BUSINESS PROCESS MODELLING USING SIMUL8

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ABSTRACT: It is apparent that developing dynamic models of business processes prior to their change could increase the success of business renovation (BR) projects. Simulation has an important role in modelling and analysing the activities in introducing BR since it enables quantitative estimations of influence of the redesigned process on system performances. An example is presented to investigate some of the potential benefits and outcomes of introducing new or redesigning existing processes that could be assessed in advance by using simulation modelling.

1. INTRODUCTION

In a period of commercial metamorphosis, organisations, large and small, are finding it increasingly difficult to deal with, and adjust to, the demands of the current business environment. Process renovation is a re-engineering strategy that critically examines current business policies, practices and procedures, rethinks them and then redesigns the mission-critical products, processes, and services (Prassad, 1999).

Many leading organizations have conducted business renovation (BR) 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% (Hammer and Champy, 1993). Some of the frequently mentioned problems related to BR projects include the inability to accurately predict the outcome of radical change, the difficulty in capturing existing processes in a structured way, the lack of creativity in process redesign, the level of costs incurred in implementing the new process, and the inability to recognize the dynamic nature of the processes. The methods of BR, which combine business process modelling and simulation modelling, enabling quantitative estimations of alternative renovated business processes (Harmon, 2003), are one of the possible approaches to address the above-mentioned problem of the evaluation of alternative solutions.

The main objective of this paper is to develop a simulation model of the IT Support function of a multinational construction firm using simulation software tool Simul8. A brief overview of simulation and business process modelling methods is presented in Section 2. A problem definition and model design using Simul8 is provided in Section 3. The evaluation of "AS-IS" model results and "TO-BE" model development are presented in Section 4. Finally, Section 5 outlines the main findings of this research and provides concluding remarks.

2. SIMULATION AND BUSINESS PROCESS MODELLING

Many different methods and techniques can be used for modelling business processes in order to give an understanding of possible scenarios for improvement. IDEF0, IDEF3, Petri Nets, System Dynamics, Knowledge-based Techniques and Discrete-Event Simulation are only some examples of widely used business process modelling techniques (Eatock, et.al, 2000, Seila, 2003). As noted by Hommes and Van Reijswound (2000) the increasing popularity of business process modelling results in a rapidly growing number of modelling techniques and tools. The list of the available business process modelling tools supporting simulation includes over 50 names (Hommes, 2001). This makes the selection of the proper tool very difficult. In (Kettinger et al, 1997), an empirical review was made of existing methodologies, tools, and techniques for business process change. The authors also developed a reference framework to assist the positioning of tools and techniques that improve re-engineering strategy, people, management, structure, and the technology dimensions of business processes.

Simulation modelling is being widely used in manufacturing, but also in areas such as health care, the service industry, network communications, traffic modelling and the military. The simulation of business processes is suggested for use in BR projects as it allows the essence of business systems to be understood, the processes for change to be identified, process visions to be developed, new processes to be designed and prototyped and the impact of proposed changes on key performance indicators to be evaluated (Greasley and Barlow, 1998). The reasons for the introduction of simulation modelling into process modelling can be summarized as follows: simulation allows for the modelling of process dynamics, the influence of random variables on process development can be investigated, re-engineering effects can be anticipated in a quantitative way, process visualization and animation are provided, and simulation models facilitate communication between clients and an analyst. The final reason for using simulation modelling is the fact that it can be increasingly used by those who have little or no simulation background or experience (Irani et al, 2000).

Despite the numerous advantages of simulation software, it is apparent that some user requirements are still not adequately met. The survey on the use of simulation software conducted by Hlupic (2000) revealed that there are two different groups of users: academics and industrial experts. Over three-quarters of academic users and over half of industrial users use simulators. Both groups stated that the main positive features are ease of model development and visual facilities, while the main problems for industrial users were the lack of flexibility (in comparison to simulation and general purpose programming languages), the lack of links with other packages (software compatibility) and the lack of interfaces for data input. It is obvious that no single simulation package could incorporate all desirable features and its selection depends on the application area and the problem complexity.

