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BARRIERS TO IMPLEMENTING SIMULATION IN HEALTH CARE

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ABSTRACT

The members of this panel were asked to provide their perspectives on the barriers to implementing simulation in health care, and how to remove them. Some common barriers are presented throughout the discussions, such as the variety of players in the health care field and their different priorities, as well as their lack of familiarity with the process and terminology of simulation. However, each discussant lends a slightly different perspective to the problem.

Brian Hakes focuses on the incentives in the health care industry and on health care managers' traditional reliance on simpler, deterministic analytic techniques for decision-making. Lou Keller discusses health care administrators' and providers' resistance to the unfamiliar and dehumanizing nature of simulation. William Lilegdon presents the argument that the traditional role of management engineering in hospitals does not foster the use of simulation. In addition, the number and variety of customers/decision makers in health care present competing priorities for the solutions suggested by simulation. Kal Mabrouk explains that management engineers can improve the promotion of simulation by "rounding out the edges" on their technical skills. Finally, Frank McGuire emphasizes the importance of implementing the recommendations from simulation experiments, and discusses the executive's and project manager's role in the implementation process.

INTRODUCTION

Why has the health care industry not taken more advantage of the benefits offered by simulation? It may be that, in general, health care providers are reluctant to embrace computer-based models of patient care processes, because these processes are simply too complicated to be reduced to representation by a model. After all, the occurrence of illness is a random event, each patient is different, and tremendous variability exists in the quantity and types of services provided. Furthermore, many different care givers and departments must interact with each other to provide the required care. But rather than an argument *against* simulation, these concerns sound more like an argument *for* the use of simulation, do they not?

So why do health care administrators and providers seem more reluctant to embrace simulation than professionals in the manufacturing field? What are the barriers to implementing this technology in health care, and how can they be overcome? Five discussants have been asked to respond to this question: two from simulation software companies who have developed specialized products for health care (Lou Keller from ProModel and William Lilegdon from Pritsker); two management engineers from multi-hospital corporations who are responsible for implementing simulation projects in their organizations (Brian Hakes from OSF Healthcare System and Frank McGuire from SunHealth Alliance); and one consultant who has experience in implementing simulation as a solution in a variety of industries, including health care (Kal Mabrouk).

The panelists were encouraged to try to make their remarks controversial, if possible, to encourage discussion during the Conference. So, don't be surprised (or offended) at the strength of each author's convictions!

PANELISTS

Brian Hakes, OSF Healthcare System

Computer simulation can be an effective tool for operational and financial analysis in the health care industry, because so many of the processes of health care delivery are stochastic. Simulation has been used in clinical research, as well as in hospitals to help in decision-making for scheduling, capacity requirement planning, forecasting and financial applications (Pritsker 1986). A review of the literature shows that simulation applications in health care began to appear in the 1960s. While this management tool has been around for thirty years, its acceptance in health care has been limited. Simulation work in hospitals is sporadic. Simulation articles are published in technical journals, but are infrequent in the professional journals read by hospital administrators and managers. Two reasons help to account for the slow acceptance of the use of simulation in hospitals. One reason is the lack of incentives, and the other is managers' continued dependence on deterministic decision making.

Before the implementation of prospective payment systems such as Diagnostic Related Groups (DRGs), reimbursement to hospitals was based primarily on costs, thus providing an incentive to expand services. Hospitals were "price makers"--they could essentially set their own prices (because health care expenses were reasonable) and pass all costs on to the payers. Furthermore, to be competitive in this environment, each hospital had an incentive to match and provide the same services as others. There were few incentives to provide services as efficiently as possible, thus precluding the need for a tool such as simulation, which is most frequently used for determining the efficient allocation of scarce resources.

