AN INVESTIGATION OF BUSINESS PROCESS MANAGEMENT ON THE APPLICATION OF RFID ON THE CASE OF MEDICAL BLOOD PACK HANDLING

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ABSTRACT

Radio Frequency Identification (RFID) provides an opportunity to explore a new approach with regards to information management and demonstrates an evolved business paradigm shift with regards to the Logistics Flows within Supply Chain Management of Blood Pack Handling (BPH). BPH is a mission-critical activity within the medical community and life sciences industry, Applications of RFID should not only be considered as a matter of ICT but more importantly as an evolution of Business Process Management (BPM) to increase the effectiveness of healthcare tasks. Hence, this research aims at exploring the best practice of using RFID as a utility to improve the BPH performance. To achieve this goal, we conducted a survey on RFID and Business Process and Performance Management as it pertains to BPH. Additionally we have looked at the implication of RFID in comparison with conventional Bar Code technology which is currently utilized in BPH. The outcome of this research is the strength of RFID over previous techniques in use and the CSF's that are required for effective RFID application. The case study was conducted through field observation and expert interviews. We have provided an operating model incorporating RFID for evaluation as an improved process by which to manage BPH. Accordingly, we propose the recommendation for blood pack data format to be included on the RFID Tag and provide a recommendation for the layout of RFID readers and the information system infrastructure as a whole. As a consequence, this paper presents an evaluation on quantitative as well as qualitative KPIs with respect to RFID application to ensure that the best practices of BPH can be delivered via BPM. The result shows that the application of RFID in BPH leads to an improvement of the quality and effectiveness of BPH.

Keywords: Blood Pack Handling (BPH), Business Process Management (BPM), Critical Success Factor (CSF), Radio Frequency Identification (RFID)

1. INTRODUCTION

Radio Frequency Identification (RFID) was invented by the English in 1948 and was used to identify Military Aircraft for many years. Commercial applications of this technology did not receive much publicity until Wal-Mart, the United Stated Department of Defense, (DoD), and Metro introduced it into applications in early 2000. The application of RFID was reported by Business Week in early 2004, thereafter market analytical companies, consulting agencies and equipment manufacturers speculated that RFID will bring many business opportunities to the market in 2004 and forecasted that the US $300 million tag business in 2004 will increase to US $2.8 billion by 2009. According to the Data from Ministry of Economic Affairs (MoE), the total amount of RFID business in 2007 increases to NT 2.045 billion.

RFID techniques are also largely applied in various industrial areas, include security and monitoring, logistics, manufacturing, and retailers [1][15].

Initially, the unit cost of the RFID tag prohibited application across multiple industries and Supply Chain functionalities, however as the applications of RFID further spread and then its cost is reduced, the application of RFID is providing more opportunity for the application of RFID [15]. One such area of deployment is in medical care that is set to be one of the five application areas by the 2005 SRB Conference held by Taiwan's National Information and Communications Initiative Committee (NICI) [14]. In the BRIDGE (Building Radio Frequency Identification for the Global

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Environment) Programme, which is a European Union funded 3-year Integrated Project and addresses ways to resolve the barriers to the implementation of RFID and EPC Network in Europe, RFID application for medical care and pharmaceutical industry is also taken as one of the most important working areas.

For the time being most of the governments and regional institutions is engaging themselves in the development of RFID applications for Medical Care [1][14]. It is worth to notice, most of the efforts for RFID's medical care applications are put into Hospital's Emergency Care, Surgery, Senile Dementia, . etc. [1][14] and there are just few implementation of RFID usages in Blood Pack Handling.

The Ultimate goal of this research is to improve the quality of the blood pack handling process, i.e. shorten operational time, reduce blood transfusion errors, and minimize error ratios. The pre-study of this research reveals the findings that many institutions, that have implemented RFID applications, did not meet the expectations anticipated in deploying this promising technology.

One of the reasons for this is that the potential changes resulting from the RFID applications are not factored into existing Business Processes and aligned with the goals of the institutions. The critical success factor (CSF) is that the existing business processes must be reviewed and changes in accordance with the introduction of new technology, implying the need for a well-formulated study and plan before the implementation of RFID applications.

Institutions also need to consider what kind of business model they want to build or achieve through the deployment of RFID and then clearly define the role of RFID in achieving this Goal. What data do we need by using RFID? What is the source of this data and when does the organization need it? And how does the data get accessed? To enjoy the best RFID benefits, the RFID applications have to be migrated into the underlying business process and hardware infrastructure. This study takes a close look at a RFID implementation model based on the viewpoint of the business process, while Business Process Management will be addressed to deploy suitable RFID applications efficiently and effectively. Through this case study, the whole business process management on the application of RFID in blood packs handling will be presented.

