organisations to take their decisions on replacing, maintaining current systems and deploying new technologies.

2 Models

A decision of making changes in an IS may have many ingredients in number and it can be complex to explain; in such a "black box" environment, it may be difficult to understand/explain (sometimes to abuse) reasons for decisions.

Similarly, adapting a new technology in an organisation can have many variables. In this point, RFID deployment model provides a good example in modelling such an adoption.
2.1 ISMRM

A common view of the inclination of IS to change through time and the quasi necessity for this activity is supported in the literature of software engineering [2]. With this motivation, ISMRM, proposed by [1] tries to highlight and itemise factors that can lead to decisions to make changes.

As Figure 1 shows, the model is composed of eight items with logical connections to provide a path to a decision box for replacement/maintenance of systems or components.

In the 1970's and 1980's information systems were required and designed for organisations. With the overwhelming growth of the multinational vendors, they are not always released as custom made products. Still, they may be specialised on specific operating environments, and they have specific functions for business. An IS is preferred to fit into the work environment by the help of its configurability. With all those specialisations, it is produced for a specific user community with similar skills; for this reason market share would be complementary. Hence, the system specialisation defines popularity of the information system. Over time, the specific attributes of the information system may not be enough for the ever changing business. The performance, usability and efficiency of the system are locked with the system specialisation.

Noting that the word "limitation" should not be interpreted always as a negative meaning, system specialisation limits productivity, such that it defines the limits. An IS may produce errors and those errors may cause failures. The impact of the failures may differ from minor print out problems to whole system collapse. Thus, errors/failures can limit productivity. Although there are some discussions to assess and define its borders in the literature (e.g. [3] [4]), in the model the productivity covers efficiency, usability and performance of the systems.

One of the reasons to take the productivity in such a broad sense is that the productivity of the work practices and of the application are not always distinguished by the organisations. Consecutively, a change (potentially a drop) in productivity may cause a request for maintenance activity. Although the maintenance activities need to be approved by the organisation's higher executive officers, available support facilities (through training, documentation, 24/7 help desk and forums) offer possible maintenance activities to request changes. Additionally and cautiously, popularity of a system (may) increase availability of support facilities in terms of exchange idea platforms of the user communities. The user feedback plays an important role in this whole process.

As a variety of works in the literature [5], [6] suggests that user reaction plays an important role in this process as alone in the success of the IS; this role can be quite extensive from the very early stages of a system, e.g. prototyping, to the last stages, where the system is about to be abandoned. Thus, user feedback informs the change requests process. Towards the end, the decision makers eliminate, modify and add change requests for the IS. Those requests are shaped and/or filtered by the policy, cost [7] and (sometimes) intuition [8] of the decision makers. To fix errors, increase performance, enhance capabilities and take precautions, corrective, perfective, adaptive and preventive maintenance activities are done on the IS (component). Those activities can be triggered by several reasons and are offered as change requests as this model suggests. Finally, a change request can cause a (corrective, adaptive, perfective or preventive) maintenance activity to respond the
request. Those are the requests made by or on behalf of an executive officer that can cause modifying (removing, adding or changing) of part or all of an information system. Those requests are the basic activities triggering maintenance activities. This factor represents the point where the decision of change is acknowledged to be approved. Although maintenance activities are changing systems specialisation for "good", they may increase risk of new errors and failures by causing instability in the long term [9], [10].

2.2 RFID Deployment Model
The RFID Rationale and Deployment Methodology model [11], [12], [13] has evolved from the necessity to assist in a successful implementation of a RFID system. It is important to have a thorough understanding of the key aspects of this technology before embarking on a possible deployment. At the time of writing, and to the best of our knowledge what seems to be missing is applied research on how and why organisations will initiate, or cease the deployment of an RFID system. Literature review into RFID by [14], [15] highlight the lack of publications relating to RFID deployment methodologies and empirically based studies.

The RFID Rationale and Deployment Methodology is divided into three environment phases:
- Business
- Infrastructure
- Deployment

Due to space constraints each phase of the methodology will be outlined in the following subsections.

2.2.1 Phase 1: Business Environment
The business environment investigates and analyses why the organisation is currently contemplating a possible deployment of RFID technology. This business phase Figure 2 has three to four processes that the organisation may follow:
- Instigating environment
- Mandated or non mandated business case
- Phase Transitional Motivator (PTMs)

The instigating environment examines what is motivating the organisation to consider RFID technology; how is their discretionary behaviour affected by the instigating circumstances; has there been mandated directives come from a supplier, customer or government and if RFID is mandated, then the organisation will be obliged to adopt the new technology and integrate this functionality into the required business case. There will be circumstances when the organisation is contemplating RFID systems from an investigative viewpoint. In this case they maybe looking to gain competitive advantage or analyse the possible benefits of RFID technology.

