Simulation: The Best Solution For BPR

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EXTENDED ABSTRACT

As it has been known, most organizations implement business process reengineering (BPR) for improving their performances. Despite this, figures show about 70-80 percent defective and unsuccessful cases. There is plenty of research for finding and describing the reasons for the defects. In this paper we introduce the main reason that this research has been neglected to date.

As will be described, using inadequate techniques and non- proper approaches seems to be the main reason for non-success. In this paper the business process simulation is introduced as the best technique for implementing BPR.

For achieving better performances, organizations must analyse their business processes and measure their efficiency and effectiveness, then diagnose the necessary changes and estimate the results of changes. To our knowledge, the best (if not only one) way for doing the former, is by "modelling" business processes.

In this area, we have two kinds of models: analytical (such as flowchart, spreadsheet, DFD, activity – role diagram, IDEF (Integrated Computer-Aided Manufacturing (ICAM) DEFinition) and so on) and simulation. We believe that the core reason for non-success in this area is the use of analytical models (especially flowcharts and spreadsheets) for redesigning business processes. To date, many researchers have identified this fact, but there is only a small body of research to illustrate "why and how "simulation gives better results than analytical models. In this paper, we demonstrate by use of a case study that when you use more than two criteria for measuring and optimizing the business processes, the results of analytical model might be non-optimal and even paradoxical.

The case study subject is about ordering process in the X organization. In the order department, there are five activities: 1-select suppliers 2- negotiate terms 3- prepare purchase order 4- place purchase order 5- audit invoice. We determine two criteria for assessing the alternative solution, the ordering cycle time and expenditure. We design three scenarios for running the process. Then we assess each of scenarios by analytical approaches and simulation. In models simulation, we use SimProcess® (CACI 2005) (one of the best products for BPR). Then we select the best alternative for redesign according to both approaches and finally compare the results of both approaches. In the last section of the paper we argue about the advantages of simulation and the disadvantages of analytical models for redesigning the business process.

1. INTRODUCTION

There are only a few organizations that have not thought of, or already used, business process reengineering. Although figures show that 70-80 percent of projects have failed, there is a lot of support among organizations to do that (Eatock et al. 1999, Hammer and Champy 1993, O'Neil and Sohal 1998). In the next section, we will introduce BPR methodology and its tools and techniques.

In BPR, we use some modelling techniques and software tools. Here are the process modelling techniques and their associated tools:

- Flow chart technique (Flowcharter, Flowmark)
- Data Flow Diagrams (CASE Tool, 4Keeps)
- Role- activity diagram (RADitor)

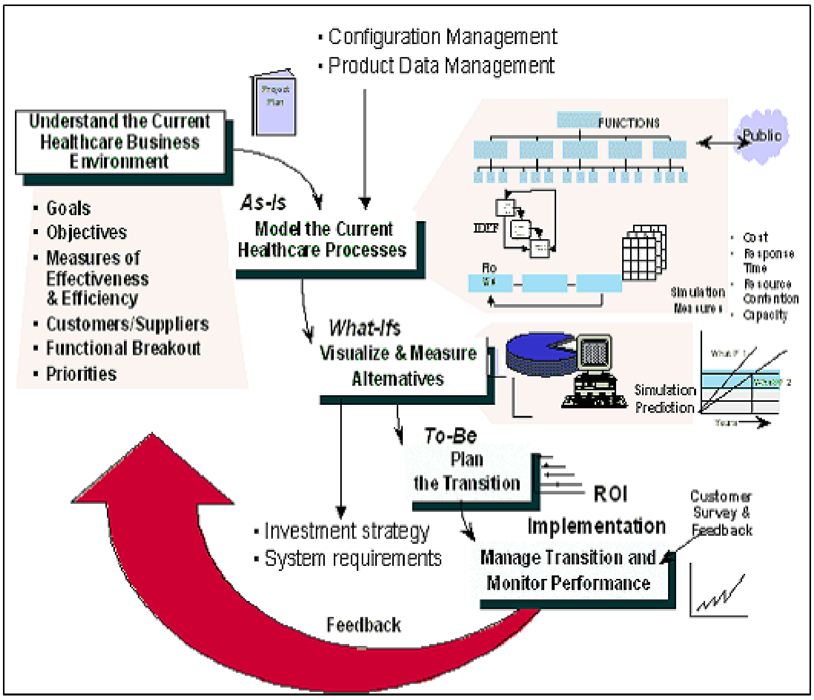

Figure 1. BPR Methodology (CACI 2005)

In Figure 1, the BPR process begins with understanding the current business environment. For this step of BPR we need to document all the information related to the BPR area, such as goals, objectives, customers, etc. Then an 'As-is' model must be built, based on the prepared documents. Based on the goals of the BPR project, some assumptions about the area and nature of changes must be made. Then, for each reasonable change, a 'What-if' analysis must be done. At the next step the what-ifs analyses must be evaluated to make a 'To-be' model. Finally, the 'To-be' model will be implemented and then evaluated according to the goals for making correction in the changes plan.

