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ENTERPRISE MANAGEMENT SYSTEMS: THE CASE OF "PRIMARY RADIOLOGY GROUP"

The article describes in details the implementation of the patient information management system which may become of vital importance for overall healthcare development. The authors present the case study of the "Primary Radiology Group" center located in a town in Australia. The project implementation is to be financed by Kuwait Gulf Bank as it is interested in the projects related to corporate social responsibility area. The article offers a good example of information solutions for business which can improve economic activities not only in healthcare but also in other sectors.

Keywords: radiology; healthcare; patient information; information management systems; server; paper work reduction; corporate social responsibility.

Олексій І. Карпіщенко, Галина О. Пересадько, Олег М. Олефіренко СИСТЕМИ УПРАВЛІННЯ ПІДПРИЄМСТВАМИ: НА ПРИКЛАДІ "PRIMARY RADIOLOGY GROUP" (АВСТРАЛІЯ)

У статті детально описано процес запровадження системи управління інформацією про пацієнтів, що може стати гарним прикладом для інших закладів охорони здоров'я. Описано приклад роботи центру "Primary Radiology Group" в одному з невеликих міст Австралії. Проект запровадження програми фінансуватиметься кувейтським "Gulf Bank", який повсякчас цікавиться проектами з корпоративної соціальної відповідальності. Даний приклад може стати взірцем інформаційних рішень для бізнесу, які підвищують економічну ефективність роботи не тільки у галузі охорони здоров'я, а й в інших сферах діяльності.

Ключові слова: радіологія; охорона здоров'я; інформація про пацієнта; системи управління інформацією; сервер; зменшення паперової роботи; корпоративна соціальна відповідальність.

Табл. 3. Літ. 22.

Алексей И. Карпищенко, Галина А. Пересадько, Олег М. Олефиренко СИСТЕМЫ УПРАВЛЕНИЯ ПРЕДПРИЯТИЯМИ: НА ПРИМЕРЕ "PRIMARY RADIOLOGY GROUP" (АВСТРАЛИЯ)

В статье детально описано процесс внедрения системы управления информацией о пациентах, что может стать хорошим примером для других организаций, работающих в сфере здравоохранения. Описан пример работы центра "Primary Radiology Group" в одном из небольших городов Австралии. Проект внедрения программы будет профинансирован кувейтским "Gulf Bank", который проявляет интерес к проектам корпоративной социальной ответственности. Данный пример может стать образцом информационных решений для бизнеса, которые повышают экономическую эффективность не только в области здравоохранения, но и в других сферах деятельности.

Ключевые слова: радиология; здравоохранение; информация о пациенте; системы управления информацией; сервер; уменьшение бумажной работы; корпоративная социальная ответственность.

Problem statement. The current situation is as follows: "Primary Radiology Group" (PRG) is a company to be created by "Radiology Associates P.C." – an

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American company, providing various radiology services (RAPC.com, 2012). The project will be financed by Kuwait Gulf Bank as it is interested in the development of such projects, valuable for society (Kuwait Gulf Bank, 2012). The plan is to create PRG on the basis of the existing radiology center based in a regional town in Australia. PRG's longer term plan is to become one of Australia's largest operators of regional radiology centers. They plan to do this by acquiring or starting new centers in major regional towns over the next 10 years. At this moment, the record keeping in PRG is organized in the old-fashioned way – on paper. The company has computers to create and edit documents but that's it.

The company has interest to install Patient Information Management System (PIMS) for its current operations. Therefore, all patients' information would be handled electronically. When PRG establishes centers in other regional towns, it should be possible to roll out PIMS to them with little difficulty. PIMS then should have an additional feature for the records in one center to be accessible from other centers. In the nearest future, the current practice of doctors writing a referral on paper is likely to continue (DivineKonection.info, 2010).

However, as technology progresses, it is expected that doctors' referrals may come electronically to the PRG, and it should be possible to adapt PIMS to handle such developments. The current situation is rather critical for the company since it has plans to expand. It is not possible without the project of IS implementation. The project is of a substantial scale and size.

As it has already been mentioned, PRG needs an appropriate IS system to be implemented in order to support the company's further development. The issue is to create PRINS (PRG Radiology Information System) that will be an electronic version of the current paper-based workflow and X-rays. It must have appropriate functionality. When a patient comes to a center for the first time, a record is created for a patient at reception. Thereafter, as the patient is moved through various stages of observation and treatment, his/her record is updated by the personnel responsible (e.g., laboratory technician, radiologist etc.).

