Simulation Modelling to Assess the Added Value of Electronic Commerce

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Abstract

One of the major challenges that companies faces today is meeting increasing customer expectations. The Internet enables companies of all sizes to develop new online business models, which means improving and altering the ways in which companies operate and interact with business partners, customers and suppliers. The paper stressed the necessity for introduction of new business processes and/or renovation of existing business processes in the context of global information connectivity.

It is acknowledged that developing dynamic models of business processes prior to their change can contribute towards more successful Business Process Reengineering (BPR). Simulation has an important role in modelling and analysing the activities in introducing BPR since it enables quantitative estimations of influence of the redesigned process on system performances.

This paper presents a methodology that responds the needs of enterprises in their BPR projects. An example of Web-based retail process modelling using simulation tool Optima is presented. The main goal of the paper is to investigate some of the potential benefits and outcomes of introducing new processes that could be assessed in advance by using simulation modelling.

I. INTRODUCTION

E-business dramatically and strategically changes traditional business models. Companies are now pursuing more intensive and interactive relationships with their business partners: suppliers and customers. Competitive conditions and pressures on global market are forcing companies to search for strategies of streamlining the entire value chain. To compete effectively, companies must structurally transform its internal and external processes. These goals could be reached by simultaneous renovation of business processes and implementation of electronic business solutions.

Business Process Reengineering (BPR) is an organizational method demanding radical redesign of business processes in order to achieve more efficiency, better quality and more competitive production [5]. BPR has become one of the most popular topics in organisational management creating new ways of doing business [10]. Many leading organisations have conducted BPR in order to improve productivity and gain competitive advantage. However, regardless of the number of companies involved in re-engineering, the rate of success of re-engineering projects is less than 50% [5]. Some of the frequently mentioned problems related to BPR include the inability to accurately predict the outcome of a radical change, difficulty in capturing existing processes in a structured way, shortage of creativity in process redesign, the level of costs incurred by implementing the new process, or inability to recognize the dynamic nature of the processes.

The main objective of the paper was to develop a simple simulation model of Web-based retail business process that could be used to evaluate the potential benefits and constraints of a BPR project. A brief overview of e-business renovation strategies and their evaluation is presented in Section 2. Simulation modelling tool Optima is described in Section 3. An example of modelling retail processes is provided in Section 4. The applicability of simulation modelling and evaluating alternative business process strategies is investigated. Finally, Section 5 outlines the main findings of this research and provides concluding remarks.

II. ASSESSING THE BENEFITS OF E-BUSINESS IMPLEMENTATION

An e-business model generally means the adoption of company's current business model to the Internet economy. Main purpose of developing and analysing business models is to found revenue and value generators inside reversible value chain, or business model's value network. BPR in 90-s has been focused on internal benefits such as cost reduction, downsizing of company and operational efficiency which are rather tactical then strategic focus. Nowdays, e-business renovation strategies put their focus on the processes between business partners and the applications supporting these processes. These strategies are designed to address different types of

processes with the emphasis on different aspects /9; 6/: customer relationship management (CRM), supply chain management (SCM), selling-chain management and enterprise resource planning (ERP).

It is well known that e-business might bring several advantages to the company. However, existing practical business applications have not always been able to deliver the benefits they promise in theory. Prior to adopting e-business, companies need to assess the costs needed for setting up and maintaining the necessary infrastructure and applications and compare it with the expected benefits. Although the evaluation of alternative solutions might be difficult, it is essential in order to reduce some of the risks associated with BPR projects.

Simulation has an important role in modelling and analysing the activities in introducing BPR since it enables quantitative estimations of influence of the redesigned process on system performances [2; 11]. Simulation of business processes represents one of the most widely used applications of operational research as it allows understanding the essence of business systems, identifying opportunities for change, and evaluating the impact of proposed changes on key performance indicators. The design of business simulation models that will incorporate the costs and effects of e-business implementation and will allow for experimentation and analysis of alternative investments is proposed as a suitable tool for BPR projects. Some of the benefits can be directly evaluated and predicted, but the others are difficult to measure (intangible benefits). Some of the intangible benefits might be (as observed in several case studies in Slovenian companies that have introduced e-sales): improved image of a company as a whole, increased market share[1] and increased customer satisfaction. This research investigates some of the benefits and outcomes of introducing new processes (time and cost savings, workload reduction and increased throughput) that could be measured in advance, by simulation modelling.

