Proceedings of the 2000 Winter Simulation Conference
J. A. Joines, R. R. Barton, K. Kang, and P. A. Fishwick, eds.

APPLICATIONS OF BUSINESS PROCESS SIMULATION AND LEAN TECHNIQUES IN BRITISH TELECOMMUNICATIONS PLC

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ABSTRACT

Business processes are increasingly key to the success of companies in the service industry. It is important that these processes are designed and maintained to deliver the most cost effective and efficient results. Simulation is being used in conjunction with other techniques to improve the performance of BT's processes, to evaluate new ideas and to plan operational resource requirements. The examples in this paper discuss firstly, the use of Value Stream Analysis (VSA) to identify inefficiencies in business processes and how simulation is used to evaluate improvement plans/ develop future business scenarios derived from this, and secondly how simulation is used to match available resources to workloads.

1 INTRODUCTION

British Telecommunications PLC (BT) faces increasing competitive pressure triggered by the continuing globalisation and development of new technologies in the telecommunications sector. This has lead to a need to minimise inefficiencies and waste while at the same time maximising the flexibility and speed of processes and systems to deliver new services to customers. In order to meet this challenge a variety of business process modelling techniques have been used to identify strategies for improvement. Among them are 'value stream analysis' (VSA) and simulation.

This paper explores how these techniques have been used as an enabler for change within BT, and demonstrates the benefits of using a dynamic modelling technique (simulation) in conjunction with a static method (VSA). Section 2 provides a brief description of the group within BT that performed the modelling work, after which there is an introduction to VSA (Section 3). Section 4 describes how VSA was applied to BT's basic telephony provision process.

The use of simulation to examine some of the recommendations brought forward by the VSA, the value added and the development of future business scenarios will be covered in Section 5. In Section 6 an approach where simulation is used to manage the resource working across the provision processes for private digital point to point services will be explained. Here the stages of the simulation project will be explained from previous project influences, to experimental stages and finally tool development. The paper concludes by discussing the benefits of using static and dynamic modelling approaches together (Section 7).

2 BT OPERATIONAL DESIGN GROUP

The Operational Design Group, part of BT's Advanced Communications Technology Centre, has for some years been designing processes and support systems for use in the operational side of the company. Over the last few years they have began to implement many techniques not previously used to increase the benefits they can give to their internal customers. The techniques include operations management, lean techniques (more commonly found in manufacturing industries), various process mapping methods and discrete event simulation (Hind 1999). The group works on projects throughout the BT organisation acting as internal consultants. They are also involved in a number of research activities based around these subjects.

3 VALUE STREAM ANALYSIS

Value Stream Analysis (VSA) is one tool from the 'Lean tool-kit' which can help to implement the five lean principles (Value, Value Stream, Flow, Pull and Perfection). The main use of VSA is to identify the value stream for a product, however it also enables waste to be easily exposed and identifies where improvements to flow and pull can be made.

VSA involves looking at all the steps involved in taking a product or service through the flow of a process to the point where it is handed over to the customer. Each of these steps is analysed to ascertain whether it adds value in the eyes of the customer. Activities that do not add value are classified as waste, of which there are two types:

- Type 1, Activities that do not add value but are currently required to complete the product/service and cannot be removed under present circumstances.
- Type 2, Activities that do not add value and can be removed from the flow immediately without having a detrimental effect.

After a first pass where the type 2 activities are removed from the process, opportunities are then sought to remove type 1 activities. This could be through re-engineering the process or by the introduction of new technologies/systems. Although VSA is good at identifying waste at the local level, its main strength lies in making visible improvement opportunities at the high strategic level.

4 VSA EXERCISE IN BT

The VSA exercise in BT (Jones et al. 1999) was based around the company's process for providing a basic telephony service. The process was analysed from the order entry contact through to successful delivery of the products and/or service to the customer. At a high level this process involves taking the customer order, allocating a telephone number, allocating a copper pair (if already physically available), providing network capacity, configuring the switches and installing equipment at the customers premises. Much of the process can be automated if the job characteristics suit.