2. SITUATION ANALYSIS

2.1 RFID (Radio Frequency Identification) and its Applications

This section details the essential components of an RFID system, and in order to put these concepts in perspective, we will also briefly discuss the history, current status, and future of the technology. This research is meant to capture the information and understanding needed for the RFID application for BPH.

RFID has contributed to a flurry of industry mandates, governmental legislation, and something of a hyperbole. It is an automatic identification technology that uses radio waves to uniquely identify items. RFID technology involves tags that transmit item identification data using radio signals to reading devices which capture and decode the signal [9][13].

A serial number that identifies an item is stored on a microchip. The microchip is attached to an antenna that together form an RFID tag, also referred to as a transponder or smart label. Identification data is transmitted to a reader by the antenna using radio frequency. The reader receives and translates the radio waves and transmits to computers in a format that can be understood. The reader can then inform another system about the presence of the tagged items. The system with which the reader communicates usually runs software that stands between readers and applications. This software is called RFID middleware, Figure 1 shows how the pieces fit together.

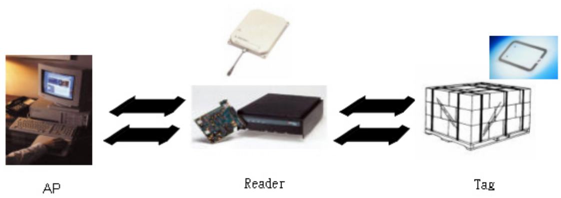

Figure 1: RFID components and application

With this technology, data as well as information becomes mobile with the goods as they move through the Supply Chain, thus effecting mobile commerce [3]. While the technology has existed for decades, new supply chain applications offer incredible potential to revolutionize the logistics industry. Much of the recent interest surrounding RFID has arisen from mandates and recommendations by government agencies such as the United States Department of Defense (DoD) and the United States Food and Drug Administration (FDA), and from a few private sector mega-corporations [3][4]. For instance, in an effort to improve efficiency, Wal-Mart called for its top 100 suppliers to begin providing RFID tags by early 2005 on pallets shipped to its stores [3][22].

This mandate caused the companies in Wal-Mart's supply chain to focus on implementing RFID solutions. Companies worked to decide which tags and readers to use, how to attach tags to (or embed them in) containers or products, and how to test the read rates for RF tags on pallets as they moved through static and mobile infrastructure within the Supply Chain. Several companies have announced their support for what are now commonly known as tag and ship applications, which tag a product just before shipping it somewhere else, but few of these companies have moved beyond minimum compliance with the mandates to using the information on RFID tags to increase efficiency in their own internal processes [3][4].

The mandates have also focused most of these early implementations on tagging, and thus on the physical side of the RFID systems. However, while it is important to both select tags and readers and find just the right arrangement of antennas to recognize tags as they move through docks and conveyor belts, the true benefit (and complexity) of RFID systems doesn't come from reading the tags, but from getting the information from those reads to the right place in a usable format. The first 100 were only the beginning of the Wal-Mart RFID rollout. Many more suppliers will be tagging pallets, cartons and bags and individual items in the near future. Meanwhile, the attention in RFID may surround the e-Pedigree aimed at reducing counterfeiting and improving efficiency and safety in the distribution of pharmaceuticals [15]. By then, many new initiatives will have been launched to apply RFID to other industries in ways which is hard to predict.

The progress of RFID adoption divides naturally into phases: the "Proprietary phase", the "Compliance phase", the "RFID-Enabled Enterprise phase", the RFID-Enabled Industries phase, and the "Internet of Things phase" [9]. In the beginning, during the "Proprietary phase", businesses and governmental entities created systems designed to track one particular type of item, and this tracking information typically remained within the same business or governmental entity. In the "Compliance phase" (the present phase), businesses implement RFID to meet mandates for interoperability with important customers or regulatory agencies but often don't use the RFID data themselves. The future will bring the phase of the RFID-Enabled Enterprise, where organizations will use RFID information to improve their own processes.