While there were some attempts in the past to control the duplication of services and proliferation of expensive capital medical equipment, the analytic methods used for this purpose tended to be deterministic and relatively simple. The early to mid-1970's saw the establishment of State Planning Agencies, HSAs and Certificate of Need legislation. Their purpose was to monitor, review, and control the expansion of services and increased capacity. Data used for analyses consisted of aggregate historical information. The information was compiled as operating ratios for comparative analyses. Requests for expansion were approved as long as hospitals met certain threshold or operating criteria. There was no need for detailed analyses. Once the project was approved, it was price making as usual. Hospitals were not indifferent to rising expenses; there was simply little incentive to control them.

Perhaps because there have been few incentives in the past to use a sophisticated analytic methodology (like simulation) for improving the efficiency of operations, health care managers have instead relied primarily on simpler, deterministic analyses. Common control systems consist of databases of comparative information. Financial and operating ratios are compared across departments for similar hospitals. The obvious outlier is noted and the exception reviewed. A discrepancy is usually reconciled or justified. The resulting analysis can beg more questions than it answers.

One possible reason for the prevalence of deterministic analyses is that hospital administrators and managers are not well prepared to deal with operational issues. While at Trinity University, Dr. John Coventry evaluated the adequacy of Masters in Health Administration programs for teaching analytic skills required for administrative decision making. Dr. Coventry acknowledged these programs address basic statistics and regression analysis. There may be some exposure to operations management, but there is little if any instruction regarding queuing or other operations research techniques. The training and education of administrators and managers does not prepare them for the ideas underlying computer simulation. Only with experience will they begin to appreciate the uncertainty and variability that computer simulation can mimic.

However, the incentives in the health care field are changing. The rapid growth of managed care plans shows the direction of the health care industry. Providers are positioning themselves with alliances and mergers, and the impetus is to better manage their institutions. Hospitals' concern with market-share has led to increased price competition. They are now becoming "price takers"--the *payers* are determining the prices they will pay--and are seeing their gross margins erode. This change will provide hospitals the incentive to impose tighter controls on operations (Hancock, 1976). Hospitals must improve upon their management of resources and expenses. Simultaneously, they must better quantify service levels and evaluate alternatives. This environment will emphasize the benefits of computer simulation.

In addition, vendors have done a good job of making computer simulation more accessible to practitioners. For a small investment in hardware and software, discrete event simulation is available to professionals involved with operations management. One major milestone in simulation software is animation. This illustrates existing and proposed alternative scenarios. To those who are unfamiliar with simulation but are familiar with the process being modeled, animation will provide better comprehension of the underlying relationships (Bodtker et al., 1993).

Animation also offers the benefit of a graphical depiction of the network being modeled, including the flow of entities, service times, queues, decision rules, etc., which is critical to decision makers who have a limited understanding of the process being modeled. The depiction of entities flowing through a process where it is interrupted by discrete events shows decision makers the flexibility of computer simulation.

To further improve the acceptance of simulation in health care, simulation output should include operating ratios or performance measures routinely used in the organization. A reduction in cost, increased productivity, or improvement in service should, whenever possible, be reduced to simpler measures that are familiar to decision makers (Jacocks, 1989).

In conclusion, managed care and capitation will provide the incentive for operations improvement. Administrators will find computer simulation to be the tool for improving operations that can best mimic random and dynamic interactions without having to interrupt the current system. The onus is on practitioners to educate administrators and managers on the value of simulation. Animation, depiction of the modeled network, and correlating simulation results to traditional performance indicators are important to the acceptance of simulation in hospitals.

Lou Keller, PROMODEL Corporation

There's nothing unique about simulation. Nothing, that is, that would single it or its users out as deserving of special attention with regard to "barriers to implementation." That doesn't mean that barriers don't exist. They do. However, they're not impregnable and they're not tied to simulation alone. In fact, they are very much avoidable as long as you know the rules. Here's what I mean.