Data were collected by interviewing the people working at each step in the process and observing them doing their jobs. Each step was broken down into a series of activities and the time taken to complete each activity was recorded. This was then classified into one of the following categories:

Value add:

- Operation – all activities that add value in the eyes of the customer.

Non Value add:

- Delay – includes queuing, batching
- Transport – of material or information that has not been changed
- Inspection – checking of existing information, rework.

Supporting information was also gathered such as the numbers of people involved, interactions with others, equipment and systems used and problems encountered. Suggestions for improvements were also noted.

The next stage was to gather together all the information to gain a view of how 'lean' this process was. This is a simple matter of grouping all the activity classifications together. Because individual provision jobs vary greatly in complexity there are large variations in the value add/non value add classifications for worst and best cases. Figure 1 shows this breakdown for the best case where a job has passed through all steps without any delays due to queuing, failures and batching. In these cases it can be seen that 37% of the time is spent on value add activities.

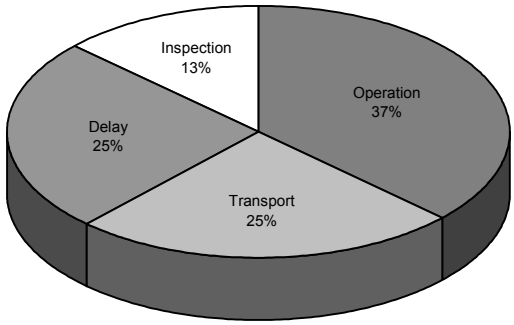

Figure 1: Pie Chart for VSA for Best Case

This is approaching a 'world-class' standard, bearing in mind that those Japanese companies that have been employing lean techniques for many years have only achieved approximately 50%. However, far too many jobs do not proceed down this 'perfect route' due to a variety of reasons including failures of automatic systems, incorrect information and queuing. The VSA enabled the most common reasons for failure to be identified and this information was used to produce ideas for solutions in the most significant areas.

5 SIMULATION AS PART OF BUSINESS TRANSFORMATION

Although the VSA provided a means for identifying issues and potential solutions, it was not able to test the effectiveness of alternative courses of action. As a result, a simulation model was developed of the provision of basic telephony services. Indeed, this simulation project was part of a larger programme put in place to transform the way that BT Customer Service operates. The project had a number of streams all targeting improvements in efficiency and cost reduction throughout the business. The simulation model built was created to assist with the Operating Strategy and Business Architecture stream. This part of the project was responsible for defining the service vision, operating principles, processes and other enablers that

formed the business architecture to deliver the service improvements.

The simulation was used to test the business improvement initiatives created by the programme team and also from the results of the VSA exercise. Using the model it was possible to predict what effects the proposed solutions would have on such things as resourcing, quality of service, cost and process efficiency.

Although the VSA exercise focussed on the process for *providing* basic telephony there was found to be a strong link between this and the repair process for the same product. Essentially many process participants are common to both processes and there were clear cause-and-effect relationships. Therefore the simulation represented both processes and the links between them. The processes were modelled at a high level and a flowchart describing the process flow is shown in Figure 2.

The simulation was constructed using Arena® software from Systems Modeling Corporation. One of the more important features of the model was that the job volumes, resource levels, performance targets, quality of service targets, etc. could be changed before running the model by a non-simulation expert. This was not so important during the bulk of the simulation project where the analysis was performed for the client but was useful when the model had been delivered to them so that they could make limited changes to try new ideas, such as changing job volumes, adjusting failure rates.

