Proceedings of the 2003 Winter Simulation Conference
S. Chick, P. J. Sánchez, D. Ferrin, and D. J. Morrice, eds.

A METHODOLOGY FOR MODELING FRONT OFFICE AND PATIENT CARE PROCESSES IN AMBULATORY HEALTH CARE

Bradley P. Morrison

16 Lafayette Street
P. O. Box 58
Cost Control
Palatine Bridge, NY 13428, U.S.A.

Barbara C. Bird

222 Guideboard Road
#175
Bird Consulting Group Inc.
Clifton Park, NY 12065, U.S.A.

ABSTRACT

Although discrete event simulation has made significant progress in the health care field, it has been tested primarily in hospitals and specialty clinics. Our mission was to assess the effectiveness and economics of simulation in free standing ambulatory health care settings. Our findings to date indicate a good fit of simulation tools for the objective of total business process improvement. In addition to the simulation tools, we used other hardware and software solutions to meet the special needs of small businesses such as small health care providers. Critical success factors for the project were visual mapping and simulation tools, extensive energy and time in process and resource mapping, data collection methods, technologies that minimize on-site time for client and consultant, and the importance of having a clinical healthcare professional on the consultant team. The techniques detailed in this paper can be applied to diverse simulation projects for effective results.

1 INTRODUCTION

1.1 Background

Simulation in hospital and other ambulatory clinic settings has been applied with success (Benson; Merkle 2000; Montealegre, Pachon and Mehmet 2003; Weng and Houshmand 1999). Specialized software packages targeting emergency rooms and other operation issues at large institutions is well documented (Schroyer 2003). The techniques employed in the referenced projects such as routing by patient type and block-scheduling scenarios was utilized in this project model. This paper deals with the implementation issues of customer education, communication, and implementation tactics of simulation in freestanding, ambulatory health care facilities.

The two medical practices discussed here, although serving different patient communities and following a different business model, each displayed the need for incremental process improvement techniques, of which simulation was only one element. Testing scenarios of changes in process methods, equipment location, resources, schedules and the like without major physical investment and risk is a key objective in the application of simulation. Application to the freestanding, ambulatory health care settings unearthed some challenges to implementing simulation as a problem-solving method.

The flow diagrams, work study data collection hardware and software, simulation models and results will be included in the conference presentation.

1.2 Critical Success Factors

Whenever a small business implements a business-improvement project, lack of time and maintaining staff resources to deliver services is a major issue. We found the two practices already in different stages of process measurement and improvement. Our offering of simulation as a process-improvement tool proved to be a catalyst for their operations improvement process.

Small, incremental project steps with quick turnaround in information to the practice management are critical to successful implementation of simulation tools. Visual information such as flowcharts, animated simulation graphics, and mouse commands for work-study data collection proved critical in client and consultant communication.

The level of detail in process mapping involved more work than anyone estimated. It became obvious that this level of process, activity, and task definition was the only way to correctly load work to all company resources. The client made quick improvements in operation procedures as a result of the process-flow diagram activity.

Decisions resulting from simulation models are very dependent upon good data. Cost effectiveness in defining and collecting the data must be included in the definition of good data. We incorporated a new work-study tool that is based on common personal digital assistant (PDA) hardware operated by screen-touch commands. The tool met our objective of both limiting on-site time and being able to track multiple events during a given time frame.

Small businesses, especially small medical facilities, are unable to devote sufficient staff time to major operations improvements. Therefore, working in small blocks of time proved effective, but created a special need for off-site, on-line tools for flow diagramming, multi-event measurement capabilities in data collection, and visual on-line simulation software.

Our consulting team's combined deep expertise in industrial engineering and ambulatory health care clinical and process improvement proved critical to client acceptance of simulation. The clients embraced the new problem-solving software and tactics, but the communication with a seasoned clinical health care consultant proved crucial in communicating clinical process and business issues.

2 AMBULATORY HEALTH CARE

Ambulatory health care is provided in a wide range of settings. This study is focused on freestanding ambulatory health care and does not address providers such as emergency departments, outpatient departments, or day surgery within hospitals.

The scope of the application to ambulatory care capacity has been confined to freestanding ambulatory health care providers. According to estimates from The Joint Commission on Accreditation of Healthcare Organizations (JCAHO), there are more than 12,000 such provider groups in the United States (Cullinan 2003).

