Proceedings of the 1994 Winter Simulation Conference
ed. J. D. Tew, S. Manivannan, D. A. Sadowski, and A. F. Seila

SIMULATION SATYAGRAHA, A SUCCESSFUL STRATEGY FOR BUSINESS PROCESS REENGINEERING

David Bridgeland
Steven Becker

Coopers & Lybrand
One International Place
Boston, Massachusetts 02110, U.S.A.

ABSTRACT

Organizations are now using modeling and simulation for business process reengineering projects. Business processes are unique and present special requirements for the tools and methodologies used compared to the tools and techniques used to model and simulate manufacturing processes. This paper outlines the differences between business and manufacturing processes and explains the special requirements of tools for business process redesign and their application methods.

1 INTRODUCTION

Many organizations are in the midst of examining and redesigning their key business processes, in efforts to dramatically raise efficiency, cut cycle time, or improve customer service (Johansson et al. 1993). Business process reengineering (BPR) is a high stakes game; much time and money are invested in transforming the business, and the pay back to the organization can be enormous. However, many BPR projects encounter unexpected problems. According to one survey, as many as 70% of BPR projects fail or do not live up to expectations (Hammer and Champy 1993).

Some organizations have begun to turn to simulation to increase their chances of success (Cochran and King 1993, Jones et al. 1993). In our consulting work, we have used discrete event simulation to model the business processes of over 50 clients since 1988. We use simulation for the same primary reasons it has been used for many years in the modeling of manufacturing processes: to allow easier analysis and measurement of an existing process, and to assess proposed changes without the risk and expense of implementation.

Unfortunately, we have found that the use of simulation for modeling business processes poses several unique dangers and difficulties. These problems may be unfamiliar (in degree if not in kind) to simulation practitioners in other domains. In this paper, we detail two such problems: the inherent contentiousness and the variability of business processes. Along with each problem, we discuss the methodology and tool features we have developed to address that problem. Finally this paper ends with a brief discussion of how the separate solutions to these two problems fit together into a single tool and methodology.

2 BPR AND ORGANIZATIONAL POLITICS

Business processes are more contentious than manufacturing processes. They are more contentious because the components are fundamentally different. Sheet metal does not care how it used or even whether it is used or not; employees do. A change that may be better for an organization (for example, because it leads to faster cycle time of a key design process) may be worse for a given employee (for example, because his expertise in updating outdated designs is no longer important).

Every employee has individual stakes, motivations, and ambitions. Some employees plan to work at the same jobs until they retire. Other employees seek to acquire specific skills that make them worth more, either to their current organization or to other organizations. Still other employees nourish relationships and game their organization for promotion up a functional hierarchy. Many employees have plans with elements of all three of these goals.

The prospect of a redesigned business process introduces unsettling changes for employees and their career planning. Some employees find new opportunities. Many others find new threats, as desired positions or jobs or even whole departments are reengineered away. Employees have varying levels of authority and power, and can use that power to support or resist the implementation of an economically sensible reengineered process.

We claim that the high failure rate of BPR projects is due to inherent and natural *conflicts of interest* between individual employees and the organization as a whole. An individual may be interested in the improvement of her organization in general, but only if the proposed improvement leads to a better outcome for her personally compared to her existing situation. This natural human response dooms many BPR projects since every significant change has negative impacts for at least some people in the organization.

2.1 Simulation Satyagraha

How can an organization be changed? What can *finesse* the finger pointing and denial that result from this natural conflict of interest. We have found a simulation-based approach that follows the following steps to be quite successful:

1. Build a simulation model that all players *individually agree* is an accurate and complete representation of their individual work.
2. Once the model is built, *meter and investigate* the model to discover and reveal the pathologies of the organizational process modeled.
3. *Present the pathologies* to the group of process inhabitants involved in the construction of the model. Allow the group to work through their denial of the pathologies exposed by the simulated model. When they work through this denial, they will insist on redesigning the process.
4. *Simulate many redesigns* of the process by altering the existing baseline model to arrive at a desired model for implementation.

