

BUILDING THE BUSINESS USING PROCESS SIMULATION

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ABSTRACT

This tutorial looks at how process simulation can provide managers a powerful means to make better decisions in *building the business* through reengineering initiatives. An illustrative simulation model is used to demonstrate the powerful application of process simulation in reengineering. The model shows the order to delivery process (or order management) of a computer hardware manufacturer in the current state and in the future state-after reengineering. Using key performance metrics, managers can evaluate the benefits of various scenarios with the goal of building the business (increase throughput, increase revenue, etc.).

1 BUILDING THE BUSINESS THROUGH REENGINEERING

Hammer and Champy (1993) define reengineering as a *fundamental, radical* redesign of business *processes* to achieve *dramatic* improvements in cost, quality, service, and speed. Reengineering is required to address customer needs, competition, and change. The results of reengineering are higher productivity, lower costs, higher profitability, greater efficiency, and satisfied customers.

Reengineering is one of the ways managers build the business. Building the business involves moving the organization forward--creating greater value for customers. Reengineering to build the business may involve greater costs in the short term, but result in greater returns in the long term. Reengineering may be conducted in a crisis mode for survival or in a growth mode for strategic purposes. Managers are essentially trying to reinvent the organization or the way in which they do business. The focus of these efforts may be cost oriented in a crisis environment and value oriented in a strategic or growth environment.

Immaterial of whether it is a crisis mode or growth mode reengineering effort, determining how the new

organizational system will react is paramount to the success of the reengineering effort. Therefore, in order to build the business using reengineering, managers need to test whether the new redesigned system will function as required. Will it handle overloads well, what are its limits? To answer these questions, managers need to understand how processes in the system interact and influence each other under the constraints of external forces--the business environment. To ensure that the organizational system produces the desired results, managers need to balance a number of variables and understand the *trade offs* to be made. Balancing controlling variables appropriately and predicting how they will influence the business affects decisions made and actions taken.

1.1 A, B, and C Work

Managerial work may be broadly grouped under three categories (Figure 1), as suggested by Kurstedt (1992). A-Work: *Administrative work* includes all the daily activities managers perform in the management of institutions. These would include activities such as reviewing information, approving or signing off on projects, and so forth. B-Work: *Building the Business* includes all the activities managers perform to help the organization grow or remain in business--increase revenue. These would include tasks such as strategic planning, predicting market requirements, reengineering processes, and so forth. C-Work: *Catering to Crises* includes all the activities managers perform to fight fires. This would include activities ranging from delegating an absentee's responsibilities to someone else to meeting with shareholders to explain a sudden drop in share value.

The focus of this paper is on B-Work or building the business. According to Deming (1993a) "management is prediction". Building the business requires better predictions. Tools that help managers make better predictions, prepare them to make appropriate decisions which will help their organizations address the three Cs

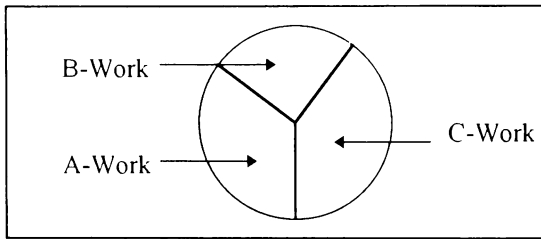


Figure 1: The ABC Model: Managers perform three categories of activities

(customers, competition, and change) of reengineering (Hammer and Champy 1993).

2 REENGINEERING AND PROCESS SIMULATION

Simulation is a powerful tool that managers can use to make better decisions. Those decisions are based on better predictions of how various controlling variables will influence the business system.

2.1 Process Simulation

Process simulation is a means of experimenting with a model of a real system to determine how the system will respond to changes in its structure, environment, or underlying assumptions (Harrell et al. 1992).

Simulation, by definition, provides a means to: a) experiment with the system, b) understand system responses to changes in the environment and c) being process oriented, simulation helps model interdependencies among activities, randomness in the system, as well variation in processes. It is thus an ideal tool for reengineering to build the business.

