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The Evaluation of Investments in Electronic Commerce

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Abstract

The decision to adopt inter-organisational Electronic Commerce (E-Comm) applications may have unforeseen consequences for the firms involved. It should therefore be taken only after careful consideration of possible implications and pitfalls. In this paper we present a real-life case study of E-Comm investment evaluation, where computer-based models of the business processes to be supported by E-Comm were developed. The models were then dynamically simulated to assist the companies involved in gaining insight on the real benefits and dangers associated with the planned business change.

Introduction

Despite the E-Comm market's steady growth over the last years, existing practical applications have not always been able to deliver in practice the business benefits they promise in theory. This has naturally resulted in lower adoption rates than initially expected.

One of the main reasons that may explain the reluctance of organizations to adopt E-Comm may be the significant amount of organizational change required for the successful employment of radically innovative ways for carrying out business operations. Indeed, E-Comm applications have been identified as bearing a close resemblance to Business Process Re-engineering (BPR) efforts. Organizations cannot be expected to embark upon such programs of radical change without first establishing a sound business case for the investments involved. E-Comm applications may account for significant expenditure, especially for small and medium firms (hardware, software, telecommunications, training, etc.).

The primary thesis of this paper is that the main benefits an organization can gain from E-Comm are inherently qualitative and cannot be easily assessed *a priori* and be expressed in monetary terms. There exists a need for developing mechanisms that will help organizations realize the real business value of E-Comm applications and overcome this problem of *measurement*. We will report on a real-life case study where discrete-event simulation models of business processes were developed to assist two companies in realizing the expected impacts of EDI on key business performance indicators. Although the study focuses on EDI evaluation, there is no reason to indicate that the same approach cannot be employed for other E-Comm applications as well (e.g. WWW-based applications). Indeed, the principles of the approach and the methodology can be used for evaluating any type of inter-organizational Information System investment.

E-Comm Investment Evaluation

In order to evaluate their Information Technology investments (including E-Comm applications), most companies will use simple accounting techniques, notably cost-benefit analysis (CBA) or Return on Investment (ROI). However, when trying to apply any of these financial techniques for assessing E-Comm, one of the main problems will be the difficulty of assigning monetary estimates to the intangible, indirect, and strategic benefits typically associated with E-Comm. One way to overcome this problem of measurement is to employ some quantitative technique that will allow for studying the business processes affected by E-Comm. The underlying notion behind this argument is simple. E-Comm investments do not usually constitute an end in themselves, but are generally part of a wider business reorganization in which E-Comm plays a specific role (significant or otherwise). In such cases, it is important that the investment in the wider business change is evaluated and not the IT investment alone.

Discrete-event Business Process Simulation (BPS) offers a theoretically attractive mechanism for modeling and studying complex phenomena in quantitative terms. Simulation of business processes constitutes one of the most widely used applications of operational research. Indeed, simulation models have been used in various practical BPM applications, even for E-Comm and multi-organizational modeling. Taking the idea of BPS a step further, we propose the design of business simulation models that will incorporate the effects of IT applications (such as E-Comm) in models and will allow for experimentation with and analysis of alternative investments. The research hypothesis tested in this paper is that "dynamic business process models can effectively support informed evaluation of E-Comm investments by providing decision-makers with quantitative data on the expected impact of a given investment on business performance."

The Case Study

The study refers to a business process improvement effort jointly undertaken by two collaborating organizations: a major pharmaceuticals company (henceforth referred to as “ABC S.A.”) and one of the regional distributors of its products (a company we will call “XYZ Ltd.”). Due to the special nature of the health care business and the subsequent urgency of most customer demands, XYZ has to operate within strict deadlines regarding deliveries. Each order has to be fulfilled within 48 hours from the time the products have been requested by a customer. However, it has been noted that this target is virtually never met in practice. Preliminary discussions were held between the two companies and it was agreed that the problems seemed to be arising from inefficiencies in the (shared) Order Fulfilment Process (OFP). It was therefore decided to examine the potential of introducing EDI to support exchange of data between the firms. However, such a change would necessarily involve significant expenditure for both firms. The main problem was to evaluate the magnitude of benefits that could be achieved by the proposed change in order to assess whether it would surpass the associated investment costs. It was decided to pursue a more in-depth study of the processes and to employ Business Process Modeling and Simulation.