The phase of RFID-Enabled Industries will see RFID information shared among partners over robust and secure networks according to well-established standards. The final RFID phase that is currently foreseeable is the phase of the "Internet of Things". By this time, the ubiquity of RFID technology and other enabling technologies, combined with high standards and customer demand for unique products based on this infrastructure, will lead to a revolutionary change in the way we perceive the relationship between information and physical objects and locations. More and more, we will expect most objects in our daily lives to exist both in a particular place, with particular properties, and in the information spaces we inhabit. RFID ONS (Object Name Service) structure as shown in Figure 2 is one of the example for this phase.

ONS ought to handle more requests than the Domain Name Service (DNS) for normal Internet services. Therefore, organizations tend to maintain ONS servers locally, which will store information for fast and flexible retrievals. Thus, an operation unit may store ONS data from its current suppliers on its own network, rather than pulling the information off the Web site every time a shipment arrives at the assembly plant. If a server with information on a certain product like a blood bag fails, ONS will be able to point the RFID middleware to another server where the same information is stored.

Figure 2: RFID ONS structure

Companies, regions, and even individuals will move through these areas at different paces. Even now, some users of RFID are touching on the RFID-Enabled Industries phase as emerging standards make this possible, while others are still in the Proprietary phase. In many other areas, RFID has not been adopted at all.

2.2 Business Process Management (BPM)

Since late 1990s, industries began to make great efforts for Business Process Re-engineering [19]. Gradually, it is recognized that BPR alone is not able to ensure the success of business process improvement. Experiences from success and failure of BPR reveal the successful factor, i.e. goal setting and weak-point finding are certainly no less important than the re-design per se [6][4]. Furthermore, new and old processes must target to the improvement of business performance by means of management. The focus of business improvement shifts thus to Business Process Management (BPM) and then to Business Performance Management (also abbreviated as BPM) [8][6].

Many business and ICT projects are at risk because they don't use a methodology to select ICTs (information and communication technologies) as an enabler for the re-engineering. Applying the right ICT enabler is one of the critical steps in understanding how to leverage information to gain insight and improve productivity and efficiencies throughout the organization. Management processes and business systems that improve future performance are the work of Business Performance Management, a category of enterprise ICT tools that replace spreadsheets and static reports with more flexible, scalable and dynamic tools. Business Performance Management goes beyond the specific functions automated by transactional systems, viz. accounting, billing, bookings, supply chain, sales force automation and call centers etc. [8]. Consisting of a consolidation and analytics platform and financial and business applications, Business Performance Management solutions use data from these systems to increase visibility, drive forecasts, predict results, manage financial and operational performance, and report on outcomes both internally and externally.

Business Performance Management gives executives, managers and knowledge workers deep insight into their current business and tools for improving performance for the future. With Business Performance Management software, companies can proactively manage their success, from the boardroom to the front lines, achieving breakthrough performance everywhere. Support for the extended enterprise is another benefit of Business Performance Management. Increasingly, organizations are adopting strategies that involve using shared services, outsourcing or partnering in a network of businesses [6][11]. These extended enterprises typically form along the value chain and require management processes that can adapt to an open and fluid organizational model.

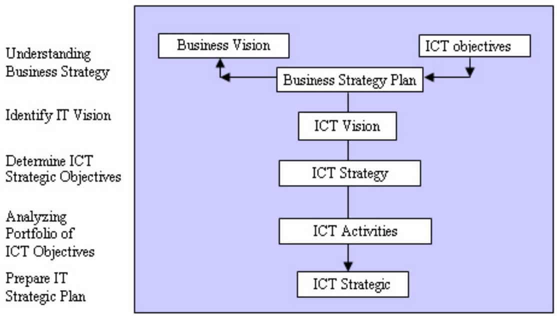

Figure 3: ICT strategy in the BPM roadmap [Chiang, 2006])

Balance Scorecard (BSC) is a performance achievement framework developed by Robert S. Kaplan and David P. Norton [12]. BSC requires performance measurement systems to identify measures related to four perspectives: financial, customer, internal processes, and learning and growth. Figure 4 illustrate BSC framework. With respect to BSC, Chiang [5] has extended the framework by using business strategy and human resource as leverage for the balance of performance measures with regards to the 4 perspective. Further, Chiang [5] has elaborated a method for deployment of the performance measures into Critical Success Factors (CSFs) and Key Performance Indicators (KPIs) as follows:

- Key problem narratives
- Highlight Charts: Information showing own judgment or preference
- Top-level financials: Number and performance ratio
- Key factors: KPI at corporate level-reflect or examine specific measures of CSF regarding problems in highlight charts
- Detailed KPI responsibility reports