This comprehensive, but not all-inclusive, list from the Joint Commission includes ambulatory-surgery centers, community health centers, group medical practices, Indian health clinics, military clinics, mobile services, multi-specialty group practices, occupational health centers, office-based surgery facilities, physician's offices, prison health centers, and student health centers. One of the project practices is among the 900 such facilities in the United States.

The first client is a not-for-profit, publicly funded women's health center in a small college city. The majority of the clients are women, but services are also provided to men. The annual number of patient visits is approximately 7,800 and the total full-time health care staff is approximately 11.

The second client is a for-profit, physician-owned family medicine practice in a suburban community. The practice participates in a medical group management organization, but decisions about the practice are made at the practice level. The annual number of patient visits is 26,000. The staff of this practice totals 28, but many of these are part-time positions.

3 WHY SIMULATION?

Both clients enthusiastically supported the idea of testing performance improvement options in patient scheduling, resource scheduling, physical resource requirements, and operating procedures. There are so many permutations of product delivery options in any given hour or day that spreadsheet software, queuing theory, and process improvement tactics like value stream mapping seemed ineffective in determining outcomes to process and resource changes. The high level of process event interdependencies with equally high statistical variation deemed simulation as the most robust and efficient diagnostic tool (Kaplan 2002).

The primary objective for each practice was to improve total business effectiveness by identifying bottleneck conditions that limit resource utilization. Each practice was also concerned about issues of patient satisfaction. Patient throughput was an objective for one client, but bottlenecks and resource utilization were still the main issues limiting performance potential. A secondary objective of combining these projects was to test the opportunity to standardize the ambulatory care model thus defining a robust project methodology that can be quickly applied to other freestanding practices and clinic types.

4 DEFINITION OF PROJECTS

Originally, clinical activities were to be modeled at the women's health center. However, following an on-site visit and meeting with the process-improvement team, it became evident that front office activities needed to be incorporated into the model because clinical and front office activities have a measurable effect upon each other. Because a significant percentage of the patient population is unable to pay for services, the client was concerned about increased services and reduced funding levels. The facility needed to do more with the same, or possibly diminished, revenue. Thus financial considerations were added to the study.

The family medicine practice client was interested in understanding the demands on front office resources. The financial and the clinical areas were not an immediate concern. There were concerns about both operational and quality issues with front office procedures. The goal with this client was to demonstrate the workload in the front office, the effect this workload has on other aspects of the operation, and possible scenarios for improvement.

We used the ten-step model building steps developed by Visual Thinking International (Concannon 2001). Each step was defined, revised and agreed upon with the client in a written project plan. Some steps were combined, where appropriate and economical. The project plan was critical in defining goals, constraints, resources, decision makers, and project timetable. Software tools were defined, and the time on-site and off-site was estimated so clients could allocate personnel accordingly. It is interesting to observe that both clients encouraged a significant level of planning detail in order to feel comfortable with the project.

5 KEY PROJECT TACTICS

5.1 Visual Techniques

Typically fear is the first hurdle to be jumped when introducing any new technology in a work environment. Our clients wanted to know, "What is simulation and how can it help me?" Additional concerns, stated or implied, are how long will it take, how much will it cost, and how much time will this take away from my staff's day-to-day responsibilities?

We prepared for these questions by using animation, a key attribute of the technology. We designed a set of simple models that showed the major processing events for a patient visit. This made it easy for the client to literally see the patient flow. As a result, the clients asked very good questions about changing staff levels, event times, patient-schedule hours, routing, and the like. We were able to respond to their questions quickly and continue the discussion.

The first demonstration model did not have any statistical variation in patient arrival or event duration times; there were also no resource constraints. The second model had statistical variation, but still no resource constraints. The third model incorporated all the above conditions. Clients literally saw the power of simulation as they observed the drastic change in results from model to model.

Additionally, we included flow diagrams or flowcharts of processes with major headings for patient and non-patient activities. By changing some of the steps at will, we were able to show how the flow diagram automatically changed and how resources and other pertinent data could be easily documented and revised.

Within the first half hour of the presentation, we demonstrated how appropriate data could be collected without requiring many additional hours of staff time recording numbers. We used a PDA to demonstrate how a work study can be executed without writing a single number. Moreover, either consultant or client could do the data collection and email the Excel data file.