5.1 Simulation of Solutions Derived from VSA Exercise

One example of where the VSA exercise helped to achieve a major improvement in the provision process was around the area of the Distribution Frame work (see Figure 2). As far as installing the actual copper pairs to the customer is concerned (Field Work) all other parts of the process must have been completed by this stage, up to this point events can take place out of sequence and often do. During the VSA it was found on certain occasions that the field engineer installed equipment at the customer premises only to discover on testing that it did not work. In most cases this was because the distribution frame work had not been completed on time, which could be due to a variety of unrelated problems in the process prior to this step. This then required a call to 'control' to have a suitably qualified

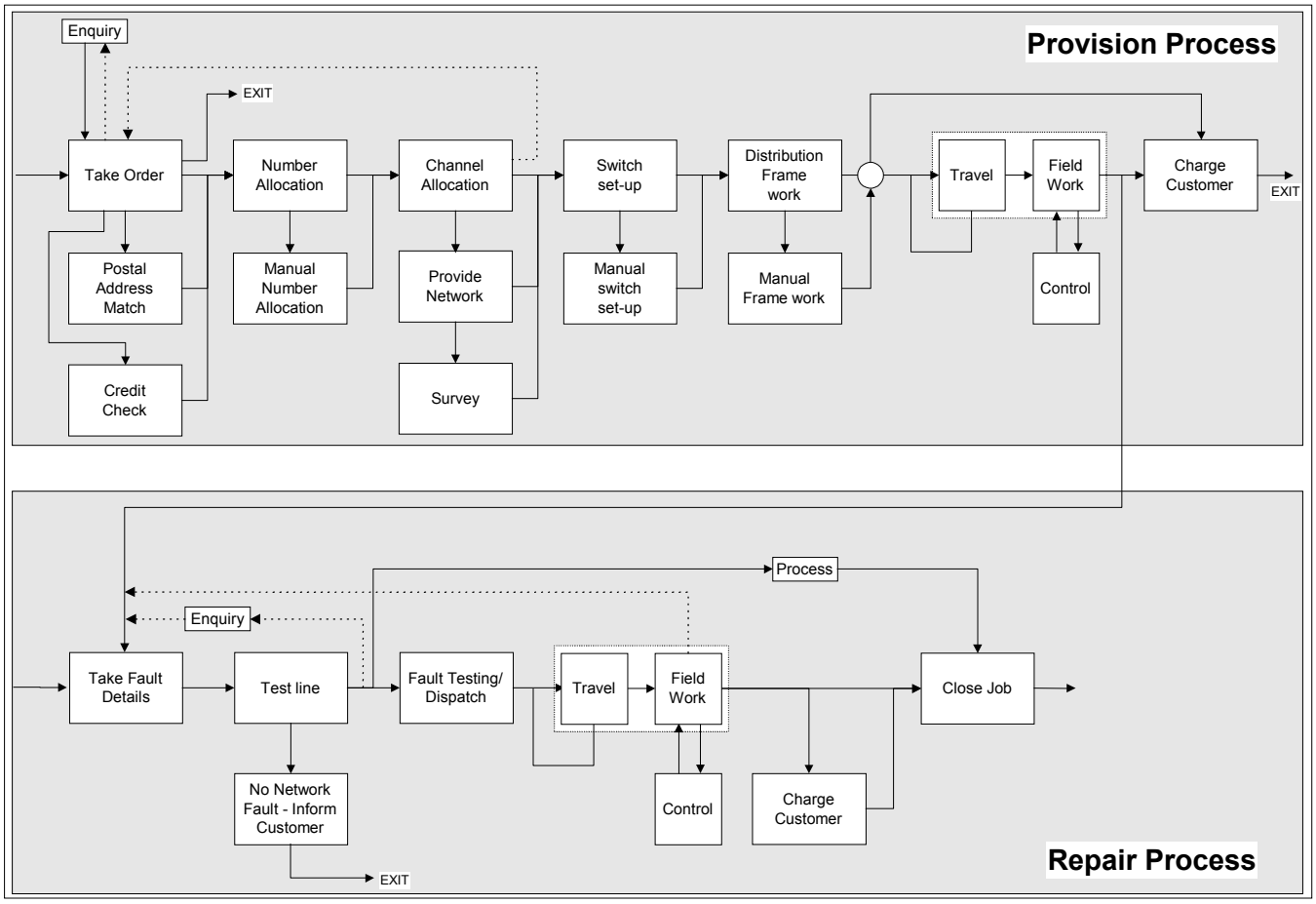

Figure 2: High Level Process Flowchart

engineer sent to complete the distribution work. Using data obtained during the exercise the process was simulated using new approaches to this work.