3. PROBLEM DEFINITION AND MODEL DESIGN

The chosen case study is based around the IT Support function of a multinational construction firm, more specifically, the support of approximately 3.000 users within the London offices. Support is provided through the provision of two helpdesks. After an outsourcing agreement, the network infrastructure, hardware and standard office automation application would be managed by the external contractor (Helpdesk 1). This left the company to provide support for the engineering applications and CAD design hardware (Helpdesk 2).

*Helpdesk 1***:** Receiving approximately 139 calls per working day, this helpdesk employs 21 full time technicians, of which 5 are employed to receive and log telephone calls. Upon receipt of a call, the operator logs the callers details and a brief description of the problem. The operator then attempts to resolve the problem over the telephone, a tactic that resolves around 20% of all received calls. However, it the telephone operator is unable to resolve a problem over the telephone, the call is assigned to the team of technicians located in the users building. The technicians check the system for calls, and visit the user at the earliest opportunity. Average waiting time for users is estimated at 2 hours and 30 minutes dependant on workload and staff availability.

Helpdesk 2: **T**his helpdesk is staffed by one operator, who allocates calls to any of the eleven technicians, dependent upon the nature of the problem. Dealing with approximately 30 calls per working day, each call is logged and prioritised according to the urgency of the problem. The helpdesk application then acts upon the call, sending an e-mail to the nominated technician, informing them of the call, and a description of the problem. The technician, upon receipt of the e-mail, acknowledges the call, and takes action to resolve the problem, which must be completed within a predefined time.

Problem areas: There are several problems related to the chosen case study. Primarily, each helpdesk refers a substantial number of calls to the other because users are not sure of (a) who to call and (b) whether the problem is with the software application, or the underlying hardware or network. This problem is further exacerbated by the two helpdesks using incompatible software applications, resulting in greater delays for users.

Inefficiencies are also evident in the operations of Helpdesk 2, as technicians spend a fair amount of time travelling between the numerous company buildings.

Translating the analysis documentation that had been prepared previously into initial model outlines was quite a simple. Process maps of “AS-IS” model were based on flowcharts (Figure 1) as a very useful, simple and well-known graphical modelling technique (Giaglis, 2001). The next step was to translate the graphical representation of “AS-IS” model into the simulation model using SIMUL8 software model-building tool (Hauge and Paige, 2001).