Appropriate forms need to be designed for each entry point (reception, observation room, cashier etc.). Similarly, different reports need to be designed to present the required information to radiologists, finance, management etc. Management is also interested in receiving statistical reports (e.g., the most common reason for X-rays) (DivineKonection.info, 2010; Moore, 2011).

In future, the information system will have to be networked so that if a patient attends more than one center, the previous record is available irrespective the location. There will also be a central administration system for the purpose of making appointments and allocating technicians and radiologists. PRG intends to centralize all IT administration activities at the headquarters.

PRINS needs to have remote access facilities to patient records for radiologists as well as referral doctors. Through this facility, PRG intends to provide basic image processing facilities on X-rays (electronic versions) initially and advanced image-processing facilities in the future. Privacy of patients is of paramount importance. The radiologists who are the employees of PRG can have access to full medical history while referral doctors can have access to the records of their referral only when authorized. Proper access control procedures also need to be implemented so that

each authorized personnel can access only the information they require. For instance, cashiers should not have access to medical history.

Among other possible problems to solve, we need to consider whether to build an entirely new system or adapt components from the existing systems used in some centers. Considering the scale of the company's plans, it would be more appropriate to create a new system from the scratch (DivineKonection.info, 2010; Moore, 2011). It is important because PRINS must be scalable to be able to easily implement at new centers opened by PRG in the nearest future.

Latest research and publications analysis. M. Orlitzky, D.S. Siegel and D.A. Waldman (2011) review the concept of corporate social responsibility (CSR) and the related areas. R.R. Harmon and D. Haluk (2011) explore the idea of CSR in different fields of its application. D. Guthrie (2012) assesses positive and negative sides of CSR applied to the current situation in the US economy. Finally, A. Karnani (2010) provides the evaluation of CSR crisis.

Aims of the project. The main goal of the project is to create a state-of-art system that would solve the following fundamental issues: elimination of paper use from various processes in order to speed up them and make results more protected and reliable (and reduce paper use in day-to-day activities); expand the companies' activities in order to standardize the quality of services and speed up the process of diagnosis using the benefits of the new system (DivineKonection.info, 2010; Moore, 2011); make radiology services more affordable to different categories of population in order to provide people with inexpensive but quality services, prevent the development of serious diseases (cancer, for example) at early stages, and state its position as corporate responsible company (Orlitzky, Siegel and Waldman, 2011; Harmon and Haluk, 2011; Henderson, 2011; Karnani, 2010; Guthrie, 2012).

Research objectives of the project.

Business and financial aspects. First of all, we need to evaluate objectives of the future project in order to see how the proposed system contributes to PRG's objectives. It is clear that paper-based system is outdated and cannot be called scalable. Moreover, a slow and inconvenient tool cannot be used in the plans of the company to expand. Computer-based system is able to propose automation, speed of data transfer, centralized storing of various data etc. (Thompson, 2005; CIDB.org.za, 2010).

It means that one computer can replace many files stored and saved in a file cabinet size of a building. Therefore, implementation of computerized system will save costs for paper, storing facilities, and other related tools and needs. Another substantial advantage of computerized system is the opportunity to provide as many copies of patients' records, X-rays images, and other documents as possible, which is rather costly and difficult to do in the paper-based organization of documents (FAO.org, 2010).

In addition, scalability of the project and creation of one shared system for all existing and future centers of PRG will provide the company with substantial competitive advantage. The speed of operations will increase; the services' costs can be lowered due to the IS automation; the customers' satisfaction should increase substantially. All these benefits will lead to the increased number of customers; the presence in various locations will provide PRG with clients that will increase income. The market share of the company will grow. The only obstacle is the speed and quality of

PRINS development and implementation (Bryce, 2011; Thompson, 2005; CIDB.org.za, 2010).

The second point is about IS planning. We need to consider the following: which systems it will replace; and how it will affect the current systems or the systems planned for future implementation. Basically, PRINS will replace the existing system, which is outdated, old-fashioned, paper-based, slow, and inconvenient. In other words, new IS will replace the barely existing information system if paper-based operations can be called so today (Saxenam and Sodhi, 2010).

As for the impact on the current situation and system, such change will revolutionize the operations with documents and information within PRG and all regional centers of the company. PRINS will provide IS users and operators with opportunities to create, edit, store, and retrieve documents of any kind from the centralized storage; this data will be available for PRG personnel and referral specialists, considering privacy issues and concerns; it will help the company provide services of substantially higher quality; PRINS will allow clients of PRG have information on their medial records, X-ray images etc. at any location of PRG center, regardless the initial treatment center of each patient. Therefore, we can conclude that the implementation of new IS will have only positive effect on the current system and will improve it (Thompson, 2005; CIDB.org.za, 2010).