Business Process Model Development

A four-phase approach was followed for modeling and analyzing the processes under consideration. The approach is presented in Figure 1.

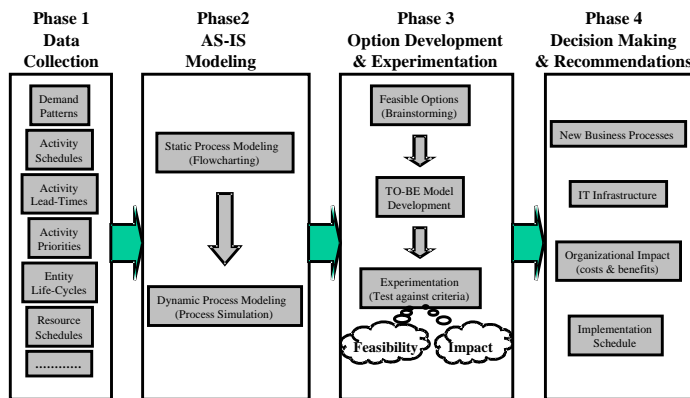


Figure 1. The Four-Phase Modeling Approach

Interviews with key process participants of both companies were conducted in order to capture the essence of the process under consideration and decompose it into its component activities. An initial static process model was developed (using an off-the-shelf Business Process Modeling software package) to depict the activities within the OFP. The static model is depicted in Figure 2.

Next, the model was populated with quantitative process data. The resulting dynamic model was validated and run for a (simulated) 6-month period. The results from the simulation run are summarized in Table 1 (only the key performance indicators are included due to space constraints). It is clear that the existing processes are far from producing results within the stated management targets. For example, orders are fulfilled in around 60

hours, while backorders need an average of nine days to reach the customers and invoices need more than 11 days to be delivered. It is worth noting that most of the time the documents remain idle waiting for something to happen rather than being processed.

Detailed model analysis brought to light a number of reasons that contribute to the inefficiencies identified. The major problems identified by AS-IS model analysis are shown in Table 2. Based on the results of the AS-IS modeling phase, four alternative process scenarios were developed and discussed with ABC and XYZ management for acceptance and feasibility. The scenarios were then simulated and results were compared with the AS-IS model to evaluate the impact of changes on key performance indicators. Table 3 shows the scenarios modeled and their relation to the problems of the existing processes.

Table 1. Key Performance Indicators

	Average Time	Average Wait	Max Time
Order	58h 39min	55h 31min (95%)	142h 06min
Backorder	215h 23min	150h 42min (70%)	334h 50min
Invoice	269h 38min	153h 41min (57%)	602h 50min

The results from the scenario runs are summarized in Figure 3. In terms of the key performance indicators we can note the following:

- a. **Orders:** The results were somewhat surprising. Contrary to what was expected, the adoption of EDI did not result in the time savings initially envisaged by the two companies. The adoption of EDI alone (scenario A) resulted in only a 17.2% reduction of average order fulfilment time. However, simulation made it possible to realize that other (non technology-supported) changes, combined with EDI, could provide a solution to the inefficiencies of the process. Thus, the combination of EDI with policy changes in scenario D resulted in a 48.3% saving of order fulfilment time, giving an acceptable average of 30 hours to fulfil an order.