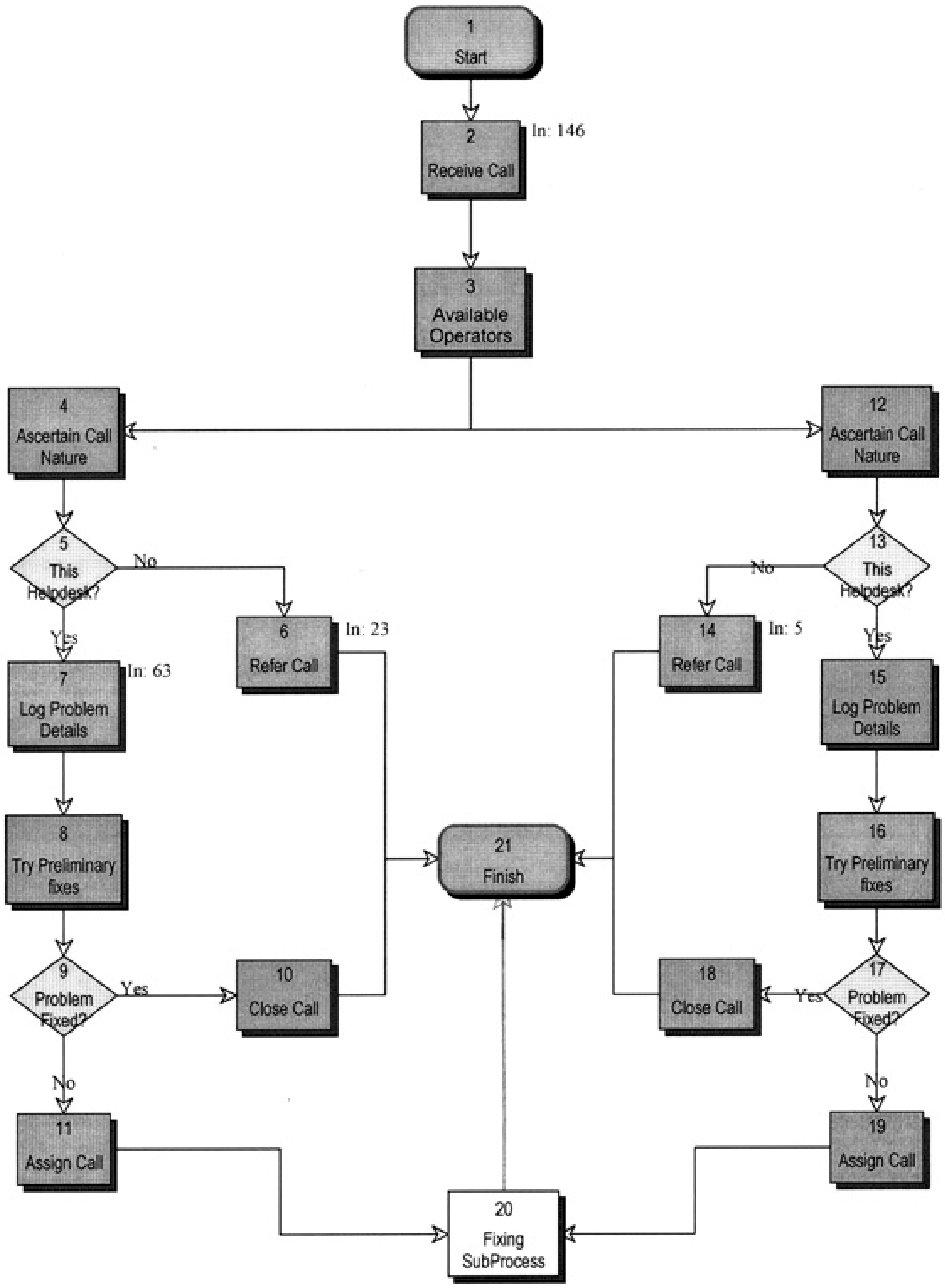

Figure. 1: Diagrammatic representation of "AS-IS" model

ID	Name	Priority	Type	Calendar	Time Option	Path Routing	Path ID	Fixed Time	Probability	Required Resource	Qty	Basis	Usage
1	Start	5	Starter	Total Open Hours	Suspend	Probability	To Receive Call	Exp. (4.633m)	100%				
2	Receive Call		Queue			On Demand	To Available Operators		-				
3	Available Operators	5	Normal	Total Open Hours	Suspend	Parallel	To Ascertain Call Nature		-	Helpdesk Operators (Early T.)	1	Activ.	Inspect
										Helpdesk Operators (Late T.)	1	Activ.	Inspect
4	Ascertain Call Nautre	5	Normal	Team 1 Shift	Finish Task	Probability	To This Helpdesk?	Normal (2m,0.25m)	100%	Helpdesk Operators (Early T.)	1	Activ.	Concurrent
										Caller	1	Activ.	Concurrent
5	This Helpdesk ?	4	Normal	Team 1 Shift	Suspend	Probability	To Refer Call		18%				
							To Log Problem Details		82%				
6	Refer Call	4	Normal	Team 1 Shift	Suspend	Probability	To Finish	1m	100%	Helpdesk Operators (Early T.)	1	Activ.	Concurrent
										Caller	1	Activ.	Concurrent

Table 1: Model definition table

Having sequentially established the processes and decisions of each submodel, the behavioural characteristics were defined (Table 1): the activities were labelled, a priority was assigned, a calendar was assigned (defining what hours it would be operational between), the path ID for the activity was defined (specifying the next activity in the model, and the statistical distribution data defining the time this process takes to complete). Having specified the behavioural details of the submodels, the resources for each helpdesk were defined. Information about the resources cost, hours and usage were defined. Finally, all the submodels and subprocesses were linked together and presented using SIMUL8 objects and parameters.

