The Implementation of Business Process Reengineering: A Case Study of Roadway Incident Data Management

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Abstract

The Inter-City Motorway Division at the Department of Highways is responsible for 146 km of Thailand's motorway network. Originally at the Inter-City Motorway Division, the process of roadway incident documentation and reporting was done manually. The incident data was collected and recorded on an incident report form by the patrol officers on-site. At the end of the week, these data were gathered and transcribed into a spreadsheet. A summary report was then written and submitted to the executives. This process is rather inefficient due to the need for reentering the data, the possibility of human error in transcribing the data, the time lag in report production, and the lack of summary reports which are easily comprehensible and up-to-date. Thus, to overcome the limitations and the inefficiencies of the paper-based process, the Inter-City Motorway Division decided to reengineer the roadway incident data collection and reporting process. This paper documents a case study of the Inter-City Motorway Division in employing Business Process Reengineering technique on its roadway incident documentation and reporting process. The reengineering process included five activities namely (a) Prepare for reengineering, (b) Map and analyze as-is process, (c) Design to-be process, (d) Implement reengineered process and (e) Improve continuously. The new reengineered process involves the use of handheld computers or personal digital assistant phones to collect incident data on-site, a web-based database to store the data, and a web application to manipulate and analyze the data. A summary report can be produced for the executives at any time when needed. The detail of the new mobile platform for roadway incident documentation and reporting, and the plan for future work are also given.

Keywords: Business Process Reengineering, Handheld Computers, Web-based Database

1. Introduction

The Inter-City Motorway Division at the Department of Highways is responsible for two major toll roads: Motorway Route 7 and Motorway Route 9.

Motorway Route 7 is an inter-city motorway connecting Bangkok to the Eastern Region of Thailand. The toll section under the responsibility of the Inter-City Motorway Division is 82 kilometers long. It begins at Srinakarin Road in Bangkok and goes in a southeast direction towards Chonburi Province.

Motorway Route 9 is part of the Outer Ring Road connecting the outer fringes of Greater Bangkok. The Ring Road is divided into three sections; namely the Western Outer Ring Road, the Eastern Outer Ring Road and the Southern Outer Ring Road. The toll section under the responsibility of the Inter-City Motorway Division is the Eastern Outer Ring Road. It spans 64 kilometers north-south beginning at Bangpa-in in Ayutthaya Province and terminating at Bangplee in Samutprakarn Province. The Southern Outer Ring Road is also a toll road under the Expressway Authority of Thailand's responsibility. Fig. 1 shows the Motorway networks under the responsibility of the Inter-City Motorway Division.

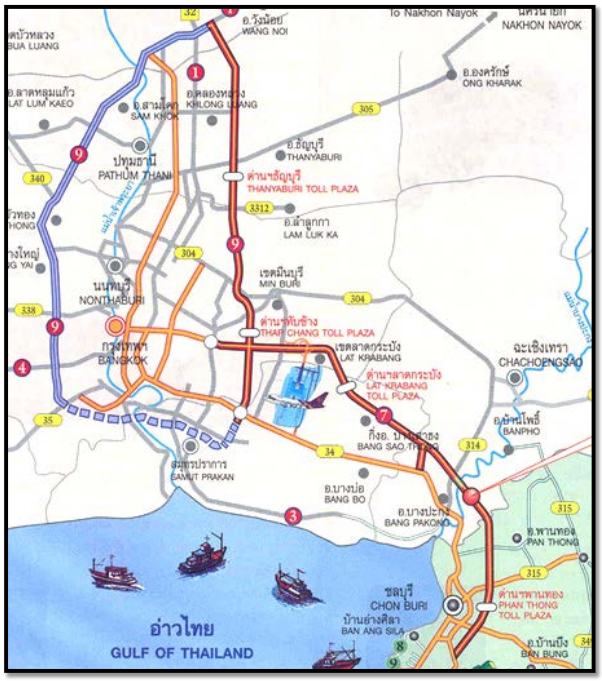

Fig. 1 Motorway network under the responsibility of the Inter-City Motorway Division