I spent a week one time trying to explain the solution to a complex staffing problem, arrived at through the "wizardry" of linear programming, to a very senior administrator with no background whatsoever in any of the quantitative sciences. Wizardry, by the way, was his word. The discussion ended when the manager stone-walled the solution with the argument that, "People aren't machines, you know; you just can't treat them like so many numbers." At the time, I remember thinking how ignorant and narrow-minded the argument was--how out-of-touch with modern methods. Later, when I had matured a little, I changed my mind. He was right. More to the point, because I hadn't taken the time to consider the human side of the problem that I was dealing with or include the administrator in my resolution of those same problems, I had created my own barrier to implementation.

Since then, I've only encountered the same argument when I've been arrogant enough to forget the rules that accompany the application of simulation (or any analytical method) to the solution of human system problems. These rules and the "barriers to implementation" they're designed to overcome are simple. What's difficult is keeping them in mind.

Barrier #1: A natural resistance to the unfamiliar. Simulation isn't a household word in healthcare. When it is employed to solve problems, users are generally management or industrial engineers, not the providers to whom the solutions are routinely applied. Accordingly, without a comprehensive introduction to the tool and its potential, non-users routinely view simulation-based recommendations as "black-box" answers to complex problems. Couple that with the presence of an often overwhelming number of statistics (or, as one provider put it, "sadistics"), and you have the makings of an environment that is not only unfamiliar but often threatening as well. Unfortunately, many users like the notion of the mystery of statistics. They often use it as a weapon to achieve some measure of equality in the pecking order of knowledge-based power. Still, such a strategy can easily take an analyst beyond barriers and well into an adversarial relationship that may never be overcome.

Rule #1: Get everybody's fingerprints on the knife. Management writers have dealt with this issue in as many ways as there are management writers but the message stays the same: involvement is the first key to success. Simply put, to gain acceptance of any solution, regardless of its source, it is imperative that every member of the affected group be involved in the decision-making process. The more complex the problem or mysterious the solution method, the more critical management support and commitment become. Oh, and by the way, involvement doesn't start with the day model-building begins or a problem is identified. It starts with the first day an analyst reports for work. And, it doesn't mean simply getting people involved in setting goals, identifying variables, collecting data or giving presentations. It means building a team whose expectations are tempered by a reasonable familiarity with the tools analysts employ and then co-opting them into making contributions to the solution of a problem from its inception to its conclusion.

Barrier #2: The Industrial "Time and Motion Study Stigma." Like the unfamiliar, there's considerable resistance to the dehumanizing nature of time and motion analysis. Most workers in general, and healthcare providers specifically, regard such things as treatment-time evaluation and standardization as unreasonable and unrealistic. And yet, those are often key parameters to any healthcare simulation model. To this end, providers often cite examples of specific patient requirements as dictating unique treatment times and thus justifying sometimes excessive patient waiting times. As one provider put it, "I have to have the freedom to spend as much time as I feel necessary with a patient and that's not something I can always control. Therefore, I don't believe you can measure it accurately." Convinced by the nature of the data we collect, such providers often regard simulation as just another time and motion tool. They often dismiss pertinent results and recommendations on the basis of the unpredictability of outcomes, or question the validity of the distributions employed in the analyses. In short, providers don't like being analyzed, viewed or treated in the same way as machines and workers were when simulation was first brought to bear on problems of productivity.

Rule #2: Educate others and avoid the industrial vernacular. The single message here is that, as much as we might like to believe otherwise, healthcare systems are not simply variations on an industrial theme. Patients are not parts, physicians and nurses are not machines, the clinical environment is not just another job shop and providing care is not manufacturing health. The healthcare environment is far more complex than that. So, to get around this barrier, avoid thinking and acting like an assembly line analyst. More to the point, try to avoid being imprisoned by your methods; be flexible. If someone objects to specific measurements or statistical inputs, be willing to replace your values with those they support--if only temporarily. Then, take advantage of the opportunity to evaluate the model's sensitivity to its inputs. If there's merit to their objection, you'll discover it soon enough. If not, then at least you will have satisfied rule 1.