From the instigating environment the organisation has a choice of moving to the mandated business case or non mandated business case steps Figure 2. Though similar questions and analysis are needed in each of these steps, there will be a difference in the imperative decision making in the situation. Both of these steps examine the business case that may have RFID technology integrated into the process.

The business case is defined as the "argument supporting a proposal to encompass all the processes and factors necessary to fulfil the business objective of a particular RFID implementation proposal" [12].

During the analysis of the business case, the organisation will determine the success or failure parameters that will guide the setting of Phase Transitional Motivator (PTM). In other words seeking what motivates the organisation to continue the possible deployment.

Table 1 outlines the PTM rating system for guiding the organisation in their decision making. A subjective weighting is given to a PTM or Step Transitional Motivator (STM) Figure 2. An example of a PTM is the available time to initiate and deploy a RFID system. In this case the organisation has 12 months to bring a RFID identification system into full production. This time constraint (PTM) is given an imperative weighting. In other words the system must be operation within 12 months. During the investigation of the business environment it is found that the feasibility rating of this PTM is viable. The outcome is successful and the action in this case is to continue.

<table>
<thead>
<tr>
<th>Weighting</th>
<th>Feasibility</th>
<th>Outcome</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imperative</td>
<td>Viable</td>
<td>Successful</td>
<td>Continue</td>
</tr>
<tr>
<td>Recommended</td>
<td>Challenging</td>
<td>Re-evaluation</td>
<td>Feedback</td>
</tr>
<tr>
<td>Optional</td>
<td>Unworkable</td>
<td>Failure</td>
<td>Exit</td>
</tr>
</tbody>
</table>

This process of assessing a PTM is undertaken for each PTM identified. With the time constraint it will be examined during all phases of the methodology. For example, during the infrastructure environment it is discovered that the level of
ambient electronic noise (AEN) will require additional changes to work practises and the installation of shielding for interrogation zones. This discovery means that the organisation will require more resources or there will be a delay to the project deadline. This finding may also have an impact on the budget of the project. In iteration two of examining the example of a time constraint, the feasibility is now rated challenging and the outcome is re-evaluation and the action is feedback. This feedback is looped back to a previous phase or step. An example of exit is where the cost of deployment exceeds the current allocated budget. Due to space constraints only one example of a PTM or STM will be presented.

2.2.2 Phase 2: Infrastructure Environment
The analysis of the physical and technical characteristics of RFID technology is the principal activities in the infrastructure environment phase. In this phase Figure 2 the mapping of the business case to the use case is tested, scoped and documented. It is imperative to examine all possible sources of AEN that may interfere with the communication between a RFID tag and reader. This phase has three steps:

- Use Case Environment
- RFID Equipment
- Design Environment

In this phase of the deployment the organisation is investigating where and how the use case is to be completed. The site assessment documents possible AEN where the use case is being performed and inputs information into the RFID equipment step. Each step has a STM which is an evaluation checkpoint, similar to the PTM for each phase. If the STM action is feedback or exit then the step flows to the PTM process for this phase. Otherwise the next step is instigated.

The RFID equipment step involves the configurations of the RFID readers and tags to optimise the identification of an object with minimal interference from other activities in the use case environment. It is important to validate the operating spectrum of the RFID system, to test if it complies with local operation specifications.

The third activity in this phase is the design step, which initiates the design of the system and the documentation of the specific use case. If the PTMs parameters are congruent with the organisational objectives, then a possible deployment of a production RFID system progresses.

2.2.3 Phase 3: Deployment Environment
The deployment environment examines the outcomes from operating a use case process once it is enabled with RFID technology. As seen in Figure 2 there are two different steps in this phase:

- Prototype Testing environment
- Pilot Environment

The prototyping test environment looks at the integration of the uses cases required to fulfil the scope and objectives of a business case as it is necessary to comply with a reasonable business case. If the outcomes of the STM have an action of continue then the organisation is recommended to commence a pilot study.

The testing of each use case allows the organisation to gain insight and experience before it examines the next use case. This modular approach to the testing prototype allows the organisation to see if it is practical to implement a pilot for the selected business case.
The pilot environment tests the selected business case with a longer duration. The documentation of benchmark metrics will be further examined during this pilot study. One objective of this step is to understand how a business case operates during an operational situation. The pilot will allow further examination and determination of the capabilities of the RFID system, before a complete integration is completed or contemplated.