2.2 Simulation in Reengineering

Simulation, as defined above, is a powerful tool for managers to redesign, evaluate, and visualize business processes without running the risks associated with conducting tests on the real system. The tool helps managers study processes from a systems perspective, providing a better understanding of cause and effect in addition to allowing better prediction of outcomes.

In a reengineering effort, simulation assists managers:

Validate the Vision: Test whether the radical, redesigned processes are feasible. A simple model of the new system can be used to understand whether the new process or processes are feasible, thus validating the vision.

Analyze the Critical Path: Model the new processes

with a focus on the critical path and determine potential bottleneck areas and thus understand where resources may be required or capacity increased. This helps avoid the Braess Paradox, thus effectively improving the system.

Prototype the Process: Once the vision is validated, the system can be "prototyped" using simulation to understand its "tolerance" limits (testing for system's "tolerance" limits). A model with the appropriate level of detail can be used to understand system performance under specific "special" or "common" causes of variation. The system may be designed to handle common causes of variation, but simulation can help managers prepare the system for special causes of variation. (Refer "Out of the Crisis," by Dr. W. Edwards Deming for a discussion of common and special causes of variation).

Understand Performance Characteristics: Once a system is prototyped, further detailed analysis can reveal specific performance characteristics of the redesigned processes--"time to satisfy customer" or "customer waiting time". These metrics can be compared with the current state or best practices metrics as a benchmark.

Communicate the New Process: Once the simulation model is built, managers can communicate the new redesigned process to other process users. The animation feature available in most simulation software enhances the communication capability.

Simulation thus provides managers a means to evaluate the trade-offs of various scenarios, prioritize influencing variables and test their impact on the business system. This is a powerful means to experiment with various strategies to build the business.

2.3 Systems Perspective

Building a simulation model that includes various interdependent processes brings a very powerful analysis perspective to reengineering and building the business -- the *Systems* perspective. Understanding how processes will influence each other provides managers a better understanding of what to expect. Thus they can make better predictions and therefore make more appropriate decisions. This is key in ensuring the success of a reengineering effort.

3 SIMULATION -- THE TOOL FOR BUILDING THE BUSINESS

Simulation brings a process orientation to building the business. This assists in understanding *how* work gets done versus *what* is done (Davenport 1993). This is key to the success of reengineering efforts. Following is a

discussion of how simulation may be used to help build the business.

3.1 The Approach to Building the Business

Here is an approach that defines building the business

- Identify key value adding attributes that add value from the customer's perspective (to the product or service).
- Identify key processes that influence the attributes identified above.
- Examine the true value adding activities or attributes in the processes that can be enhanced through modification or complete redesign to create further value for the customer.
- Improve the processes as a whole, upstream and downstream.

Simulation helps address the approach outlined above by :

- Providing a means to test various scenarios to arrive at a close to optimal solution that addresses customer needs as well as the organization's.
- Providing a means to examine which processes contribute significantly to increasing value for customers and then analyzing them for improvement.
- Providing a model that can be used to continually improve processes that add greatest value to customers. Further, the simulation model also helps analyze new value adding processes as customer requirements change.

The following case study provides an illustration of how the above approach was addressed through a reengineering effort using simulation. Though the case is fictitious, the problems and approach to the solution are based in actual consulting engagements.

3.1.1 ABC Computer

ABC Computer Company is in the business of producing and supplying personal computers, software and peripherals to companies and individuals. They are primarily in the mail-order business marketing and selling to end users over the phone. Their market niche and differentiation is supplying high quality PC hardware and software to customers quickly and easily. They pride themselves on providing the lowest cost and highest quality, and being able to deliver customer specified computers faster than anyone else in the market.

ABC's business has grown tremendously over the last 24 months. ABC started as a "Mom & Pop" business in 1989 and has grown into a company with annual revenue exceeding \$150 million. They have historically

dealt with individuals and small businesses, but over the last 12 months the larger companies have become a larger percentage of their business, contributing to their rapid growth.

To remain competitive ABC must continually look to improve the way it does business. Because their business base includes larger and more sophisticated clients, they must prepare to meet increasingly high expectations. The task was to evaluate the order management process for ABC Computer. The streamlining of this process will do two things: the first is to reduce the cost associated with delivering and invoicing their products, and the second is to respond to customer demands quicker.