Barrier #3: The Poorly Conducted Simulation Study. More than half of the studies that I've seen fall short of acceptance and implementation failed as a direct result of poor procedure. It's just that simple. In some of the cases, the analysts allowed themselves to be caught up in the continuing argument that more needed to be investigated before anything could be done. In other cases, they simply assumed away critical limitations and in still others, they went overboard in search of a level of complexity that was totally unwarranted or were trapped by the temptation to examine everything at once. In all cases, the results were the same. Each study either continued until it was shelved in favor of more pressing matters or was terminated as a result of low confidence in the method or results. Interestingly enough, many of the studies had a great deal of promise and could have produced significant contributions if someone had only taken the time to structure them correctly.

Rule #3: Don't wind your toys too tight. Simulation is a robust analytical tool. It empowers the user to do a variety of things and it generally provides a wealth of information about the system under study--often far more than needed. As such, among the family of analytical tools available, it occupies a position of prominence with respect to the potential for analytical disaster. It's for that reason that the analyst must establish firm objectives, identify pertinent questions to be answered, single out specific measures of performance and, above all, focus on the problem at hand. Any other path places too great a burden on the method and not enough emphasis on the problem.

Needless to say, there are other barriers--politics, personalities, over-confidence, misunderstanding, ambition, poor data collection, etc. Interestingly enough, the one thing these barriers have in common is that they can be divided rather neatly into two distinct groups--those that are inborn and those that are generated by the analyst. Of the two, the most common and yet most easily avoided are the ones we create for ourselves. Maybe that's the real problem--not that barriers exist but that we readily add to them as a result of our own efforts. So...

RULE #4: Don't build barriers; build bridges.

William R. Lilegdon, Pritsker Corporation

Simulation provides an ideal tool for the analysis of dynamic health care delivery systems. The use of simulation tools in facility development and design activities, staff level assessment, and new policy evaluation within health care organizations has been documented. However, the implementation of simulation relative to the potential for profitable contribution to the health care organization has lagged when compared to other industries. Several potential barriers are examined in the following discussion.

Most applications of simulation within health care organizations are performed by management engineers in larger metropolitan hospitals or by staff engineers of a large health care conglomerate. In single hospitals, the management engineering group generally consists of less than three people and their primary activities relate to facility development and equipment acquisition. Simulation can support these activities, but the focus of these groups often heavily emphasizes the financial analysis or aspects of these decisions. The operational analysis is subordinate to the estimated return on assets or other financial measures.

Often simulation of a proposed purchase or new facility is viewed by these engineers as requiring too great an investment time to be completed to support administration's decision making. Additionally, these management engineers do not possess significant training in simulation and therefore require tools that can reduce the perceived learning curve.

Obviously simulation tools can address some of these perceptions and shortcomings to increase the use of simulation to the benefit of more health care organizations. Some of the barriers to simulation's use in these organizations are cultural and will require a cultural shift.

For example, often management engineering groups are seriously under-powered relative to computing equipment. The computing dollars in a hospital are instead spent on patient accounting and medical information systems. Management engineering's perceived contribution in these organizations does not warrant an investment in simulation software and the associated hardware.

Another significant barrier to the successful implementation of simulation within health care organizations is the existence of many systems with multiple customers and no clear decision maker. For example, in a project analyzing the policies and operations of the patient pre-op, operating, and recovery rooms, three distinct customers/decision makers were present. Administration wanted to find the policies that provided the best utilization of facilities and staff, thereby reducing expenses and increasing profitability. The surgeons required a policy that would preserve their ability to schedule operating room suites based upon a pre-defined schedule and hierarchy. Finally, patient throughput times were dramatically impacted by the uncertainty surrounding specific procedures, and efforts to improve these times were predicted to result in increased patient volume. This description over-simplifies the issues relative to each group; but without a single decision-maker to set priorities, clear project objectives were never identified. The successful completion of projects with many masters and without clear priorities is difficult.