Technical aspects. As for the technical side of the project, we need to evaluate the following issues: Will the existing infrastructure be sufficient to support project implementation? What technical infrastructure is needed for system operation? Are the solutions strategies in alignment with the strategic IS plan? At first, it should be noted that the existing infrastructure is not ready for the implementation of the project. In fact, there has to be built a new IS infrastructure to make it possible for at least basic functions of the project to operate (FAO.org, 2010; King, 2006).

PRG has computers for word processing operations that are not connected anyhow. Therefore, there is no computer network and other related hardware necessary for PRINS installation and implementation. It is necessary to purchase hardware, such as servers, routers, network hardware, workstations etc. in order to create new infrastructure, install new workstations and storage capacities, centralized IT administration, etc. It is also necessary to install appropriate software on servers and workstations (operation systems, supplementary programs etc.), so that they would be able to support PRINS in full (Saxenam and Sodhi, 2010).

In terms of building a network and creating IT infrastructure, the following hardware and software should be acquired: servers (12 pcs) – with processor 2.6 GHz or higher, 8 M cache, memory of 4 GB or higher, storage capacity 10 TB or more; workstations (depends on the number of employees) – processors 1,6 GHz or higher, memory 2 GB or higher, storage capacity 320 GB or higher; routers and switches (10 pcs or as many as needed); printers (10 pcs); and other related peripheral hardware; Windows Server 2008 (12 copies); Windows 7 (depends on the number of workstations). The main server will require a purchase of the appropriate database management system (DBMS).

Therefore, the technical infrastructure needed to support system operations should be designed as follows: Headquarters of the company should be the center of IT administration and have main storage capacity, e.g. servers, backup servers etc.; it

should also have sophisticated and highly effective security system to protect the privacy of the clients' records, which is the cornerstone of the system; regional centers should have intermediate servers with current data available for being used by personnel as well as referral specialists outside; however, this data must not be accessible in the Internet to avoid security issues (Thompson, 2005; CIDB.org.za, 2010; King, 2006).

Intermediate servers should contain only the most up-to-date data to be transferred to the main storage at the headquarters. It is necessary to be organized in this way for the following reasons: the latest X-ray images and current updates in medical records of the patients should be stored for some time on the intermediate server of the regional center to be easily accessed by all interested parties, like radiologist, other specialists, and referral doctors; when this period expires, the data should be transferred to the main office of PRG for storing and archiving; it is the only appropriate way to have most up-to-date data available in short period and to keep medical record of the patients safe (Saxenam and Sodhi, 2010).

Such activities in terms of infrastructure creation (hardware and software acquisition, network organization etc.) are in perfect alignment with the general strategy of the company to expand and create new centers regionally. Only the interconnected, highly protected, and efficient system of data collection, processing, storing, and retrieval can help PRG provide its clients with new standard of high-quality services. Otherwise, the company's expansion plans would not be possible to fulfill (FAO.org 2010; Saradhi 2010).

Organizational aspects. In terms of organizational structure, PRINS will affect it as well. The current system is not appropriate for planned operations. Employees do not have skills and knowledge on the electronic documents management. They know how to create and keep records on paper. It is not sufficient to be effective users of computers in order to improve the operations efficiency. Therefore, we can conclude that the existing department structure is not sufficient to operate the new system. It needs to be rebuilt (Thompson, 2005; CIDB.org.za, 2010; TechnologyAwards.org, 2012).

It is also important to clearly understand what information the system will provide to different levels of management. Medical personnel will fill the forms with patients' information; radiologists and other specialists will make the appropriate notes on the results of X-rays and treatment course; management will be able to receive information on the statistics of the most common reasons for X-rays, the feedbacks from clients on the quality of services, the most frequently attended regional centers, and other statistical data.

All this data will create electronic database, stored on the main server in the central PRG office. It will make administration and protection of this data more productive and effective. Electronic tools to create, process, and store medical data of different kinds will make management information systems (MISs) (for different managerial levels) be as efficient as possible. Old paper-based MIS was not able to provide either quick search, or comparison, or other similar operations with papers, like the extraction of some particular data for quick reports, for example (Thompson, 2005; CIDB.org.za, 2010).

As it has already been mentioned, the current personnel will not be able to cope with new features, capabilities, and opportunities provided by PRINS. Therefore, it will be necessary to work in two directions regarding the personnel issue: the existing personnel must be retrained to be able to work in the new environment; and new people should be hired to cover the areas not exploited earlier – image processing software, automated reports creation, database management systems etc. (FAO.org; TechnologyAwards.org, 2012).