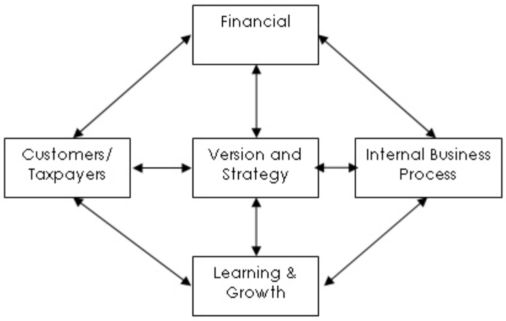

Figure 4: BSC Framework [12]

BPM is a task encompassing goal setting, analysis as well as evaluation of existing processes design of new processes with support from Information and Communication Technology (ICT) such as RFID etc. Being a task of such complexity, BPM per se needs ICT support as management tools. However, the connotation of BPM is not only limited to ICT but most important in business process. BPM is a matter of business innovation towards high performance rather than the technical implementation. Most importantly, BPM is a metaphor addressing the complete process life cycle and its major theme lies in the effectiveness, especially with regards to cost productivity and efficiency measures. Obviously, CSF's and KPI's play the important role in this kind of work.

2.3 Blood Pack Handling Procedure

After the field-observation, Chen [4] has described that the blood pack handling process as a whole encompasses two procedures, i.e. blood collection and pack generation (by blood donation centers) and hospital usage.

1. Blood collection and pack generation: The work package includes blood collection, testing, and inventory. Starting from blood donation, blood donor or group entering a blood donation or transfusion center, going through primary history taking and examination, qualified individuals undergo blood collection. Besides blood pack, to ensure safety, other tests were done to the test tube. Finally, blood pack, test tube, and blood donation records were double-checked with laboratory reports. Disqualified collections are destroyed, while qualified collections are stored into the blood bank.

2. Hospital usage: This step is the consuming procedure in the hospital after blood pack has been delivered to the hospital. It starts from the hospital dispensing blood packs. Then, it continues with a series of transfusion processing steps (blood preparation, blood pack pickup, transfusion, blood pack return or storage), transfusion to the recipient.

2.4 RFID Applications in Blood Pack Handling

There are some initiative studies that applying RFID technologies in the blood handling process with positive outcome. These cases are illustrated below

1. Georgetown University Hospital (GUH): In 2004 GUH began test between RFID and bar code system, the result shown not only was the scanning of the RFID tags fast and accurate, but they also had more capabilities than bar code system.
2. San Raffaele Hosipital (SRH): SRH started RFID pilot program in 2004. The pilot program was a success resulting in 100% accuracy. The pilot reported cutting verification time in half and 41% improvement in overall accuracy.
3. Mississippi Blood Services (MBS): Before experimenting RFID, MBS scan bar codes on each blood bag. This process is very laborious. In their RFID pilot, blood bags were placed into bins and were read simultaneously and instantaneously.

3. RESEARCH METHOD AND LIMITATION

3.1 Research Method

To get the best from the application of RFID, organizations need to develop and plan ICT solutions and integrate the application process. This study focuses on process. Based on process management, it will allow us to understand how to implement RFID applications. By means of management concepts for the integration process, we can establish the RFID implementation operational step model. The operational step model will be introduced in the case study.

3.2 Research Limitation

Key point of this study is to address a RFID technical implementation mode based on BPM. Medical care regarding on BPH is chosen as the objective of case study. Due to time limitations we are unable to cover all working areas in the medical care as a whole. This study will be majorly focusing on the improvement and re-engineering plan for blood pack handling process of the supply side and to analyze which of the existing RFID technologies can be used on the blood pack handling process. In this study, information on medical blood transfusion and usage on hospital side is taken into account for the sake of process integrity.

4. CASE STUDY

The case study has been employed as the research method and a blood donation center was chosen as the research objective. The business process management on RFID application addressed in this study encompasses the following phases, viz. forming of mutual understanding and consensus, process re-appearance, process analysis, ICT evaluation, re-design process five phases, what are suitable to the center. The study can be described in the following phases.

4.1 Build Consensus and Mutual Understanding

An Ac-Hoc Team was formed to identify related tasks and responsibilities for achieving the targeted goals. The organization of Ac-Hoc Team is shown in Figure 6. On top of this organization, consensus forming is implemented through various steps. Questionnaire was conducted to capture initial input from target user group, and then the result of questionnaire was reviewed by seminar for final consensus. The consensus development process is shown in Figure 7.