The results obtained suggested that in 75% of cases where an engineering visit is required the cycle-time could be reduced by ~7% of the overall engineering job time and in 10% of cases an average of 22% of engineering cycle-time could be saved. This was a significant saving for this type of product. When applied to all jobs completed by the company in one year a substantial cost saving could be made as well as the added potential of increased productivity.

5.2 Simulation of Future Business Scenarios

The simulation was also used for testing future scenarios for the business. Common scenarios were:

- Introduction of new products using the same processes
- Increased/more efficient automation
- Uplift of network equipment that reduces fault rates
- Ability to meet improved customer satisfaction targets
- Effects of marketing campaigns
- Year on year increases on new products uptake and the associated resourcing requirements.

One example scenario was that of a new product being introduced that uses the same processes as the basic telephony provision. Over the next few years the use of ADSL (Asymmetric Digital Subscriber Line) will increase. This technology allows faster data transfer rates meaning, for example, improved internet access speeds and access to interactive services over a standard copper pair telephone line. The processes for this technology will be similar to the process currently used for basic telephony provision and repair and therefore the simulation was re-used to assess the impact on resources and quality of service (QoS). Forecast data were provided for the next 5 years and all the relevant impacts were implemented in the simulation. Figure 3 shows the results obtained when measuring the quality of service for each year forecast for one customer segment.

The graph in Figure 3 shows the quality of service for a one month run achieved for each forecast over the next five years. This result shows the effect if current resource levels are maintained.

It can be seen that during the first three years current resource levels are capable of coping with the introduction of the new product due to network uplift etc reducing the repair work load of older products. But as the new product volume starts to increase more sharply in later years it is clear that the quality of service will start to drop unless resourcing and/or process issues are addressed.

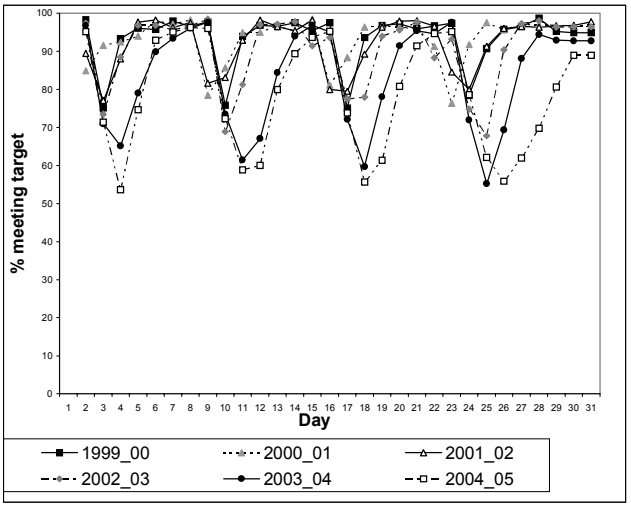

Figure 3: Quality of Service Results of Product Forecasts

The simulation allowed the transformation team to see the effect of many interacting variables on, in this case, the quality of service.

5.3 Conclusions on Use of VSA and Simulation in Business Process Transformation

The example discussed shows how VSA was successfully used in a service industry to identify and prioritise improvement initiatives. It also highlights the need to examine the whole end-to-end process and not focus on individual functional units. Many of the problems exposed were due to the interfaces between different functions and the cause-and-effect relationships that this produced.

In this application, simulation was the only realistic way to measure the effects of the various business scenarios. All parts of the process were dynamic in their behaviour and several variable changes needed to be experimented with in each run. The results were extremely useful in assessing the potential benefits of numerous business cases and were an invaluable aid in gaining acceptance and authorisation for business transformation.

It can be seen from this example that significant benefits were gained by using a static modelling approach (VSA) in conjunction with a dynamic approach (simulation). The former enabled problems and potential solutions to be identified rapidly, while the latter focused on testing the effectiveness of proposed solutions.