The order management process is broken down into three distinct sub-processes which include customer service and sales; manufacturing; and accounting and invoicing. The sales and customer service portion of their business is done almost exclusively over the phone. The direct customer contact is broken down into three distinct departments. These include: Customer Service, Technical Support, and Product Sales.

The customer service department takes care of all customer or prospect inquiries including things like delivery dates and billing questions. The technical support department takes care of current customers technical questions. They field a wide range of questions regarding the functionality of their software and hardware previously purchased through ABC. The Sales Department is where quotations are prepared and orders are taken. There are currently two separate sales groups each servicing different portions of the market. The BIR (Business, Institutional, and Retail) services large businesses, schools, hospitals and retail resellers; primarily the larger accounts. The ABC Contact group primarily deals with individuals and smaller companies. This current segmentation, ABC feels, allows processes to be more customized to the customers needs.

3.1.2 Problem

During the last three years, ABC has experienced annual growth rates in excess of 75%, in an industry where the typical growth rate has been 12%. ABC management is worried that this growth has strained their current process, specifically the order management process, and has the potential to stifle growth and deteriorate customer service levels.

Many of their current processes have evolved from old ways of doing business when they were doing 10% of their current capacity. Management feels that many of their processes and methods are outdated and are creating as many problems as they are solving.

Management concern has been prompted by reports

of the following problems:

- Customers on hold too long waiting to speak to associates (all departments)
- Delays in product ship dates
- Quality control problems in delivering customer specified equipment
- Increase in invoice error rates
- Excessive labor costs as compared to competitors
- Delays and errors in delivering quotations

Any process improvements that we propose and initiate should be aimed at one, if not several, of the problems stated above.

3.1.3 The Process

The following section details the “business rules” of ABC Computer’s order to delivery process. The bulk of customers initiate calls through one of ABC’s 800-numbers which funnel directly into a bank of operators. These operators are responsible for determining the customers needs and transferring them into one of the four departments: Business and Institution Sales (BIR), Direct Sales, Customer Service, or Technical Support. Depending on the availability of associates in each department, the caller may be placed on hold before actually speaking to an ABC representative. Data has been collected detailing the volume of calls that are directed to each department and the length of time it takes to complete a call to each functional group.

Within the Tech Support and Customer Service departments callers can normally be satisfied without any more contact. In the sales departments a series of other tasks must be completed either during or after particular calls. Some callers may call in requesting quotations on specific hardware configurations. In this case the sales representative must go prepare the quotation in an entirely different area and then return to his cubicle and continue answering sales inquiries. When customers call in and place orders, normally separate from issuing quotations, the sales rep takes down the information and completes an order form. These order forms are accumulated in a central repository where they are picked up every hour. The orders are then taken over to Central Processing where they are sorted by payment method and sales department, and the work order for each is issued to the shop.

The primary purpose of the Central Processing Department is to log each order into the system for tracking purposes and to issue the work order to the shop. This department is where each order is split into two components, the paperwork and the work order, which recombine to create the shipment to the

customer. Orders arrive here from the phone sales reps every hour.

The Accounting Department is broken into two distinct accounting groups, one for Direct Sales and one for BIR, each of which have a credit department and an accounts receivable department. The credit department takes every order and verifies that the customer is credit worthy. The accounts receivable department takes the order from Credit and issues the invoice for each particular order. The payment methods include credit card, direct invoice, or Purchase Order. Purchase Orders are only used for ABC’s larger business and retail clients where there exists a pre-approved pricing agreement. Credit card payments are only accepted for direct sales, and these payment types do not need an invoice to accompany the order (but they do need a credit receipt). Credit card payments create a receipt in the credit department and do not go through the Accounts Receivable department. Credit cards make up about 25% of the orders taken in the Direct Sales group.

Within the Shipping Department a verification of all orders is done, making sure that the invoice matches the corresponding shipment. In cases where either the paperwork is incorrect, or the hardware, it must be returned to the corresponding department to have the error taken care of. Once it is verified that everything is correct the package can be shipped along with the invoice or receipt.