- Role interaction diagrams (RADitor)
- Gantt Chart (Project Scheduler7, Workflow BPR)
- IDEF (Design IDEF, IDEF Tools)
- UML (Magic Draw UML, Visual UML)
- Simulation (Metis, Arena, SimProcess)

Using the right techniques and tools is an important issue during BPR which becomes more and more complex, firstly because of the huge range of approaches available; and secondly due to the lack of guidance that explains and describes the concepts (Hansen 1994, Swami 1995).

There are different reasons for these failures. According to Petrozzo and Stepper (1994) and O'Neill and Sohal (1999), obstacles in a BPR project can be categorised into three main subjects:

(i) lack of sustained management commitment and leadership

(ii) unrealistic scope and expectations

(iii) resistance to change.

2. ANALYSIS OF FAIL IN BPR PROJECTS

As discussed above, we found that the main reasons for failure are the human factors. Resistance, expectation and lack of sustained are human properties. Therefore some researchers use a human relation approach in their plans for increasing the success rate (Oblineski 1994). We believe that the main obstacle in this area is in a lack of methodological understanding of solution in the field of business process reengineering. Re-expressed, this means that analysers and managers believe that the capability of an organisation is based on what they do (actions), not how they do it (process).

In the BPR projects, analysts discover the reasons for the problems of the current system and what they don't want, but about the required system, they only determine what they want without any understanding of "how what they want must be done". They implement what they want by "trial and error". Meanwhile since the changes that must be taken are big, the first failure causes top management to cut off the BPR approach.

A survey of implemented tools and methods in BPR supports the above analyses. Flow charts and spread sheets are the most popular tools for system analysis (Weston 2004, Tumay 1995). They are capable of answering the question of "What" but they can't provide answer to the questions of "Who", "When" or "Where" of our processes. Business processes are way too complex and dynamic to be understood and analysed by flowcharting and spreadsheets alone. Making radical changes is naturally risky work — if you are unable to forecast your replacement system clearly, this risk increases and leads us to human problems such as lack of sustained management, lack of communication, resistance to change, etc. In addition, reengineering is a process that involves "humans", "processes" and "technology" "over time".

The expression "over time" is critical to understanding any change plan. Most implemented tools in business process reengineering are unsuitable for analysing processes dynamically. This may cause many problems in the results of BPR. In addition users' interactions with processes and technology over period of time can take different scenarios and finally make different outputs. Therefore analysing the scenarios and estimating their outputs isn't possible without using **computer simulations**. Using virtual reality (VR) in simulation can draw a clear and touchable picture of the future system for the managers and users. Using a What-if approach for sensitivity analysis of system in future can guide us to make decision support system (DSS) for managers in BPR area. Using cutting-edge software that are capable of optimizing processes gives us the opportunity to measure criteria of the required system.

The appearance of changes in the period of time is due to the phenomenon that we called "randomness variability". Many business processes contain random variables in their demand (for example the rate of entry of a customer to a service process) and the time model of implementing processes (for example customer service time). Using deterministic parameters (for example the mean of a variable) in conventional approaches is a very important factor in misguiding the analysis. Especially in customer based systems, the average of parameters is important, but the maximum and minimum of parameters play a critical role in improving the result of the BPR. As Nordgrin says: "optimisation isn't possible without recognizing the effect of variable factors in systems with queues".

Cheung and Bal (1998) compare computer simulation and flowcharting and spreadsheets using 2 factors, randomness and interdependencies (Figure 2). As can be seen, computer simulation supports greater randomness and interdependencies with our problems for BPR.