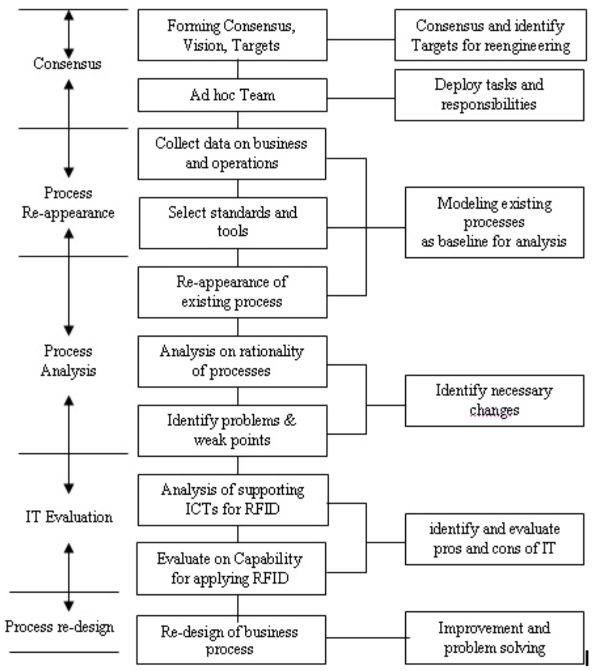

Figure 5: Business management process for applying RFID

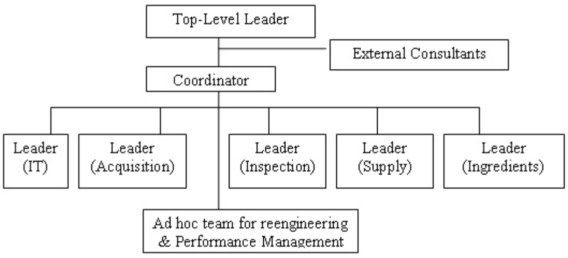

Figure 6: Organization of the Ad Hoc Team [2]

In Taiwan, major areas for RFID application lie in medicine control, blood bag management and emergent medical treatment. With regards to blood pack management, safety is always the critical issue. Nevertheless, errors in blood handling and transfusion still occur. In the research reported by Sazama [20], Linden [16] and McClelland [17], the error ratio is 1/29,000, complication ratio is 1/275,000, and the death ratio is 1/550,000. Jim MacPherson, the President of the American Blood Centre, has speculated that these error ratios can even be higher as many cases are not reported [11].

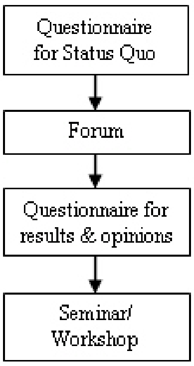

Figure 7: Consensus development process

Two CSFs (Critical Success Factor) were clearly identified after the consensus development process. The first CSF is the reduction of error rate blood pack handling and the second CSF is to shorten the manual work time and manpower with regards to reduction of error ratio. Traditional bar code system requires a scanner to pass over each blood pack. It causes operational error due to human intervention in the data capturing process. The core principle in using RFIDs is to reduce the manpower-intensive and time-consuming works to facilitate correctness of the overall blood Pack Handling work package.

Cost issue was raised during the workshop. However, the project was positioned as a pilot program. Its primary objectives are exploring potential solutions for reduction of error rate blood pack handling and shorten the manual work time in the initial phase; cost justification will be reviewed afterward.

4.2 Process Re-appearance

In order to capture the process model and be more familiar with the existing processes by the donation center, we have collected related data as a reference for process analysis, ICT evaluation, and process re-design. A field observation, including interview, was also arranged to ensure the data accuracy. BPMN/BPEL [23] is then applied to construct the model as re-appearance of the process where the results of this work may be further used to develop usable web services in the future.

4.3 Process Analysis

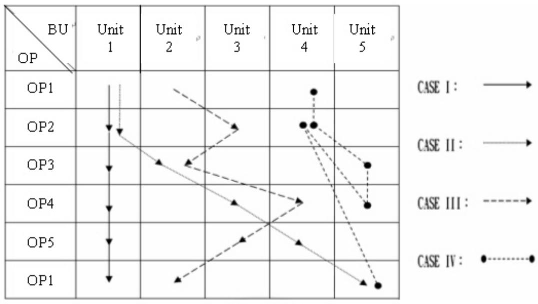

Figure 8: Dispatch flow (Pool-Lane Chart) with respect to operation-unit relationship within the As-Is Model

The aim of this phase is to improve each process by using Pool-Lane chart [17] to figure the physical movement trajectories along the business operation. By means of the chart, we are also able to examine the rationality of each physical movement line, identify problems, find solutions and set achievable targets. The Pool-Lane Chart with respect to operation-unit relationship is shown in Figure 8. The potential needs for RFID applications can also be explored through visualizing these operation processes. Case III and case IV are the crucial parts for the analysis. The operation units within the AS-Model encompass Supply, Acquisition, Ingredients, inspection and IT divisions (Figure 8).