These barriers prevent simulation from being used as widely as possible in health care. Some of these barriers can be addressed with changes to simulation products and its delivery to this important industry. Other barriers must be dealt with through changes in the health care organizations. Simulation is a tool that can improve the health care delivery system from the patient's viewpoint and improve the profitability of the health care organization. Exposing and addressing the barriers to implementation will speed us toward both objectives.

Kal Mabrouk, The Model Builders, Inc.

The greatest barrier to implementing simulation in the health care industry is the people most interested in promoting simulation. Their strong technical nature does not allow them either to properly appreciate simulation or to promote the use of the tool within their own organization.

The health care industry can differ significantly from other industries in the specific requirements for both promoting and executing simulations. In most other industries the organization is split into operations and staff personnel. Operations people are concerned with getting things done on a day-to-day basis. Staff personnel are charged with more long term planning and problem solving.

In health care, the organization is split into three major groups: doctors, nurses, and administration. The doctors and nurses are separate groups that perform an operations-oriented function, while administration performs a staff-oriented function. In contrast to other industries where both staff and operations personnel can execute simulation, simulation must be a staff function in the health care industry--you can't really expect doctors or nurses to build simulation models. In addition, when promoting simulation in the health care industry, it is critical for the staff personnel to promote the tool to the other two groups (versus just one group in other industries).

The staff group most interested in promoting simulation within health care is management engineering (or staff group with a similar pseudonym). These people have an appreciation for simulation because of their strong technical orientation. They wonder why other people can't understand how wonderful this technology is. However, in promoting simulation, they may perpetuate a number of myths, which can serve as barriers to the acceptance of simulation. These include such beliefs as, "Simulation projects must be difficult;" "Analyze simulation results with an eye towards precision;" and "Build models of everything" (Mabrouk, 1994).

Many management engineers understand that simulation, given the same input information, can provide a significantly better understanding of system behavior than other analysis tools (Pritsker, 1992). They also know that their simulation models are capable of handling a significant amount of detail. As a result, they tend to believe that simulation is a process that must be difficult, and should only be used with critical complex processes. On the other hand, they ignore the many opportunities where simulation can quickly and efficiently resolve simple issues.

On a daily basis, management engineers are asked to analyze reams of data and make recommendations. They get in the habit of analyzing these data with an eye for precision. Their simulation reports also provide them with reams of data. The tendency is to analyze these data with the same precision that they would operational data. They ignore the fact that simulation output is a set of estimates based on sample points (replications). In addition, the expected error of their confidence intervals can be additive. As a result, they may interpret simulation results as precise when the actual confidence level is close to zero! Instead, their analysis should focus on key performance measures.

The management engineers who have a very strong appreciation of simulation will occasionally feel the urge to build models of every department within the hospital. The thinking is that these models will be available when they need them later to "fight fires" that inevitably arise. The reason these engineers are driven to do this is because they understand that there is always a lag between the time that the fire fighting begins and the time that the simulation model will be ready for analysis. Even though this is a noble objective, it is impractical. By the time the model will be needed, the system will have changed so much that the model is invalid.

All the problems discussed so far deal with the technical side of this issue. The more critical cause of the failure of simulation in health care is the techno-babble utilized by these engineers to sell simulation. This techno-babble causes management and operations personnel to lose interest in this technology (Law, 1993). As a result, a tool that can be critical to the success of the health care industry is largely ignored.

These management engineers need to keep in mind that most organizations are technophobic. Concepts such as "statistically analyze," "confidence intervals," "simulation," "data fitting," statistical validity," etc. are critical from a technical standpoint. On the other hand, these words tend to widen the gap between the engineer and the decision maker/operations personnel. This may be especially true in health care where providers have little tolerance for other professionals who do not speak the same language. A good course in sales and marketing would not hurt these engineers (Keller, Harrell, and Leavy, 1991).

It is not the responsibility of management to be technically proficient; engineers are hired to handle the technical issues. However, engineers must also be familiar with business issues and terminology to facilitate communication with management. In business meetings where the decision needs to be made on whether simulation is an appropriate tool to solve the problem, engineers need to focus more on such concepts as "minimizing business risk," "optimizing patient flow," "reducing operational costs," "improving the competitive advantage," etc.

