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THE USE OF SIMULATION IN PROCESS REENGINEERING EDUCATION

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ABSTRACT

The purpose of this paper is to show how simulation technology can serve as an effective educational tool to enhance the learning of process reengineering concepts. Three examples used at the Information Resources Management College, National Defense University are presented all of which illustrate the successful application of simulation to a process improvement. This paper also discusses lessons learned and implementation issues and explores the future of simulation in the classroom.

1 INTRODUCTION

In approaching the new millennium, industry and government are faced with a major challenge in ensuring a skilled, innovative work force that would strive for effective, streamlined operational processes. Significant improvements will still be needed to address our often-antiquated system processes. One way to address this challenge is to turn to our educational system and examine the paradigms and tools used to teach process reengineering.

This paper explains why simulation technology is an effective educational tool to enhance the quality of learning in the area of process reengineering. Three examples showing the application of simulation to a process improvement are presented. This paper also shares lessons learned that will help ensure others success in the application of this technology to their course plans. It goes on to explore the future of simulation in the classroom.

The strategies and ideas contained in this paper are based on experiences the authors have had while team-teaching courses in simulation for process re-engineering at National Defense University's Information Resources Management College since 1995.

2 SIMULATION IN THE CLASSROOM

Educators are on constant vigil for that breakthrough paradigm which would dramatically improve how a student thinks and learns. Simulation can offer that breakthrough by providing an exciting educational environment for communication, analysis, design, optimization, testing, and training. The Institute for the Learning Sciences was recently commissioned by the National Economic Council and Office of Science and Technology Policy to identify information technologies, which would support new effective educational paradigms and tools. The Institute stated that computer technology provides that new paradigm by supporting a learning-by-doing approach in various ways:

- Computer simulations make it possible for students to perform activities which would be too expensive or too dangerous to do in real life;
- Computers (and simulations) provide individualized coaching feedback which is economically more feasible than to provide a human teacher for each student; and
- Simulation provides tools to help a student conduct a structured preparation of case studies. It has been found that effective learning is significantly enhanced through the use of cases because students can easily relate to specific personal experiences over abstractions.

Gokhale’s study concluded that the integration of computer simulation into traditional lecture-lab activities enhances student performance. Guided computer simulation activities can be used as an educational alternative to motivate students into self-discovery and develop their reasoning skills. The simulation lab activity can then focus on the actual transfer of knowledge. This approach helps improve the effectiveness and efficiency of the teaching-learning process.

Process reengineering has been around for many years but received a high level of public recognition when Michael Hammer published his seminal paper on reengineering in 1990 and his book in 1993 which he co-authored with James Champy. Since then, industry and government have applied his philosophy, resulting in the more efficient and effective delivery of products and services.

Some of the main reasons why an organization would want to simulate business processes are listed below:

- Process in parallel
- Eliminate duplicate activities
- Combine related activities
- Eliminate multiple reviews and approvals
- Eliminate inspections
- Simplify processes
- Outsource inefficient activities

As part of process evaluation procedures, there have been a number of different approaches used to support the modeling of the baseline ("as-is") and envisioned ("to-be") approaches. Often, this has been done using static models such as Integrated Definition (IDEF) approach. Useful outputs from these models include (1) a clearer understanding of the business and its processes and (2) the identification of information requirements for use in data modeling. However, these models fail to capture the dynamic nature of the business, e.g., the behavior of processes over time is not clearly identified, resource utilization is not considered, problems of resource contention are not addressed, cycle time measurements are not included, and there is no provision for performing cost-benefit analyses. Also, the use of blocks, flowcharting symbols or static icons in these models do not effectively help managers and other stakeholders visualize the process.

The use of simulation technology, particularly, fourth generation discrete-event simulators, overcomes these issues by capturing the dynamic states of the system and providing the animation needed for effective visualization of the process. Examples of simulators include Lanner Group's Witness™, ProModel Corporation's ProModel™, and F&H Simulations' Taylor II™. These are data driven systems with little or no programming required. This approach is rapid, easy and supports animation. Most simulators include costing functionality as well, which permit cost-benefit analyses to be accomplished.