Name	Type	Distrib.	Av.	Std. Dev.	Repl.	Routing In	Routing Out	Resources	Actions
Calls Received	Work Entry	Exp.	29.17						
Received Calls Queue	Queue								
Ascertain Call Nature	Work Centre	Normal	2.7	0.5	1	Received Calls Queue	20% Refer Call 80% Log.Assign. Prioritise	Helpdesk Operator Caller	Callers Wage x 25 Helpdesk Operator Wage x 8
Refer Call	Work Centre	Fixed	1		1	Ascertain Call Nature	100% Completed Calls	Helpdesk Operator Caller	Callers Wage x 25 Helpdesk Operator Wage x 8
Log.Assign. Prioritise	Work Centre	Normal	7	1.8	1	Ascertain Call Nature	100% Queue for Technicians	Helpdesk Operator Caller	Callers Wage x 25 Helpdesk Operator Wage x 8
Queue for Technicians	Queue								
Fixing Process	Work Centre	Fixed	0		11	Queue for Technicians	100% For Call Priority Routing		
Close Call	Work Centre	Fixed	3		1	Problem Fixing (FC) Problem Fixing (FN) Problem Fixing (FS) Problem Fixing (RH) Problem Fixing (RN) Problem Fixing (RS)	100% Completed Calls	Helpdesk Technician	Helpdesk Technicians Wage x 20

Table 2: Model definition table in Simul8

Using the symbol set available within Simul8, the work entry points, work centres, queues and work exit points that constituted the top level of the submodels were defined (Table 2). All the objects were connected together using the simple arrow facility, and the finer details of the models were entered using the properties tab (Figure 2).

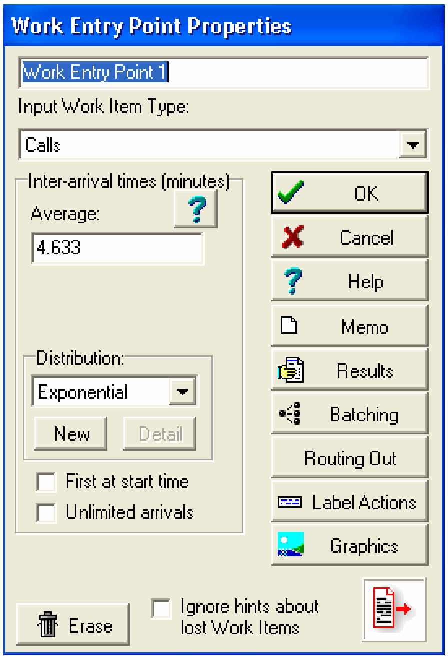

Figure. 2: Simul8 Activity Properties Tab

As mentioned before, to handle the complexity of some of the models, several layers were necessitated. Each submodel was validated and tested both, under its normal working conditions, as well as under increased volumes of calls and reduced levels of staffing.

4. EVALUATION OF MODEL RESULTS AND "TO-BE" MODEL DEVELOPMENT

From the experiment conducted, it appears that operators are operational for 23% of the business day, with the technicians not far ahead on only 26% and most alarmingly the supervisors being involved with helpdesk for 2% of their business day. Calculating the mean resource utilisation, indicates that the personnel resources for Helpdesk 2 are only occupied for 18% each working day. An examination of the resource utilisation in Helpdesk 1 illustrates that they are occupied for 75% each working day.

Prior to initiating the actual reengineering activity, a selection of "what-if" queries has been run on the implemented model. One of the questions examined was: What if both helpdesks were merged together? The aim is to ascertain whether, by pooling the resources of both Helpdesk1 and Helpdesk2, there would be a noticeable drop in the waiting times and quantity of calls being left until the next working day. The results show (Table 1) that, without fundamental redevelopment of the model, there is a marginal improvement in the time taken to get a response from an operator, but a profound improvement in the responsiveness of the technicians, with the maximum waiting time nearly third of it's present value.

As the "what-if" analysis proves (Table 3), the first problem that needed to be addressed was the matter of how to improve the response times to callers, both for the operators and technicians. It was proven that the overall time taken to deal with user calls was only marginally improved when the number of operators was merged between the two helpdesks. To overcome this problem, the reengineered process would comprise a pre-screening operator, responsible for picking up calls as soon as they arrive and quickly ascertaining what their problem is, from where the call is routed to the correct people. Behind this, helpdesk 1 would have reorganised their shift system as follows: 2 operators on the early shift, 1 operator on the normal business day shift, 2 operators on the late shift. This would ensure that the busiest times of the day were covered and hopefully lead to an improvement in the response times. With regard to improving the response times of the helpdesk technicians, the reengineered model would have had the 11 technicians from helpdesk 2 located in teams in the different buildings, so as to get breadth of knowledge but to benefit from the decreased travelling times. Furthermore, the adoption of the information system that is presently in use in helpdesk 2, is proposed. This would mean that technicians would no longer have to log into the system to find their calls, they could simply read their e-mails.