To summarize, management engineers can overcome the barriers to implementing simulation in health care by improving their promotion of the tool. This includes recognizing that the audience is much different from those in other industries, as well as rounding out the edges on their technical skills. Management engineers can achieve these objectives by simplifying the simulation process and improving their sales skills.

Frank McGuire, SunHealth, Inc.

In order for any simulation project to be considered a success, the recommendations resulting from the study must be implemented. A major barrier to implementation of these recommendations is a failure of the sponsoring manager to follow through on the studies' recommendations. The manager with direct managerial responsibility (over the department(s) included in the study) must clearly communicate what the expectations are and who must actually implement the plan (or part of the plan). Too often a director or vice president will authorize a study and then fade into the background as his/her subordinates take over responsibility for implementation. This can work when the subordinates have authority to make the necessary changes. All too often, however, an executive will insist that changes are necessary, request simulation to identify the most appropriate alternatives, and then fail to make arrangements for implementation. The expectation is that the manager over the area in question will take it from there. This does not always happen for several reasons:

1. The manager might resent the executive's interference.
2. The manager may not have authority over all the areas that require change.
3. The manager may not be strong enough to overcome the obstacles that will be presented during the process of implementation.
4. Cooperation or help from external personnel is necessary and the external personnel are too busy or unwilling to provide the needed assistance.
5. The manager may have to make major changes and carry on all his/her current responsibilities as well. (The manager has good intentions, but not enough time available to apply the changes.)

The executive requesting the study must follow up to see that implementation is occurring as expected. Time pressures are real and implementing significant changes takes considerable time and effort. Stress levels increase, and pressure to stop short of full implementation can be intense. The executive should define steps to ensure proper implementation. The steps should include:

1. Set time frames for implementation, including incremental steps.
2. Hold periodic meetings to review progress and address any problems that exist.
3. Monitor the progress of implementation along with the effectiveness of the process being put in place (the change itself).

Follow-up and guidance from the executive will not repair a faulty simulation study. However, if the study is valid, follow-up and guidance from the executive are essential to the study's implementation.

Implementation of simulation findings in healthcare represents a special challenge, because of the number and variety of staff involved in the delivery of patient care. In manufacturing, the decision to implement a change often revolves around implementation cost and return on investment ("payback" period). In healthcare, cost is certainly an issue, but it may be secondary to such issues as the appropriate use of ancillary and technical personnel. For example, I have recommended that formal triage protocols be set up in emergency care that allow registered nurses to order certain ancillary tests. While this is an accepted practice in many hospitals and by the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO), many medical directors do not believe it is appropriate for any RN to order tests. Whether nurse practitioners should be used in emergency care is another issue. Who should collect blood specimens, run EKG strips, and many other procedures can also pose problems. Some hospitals allow emergency medical technicians to take vital signs or perform other minor tasks, and others refuse to even consider it. These types of problems, while not unique to healthcare, occur more often than in manufacturing or other service sectors.

The project manager (e.g., the management engineer in charge of developing the simulation model) can help minimize the chance that implementation will not happen. Unless the project manager happens to be in a position to directly enforce implementation, he/she will have to settle for providing a framework for success. This would include early discussions about implementation during the project planning phases of the study. When alternatives are discussed, methods of implementation should also be discussed. In addition, the project manager should make sure that enough people are involved in the verification stage. Finally, the best thing that the project manager can do to help the implementation process is to make sure the model is valid.

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KAL MABROUK is a Project Leader for The Model Builders. He has spent the last seven years assisting many companies in the U.S. and Canada to successfully implement simulation as a productivity improvement tool. His contributions include assisting these companies in choosing the appropriate software tool, training their employees on how to properly implement this tool, and managing simulation projects for them. In addition to his duties at The Model Builders, Kal is a senior member of IIE and APICS. He is also one of the cofounders of the Michigan Simulation User Group.

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