III. BUSINESS PROCESS MODELLING AND SIMULATION USING OPTIMA

Process modelling is one of the most cost-effective and rewarding ideas to come along in years. Many different techniques can be used for modelling business processes in order to give an understanding of possible scenarios for improvement [8], Flowcharting, IDEF0, IDEF3, Petri Nets, System Dynamics, Knowledge-based Techniques, Activity Based Costing and Descrete-Event Simulation are only some examples of business process modelling techniques widely used [4]. There are also many software tools on the market that use these modelling techniques. According to Curtis at al [3], a modelling technique should be capable of representing one of more of the following modelling perspectives: *functional* (represents what activities are being performed), *behavioural* (represents when and how activities are performed), *organizational* (represents where and by whom activities are performed) and *informational* (represents the informational entities – data). Deeper analysis of simulation modelling techniques suggests that these are suitable to address at least the functional, behavioural and organizational perspectives [1] .

This study presents Optima [7] (Micrographix) software as a suitable tool for process mapping and simulation modelling in BPR projects. An activity is an individual step of a process map presented as a symbol in a flowchart. Each activity can set or determine the following information: *inputs*, *resources* (an activity can use several resources or more than one kind of resource simultaneously), *task* (the task information covers the duration that the activity takes to complete, its associated costs, activity base, and schedule) and *outputs*. Modelling elements are connected with links that describe the process flow. Each activity is placed in one or more departments that represent an organizational unit that performs these activities.

IV. SIMULATION MODELLING OF RETAIL PROCESS

Processes directed at the customers and the satisfaction of their needs are considered to be the basic processes of every business, and especially retail sales. The retail business is the broadest form of commercial activity and we can define it as sales of smaller quantities of goods and/or services to the end consumer for his personal, non-commercial consumption. The increasingly complex conditions of retail business create the need for constant advances in the retail process and increasing productivity so as to become more successful in relation to the competition. Starting with the objectives of modernising the retail business process it is possible to re-define scenarios of existing retail processes.

This study refers to a business change effort undertaken by a virtual company that performs catalogue sale over the telephone. Some interviews in the Slovenian companies that have introduced Web-based retail process were carried out in order to evaluate the costs and benefits of e-commerce implementation. In order to separate the introduction of e-retail from the informatization of the process it was assumed that the company already had implemented integrated information system. It was also assumed that the delivery channel had been developed and no further improvements were needed. *In the first step* of the research, "AS-IS" model was developed (Figure 1). The retail process was performed in two departments: Sales and Warehouse. Ten employees worked on this process: 4 sellers and 6 warehousemen. Seller's hourly rate

[1] In many cases, as observed through Slovenian case studies, customers find and select a product in web-stores and then buy it later in traditional (physical) stores.

was 10 EUR and warehousemen's 7 EUR. The details about activities are presented in Table 1.