While all the paperwork for each order is being processed the actual hardware must be assembled and inspected. The manufacturing is initiated through a work order created in the Central Processing department. Within the shop the time to assemble an order is directly proportional to the number of PC’s that the order contains. After each order is assembled an inspection occurs to verify that the hardware matches the customer order. Currently 15% of the orders have errors and must return to the shop to be reworked, this takes about 50% of the time it would take to assemble one machine.

3.1.4 Current State of the Order to Delivery Process

A simulation model of the current state (Figure 2) was built to help analyze the problems in the order to delivery process. The business rules were used to define various processes in the model. The model was validated using performance data from ABC Computer. The following process problems were identified, using the model and ABC Computer’s data.

- Quotes required sales personnel to leave their station and go to another desk. Time spent in going to another location to generate quotes was non-

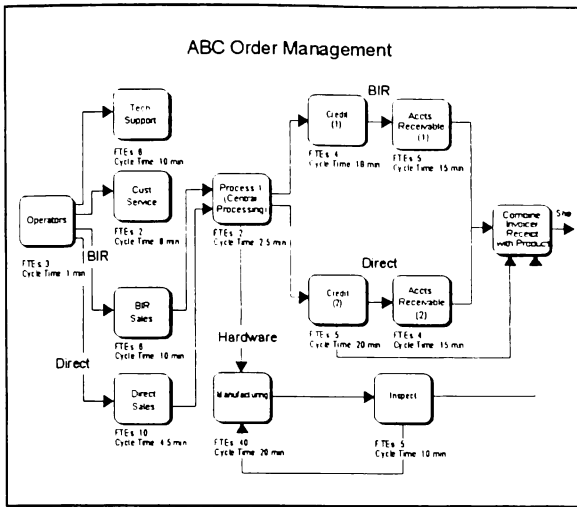


Figure 2: The ABC Order to Delivery Process

value-adding and inefficient as the customer was either kept on hold or called back later.

- Confirmed orders were being kept on hold for an hour and then sent to manufacturing. This added to the overall cycle time from order to delivery.
- Telephone operators were not efficient at routing orders appropriately. Customers were kept on hold for too long.
- Errors in manufacturing were creating rejects which delayed the time to ship customers' orders. Further, this process was excessively staffed.
- The credit checking/accounts receivable process was inefficient and overly staffed.
- Customer Service was poor, as customers were kept on hold for too long.

These problems led to the design and development of the future state model of the process.

3.1.5 Future State of the Order to Delivery Process

ABC embarked on a reengineering effort to build their business and remain competitive. Their primary goal was customer satisfaction. They used the time to ship a customer's order as a key metric to measure this customer satisfaction. This allowed them to translate the qualitative metric into a quantitative metric with which to measure their operations.

The order to delivery process was reengineered

(Figure 3). A simulation model was built to assist in the process of reengineering. The new "business rules" or processes are described here:

- First, the telephone operators were replaced with an Automatic Call Distribution System (ACD) that would automatically route calls to appropriate departments. This reduced the on-hold time as well as increased volume handling capacity. An FTE

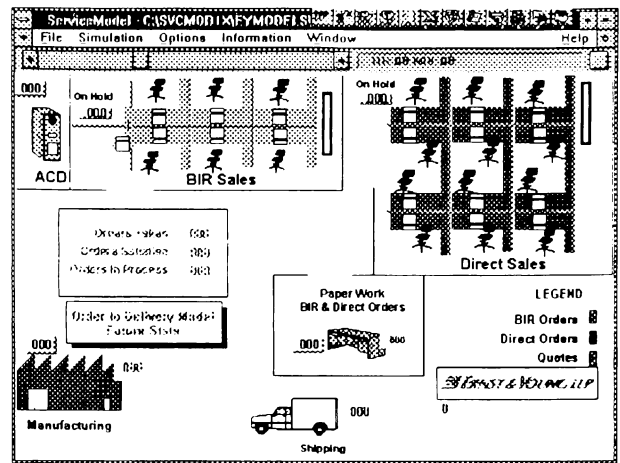


Figure 3: Future State of ABC Computer's Order to Delivery Process

was added at Customer Service reducing on hold time.