In order to retrain personnel, it is necessary to hire professionals in this area that will increase the costs of the project implementation. However, these expenditures are investment in this case – the personnel have no skills to use computers in full; the employees have no knowledge to develop these skills as it could have been possible in case of the previously utilized MIS of such kind. In addition, system administrators and other related personnel will be needed to get hired in order to design, create, develop, and implement absolutely new IT structure within PRG and its regional centers (Thompson, 2005; CIDB.org.za, 2010).

There is one more issue to consider: the company's image. Healthcare is rather conservative in terms of applying new technologies. However, IT has become an integral part of every part of our life. People got used to technologies everywhere around, so PRG as a trustworthy radiological center will only win from the implementation of new technologies. Customers would only be glad to see they are served in a quick manner, which is however, very effective and of high quality (Saxenam and Sodhi, 2012; TechnologyAwards.org, 2012).

Clients will focus on the procedures that should be performed as quickly as possible. They will not have to wait while their information will be added to paper form – everything will be entered into the computerized database by skilled professionals, finally, networking technologies will provide customers with an opportunity to avoid unnecessary duplication of data in case of visiting.

Feasibility analysis. The implementation of such kind of project will require expenditures for the following: salaries and other employment costs; consultancy services; and expenditures for different equipment (hardware, software etc.). Thus, salaries, bonuses, reformatting of units and departments, even termination of employment contracts in some cases will require extra money. Let us assume the following: 30% of staff involved in the processes of filling paper of different kind and not directly involved into medical care procedures will be dismissed. Therefore, dismissal payoffs will require expenditures (MindTools.com, 2010; Mo Adam, Rajiv and Sarv, 2004).

The rest of the employees will be retrained and should receive higher salary, which is costly as well. Consultancy services will be necessary for the entire development process and it will be the second most expensive part of the project. The first part is the purchase of equipment, such as servers, networking hardware, software packages, and, of course the price of PRINS (Thompson, 2005; CIDB.org.za, 2010).

Operational costs. Operational costs will include the following: the cost of any legacy conversion; training costs; recruitment costs; and purchase of additional equipment. It will be necessary to convert paper originals of medical records into electronic copies. Therefore, there will be a necessity to either pay extra money for special training and further work of employees or hire third party specialists to per-

form these operations (MindTools.com, 2010). Training of the personnel will be probably the most important part of the entire project implementation activities because if employees are not able to use PRINS in full, it will be cost ineffective and the project seems rather useless in such case (Thompson, 2005; CIDB.org.za, 2010).

Hiring consultants for each department will require substantial sums at the beginning of systems' functioning to provide all employees with necessary support. These consultants will have short-term contracts but their services will be rather costly. Additional equipment might be needed – mobile devices, like personal digital assistants, or something similar in order to improve the overall functionality of PRINS (MindTools.com, 2010). Finally, additional costs for operations should be planned to cover any emergencies of the training process. Table 1 summarizes all costs and presents the overall budget.

Table 1. Development and operational costs

Requirements	Number x cost, USD	Total cost, USD
Development costs		
Salary		
Programmers	5 x 10,000	50,000
Database designer	3 x 15,000	45,000
Interface designer	1 x 5,000	5,000
Team Manager	2 x 30,000	60,000
Other employees		50,000
Cost of equipment		
Software tools		15,000
Project Scope		1,000
Software Project Plan		2,000
Project Team Org worksheet		3,000
Cost Estimate Worksheet		2,000
Consulting Time Estimates		10,000
Performance Evaluation		1,000
Development Tool		2,000
Hardware		
Computers	100 x 500	50,000
Printers	10 x 1,500	15,000
Routers	10 x 1,000	10,000
Switches	12 x 700	8,400
Others		20,000
Operational costs		
Setup costs		
Cost of legacy conversion		30,000
Training	3 x 5,000	15,000
Purchase of equipment		15,000
Overall costs		374,400

Now, we need to forecast the cash flow to continue our evaluation. Due to such substantial expansion, the company expects rather substantial profits in 7 years. Therefore, Table 2 presents the forecasting of the cash flow.

Then, applying Net Profit and Return on Investment (ROI) techniques we can determine if the project is worth doing. Thus, Net Profit is equal to 125,600 USD, while the payback period is 7 years. We can calculate its ROI using the following formula: $ROI = 100 \times (\text{Average annual profit} / \text{Total investment})$. The, average annual profit is equal to 125,600 USD / 7, which would be 17,940 USD; $ROI = 100 \times (17,940 \text{ USD} / 374,400) = 4.8\%$. Interest and inflation will be determined in case we would

like to have less income now or more income later on. We assume that the annual interest rate should be 10%. Basing on previous calculations, we obtained the following results, presented in Table 3.