With the total length of 146 kilometers and the Annual Daily Traffic (ADT) of over 150,000 vehicles in some sections, an efficient roadway incident management program can help reduce incident-related congestion and avoid secondary crashes. The first step towards developing an efficient roadway incident management program is to establish good management of incident data with a proper technology and allowable budget. This data can be used, for example, to design the distribution of patrol vehicles on the motorway network, to assess the impact of areas under different

incident scenarios, or to identify hazardous locations for road safety improvement programs.

Originally at the Inter-City Motorway Division, the process of roadway incident documentation and reporting was done manually. The incident data was collected and recorded on an incident report form by the patrol officers on-site. At the end of the week, these data were gathered and transcribed into a spreadsheet. A summary report was then written and submitted to the executives. This process is rather inefficient due to the need for reentering the data, the possibility of human error in transcribing the data, the time lag in report production, and the lack of summary reports which are easily comprehensible and up-to-date. Thus, to overcome the limitations and the inefficiencies of the paper-based process, the Inter-City Motorway Division decided to reengineer their roadway incident documentation and reporting process.

This paper documents a case study of the Inter-City Motorway Division in employing Business Process Reengineering on its roadway incident documentation and reporting process.

The paper is divided into a number of sections. Section 2 provides a literature review in Business Process Reengineering. It outlines the concept of Business Process Reengineering, discusses the relationship between Business Process Reengineering and Information Technology, and presents a brief overview of Business Process Reengineering in public sector. Section 3 documents how the Inter-City Motorway Division went about reengineering its roadway incident documentation and reporting process and describes a new mobile platform for roadway incident documentation and reporting. Section 4 concludes the paper.

2. Literature Review

2.1 Business Process Reengineering

For almost a decade, business process reengineering (BPR) has been embraced as an effective tool to implement changes to make the organization more efficient and effective. Several experts have provided their own interpretation of BPR. For example, Hammer and Champy [1] defined BPR as the fundamental rethinking and radical redesign of organizational processes to achieve dramatic improvements of current performance such as cost, quality, service and speed.

Other authors such as Davenport and Short [2] have depicted BPR as the analysis and design of workflows and processes within and between organizations. These experts touted BPR as the next revolution in obtaining breakthrough performance via process improvement.

2.2 Business Process Reengineering and Information Technology

Information Technology (IT) plays a crucial role in BPR and is considered by many as an essential enabler [3]. Processes can be automated and fundamentally restructured to take advantage of enormous efficiencies in information gathering, storage, processing, retrieval and presentation. In the leading edge practice, the relationship between BPR and IT is rather recursive i.e. each is the key to thinking about the other. Thinking about IT should be in terms of how IT can support business processes and thinking about BPR should be in terms of how business processes can be transformed using IT [2].

2.3 Business Process Reengineering in Public Sector

In Thailand, Office of the Public Sector Development Commission (OPDC) has encouraged public sector to continually integrate process-oriented concept and information technology to improve their processes and procedures. OPDC supported the initiation of a blueprint for change in public sector focusing on improvement of work efficiency and quality of service. In improving work efficiency and quality of service, the public sector must reflect its internal situation. Current work processes must, therefore, be analyzed to see whether there is a strategic gap or not and which processes need to be improved or redesigned. This then will lead to changes in different aspects such as work processes, technology, tasks allocation and personnel. To ensure public benefit, all public sectors were expected to reduce its work processes by 30% - 50%, starting from 3 to 5 main working processes at the beginning and extending to the whole processes [4].