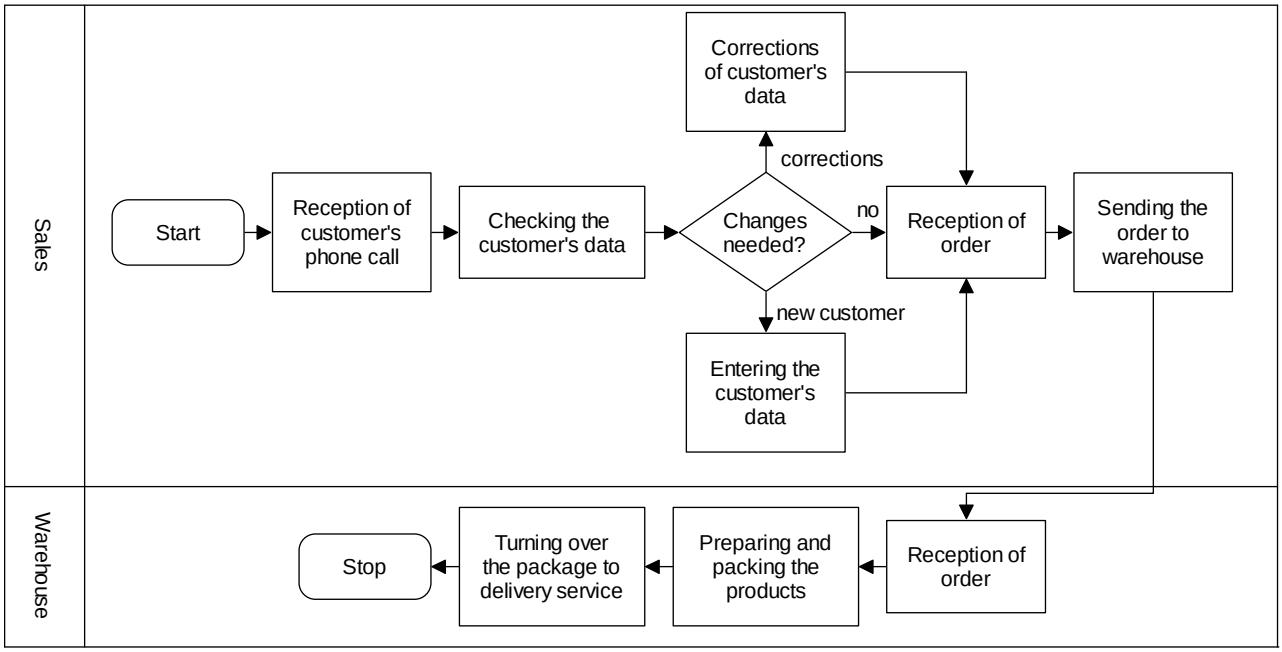

Figure 1: Existing process (AS-IS model)

Activity	**Time**	**Resources**
Reception of customer's phone call	10 s	Seller
Checking the customer's data	1 min	Seller
Corrections of customer's data	1 - 3 min	Seller
Entering the customer's data	5 min	Seller
Reception of order	2 - 10 min	Seller
Sending the order to warehouse	5 s	Seller
Reception of order	1 - 3 min	Warehouseman
Preparing and packing the products	5 - 15 min	Warehouseman
Turning over the package to delivery service	30 s	Warehouseman
Decision	**Outputs**	
Changes needed?	Corrections (20%), new customer (30%), no (50%)	

Table 1: Activities in AS-IS model

The simulation of *six months* was performed and the report has shown very realistic results: 23400 transactions were executed, average cost of the transaction was 2.98 EUR, resource utilization was 86% for sellers and 76% for warehousemen, while total costs of labour for this model were 69,732 EUR.

The results of the analysis were used in *the second phase* of this research, as the basis for introducing new on-line business model of the retail business process ("TO-BE" model). It was assumed that the company would offer the e-retail additional to telephone sale.

In the improved model the total number of orders remained the same, but 10% of orders was performed by the Internet. The results of the simulation showed that the average cost of the transaction was lower (2.84 EUR). The resource utilization for sellers was lower (78%) and remained the same for warehousemen (76%) while the total costs of labour for the period of six months were decreased by 3,276 EUR. As the interviewed companies reported that the total costs of development of web-based retail were between 15,000 EUR and 20,000 EUR, the results of the redesigned simulation model showed the investment would pay out in two to three years.

In *the third phase* the input parameters of "TO-BE" model were changed. According to the experiences of Slovenian companies, the number of telephone orders was reduced a little, but the total number of orders was increased by 10%. The obtained results for the same period were as follows: 26000 transactions (3446 Internet orders and 22554 telephone orders), average cost of each transaction 2.78 EUR, resource utilization 83% for sellers and 87% for warehousemen.

The models were analysed and compared according to the profits (Table 2). The results of the comparison showed

that the investment would pay out in six months or even sooner (the profit of the third model was increased by 23,452 EUR). The introduction of e-retail brings additional work to the employees, especially to the IT staff and sellers (about two hours of additional work daily for one of the sellers), but according to the evaluation of interviewed companies it could be done with the existing resources (since the utilization of the sellers in the model was about 80%, existing resources could do the additional work).

Duration of the simulation		6 months	
Average value of the order		60 EUR	
Average income per order (income = difference betweeen costs of aquisiton and value of the order)		10 EUR	
Employees	Number	Hourly rate	
Seller	4	10 EUR	
Warehouseman	6	7 EUR	
	AS-IS m.	**TO-BE m. 1**	**TO-BE m. 2**
Number of transactions	23400	23400	26000
Number of tel. orders	23400	21239	22554
Number of Internet orders		2161	3446
Costs of each transaction	2.98 EUR	2.84 EUR	2.78 EUR
Total costs	69,732 EUR	66,456 EUR	72,280 EUR
Total income	234,000 EUR	234,000 EUR	260,000 EUR
Total profit	164,268 EUR	167,544 EUR	187,720 EUR
Lower costs		3,276 EUR	
Greater profit		3,276 EUR	23,452 EUR
Resource utilization			
Seller	86%	78%	83%
Warehousemen	76%	76%	87%

Table 2: . The comparison of all three models

V. CONCLUSIONS

Survival and growth of enterprises in current market conditions demands constant modernisation of the business processes. One of the ways to accomplish these goals is BPR using additional features included in simulation modelling methods. In this research a "prototype" of the e-retail model was developed using Optima process maping and simulation tool. The costs and benefits of the e-commerce implementation were analyzed and different scenarios were compared. Business process modelling and discrete-event simulation proved to be valuable mechanisms for realising the real business value of Web-based retail. A real-life case study should be explored through further research in order to evaluate the added value of electronic commerce.

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