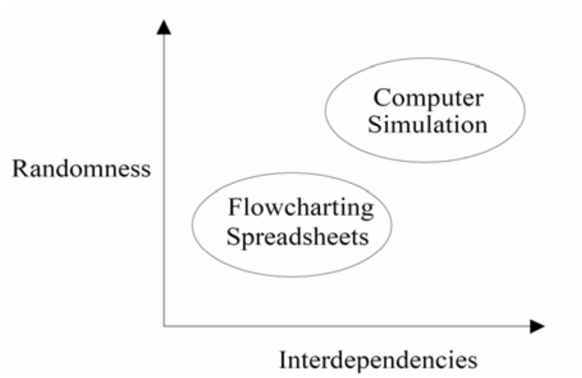

Figure 2-Comparison between Computer simulation and Flowcharting and Spreadsheets for BPR (Cheung and Bal, 1998)

3. SIMULATION AS A PERFECT TOOL FOR BPR

Organizations reengineering their processes need firstly to be acquainted with the mechanism of operating system, and secondly an understanding of its performance and the measure of its effectiveness, and then recognize the critical changes and methods of implementing the changes. Finally the organizations must evaluate the effectiveness of the changes and adjust the change plan (if required). For these reasons there is only one known way, called modelling.

Modelling provides the ability to analyse business processes in these areas:

- Determining bottlenecks and wastage
- Planned reviewing of processes for improving the performance
- Choosing better-designed processes to get better-results
- Cost evaluation
- Measuring the performance of new processes.

Modelling is available in two categories: analytical and simulation. We categorise all modelling techniques (except simulation) as analytical. It is too hard and complex to explain relations between different variables especially when you are involved with complex processes. Analytical tools only able to guesstimate the results but simulation can give correct and reliable estimate of results.

Analytical tools don't help analysts in the following areas:

- Time variable properties of many processes
- Time based processes (changing the state of system by time)
- Non-linear relations between elements of process
- Randomness property of real processes
- Unwanted events and occurrence in business environment.

We will now explain how simulation tools completely fit our needs in BPR projects. Typically a BPR project begins with one or all of the following objectives (Tumay 1995):

- Increase service level
- Reduce total process cycle time
- Reduce waiting time
- Reduce activity cost
- Reduce inventory costs.

Youngblood (1994) lists 32 ways to achieve these objectives. Most of the principles are fundamentals of industrial engineering that have been applied in manufacturing industries for many decades. Many of them are the same principles that usually applied to reengineer business processes. Here are some of those principles (Tumay, 1996):

- Combine duplicate activities
- Eliminate multiple reviews and approvals
- Reduce batch sizes
- Process in parallel
- Implementing pulling system for customer demand
- Outsourcing inefficient activities
- Eliminate movement in work
- Organizing multi-functional teams.

These principles clearly answer the question "What needs to be done?" But BPR involves changes in people, processes and technology over time. The interactions of people with processes and technology can take place in plenty of scenarios that are impossible to comprehend and evaluate with analytical tools.

With a simulation tool, we can take a dynamic picture of models.

Some researchers postulate that simulation is the only suitable technique for BPR because Business Processes are too complex and confusing (Fathee, 1998):

- Many business processes are undetermined and include random variables.
- Activities and resources that are main business process elements have interactions.
- Business processes of organizations affect each other and are changed by agents outside the organization.

4. CASE STUDY

In "A" Company, the department of ordering and supplying materials is organized centrally. This means all activities for all products are done in this department. Activities in the ordering department are shown in Figure 3.

1-Select Supplier

2-Negotiate Terms

3-Prepare Purchase Order

4-Place Purchase Order

5-Audit Invoice.

A problem in the current system is the "long time for ordering". In addition the cost factor is very important. Cost and time are tabulated in Tables 1 and 2.

The buyer has a higher wage than the other clerks because of work variety and more experience needed for doing the work. In addition time for doing activity 3 and 4 by Purchase Order clerk is larger than others. Also the manager does activities 1 and 2 for all products in larger time. It's clear that the wage of the manager is greater that others.

Table 1- Time required for each activity with specific personnel per Hour

Human Resource	No.	Act.1	Act.2	Act.3	Act.4	Act.5	Cost
Manager	5	1	1	-	-	-	5000
Buyer	30	-	-	Tri(4,5,10)	4	5	3000
Product A Personnel	5-6	1.2	1.2	Tri(0,4,8)	3	5	2500
Product B Personnel	7-9	1.2	1.2	Tri(0,4,8)	3	5	2500
Product C Personnel	18-20	1.2	1.2	Tri(0,4,8)	3	5	2500

Table 2- Entrance rate of orders to system

Product	Rate of entrance
A	0.2
B	0.3
C	1

The goal of this study is reengineering business processes to decrease cycle time and costs of ordering system. We assume that resources and parameters in the system are not changeable, and that each scenario can improve the system only by re-organizing the process (with no changes in activity and related parameters).