In order to modernize the public sector by applying IT in improving work efficiency, it is necessary to utilize e-government as an enabling tool to move toward a knowledge-based society. Thai government has launched many e-government initiatives, i.e. smart card, e-auction, e-passport, and GFMIS (Government Fiscal Management Information Systems). In 2002 the Thai cabinet had the resolution that every department and state enterprise must procure through e-auction to improve the procurement process in the public sector in order to (a) protect collusion and corruption, (b) reduce the cost of procurement, (c) increase efficiency, and (d) stimulate investment and economy. The government utilizes GFMIS to build a comprehensive integrated computerized fiscal system to best serve the government, citizens and investors. This system is a computerized database covering all activities related to the public finance sector, i.e. budgeting,

procurement, financial and accounting, cost, and personnel systems. It is expected to provide smooth automatic flow of information between the Ministry and its departments, and between the Ministry and other ministries [5].

3. Case Study of Inter-City Motorway Division

In this section, we describe how the Inter-City Motorway Division went about reengineering its roadway incident documentation and reporting process. According to the literature, a number of BPR methodologies have been proposed (e.g. [2], [6], [7], [8], and [9]). In our study, we adopted a methodology proposed by Muthu et al [10] as it provides a consolidated and systematic approach to the reengineering process. The methodology includes five activities: namely (a) Prepare for reengineering, (b) Map and analyze as-is process, (c) Design to-be process, (d) Implement reengineered process and (e) Improve continuously. The next sections present the detail of each activity.

3.1 Prepare for Reengineering

Planning provides the context for developing a process vision, which is the fundamental driver of all improvement efforts. Planning also determines the measures and critical success factors that will be used to evaluate the success of improvement projects. The principal benefit of the planning stage is that the reengineering teams begin their work with a clear understanding of their mission and an idea of what successful performance will look like [9].

In our case, the executives and the management staff at the Inter-City Motorway Division were very well aware of the issues and the shortcomings of the existing roadway incident data collection and reporting process and provided full support for the reengineering process. A cross-functional team comprising traffic engineers, patrol officers, management staff, consultants and IT experts was established with a clear vision for the reengineering. Its vision was to redesign the process of the roadway incident data collection, documentation, and reporting and to develop a system that can be used to record, store, process, retrieve, and present the incident data efficiently and effectively. After the reengineering, the executives and the management staff should be able to access the most up-to-date historical incident information whenever they want.

3.2 Map and Analyze As-Is Process

In BPR, one of the most difficult and crucial steps is to identify and describe current process. This as-is analysis phase of BPR is aimed specifically at identifying disconnects (i.e. anything that prevents the process from

achieving desired results) and value-added activities within existing business processes [9].

Several methods can be used to study the current process. In our case, the study of as-is process was done through document studies, semi-structured interviews and direct observations. The document studies provided the reengineering team with good materials for the preparation of semi-structured interviews and direct observations. During the interviews, each patrol officer and data entry operator was individually interviewed and asked to describe their data collection and recording process. The reengineering team also rode with the patrol officers on duty to observe their work demands and their actual work process. The insights gained during the interviews and observations were also used to direct further document studies.

In our case, the as-is process can be described as follows. In the case of accidents, the patrol officers will attend the scene and provide their assistance. Then, they will collect the accident data and record it on a one-page highway accident report form. In the case of stalled vehicles, they will attend the scene and provide their assistance; and then they will collect the information on location, date and time, the detail of the assisted vehicle, and the cause of vehicle breakdown. During the direct observations, it was found that not every field in the form was filled in. This thus leads to incomplete and inaccurate data.

At the end of the week, these forms were given to the data entry operators at the main office and then the data were transcribed into a spreadsheet. A summary report was then written and submitted to the executives.

As one can see, the as-is process is rather inefficient. First, there is a need for reentering the data. Second, the quality of the incident data may be affected by human error in transcribing the data. Third, the time lag between the incident and the report production is very large. Fourth, the summary reports need to be prepared manually every week. Lastly, there is a lack of summary reports that are easily comprehensible and up-to-date at a point of need. All of which were identified as disconnects in the existing process.