6 USING SIMULATION TO MANAGE RESOURCE BARRIERS

This simulation exercise formed part of an ongoing set of projects looking at the Private Circuit (Wideband) Provision Process within BT. This provision process covers a wide range of products in the digital private circuits

market. For the bulk of these provisions BT has a 30 day window within which a number of activities need to be completed. These activities include network and customer site planning, external and customer network construction, core network jumpering, exchange equipping and final tests, and service commissioning. As well as the type of product being provided there are a number of other factors which affect the provision time, and hence Quality of Service to customers.

For example a given product may be supported by a particular technology, such as fibre or radio, depending on the geography of the area in which the circuit is being placed. Also within a given geographical area activities need to be completed by a number of differing functional groups (such as Planning, Internal Works, External Works, Circuit Provision) that are specialised in a certain aspect of the provision process and have dependencies with other functional groups.

These factors, along with varying daily order volumes, dictated mainly by the customers, create a process that is difficult to effectively resource. One method to manage resources more successfully is by using simulation to highlight areas of high resource workload so that people or work could be moved in an effort to manage the varying work demands.

6.1 History and Aims of Wideband Projects

In a separate project to that discussed in the first part of this paper, the end-to-end process for provision of digital point to point services was modelled using similar techniques to VSA, so that cost benefits of various scenarios could be analysed. The simulation model of this process was built using PROMODEL's ServiceModel ®.

A detailed model of the provision process was built by capturing the key activities of the separate groups within BT that contribute to the overall provision process for private circuits. Historical order data were then used to analyse the effects of changing aspects of the process in an attempt to identify the most cost effective changes that could be made to the process.

From this detailed model it was possible to look at different aspects of the provision process other than cost. The rest of the chapter describes the modelling process that was used in looking at the resourcing aspect of the provision process. It is important to stress that this is a separate task to the detailed cost analysis but was built on the knowledge and understanding attained from that analysis.

The aim of the resourcing model was to effectively manage resources over a given geographical area so that Quality of Service measures never fell below BT requirements. This is shown in Figure 4. These graphs were produced from an experimental model which was built with a representative structure and inputs.

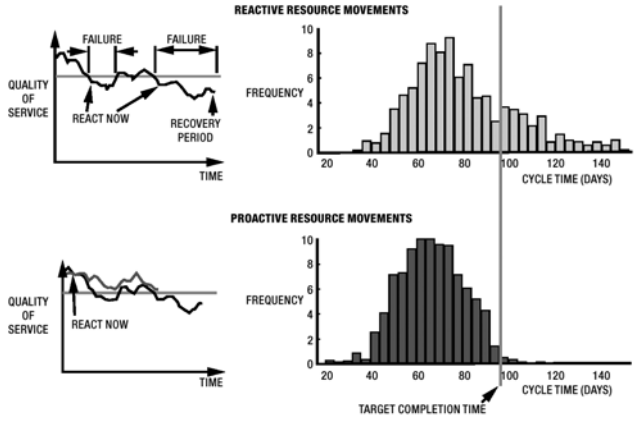

Figure 4: Managing Resources

The upper two graphs represent the current situation where resources are assigned to a particular area and are not able to move to balance workloads. The top-left graph shows the effect on a QoS measure of not being able to match resources to workload. This may result in a recovery period where the QoS measure is not adequate; its effect is also evident in the cycle time of the provision (top-right).

The bottom two graphs show outputs from the same model when resources are matched to workloads dynamically. QoS measures can be maintained (bottom-left) as the correct resourcing is allocated to the appropriate high workload areas and the cycle times are reduced (bottom-right) meeting BT's criteria.

6.2 Applying Reality

The following stages of this resourcing project involved applying reality to this experimental model.

In order to predict 'hot-spots' in resource workload, various forms of information and parameters needed to be applied to the appropriate degree.

BT currently has a system in place that manages the flow of activities needed for a successful Wideband Provision. This system tracks the status and dependencies of various activities from the first customer contact to the end-to-end test before the circuit is finally handed over to the customer. From this system a snap-shot of orders, already in progress, can be obtained on a daily basis. This allowed the model to be populated with a representative profile of work.

Also historical analysis was done on this snap-shot so that the model could be kept fluid by introducing future orders for the next month or two of simulated time.