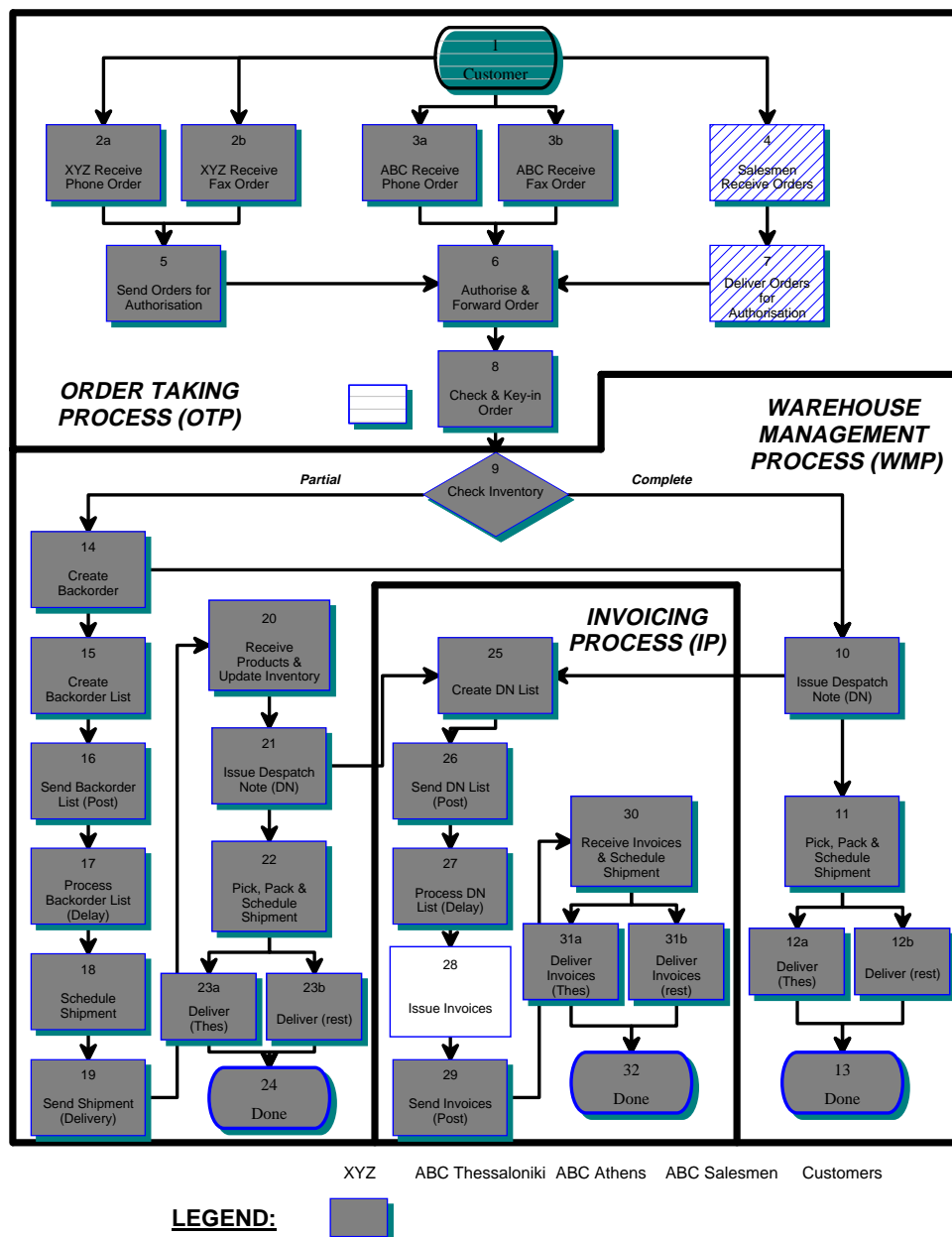


Figure 2. The Static AS-IS Process Model

- b. *Backorders*: EDI here provided an efficient mechanism for alleviating the identified problems. The adoption of EDI alone (scenario A) reduced the average backorder fulfilment time by 43.3%.
- c. *Invoices*: Again EDI proved, as expected, to be instrumental in substantially reducing the invoice delivery time. Scenario A resulted in a 74.7% reduction in average invoicing time (from 269 to 68 hours). Like backordering, the remaining scenarios B to D did only marginally affect invoicing time, as expected.

Table 2. Major Problems of Existing Process

Problem	Description
I	The existing policies for document exchange are a major process bottleneck.
II	There is an unacceptably high workload in Company XYZ warehouse.
III	The order authorization policy results in unnecessary delays without adding value to the process.