3.3 Design To-Be Process

The goal of to-be process design is to produce an alternative to the current situation, which proposes desired outcomes of process. In our case, the desired outcome is that the executives and the management staff are able to access the most up-to-date historical incident information whenever they want. In order to achieve this desired outcome, we needed to

improve both the incident documentation process in the field and the incident reporting process in the main office. The reengineering team used the recursive approach in designing the to-be process. We thought about how IT can support this two work processes and also how these two work processes can be transformed using IT. A number of IT solutions were purposed to eliminate the disconnects identified in the previous section and to improve the work processes. These included the use of handheld computers to collect the incident data on-site, a web-based database to store the data, and a web application to manipulate and analyze the data. The to-be process was then designed as follows.

First of all, there are 3 groups of users in the to-be process i.e. the patrol officers, the system administrators, and the executives and management staff. After the patrol officers attend the scene and provide their assistance, they will collect the incident data and record it using a Personal Digital Assistant (PDA). At the end of the day when they are back in the office, they will synchronize the PDA with the office pc and transfer all the incident data to the central database in the remote server. At this point, the patrol officers can verify the data, make additional changes and upload the photos to the central database via a web-based application. This new process will eliminate the first and the second disconnects identified in the previous section. The executives and the management staff can also use the web-based application to access the most up-to-date historical information in the central database and to generate a summary report. The implementation of the web-based database and the web-based application will eliminate the third, the fourth and the fifth disconnects identified in the previous section. The system and the database will be maintained by the system administrators.

The roadway incident documentation and reporting system was then developed to support this to-be process. The system is composed of 3 major components: the PDAs, the central server and the Office PCs. The PDAs are used to collected incident data from the field. The data collection component in the PDAs was written using .NET to provide a windows-like Graphical User Interface (GUI). The database at the central server was implemented using MySQL database. The Office PCs are used not only to synchronize and transfer the data from the PDAs to the central server, but also to manipulate and to generate a summary report. The web-based application which is used to manipulate and generate a summary report was programmed using PHP language. The architecture of the proposed system is illustrated in Fig. 2.

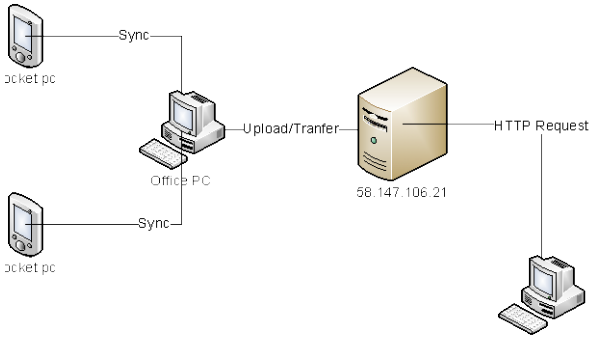

Fig. 2 Architecture of the proposed system

3.4 Implement Reengineered Process

After the to-be process has been designed, the next step is to implement it into the organization. The implementation stage is where reengineering efforts meet the most resistance and hence it is by far the most difficult one. Thus a transition plan must be developed.

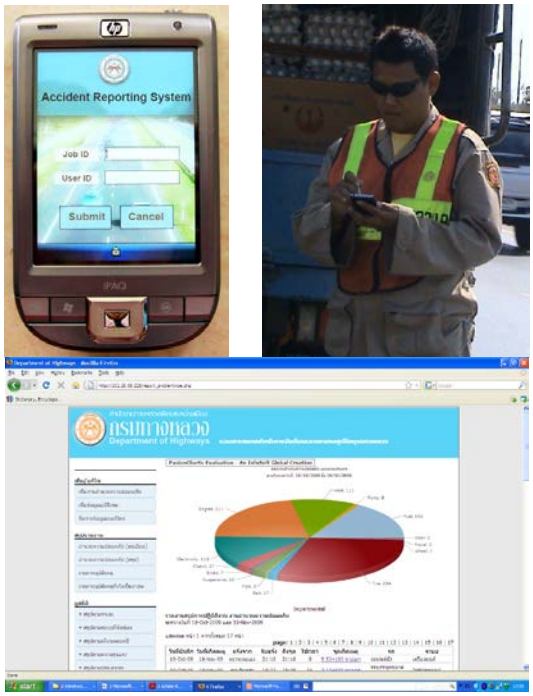

Fig. 3 PDA's Log on screen, the system at work and the screen of the web-base application