Gladwin states that simulation provides ways to model work flow and customer flow including parallel flows and the dynamic behavior of a business process. Realities such as random behavior, uncertainty and interdependencies of resources can be accurately modeled using simulation. Should there not be a requirement for the detailed modeling capabilities offered by most simulators, there are specialized tools that exist solely to support workflow.

3 APPLICATION OF SIMULATION IN THE CLASSROOM

At the National Defense University, three strategies have been found as most successful in illustrating process reengineering through the use of simulation. They include the following:

- Introductory BPR modeling
- Collaborative project
- Case study

3.1 Introductory BPR Modeling

In the students' first exposure to using the simulation tool, they are tasked with creating an as-is model of a small business (which contain serious operational problems), then re-engineering its process, and finally developing a "to-be" model reflecting the new processes.

3.1.1 As-is Model

A firm specializing in benefits planning and management sees about 40 clients per day who arrive at random times (no appointments) throughout the hours they are open. Clients enter the office and proceed directly to the reception area where they explain to the receptionist what they want. The receptionist directs the client to the appropriate staff member, if available. If the staff member is not available, the client is directed to the waiting area where they wait until the staff member is free. When the staff member they wish to see is free, the receptionist informs the client, who then walks to the appropriate office.

After meeting with the staff members, some of the clients exit the office while the others are referred to the Office Manager, who they will visit before leaving the office. Visits to the Office Manager result from difficult or special cases or complaints with the service they received. When completed, the model is used to assess the utilization of the staff members and the waiting times encountered by the clients as the system is currently operating.

3.1.2 To-Be Model

The model is revised to reflect the re-engineering of the process used in the small business. An integrated product team was formed and, after its thorough investigation and research, recommended the following: In lieu of specialists, have all of these employees cross-trained and available to serve any type of client. With this change, while service time for each "knowledge worker" and the

Office Manager increases slightly, overall throughput improves through the redistribution of workload. As with the previous "as-is" model, this "to-be" model is used to evaluate staff utilization and client wait times.

3.1.3 Findings

This exercise results in the student:

- Appreciating the ease of use associated with the simulation tool and how it can be used to identify operational problems visually and through generated statistics,
- Learning how to identify the critical performance measure used to compare alternatives,
- Identifying one effective approach for reengineering, namely, cross-training, and
- Learning the "people" issues associated with reengineering, and
- Discovers that certain simulation tools are better suited for specific applications, for example, ProModel's ServiceModel™ is for modeling service processes while the same company's MedModel™ is for medical operations and ProModel™ is for production processes.

3.2 Collaborative Project

Students have the opportunity to apply concepts learned in class to real-world situations, which they can easily visualize and relate. They are divided into small groups of 3 to 4 students (there should be at least one student with strong microcomputer skills) and assigned specific projects to review and analyze. Results of their analysis including recommendations are presented on the last day of the course.

Their instructions are as follows:

- Select one of the following projects described below.
- Examine and analyze the current business processes used. Collect all necessary data. Make all necessary assumptions throughout this project.
- Set up a simple simulation model that depicts the current layout and operations.
- Identify alternative processes, which address the management problem.
- Develop a simple model or models which simulates these alternative processes.
- Present your assumptions, findings and recommendations during the student presentations. Discuss any implementation issues.

3.2.1 Projects

NDU Cafeteria: The NDU Cafeteria provides meals for students, faculty and visitors to the National Defense University. The management is concerned about waiting time. A number of the customers (particularly faculty members) have complained that they need to get lunch quickly in order not to be late for classes. They would like to be in the cafeteria for no longer than 10 minutes before they receive their food.