4.4 ICT Evaluation

Due to the cost issue and the center's emphasizes on "accountabilities", we used the read-and-write RFID tags. For the sake of facilitating process and security concerns, we split blood pack handling process into two phases. The first phase encompasses the process moving from blood collection division to the blood ingredient division for verification of blood packs. We call this process as the "generation phase". The other one is the process in which the blood packs move from blood ingredient division to the supply division for storage and inventory. We call this phase as "inventory management phase".

During the generation phase, EPC codes should be written onto RFID tag while withdrawing blood bags. The multiple read-write passive tags are selected for generation phase. During the inventory management phase, data has been confirmed so that equipped with RFID read only tag in this process to avoid illegal data modifications. Table 1 shows the example of the crucial information, in particular those related to the back-tracking of time and place, and corresponding abbreviations by the blood pack generation.

Table 1: Necessary information and abbreviations for blood pack handling

	Contents	Abbreviation
Donator Inform	Name	N
	ID	ID
	Birth Date	BD
	Blood Group	ABO_BT, RH_BT
Blood Bag Inform	Donator ID	BID
	Code Number	BN
	Bag combi, No	BBN
	Blood Group	BBC
	Volume	VOL
	Date	D
Test Results	End effects	VD
	Hepatic Function Test	ALT
	Blood Group Test	ABO_BT, RH_BT
	Syphilis Test	STS
	IA	IA
	HIV (AIDS)	HIV
	B type Hepatitis Test	B_hepa
	C type Hepatitis Test	C-hepa
	Hemo, Lymph Virus Antistrophe test	HTLV

Because of the official regulation up-to-date, barcode can't be removed completely in the current blood bag handling process and necessary barcode labels are placed besides reusable RFID tags in the works within the generation phase. We choose the read/write type of RFID tags for the generation phase, that each of them is covered in a hanging ring and can be used for a newly gathered blood pack after the old data are transformed for the inventory phase. In the inventory management phase, we use combined barcode and read-only RFID chip (embedded RFID chip in the barcode label), and attach the label onto blood bags, so that the data gathered after inspection can only be read but not modified by the Transfusion Institutions.

EPCglobal is leading the development of industry-driven standards for the Electronic Product Code (EPCglobal Taiwan) to support the use of RFID (EPCglobal, ITIS). This study follows the standards of EPCglobal Gen. 2 where the frequency range is UHF: 860MHz~930MHz. Frequency of 13.56MHz is selected for collection and processing phase whilst 860MHZ~930 MHZ is chosen for the inventory management phase.

In this study, we adopt EPCglobal standards so that the coding mechanism can be expandable. Figure 9 and Figure 10 show the RFID tag coding process we developed for the collection and inventory management by the supply side and the transfusion by the hospital usage. On top of the layout and information, the process is re-designed centric to those of Category III and IV.

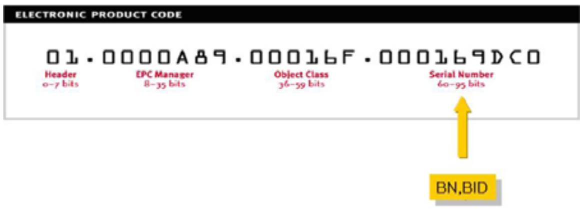

Figure 9: RFID tag coding representation in generation phase

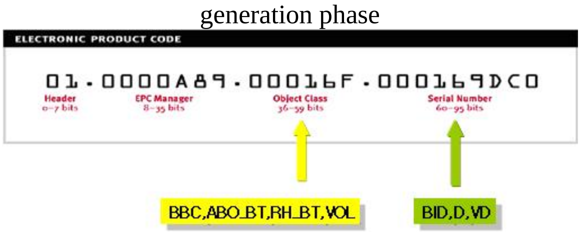

Figure 10: RFID tag coding representation in inventory management phases

4.5 Process Re-design

In the process re-appearance and analysis, we have identified the necessary work by each division (units) and recorded the workflows and results of the ICT evaluation. By means of Lane-Pool diagrams, we have figured some workflows of category III and IV as shown in Figure 5 that are the most crucial for the application of RFID. Figure 11 shows a part of the rationalized inventory process as an example to prevent the handling errors and to reduce time and man-power.