In our case, before implementing the reengineering process, extensive tests including the software testing and the user acceptance testing were conducted. Training was also given to all 3 groups of users emphasizing on the importance of the reengineering. Fig. 3 shows the PDA's log on screen, the system at work and the web-based application.

3.5 Improve Continuously

BPR can be continuously involved in any organization for better performance. For the organization to continue to survive and thrive, it must incorporate BPR as a corporate philosophy and tradition to adapt to the changing environment as the fact that it is very dynamic. BPR as an organic discipline must continue to grow as lessons are learned from its practice and information technology continues to evolve.

In our case, after the implementation phase, the reengineering team also kept monitoring the performance, the level of acceptance and the attitude towards changes of the staff. The results of the monitoring will be used for the next phase of the reengineering.

With regards to the evolving information technology, the reengineering team is aware of the shortcomings of the current system. One of which is that the incident data are transferred to

the server at the end of the day when the patrol officers are back at the office.

In the future system, the incident data from the PDAs will be sent to the server immediately. This would enable real-time communications and could pave a way towards the development of an incident management supporting system. In addition, Short Message Service (SMS), Google map and a decision support system for accident analysis will also be integrated into the system to enhance its functionalities. SMS will provide a coordination functionality i.e. SMS will be sent to the Variable Message Sign (VMS) operators automatically to alert them when there is an incident, while Google map will provide a visualization of the incident data. The architecture of the future system is illustrated in Fig. 4.

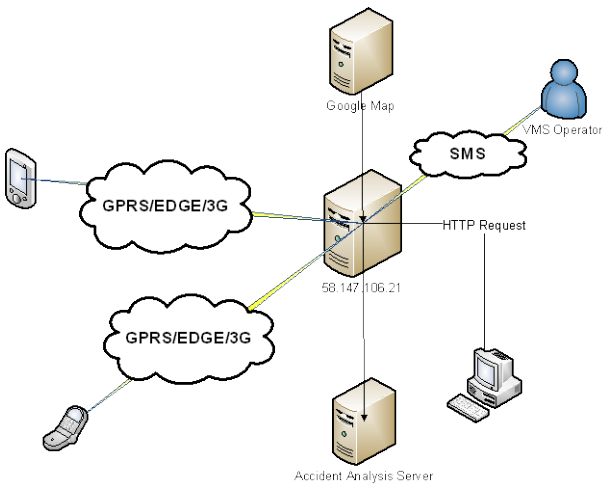

Fig. 4 Architecture of the future system

4. Conclusion

This paper documents a case study of the Inter-City Motorway Division in employing BPR technique on its roadway incident documentation and reporting process. The adopted reengineering process included five activities namely (a) Prepare for reengineering, (b) Map and analyze as-is process, (c) Design to-be process, (d) Implement reengineered process and (e) Improve continuously. At the end of the reengineering process, the process of roadway incident documentation and reporting at the Inter-City Motorway Division has been transformed from an inefficient paper-based one to a more computerized and efficient one. The key factors to the success of BPR at the Inter-City Motorway Division can be summarized as follows:

- The executives were very well aware of the shortcomings of the existing process and provided full support for the BPR
- The reengineering team comprised of not only the consultants but also the people who will actually do the work. This thus made BPR more acceptable.
- The IT experts were part of the reengineering team from the start.
- The reengineering team had a clear vision of the reengineering.

- A transition management was done before the implementation phase. Constant communications with the staff were also maintained throughout the reengineering process.

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