5. REENGINEERING ORDERING PROCESS WITH ANALYTICAL APPROACH

With the analytical approach, we could find various scenarios for reducing time and cost. Two of these scenarios are:

- decentralized processes for each product (Scenario II) (Figure 4)
- compound process with one or more activities centralized and others decentralized (Scenario III) (Figure 5).

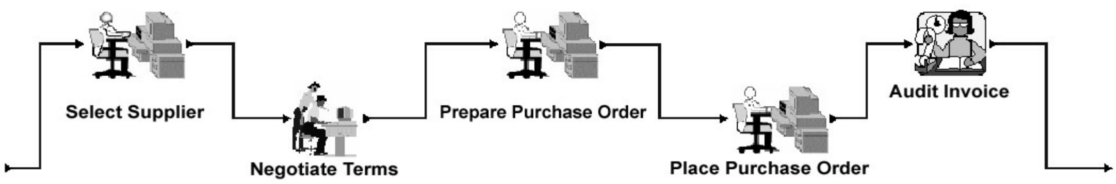

Figure 3-Centralized Ordering Process

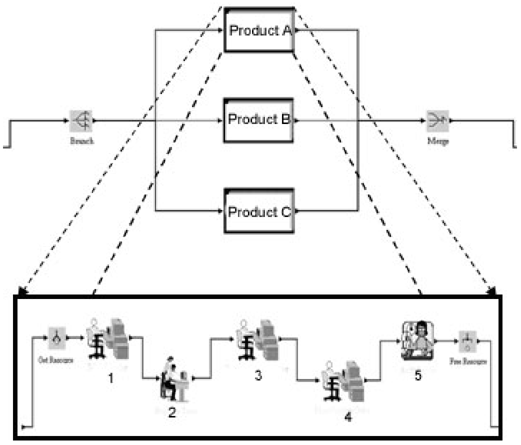

Figure 4- Decentralized Ordering Process

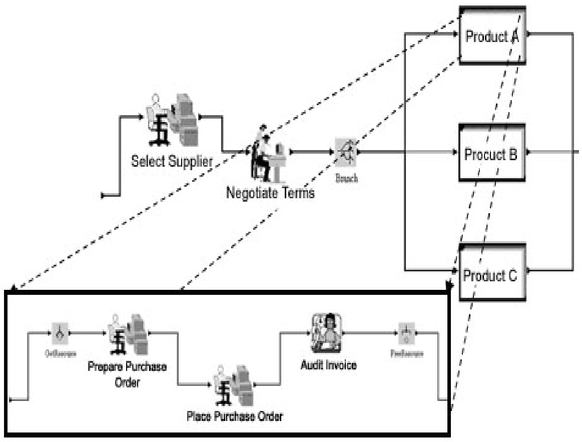

Figure 5- Hybrid or Compound Ordering Process

The 'As-is' centralized ordered process is labelled Scenario I in the following analysis. For simplicity, we suppose that all activities can't break down into small tasks and sequence of activities that cannot change. In addition, in scenario III we could have different solutions but we discuss only one of them whereby two of the activities are done centrally and the others are processed decentralized.

The critical question is "Which of these options (and other proposed choices) will increase performance (in comparison with the current centralized situation)?" In fact, analytical approaches are not capable of answering this question and practically systems analysts with "trial and errors" can evaluate and compare the alternative solutions. In the next section we compare the three scenarios using the analytical approach and select the best solution. After selecting the solution we will show that a big mistake occurs here.

6. SCENARIOS EVALUATION USING ANALYTICAL APPROACH

6.1. Comparing scenarios according to the cycle time of ordering

The average cycle time for processing one order for all products in the centralized ordering process is approximately equal (in hours) to:

$$1+1+5+4+5 = 16 \quad (1)$$

while in the decentralized ordering process it is equal to:

$$1.2+1.2+4+3+5 = 14.4 \quad (2)$$

Therefore the decentralized scenario (Scenario II) seems to be better than the centralized scenario with regards to cycle time.

The hybrid scenario (Scenario III) seems to be a better solution because all the activities have smaller or equal cycle time in comparison with the others. In this scenario, cycle time is equal to:

$$1+1+4+3+5 = 14 \quad (3)$$

Table 3-Resource allocation for the 3 Scenarios

Scenario I- Centralized		Scenario II - Decentralized		Scenario III-Compound	
Activity	Resource	Activity	Resource	Activity	Resource
2,1	Manager	1,2,3,4,5	Pro.A Personnel	2,1	Manager
5,4,3	Buyer	1,2,3,4,5	Pro.B Personnel	5,4,3	Pro.A Personnel
		1,2,3,4,5	Pro.C Personnel	5,4,3	Pro.B Personnel
				5,4,3	Pro.C Personnel
5+30=35		6+9+20=35		5+5+7+18=35	

Activities 1 and 2 are done by the manager in 1 hour and activities 3 to 5 are done by product clerks. (See Tables 1 and 3). It is not necessary to note that we assume infinite resources, in addition we ignore the randomness property of activity 3 and then we calculate the cycle time of ordering. In this manner we can determine the best scenarios according to the cycle time of ordering. These are respectively: 1-Hydrid, 2-Decentralized, 3- Centralized.