Visitor Processing: When new students, visitors and guests enter NDU, they must undergo a procedure with security guards to check-in and receive their badges. Often, they are required to be met by a faculty member to confirm their identities. If the faculty member is not present, the guard calls the appropriate faculty member for confirmation.

Management has received complaints that on the first day of classes, the lines in front of the guards quarter get much too long. Faculty members would like students to wait only 5 minutes if they are there to greet them or 10 minutes if the guard calls the faculty member.

Help Desk: The National Defense University has a user support help desk that serves the entire faculty and student community on campus. They do not support on-site visits but instead users must send an e-mail message if they have a problem with their system.

The help desk has received many complaints from the users that it typically takes a whole day for the help desk to respond to their problem. In most cases, the problem is simple and straightforward such as the user forgetting their log-in password. Users want a one-hour turnaround time on their help requests.

Front Gate: The front gate to Fort Lesley J. McNair (the home of NDU) is located at P and 4th Streets in Washington, D.C. A steady stream of vehicles enters and exits the gate daily and at all hours of the day. During the morning rush hour, it is not usual to see up to 15 vehicles lining up to enter the fort. Because of this backup, private driveways adjacent to the entrance to the fort are blocked. Also, drivers in the queue get very impatient. They prefer to see a backup of 5 vehicles or less.

3.2.2 Findings

Upon the completion of these projects, students are able to:

- Identify the problems associated with conducting a simulation project. For example, the students always discover that collecting accurate input data is often a difficult task. Individuals are not always forthright in their answers when interviewed. Collecting data in full view may change the

behavior of the system. Converting raw data to continuous distributions require sophisticated tools and some knowledge of statistics.
- Identify the key techniques and potential pitfalls for initiating and sustaining a successful simulation project. For example, the students discover that the scope of the project has major implications on completing the effort on time. Some students wanted to model the entire university in order to study the behavior of the cafeteria.
- Assess the effectiveness of simulation in improving the process activities within an organization. The students are able to compare and analyze the "as-is" and the "to-be" states and identify areas of improvement.
- Apply their creativity in identifying possible "to-be" states. Some of the alternatives have been so innovative and potentially beneficial that they have been presented to managers involved in the real systems.
- Identify and assess approaches for presenting simulation results. For example, in presenting their simulation results, students are often faced with the audience focusing on the lack of fidelity in the model and not on the actual process being illustrated.

3.3 Case Study

In the previous two applications of simulation in the classroom, the students create actual simulations. In this application involving a case study, they are provided with a model of the “as-is” situation and use it to gain insights into the causes of the problems being experienced. This approach was taken since the fidelity of the model required to achieve credible results necessitated the use of more sophisticated modeling techniques than the students could accomplish.

The case itself involves a supply depot that has been tasked to handle a significantly higher volume of traffic than it was designed and staffed for – not an unusual situation as organizations try to do more with less. By running the model, students can determine causes for processing delays and less than optimum use of resources. Based on the authors’ own analyses as well as numerous previous classes suggestions, a number of potential “to-be” process improvements have also been modeled. These models are provided to the students after they have wrestled with conceptualizing improvements. The models were created using ServiceModel™ and represent the expenditure of somewhere in the neighborhood of 40 hours of time by one of the authors.

3.3.1 Description

Students play the role of the Assistant Department Manager of a Department of Defense Supply Depot Receiving Department who works directly for the Receiving Department Manager.

The Supply Depot is divided into five departments consisting of Receiving, Storage, Shipping, Inventory Management and Support Operations. Each department has a department manager who reports to the supply depot director. Each department operates as a cost center. It must charge a sufficient fee to recover all costs directly associated with the operation of the department. A special amount, determined by the percent of labor hours per department, is assessed each department to cover the overhead or indirect expenses associated with the operation of the Supply Depot.