Results	Old Times	New Times
Wait for an operator (av.)	24s	14s
Wait for an operator (max.)	7m 22s	6m 57s
Wait for a technician (av.)	63m 59s	2m 24s
Wait for a technician (max.)	165m 13s	60m
Work items in	131	157
Work items out	75	97
Work in progress	56	60

Table 3: The results of the "what-if" analysis

5. CONCLUSION

It is evident form the material presented within this research that simulation modelling is the "cost-effective" method of exploring "what-if" scenarios quickly, and finding a solution to or providing a better understanding of the problem, as this method is supported by a number of software tools (similar to Simul8) that provide a graphical representation of the business processes through executable models.

By engaging dynamic modelling techniques, an examination was made of a chosen case study. Based on the data presented from the modelling already undertaken, a reengineered business process was proposed and refined. Additionally, the effects of reengineered model were created by performing "what-if" analysis. In this phase of the research a "prototype" of the “TO-BE” model was developed. The improvements made in the process were evaluated presenting the simulation results to the managers and end-users. The model was well accepted by both of them and management was impressed enough to plan to make simulation modelling an integral part of its business renovation plans. The authors plan to explore the benefits of the developed model through further research and the model implementation

REFERENCES

Eatock, J., Giaglis, G.M., Paul, R.J., and Serrano, A. 2000. "The Implications of Information Technology Infrastructure Capabilities for Business Process Change Success". In: Henderson, P. (Ed.), *Systems Engineering for Business Process Change*. Springer-Verlag, London, 127-137.

Giaglis, G.M. (2001). “A taxonomy of business process modeling and information systems modeling techniques”, International Journal of Flexible Manufacturing Systems, Vol. 13, No. 2, 209-228.

Greasley, A. and Barlow, S. 1998. "Using simulation modelling for BPR: resource allocation in a police custody process", International Journal of Operations & Production Management, Vol. 18, No. 9/10, 978-988.

Hammer, M. and Champy, J. 1993. "Reengineering the Corporation: A Manifesto for Business Revolution", London, Nicholas Brealey Publishing.

Harmon, P. 2003. “Business Process Change: A Manager’s Guide to Improving, Redesigning and Automating Processes”, Morgan Kaufmann Publishers, San Francisco.

Hauge, Jaret W., and Kerrie N. Paige. 2001. *Learning SIMUL8: The Complete Guid*e. Bellingham, Washington: PlainVu Publishers.

Hommes, B. 2001. “Overview of Business Process Modelling Tools” [URL:http://is.twi.tudelft.nl/~hommes/scr3tool.html]

Hommes. B. and Van Reijswoud, V. 2000. "Assessing the Quality of Business Process Modeling Techniques". 33rd Hawaii International Conference on System Sciences, Vol. 1, January 4-7, Maui, Hawaii.

Irani, Z., Hlupic, V., Baldwin, L.P. and Love, P.E.D. 2000. "Re-engineering manufacturing processes through simulation modeling", Logistics Information Management, Vol. 13, No. 1, 7-13.

Hlupic, V. 2000. "Simulation software: An operational research society survey of academic and industrial users". In Joines, J.A., Barton, R.R., Kang, K. and Fishwick, P.A. (Eds.), Proceedings of the 2000 Winter Simulation Conference, 1676-1683.

Kettinger, W.J., Teng, J.T.C., and Guha, S. 1997. "Business process change: a study of methodologies, techniques, and tools", MIS Quarterly, 21: (1), 55-80.

Prasad, B. 1999. "Hybrid re-engineering strategies for process improvement", Business Process Management Journal, 5: (2), 178-197.

Seila, A.F. and Ceric, V. 2003. “Applied Simulation Modeling. Thomson Learning, Southbank, Australia.

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