The simulation tool was made realistic by using digital photographs of work sites and employees as icons in the simulation model. Again, we used a visual tool to support effective communication between the client and the consultants.

5.2 Flow Diagram

Once the project goals were defined, it became evident that the success of the model depended upon identifying those tasks that totally absorbed the resources for each day of business. This process took approximately 40 hours of consultant time and spanned almost three months.

To meet the diverse client objectives, the level of detail in the events and resource definition was quite different for the two facilities. The women's health center required a macro level of activity definition that encompassed general administrative, or front office tasks, and clinical tasks including exam room, laboratory, restroom, and administrative activity loading. We made separate process maps for patient and administrative events and showed the interrelationships between tasks and resources.

The medical practice required great detail for the administrative events on the flow diagram, but no patient events were shown. There are a significant number of administrative off-site events driven by clinical services such as referral procedures, laboratory, and other patient information management with other practices. It was clear that this task load was not realized by clinical personnel, but was critical in patient processing. We noted that any given task typically requires immediate implementation thereby blocking resources from other activities.

For both facilities, patient processing starts at least 24 hours before the patient arrives and continues for days or even weeks after they leave. Patient check-in and check-out, patient calls, referral calls, and paperwork into and out of the office, billing, and prescription fulfillment are just a partial list of resource-intensive tasks. Health Insurance Portability and Accountability Act of 1996 (HIPAA) regulations added another layer to the list of administrative requirements.

In each project, the client made adjustments, sometimes iterative changes, to their process as a result of the flow-charting phase. The process also united the team members in communicating their responsibilities to co-workers. As a result, process improvement occurred without simulation, and thereby strengthened the remaining steps of the business-improvement project.

5.3 Data Collection

The model required data distributions for tasks associated with telephone calls, medical records, clinical, and business paperwork for patients. But time data for these tasks did not exist, thus more thorough data-collection techniques had to be implemented.

The women's health center had been through a series of Patient Flow Analysis, which is a DOS-based software program developed by the Centers for Disease Control and Prevention. The program reported statistical analysis of process time variables such as patient slack times and staff utilization for direct face-to-face contact with the patient. One or two days of patient data logs formed the data input. This did not give statistically valid information for day-to-day and week-to-week variation, and did not show the effect of non-patient work items.

The need for three types of data collection became evident and created a project-implementation challenge. The three data types were patient activities directly with administrative and clinical staff, non-patient contact time that consumed staff time, both clinical and administrative, and on-site non-patient activities such as mail prescription programs, appointment scheduling, and reminder calls.

The challenge was how to get this data without spending an exorbitant amount of time on site. We solved this problem by using PDAs and software that could record multiple events at one time and be used for elapsed-time events as well as random samplings of event occurrences.

5.4 Time-Efficient Project Tools

Great ideas meet their mark only upon successful implementation. Vince Lombardi had it right—execution is everything. A key business goal for the authors was having enough medical practice projects over a period of three years to make a return on our collective investment in software, know-how, and project time. We literally could not afford to spend days on-site and invest in multiple plane fares; furthermore, the client was never able to spend more than two hours with us in any given week.

The solution was to develop a set of tools that could be implemented in small time blocks without requiring significant resources on site. The flow diagram, simulation, and work-study software all met these requirements. The client could view, but not revise, the flowchart and simulation model and give us instant feedback via email. These tools also permitted the client to review on their time schedule, which was much more effective than scheduling limited staff for a two-hour consultant visit.

Although the project elapsed time spanned months, actual on-site time was a matter of only a few man-days. The remote process was clearly understood and well implemented by all parties and met the objective of the project plan.

It is interesting to observe how many diverse contemporary technologies made this project viable. Personal computers, visual type of software—especially the simulation software, email, spreadsheet and word processing software, personal digital assistants, and web-based communications are the new way of conducting business for any size organization. Technologies like line-code simulation software and stop watches are not as client friendly nor as effective in business process improvement projects.

5.5 Consultant Team Organization

Simulation, in effect, is a communication tool. The ultimate communication is person-to-person. The consultant team of a seasoned clinical and operations manager health care professional, Barbara Bird, combined with industrial engineering expertise, Brad Morrison, proved successful in project communications.

Bird's experience enables her to understand the unsaid issues in the client's business. She handled the entire client interface, including process mapping and data collection.