The primary purpose of the Receiving Department is to take initial receipt of all shipments arriving at the depot by motor carrier. The motor carrier shipments consist of less-than-truck load, bulk and full truckload. The receiving area has 8 bays that trucks back into to unload. The receiving bays are open from 7:00 AM until 6:00 PM. It is not unusual to have 25 to 30 trucks lined up waiting to unload on a first come, first to unload basis. This line consists mostly of common carriers, but also includes a large number of parcel delivery and courier companies all competing for a receiving bay to unload a shipment.

The Receiving Department Manager returns from the Depot Manager's weekly business review and states that the Depot is working with too few people, has too many incoming shipments, is always behind in processing, and now each department, including the Receiving Department, is faced with another budget cut. The Deputy Depot Manager's idea is to create a business process reengineering team that will help the Receiving Department identify possible improvements to reduce costs.

The first task as the head of the Receiving Department's business process reengineering team is to gain a clear understanding of the "as-is" receiving process. The team will gain this understanding by analyzing available information, interviewing other employees as needed, and then modeling the "as-is" process.

Having completed the modeling of the "as-is" processes within the Receiving Department the next task as the head of the business process reengineering team is to critically examine the "as-is" receiving process that has been documented. The students should seek to identify the most critical problem areas and achieve collective agreement on which problems are most important, from a business-wide perspective.

The team next identifies a number of areas in which performance improvement must occur and produces a prioritized list of process problems. Benchmarking is used to indicate the level of improvement that can be expected in any particular area. Students then suggest possible process improvements and to examine these improvements in a manner that provides a good level of confidence that the claimed benefits can be achieved in practice.

The students first use IDEF modeling approaches to create the "as-is" and "to-be" scenarios using flipcharts or whiteboards and then are exposed to the use of discrete event simulation. Students discuss the advantages of simulation over static modeling techniques such as IDEF. (There are tools available to convert IDEF models to dynamic simulation models, namely, Meta Software's WorkFlow Analyzer™ toolset.)

3.3.2 Findings

- Students received a true appreciation for the dynamic nature of simulation and how it is much more effective than static modeling techniques.
- Students learn and understand the value and effectiveness of simulation within a collaborative team environment. The synergy resulting from a collection of minds resulted in creative solutions to improve an inefficient process.
- Students learn about the value of simulation in terms of creating models which representing benchmarked processes.

4 LESSONS LEARNED AND ISSUES

- Simulators are easy to use and can be used to create applications in a matter of hours.
- Although some students are not technically astute with the computer, working in a multi-disciplinary team usually overcomes this problem and their contribution to the simulation effort is often significant.
- Occasionally, individuals involved in the systems modeled do not want to participate in the data-gathering phase. This forces students to come up with creative approaches to collecting the necessary information they need for the project.
- Students find it as an exciting challenge to develop simulations because they are often goal-oriented; however, some get carried away and spend inordinate amount of time working on their projects. For example, some spend too much time on getting the visual aspect of the simulation correct such as the fidelity of the graphical setting of the simulation.
- Simulation supports collaborative efforts by providing an environment where personal perspectives and experiences about a specific process can be shared and discussed. Students can relate to real world processes and approaches brought forth during a simulation project.

5 FUTURE OF SIMULATION IN THE CLASS-ROOM

- Internet **-** The Internet offers opportunities to make available simulations to a global audience.
- Collaboration **-** Team simulation in which the participants located remotely are connected either synchronously or asynchronously will help overcome geographic barriers sometimes associated with system development. Participants could include a spectrum of stakeholders and model designers.
- Virtual Reality **-** Some simulators are now incorporating virtual reality (VR) technology into their software. For example, Witness™ now has a VR plug-in while Deneb markets a package called Quest™.

6 CONCLUSIONS

Simulation has proven to be an effective educational paradigm, which allows the student to be more innovative and creative in developing new ways of doing business. This tool provides a sound analytical tool for evaluating the various alternatives and presenting the results to stakeholders. Simulation offers educators much potential in providing the next generation work force an effective means to improve systems processes well into the 21st century.

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