Table 2. Cash flow forecast

Year	Project CF, USD
0	-374,400
1	40,000
2	30,000
3	50,000
4	80,000
5	90,000
6	80,000
7	130,000

Table 3. Results

Year	Project CF, USD	Present value $v = (vt) / (1 + r)t$, USD
0	-374,400	-374,400
1	40,000	36363
2	30,000	27,272
3	50,000	45,454
4	80,000	72,727
5	90,000	81,818
6	80,000	72,727
7	130,000	118,181
Net profit		43,779

As for the risks that could be major obstacles for the successful completion of the project, we can outline the following issues: There are such risks of high importance as the inability of the software company to complete a project in full before the deadline, low quality of software, and low number of visitors due to bugs and flaws in the system in the first year of operations; among the risks of medium importance most likely would be expenses exceeding 10% of the planned sum and further maintenance issues.

However, the likelihood of high importance risks is rather low because the company-developer has experience in the field of medical software creation. The quality of the software will be under severe control due to the accuracy of the results it has to provide. As for the risk of not having enough visitors, the price policy of the company should solve this issue so it is very unlikely that it could happen after the system deployment and launch. It is unlikely as well that the overall price of the project will exceed 10% of the planned because estimated costs already include all possible issues and extra expenses. Therefore, due to the quality of the equipment of the software part of the project, the maintenance issues are moderate.

Envisaged benefits. The benefits of the project fall into the categories of direct, secondary, and intangible (Mutt, 2010; Rampur, 2010). Therefore, direct benefits of the project are as follows: despite the expenditure for dismissal payments needed to shorten the quantity of personnel and increased salaries, the efficiency of the employees will increase substantially (one person will be able to perform the previous duties of 3 people, at least) and it will decrease the overall expenditures for salary; PRG personnel will be able to serve more clients than before and it will increase income as

well; electronic record keeping will provide referral doctors with the opportunity to assess the situation remotely that will substantially decrease the overall costs of services; the image of the company will improve due to the ability to provide services of higher quality and it will attract more customers to the medical centers of RPG (Thompson, 2005; CIDB.org.za, 2010; Mutt, 2010).

The following benefits can be addressed as secondary ones: employees will be able to automate routine procedures and thus, decrease the number of possible errors that will lead to the cutting costs for their correction (extra paper, new forms, law suits etc.); remote access to the database will provide responsible employees with opportunity to work with records regardless their physical location; centrally stored patients' medical records are much easier to be protected and kept safe; changes to PRINS will be substantially easier to implement in case of necessity, comparing with paper-based record keeping system (MindTools.com, 2010).

Intangible benefits are long-term however, they can be rather important as well: The need in new employees because of the turnover will decrease eventually and it will decrease the expenditures for recruitment and training; quality services, provided by PRG will attract new clients to their centers across the country; people will know that this company not only provides services of high quality but is also available in different regions and thus will recommend it as a reliable partner for cancer diagnostics. Finally, further improvement of PRINS will allow the company to develop and implement new ways of providing clients with their services, like remote diagnosing, consulting etc. (Thompson, 2005; CIDB.org.za, 2010).

Conclusions. The PRINS implementation project is vital for the future development of the "Radiology Associates P.C." subsidiary – "Primary Radiology Group". The project is going to be financed by Kuwait Gulf Bank as it is interested in the development of such projects, valuable for society. Therefore, it is necessary to carefully consider technical, economic, and organizational issues during the development of the project to make it effective for PRG. The project will allow the company complete its major objectives: elimination of paper use in various processes to speed them up and make results more protected and reliable (and reduce paper use in day-to-day activities); expand companies' activities in order to standardize the quality of the services and speed up the process of diagnosis using the benefits of the new system; make radiology services more affordable to different categories of population in order to provide people with inexpensive but quality services, prevent the development of serious diseases (cancer, for example) at the early stages, and state its position as a corporate responsible company; the benefits for the company in terms of future profit are also clear and undisputable: the project cost is 347.000 USD; the implementation of the project will decrease the use of paper, speed up the processes within the company and thus, increase the number of potential clients; it will make it affordable for lots of people and substantially improve the corporate responsibility image of the company at the market. In perspective the company should dominate at the targeted market.

The PRINS implementation will improve the company's image; allow gaining competitive advantages and increase its market share; finally, it will improve not only customer satisfaction but the efficiency and satisfaction from work among personnel.

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