Morrison was able to quickly distill the information into quantitative form. Jargon and engineering vocabulary were kept to a minimum. Both clients were attuned to technical issues and became proactive in solving root-cause issues.

In all consulting projects of this type, management does not have time to educate consultants on the basics of their businesses. We were able to keep client time productive because we combined specific health care expertise and with skilled engineering resources.

6 SUMMARY

Although it is tempting to have an impressive simulation up and running quickly, it is probably the shortest road to disaster. The first important step is mutual agreement on the processes to be modeled. The second critical step is meticulous collection of information for the flow chart and time study. Validating the accuracy and completeness of each task and its component activities was the slow part, but the most essential part.

The process definition and data collection phases strengthened communication between the two parties, built trust, and clarified the steps in many tasks. It was satisfying to see the client staff teams identify weaknesses in their current systems as they stepped through the definitions and flow-chart process. As they identified improvements, they could either implement them immediately or elect to see them in a simulation.

A significant goal for the consultants was to develop standardization for future models to avoid major learning curves with each new client. The consultants needed to have confidence in their methodology, the software and hardware, and the marketability of this consulting service. The consultants can use the methodology described here for continuous process improvement with clients at many levels. It can be used for both short-range and long-range consulting agreements.

REFERENCES

Benson, C., Discrete Event Simulation Helps Pre-Surgical Clinic Reduce Personnel by 2 Full-Time Employees, Freeman White Associates, Charlotte, NC, U.S.A.

Concannon, L. 2001, *Simul8 Training Course Manual*, Visual Thinking International, Toronto, Ontario, Canada.

Cullinan, J. 2003, E-Health Information Products, Division of Support Operations, Joint Commission on Accreditation of Healthcare Organizations.

Kaplan, C. 2002, The Millions that a Major Computer Manufacturer Almost Saved, *Proceedings of the 4th Annual Simulation Solutions Conference,* Institute of Industrial Engineers, Norcross, GA, U.S.A.

Merkle, J. 2000, Computer Simulation: A Methodology to Improve the Efficiency in the Brooke Army Medical Center Family Care Clinic, *American College of Healthcare Executives,* Chicago, IL, U.S.A.

Montealegre, L., J. Pachon and A. Mehmet, 2003, Customer Satisfaction Improvement: Waiting Time Reduction Through Scheduling Implementation, *Proceedings of the 2003 Society for Health Systems Management Engineering Forum,* 153-160, Institute of Industrial Engineers, Norcross, GA, U.S.A.

Schroyer, D. 2003, Crisis in the ED-How to Resuscitate Profitable ED Performance, *Proceedings of the 2003 Society for Health Systems Management Engineering Forum,* 117-129, Institute of Industrial Engineers, Norcross, GA, U.S.A.

Weng, M. and A. Houshmand, 1999, Healthcare Simulation: A Case Study at a Local Clinic, *Proceedings of the 1999 Winter Simulation Conference,* P. A. Farrington, H. B. Nembhard, D. T. Sturrock, and G. W. Evans (eds.), 1577-1584.

AUTHOR BIOGRAPHIES

BRADLEY P. MORRISON is a consultant specializing in profit and cash-flow improvement projects, discrete-event simulation, management and industrial engineering, and turnaround management. He is president of Cost Control, a consulting firm located in Palatine Bridge, NY. Brad worked for Eastman Kodak Company, Remington Arms Company, and Gray-Syracuse. He received a master of business administration from Syracuse University, a master of science in industrial and management engineering from Rensselaer Polytechnic Institute, and a bachelor of science in mechanical and industrial engineering from Clarkson University. He is also certified in Production and Inventory Management by APICS. He can be contacted by email at <costcontrol@frontiernet.net>.

BARBARA C. BIRD specializes in consulting services to health care management, helping the health care professional identify and solve the problems of practice management. She is president of Bird Consulting Group, Inc. in Clifton Park, NY. Prior to establishing her own consulting practice, Barbara was a consultant nurse in the Bureau of Reproductive Health of the New York State Department of Health and a clinician and Director of Family Planning in Greene County, NY. She has specialized experience in conducting patient-flow studies, program evaluations, writing and evaluating grant applications, developing staff job descriptions and policy and procedure manuals, and patient-education materials. Barbara holds a bachelor of science in nursing from the University of Michigan and is a certified nurse practitioner in Women's Health. She can be contacted by email at <BCBird6537@cs.com>.