Figure 12 illustrates the design of the ICT infrastructure compliant to the new process encompassing RFID devices by the blood donation center, where the layout of RFID readers on the gates is the major consideration and one "as-is" step can be eliminated. IT, Test and Ingredient Division shown in Figure 12 require multiple bar code readers and printers before RFID deployment (AS-IS). The three divisions just need a RFID reader after RFID implementation (TO-BE).

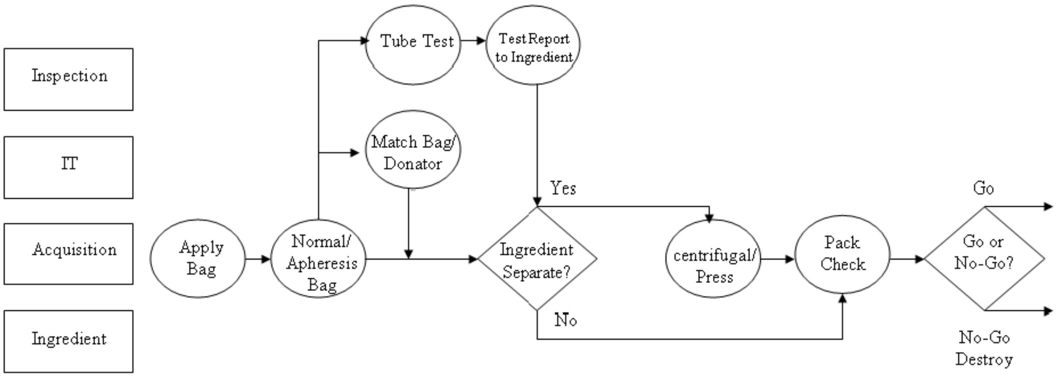

Figure 11: "To-Be" blood pack inventory process based on RFID

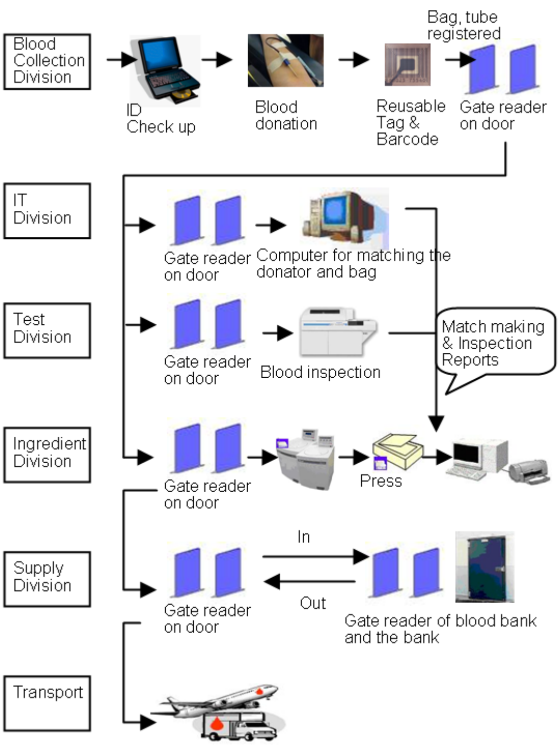

Figure 12: RFID-centric ICT infrastructure

5. CASE STUDY SUMMARY

The purpose of this study is to utilize RFID technology for improving the BPH process. Targeted expectation can be classified into two parts. Quantity: time and manpower. Quality: security, timeliness and transparency of blood bag dispatch flow.

5.1 Quantitative KPI Improvement: Time and Manpower

After re-engineering the existing process, some improvements have been identified. Table 2 illustrates in-stock pre and post reengineering improvement (time and manpower).

Table 3 shows out-stock pre- and post-process improvement (time and manpower). Normally, each batch blood bag in-stock process, we can save 62 man-min (60 + 2 + 24 - 24), improvement rate is 72.09% (65/89). For special case, we can save 105 man-min (60 + 2 + 3 +90 + 24 -50 -24), improvement rate is 58.66% (105/179).