6.2. Comparison of scenarios according to the ordering cost

In the decentralized scenario, the cycle time of activities 3 to 5 is less than in the centralized scenario, also the cost of product clerk (clerk assigned to a specific product) wage is less than buyer Meanwhile the cost in activity 1 and 2 in decentralized scenario is 50 percent less than the centralized, but cycle time is 20 percent greater. So we can conclude analytically that the decentralized scenario (Scenario II) seems to be better with respect to cost criteria than the centralized. As shown here we can conclude analytically that the hybrid scenario (Scenario III) has a greater cost than the decentralized. So as a primitive conclusion the decentralized scenario (Scenario II) is the best option with respect to cost criteria.

In comparison between hybrid and centralize scenario, activities 1 and 2 have equal conditions, also activities 3 to 5 in hybrid have less cycle time and cost(in man-hours). Therefore we could say hybrid scenario (Scenario III) is better than centralized scenario. Hence, scenarios priority seems to be respectively: II- decentralized, III- hybrid and I- centralized. It is obvious the optimum solution differs from one criterion to another, so the ultimate option would be found by quantitative methods like weighting, MCDM (Multi Criteria Decision Making) and so on. In the next section we use simulation to evaluate all scenarios.

7. SIMULATING ORDERING PROCESS

These processes were simulated with SimProcess software for a one- month period. (For increasing reliability we simulated each scenario 10 times). The simulated results are in Tables 4 and 5.

Table 4-Simulation results for each scenario-product

Scenario	Product	Total Generated	Cycle time	Wait for resources	Cost per product	Total cost of products
Centralize	A	80	187.742	170.386	3467923	19730453
	B	107	195.931	178.629	4567864	
	C	275	194.369	177.048	11694666	
Decentralize	A	73	71	57.507	3401004	19878791
	B	113	71	57.444	5742615	
	C	276	86	71.706	10735172	
Hybrid	A	82	122.23	108.10	2833044	16321533
	B	104	109.92	96.00	3711147	
	C	110.23	274	96.33	9777342	

Table 5-Simulation results for each scenario-employee

Scenario	Personnel	performance	Income per month
Centralize	Contract Administer	95.708	880515
	Buyer	92.56	510929
Decentralize	Product A Personnel	88.568	566834
	Product B Personnel	91.133	838068
	Product C Personnel	94.461	536758
Hybrid	Contract Administer	95.435	878000
	Product A Personnel	88.84	408664
	Product B Personnel	84.249	387545
	Product C Personnel	86.649	404188

It is helpful to note that with using optimizer tools we can optimize the parameters of scenarios, but for better explanation in BPR process, we have not used the tools.

8. EVALUATION OF SCENARIOS WITH SIMULATION RESULTS

The priorities of the scenarios based on cycle time are:

- Centralized (I) (71-86 hours)
- Hybrid (III), (109-122 hours
- Decentralized (II) (187-195 hours).

The priorities of the scenarios based on cost are:

- Hybrid (III) (16321533)
- Centralized (I) (19730453)
- Decentralized (II) (19878791).

9. ANALYSIS OF RESULTS OF ANALYTICAL AND SIMULATION METHODS

According to the above results, we could see the big mistakes that occur using the analytical method. In the analytical method results, the decentralized scenario has less cycle time than the hybrid; meanwhile the simulation shows the contrast of it. Also, the decentralized scenario has more cost than the others, according to the simulation results; meanwhile the analytical method shows the contrast.

10. CONCLUSION

The case presented in this paper is much simpler than reality. In this case we assume that the activity time is the only variable. All of the input parameters are assumed constant. For determining the relationship between activities, only precedence is determined. Despite this simplicity, results from using the analytical approach are wrong. The sample process has been kept deliberately simple. Each of the scenarios can be implemented in different ways, but it is neglected here.

In addition, relations between parameters and activities are complex and non-linear. So we can conclude that simulation is not only an efficient tool but also a unique and standard tool for BPR.

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