Table 3. TO-BE Scenarios

Scenario	Description	Problems Tackled
A	EDI is used to facilitate document exchange between ABC and XYZ.	I
B	Same as Scenario A, plus XYZ employs an extra employee at its warehouse.	I+II
C	Same as Scenario A, plus XYZ is also empowered to authorize the orders they receive.	I+III
D	Same as Scenario A, plus XYZ employs an extra employee at its warehouse AND is also empowered to authorize the orders they receive.	I+II+III

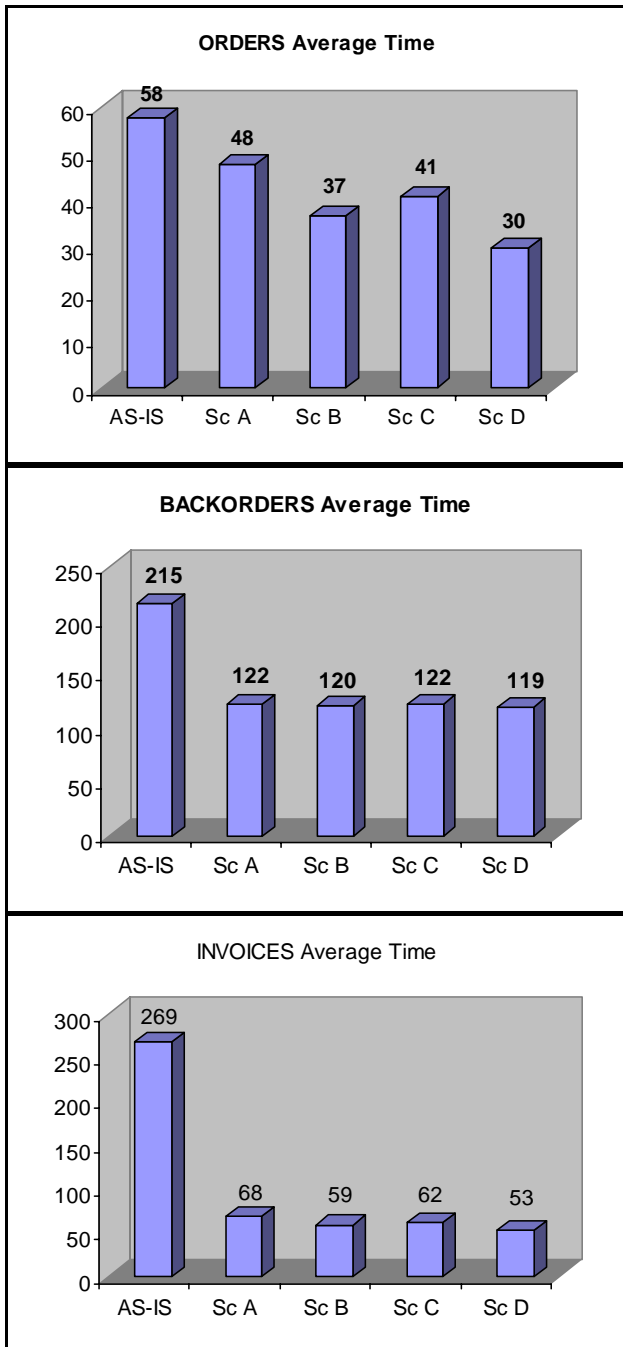


Figure 3. Simulation Output Data

Conclusions

Discrete-event simulation proved to be valuable mechanisms for realizing the real business value of EDI. Both ABC and XYZ management were able to see for themselves and assess the costs and benefits associated with various proposed options. This hands-on experience helped them to overcome their doubts about adopting EDI and build their confidence in the technology, without bearing the risk and cost of developing prototype applications and disrupting the operation of their businesses.

It was further appreciated how simulation showed that the adoption of EDI alone would only marginally improve the main performance indicator (order fulfilment time), contrary to what was initially expected. Management was able to experiment with other options that would complement the EDI investment to achieve the desired results. If simulation had not been employed and the EDI application was adopted in the hope that order fulfilment times would be substantially decreased, it is very likely that the management of both companies would be disappointed. Thus, they could develop a negative perception of the value of E-Comm in general and hence be unwilling to invest further in similar applications. Thus, the case study provided empirical evidence to support the hypothesis that the application of BPS can provide an efficient mechanism for allowing organizations to assess the real business value of EDI. By assisting managers to overcome their hesitance about E-Comm and understand the benefits it can bring to their businesses, it is believed that critical user masses can be more easily built, thereby resulting in better adoption rates for E-Comm in general.

References

References available upon request from the first author