Table 2: Improvement of inbound process in relation to time and man-power

Activity	As-Is (min/person)	To-Be (min/person)
Counting the No of Blood Bags	30/2=60	-/- =0
Checking the No	1/2=2	-/-= 0
Report on disqualified blood packs	3/1=3	-/-= 0
Picking up disqualified pack code	45/2=90	25/2=50
Blood and Bag inventory	12/2=24	12/2=24
	179 (man-min)	74 (man-min)

Table 3: Improvement of outbound process in relation to time and man-power

Activity	As-Is (min/person)	To-Be (min/person)
Access on the blood packs according to application forms	12/1=12	12/1=12
Blood bag code scan	6/2=12	-/- =0
Qualifying blood pack	1/2=2	-/- =0
Return to supplier	2/1=2	2/1=2
	28 (man-min)	14 (man-min)

Table 4: Improvement of constitute checking process in relation to time and man-power

Activity	As-Is (min/person)	To-Be (min/person)
Blood pack assessment	30/4=120	-/- =0
Judge for ingredient separation	20/3=60	20/3=60
Centrifugation	40/3=120	40/3=120
Pressing	40/5=200	40/5=200
Blood ingredient checking	40/3=120	40/3=120
	620 (man-min)	500 (man-min)

Each blood bag out-stock process, we can save 14 man-min (12 + 12 + 2 + 2 - 12 - 2), improvement rate is 50% (14/28). Excluding in-stock and out-stock improvements, the daily inventory control task handled by supply division at 2 men, 40 minutes each can be reduced. This task can be completely replaced by RFID application technology, improvement rate is 100% (80/80).

Table 4 shows the pre and post improvement for blood ingredient division, 120 man-min (120 + 60 + 120 + 200 + 120 - 60 - 120 - 200 - 120) can be reduced and the improvement rate is 19.35% 9,120/620).

5.2 Qualitative KPI Improvement: Security, Timeliness and Transparency of Blood Pack Dispatch Flow

The case study shows two kinds of advantages from EPC network infrastructure. One is more accurate information, and the other is blood bag movement trajectory in the complete supply chain. The quality improvements from RFID include:

1. Security: Temperature data is critical for the BPH (Blood Pack Handling) process. The safety of blood bag can be assessed if various temperature data were recorded. For example, if the data of blood temperature could be updated during transportation, we can ensure its quality and improve safety of blood usage. RFID tag is durable and anti-counterfeiting, so data is accurate and the blood usage safety can be improved. If RFID is widely used in the medical care environment, the blood safety usage can be improved dramatically once the blood bags, blood donators and patients are linked together. However, the implementation of RFID infrastructure in the medial care environment is not the major purpose of this study.
2. Timeliness: After re-engineer and shorten process time, the blood bags will be ready-to-use much faster.
3. Transparency of blood bag dispatch flow: In the blood donation center the blood bag moving line can be easily traced and found. By data exchange, the blood bags can be easily tracked and transferred when needed.

6. SUMMARY AND FUTURE WORKS

More and more institutions deploy full RFID as more corporate success stories unfold. To obtain the best benefits of using RFID, we need to integrate RFID with the business processes to improve system efficiencies by means of well defined BPM (business Process Management). RFID data meshes with work flow and business process, information technology and application process are integrated to produce the best outputs.

The research has identified the most crucial CSF for introducing RFID into BPH as a solution for declining of error ratio. As the most important result of this study, RFID is obviously most cost-effective solution for this kind of deficits while it is strictly difficult to get rid of them, even with high costs. Among others, the research findings can be summarized as follows:

1. We have accomplished a RFID implementation mode based on business process management. The tasks in each phase are completely described and stated the importance to the application process integration. It can be used as a reference model to support medical institutions and enterprises to implement RFID in the future.
2. We adopt BPMN as the process modeling standard and apply the BPMN/BPEL modeling tool to analyze and develop the Blood Pack handling processes. BPMN/BPEL specifications and related developing tool for web services can facilitate the realization of SOA compliant information system.

3. To provide blood donation centers with blood pack handling process, the method, model and CSF/KPI resulted in this research can serve as guideline for the further implementation of RFID applications.

RFID technology isn't just hardware labels or a sensitive device. It is not the panacea that can resolve all problems but a technology that needs close integration with the current system, business process re-engineering and business process management. One of the key success factors is the capability for targeting the change of existing application processes, therefore we must be able to understand the as-is process and to re-define to-be process, to get the best performance. This study addresses the blood pack handling operation process mainly in the blood donation centers for blood acquisition, blood examination and pack inventory. The blood usage in the hospital as the demand side should be included in the future study for the more comprehensive RFID application planning.

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