Resource information for the different functional groups could also be fed into the model so that each area had the appropriate number of people for a particular day.

It was also necessary to model how the resources behaved for the diversity of orders which they were

required to work on; this being the clinch-point of the model.

Certain parameters of the order (such as the type of product being provided, status of the order, type of provide) all affect how much resource time is necessary to do a particular task. These parameters were used by the simulation to determine activity task times, how the simulation behaves, and hence the effectiveness with which the model highlights mismatches of workloads to resources.

Various stages of validation were carried out on the component information used and the overall model.

One important stage of validation was in terms of how the resources behave for a particular order as mentioned above. Due to the amount of information being used in the model on a daily basis a separate tool was created which enabled the users to view a specific workstack, or group of workstacks. An example of this is shown in Figure 5 and Figure 6.

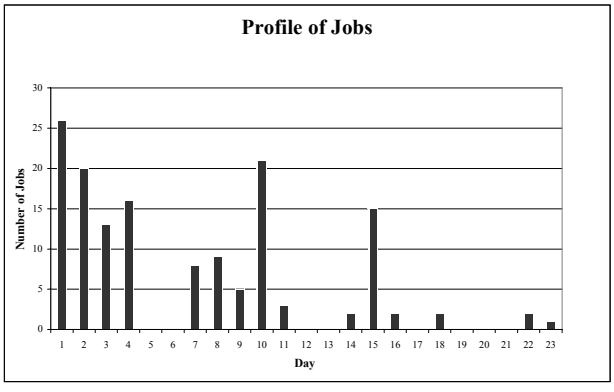

Figure 5: Profile of Jobs

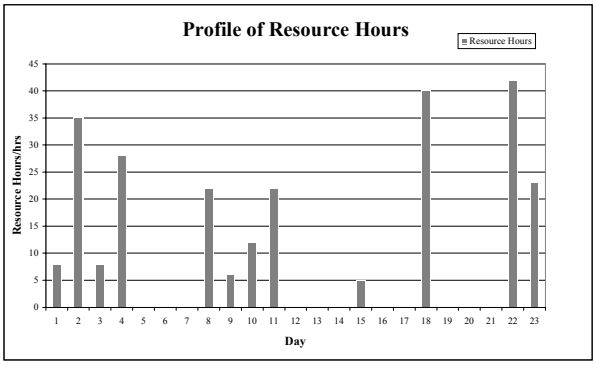

Figure 6: Profile of Resource Hours

Both these graphs show the same group over the same period of time. Figure 5 represents the profile of the number of jobs. However by using the tool the users could manipulate the affects of key parameters of an order so that a realistic resource timing for a particular job could be produced, as represented in Figure 6.

This stage of validation was not only crucial in terms of the model behaviour, but also getting the end-users of the simulation involved in establishing the assumptions which were being put into the model.

6.3 Conclusions on Use of Simulation in Managing Resources

This simulation is currently in development both in terms of the model and its use in BT.

Clearly, simulation provides a useful environment where many dynamic inputs can be used to answer a specific question. In this example, the simulation uses available information about existing orders, people availability and resource calculations on a geographical basis in order to highlight 'hot-spots' in workloads relative to resourcing. By developing this simulation the user will be able to experiment with differing resource profiles, changes in influx of work, or even activity times so that he/she can make a reasoned decision on how to tackle a resourcing problem.

Along with these functions of the simulation the entire exercise offers the user:

- a greater understanding of the key drivers in resource management
- increased resource effectiveness leading to lower unit costs
- increased dependability in terms of the decisions made
- improved customer satisfaction in terms of deadlines being met.

7 CONCLUSION

This paper has shown how simulation can be used in conjunction with static modelling methods to aid business process re-design. By describing two projects that have been performed by the Operational Design Group within BT, it can be seen that simulation is particularly useful for assessing the effectiveness of alternative strategies of business process design.

ACKNOWLEDGMENTS

The authors would like to thank all people involved with the Value Stream Analysis exercise, particularly Carole Jones, and the Wideband Process project teams.

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