- New technology was installed to allow sales personnel to generate quotes at their desk and route work orders immediately to manufacturing. This eliminated Central Processing. This also eliminated errors in quotes and allowed customers to get their quotes almost immediately.
- Manufacturing instituted a TQM program aimed at zero defects, thus eliminating the need for inspection. FTEs were also reduced in manufacturing, eliminating redundancies in the assembly process.
- Accounts Receivable was redesigned, using technology and changing the way in which the AR function was performed. One process would handle direct and institutional customers. Databases were built and made accessible to AR so appropriate information was available in a timely fashion. This also reduced processing time. FTEs were also reduced due to consolidation.

3.2 Simulation as a Tool to help Reengineer the Business

The simulation models of the current and future states helped ABC Computer's managers examine the feasibility of the new reengineered order to delivery process and thus build their business. The future state model helped managers test the old environment in the framework of the new processes. Here is how the model helped:

- *Validating the Vision:* The initial future state simulation model helped validate the feasibility of the overall process flow. Having orders sent

directly to manufacturing versus batching them would effectively reduce overall cycle time. Also, having quotes generated at the sales reps' desks would help them answer more calls, thus reducing hold time.

- *Analyzing the Critical Path:* Critical path analysis showed that the ACD, BIR, Manufacturing, and Shipping were the critical activities in the process. Focus was thus placed on these critical activities for capacity improvements. Capacity was increased through the ACD, but Direct Sales was kept at the same capacity, though they received a larger percentage of calls.
- *Prototyping the Process:* Once the initial future state model was validated, further detail was added along with appropriate processing times. The model was then used to determine whether "common causes" of variation were being addressed. That is, whether the overall order to delivery process would perform at the required levels--could it handle the normal call volume? Further, the model allowed managers to test how the system would respond to sudden increases in phone calls due to a marketing effort--a special cause of variation in the system. They found that the system could handle a 22% increase in call volume.
- *Understanding Performance Characteristics:* The future state simulation model was used to analyze the order-to-delivery time or time to satisfy order metric. This was a key criterion in determining whether ABC Computer could effectively address customer satisfaction. Customer on-hold times were also measured and various time reduction alternatives examined.
- *Communicating the new process:* The animated future state simulation model was used to illustrate the new process to process owners. This communicated the new process flow as well as the advantages gained from the reengineering effort.

3.3 Simulation Helps Build the Business

Once the future state processes were validated and accepted as feasible, the model was used to help managers *build the business*:

- The model helped managers identify processes that were key to adding greater value to customers. The model helped improve these processes through increasing capacity, reducing on-hold time and also identifying training requirements for personnel to enhance the value added.
- Various "what if" scenarios were tested to examine

which of those scenarios would be most beneficial to the company and the customer. Using key metrics such as time to satisfy order and on-hold time managers were able to try various scenarios and test which would address various needs. The model thus helped arrive at an "optimal" "win-win" solution.

- The model was used on an ongoing basis to test and improve processes to help address the needs of customers as well as ABC Computer.

Simulation thus proved to be a powerful tool in the reengineering effort and also later in building the business.

REFERENCES

- Davenport T. H., 1993. *Process Innovation*. Boston, Massachusetts: Harvard Business School Press.
- Deming E. D., 1993a. *The New Economics: For Industry, Government, Education*. Cambridge, Massachusetts: MIT Center for Advanced Engineering Study.
- Deming E. D., 1993b. *Out of the Crisis*. Cambridge, Massachusetts: MIT Center for Advanced Engineering Study.
- Ernst & Young, LLP. 1994. Performance Series: Process Simulation Level II Case Study #2. Cleveland, Ohio.
- Hammer M., and Champy J., 1993. *Reengineering the Corporation: A Manifesto for Business Revolution*. New York: Harper Business.
- Kurstedt H. A., 1992. *Management Systems Theory, Application, and Design*: Working Paper, Management Systems Laboratories, Virginia Tech, Blacksburg, VA.
- Swami A., 1994. *Reengineering and Process Simulation, Information Brochure*, Center for Business Transformation Ernst & Young LLP, Cleveland, Ohio.

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