3 Co-ordination of the Models
As we deduce from Section 2, ISMRM supports the PMT and STM processes of RFID deployment model. This support can be extended to comply with the rating system given in Table 1.

IS change and RFID deployment models show associations as following examples suggest. For instance,
- system specialisation of the ISMRM incorporates whether a system or component uses an open source to reduce dependency.
- Another example is the error/failure rate that helps in deciding whether the version of an RF component is stable or not.

This association/correspondence can support coordination and subsequently a collaboration of both models. A protocol for RFID deployment requires continual updating of specifications, (plurality of) standards and changes in the equipments. The ISMRM supports those requirements as the model give more clarification to the decision on whether or not to adopt, or change, or negate the deployment of RFID. This must conform within the boundaries of an organisation and its objectives of the business case, which are also identified in eliciting change requests in the ISMRM.

The weighting scheme provided by the RFID model allows the organisation to subjectively decide the motivators to continue or exit the methodology; on the other hand ISMRM provides further guidance beside RFID deployment model items.

Although it is too early to perform strict mapping between two models, current analyses of both models show following overlapping for collaboration (Table 2).

As seen in Table 1, system specialisation puts an extent to investigate infrastructure environment. For instance, examination of AEN and the problems this may have on the communication between RFID tag and reader/antenna. In addition to those points reported by the RFID model, compatibility and portability of the hardware as well as software is covered by the ISMRM. Additionally, further maintenance will be probably needed, for this reason, availability of support facilities need to be identified in order to solidify the future of the technology to be applied in the work place.

Table 2. Preliminary mapping of two models.

<table>
<thead>
<tr>
<th>ISMRM</th>
<th>RFID model</th>
</tr>
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<tbody>
<tr>
<td>System Specialization</td>
<td>Infrastructure env.</td>
</tr>
<tr>
<td>Change Request</td>
<td>Business env.</td>
</tr>
<tr>
<td>Productivity</td>
<td>Business env.</td>
</tr>
<tr>
<td>Availability of support</td>
<td>Infrastructure env.</td>
</tr>
<tr>
<td>User feedback</td>
<td>Deployment env.</td>
</tr>
<tr>
<td>Errors</td>
<td>Deployment env.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>All of them</td>
</tr>
<tr>
<td>Popularity</td>
<td>Deployment env.</td>
</tr>
</tbody>
</table>

Similarly, business environment can be extended by investigating change request, productivity and maintenance factors covered by the ISMRM. In this way, implementation of the new technology can be investigated in a broader base by covering organisational restrictions such as policy and cost.

Deployment environment is the last phase of the RFID model. As ISMRM underlines, user feedback, popularity of the technology and errors in the beta testing need to be investigated. These factors affect change requests for modifications or abandoning the attempt to implement application.

4 Discussion of Limitations
The limitations to this work are apparently in addition to the limitation emerging from both models' nature.

Although this work explores potential applicability of the ISMRM to the RFID deployment procedure, it is early to draw a constant conclusion that both models will work at any circumstances. The authors found several limitations to cover including testing of this potential co-ordination.

A preliminary framework to address this limitation is to draw future work on empirical testing; choosing a variety of domains beyond the health sector; testing the validity of this co-ordination by a qualitative research method (preferably semi-structured interviewing supported by some participant observation data) through which the correspondence of the factors (of the ISMRM) to the RFID deployment model can be assessed. By this research method, we believe to establish more associations with increasing business case opportunities in implementing collaboration of both models.
5 Conclusion
As the previous section implies, the authors are aware of potential limitations. However, this work can still suggest that RFID deployment model can be supported and extended by ISMRM so that the procedure of a change request to maintain or replace already installed IS or component can be explained by stronger reasons. In this work, this is RFID technology centred.

ISMRRM may help in explaining reasons behind a component change but lacks providing any relative rating, while RFID deployment model provides a step-by-step protocol but can be enhanced by further analyses in itemised factors that can lead to a change request. This collaboration explores points, which are not handled solely in either of the models, including reasons behind abandoning a new technology. As the nature of those items shows, both models can be combined at a level neither technical nor abstract; hence, this collaboration may be scaled as a moderate level, currently.

This research predefines necessity of preparing a step-by-step framework in which mapping between both models can be tested and validated in order to meld both models and apparently increase their potential collaboration.

References:
[1] Pusatli, O.T., Interoperability and Information System Replacement in the Health Sector (PhD dissertation) at The University of Newcastle, Australia, 2009 (submitted)