We call this process *Simulation Satyagraha* .

Satyagraha is a technique of political change pioneered by Mahatma Gandhi during the early part of this century to induce the British Empire to free India (Gandhi 1921), and later adapted by Martin Luther King, Jr. in his efforts at changing racial policies in the United States. Satyagraha roughly translates as "the force given rise to by the insistence on facts and conscience". Employing satyagraha one first obtains universal agreement on the facts of a situation, and then presents those facts in such a manner that calls upon the consciences of the interested players to abandon their personal stakes and commit to the change needed.

Simulation models are a good vehicle for employing satyagraha because simulation directly supports the two step finesse implicit in the satyagraha process. First, each process inhabitant can individually agree that the model of the process is accurate, at least where it models the part of the process where they live. Second, simulation gives analysts a way of discovering the conscience-evoking pathologies. Any established interest is already disarmed; he cannot argue that the model is inaccurate because he has already agreed that it was an accurate representation, so he is forced to agree with the pathologies that it exhibits.

Some examples of pathologies that have induced long-resisted organizational change include:

1. An advertising agency interested in speeding up the process of creating communications discovers that the slowness is not due to the disorganization of the creative staff but to the number and extent of management reviews.
2. A foreign exchange trading house discovers that the source of their difficulties with settlement are not due to the procedures of the back office staff, but due to traders who regard themselves as too important to be bothered with the accuracy of the trades they have made.
3. A brokerage firm discovers that long cycle times and high frequency of errors observed when processing incoming funds is not due to the complexity of transaction processing, but due to unnecessary hand-offs that introduce errors and redundant review cycles to catch those errors.

2.2 Tool Implications

Simulation satyagraha puts unusual requirements on the simulation tool used. During the modeling of the process, the modeling expert is not designing a model so much as facilitating the process inhabitants in the construction of a joint model of their world. The process inhabitants are effectively in control, and they change the model repeatedly until they are satisfied with its correctness. (Of course the modeling expert ensures that the model is syntactically correct, agrees with any empirical data that exists, and is well organized and well documented.) Hence the tool must make *all details of the model visual and trivial* for business users to understand.

Process inhabitants typically have little technical training. While simulation tools have made much progress in ease of use and understandability, most existing simulation tools are still too difficult for process inhabitants to understand easily. The contentiousness of business processes makes it essential that the tool match the task quite closely. The minimum requirements for a tool that builds detailed models that are understandable to a process inhabitant are as follows:

1. The tool must be visual and graphical. Everything in the model must be represented visually in a manner that allows process inhabitants to spot problems and verify correctness. The tasks need to be visually represented by icons allowing subtle distinctions of work to be shown. For example, it is useful to have separate icons for tasks involving data entry, and tasks involving inspection of data already entered.

2. The individual visual components of a model must be concrete things that are easy for the process inhabitants to understand, like tasks and people. In some tools it is possible to build business process models, but they must be built from more primitive objects like stocks and flows. The grain-size of such tools make it difficult for use in modeling contentious business processes.

3. In all tools, some of the objects visible to the user do not actually represent anything in the world but are artifacts of the fact that there is a model. For example, in some modeling tools, counters or graphs are positioned along the process flow to monitor statistics of the jobs as they pass. Such "model artifacts" must be used sparingly and not compete for the user's attention with the actual modeled objects.

4. The tool must represent resources and tasks differently and separately. In many manufacturing-oriented tools these concepts are combined. In such tools, a process that started with Joe, continued to Michelle and then returned to the Joe for a different task (e.g. for review of Michelle's work) must be represented as physically looping from Joe to Michelle back to Joe, as shown in Figure 1.

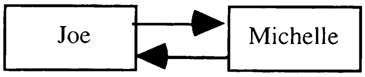

Figure 1: A Conflation of Process and Resource

Such a constraint makes it unnatural to represent the difference between the work Joe does initially and the review work Joe does later. It is essential to represent this simple process as in Figure 2, where the representation of the resources, Joe and Michelle, are shown elsewhere in the model.

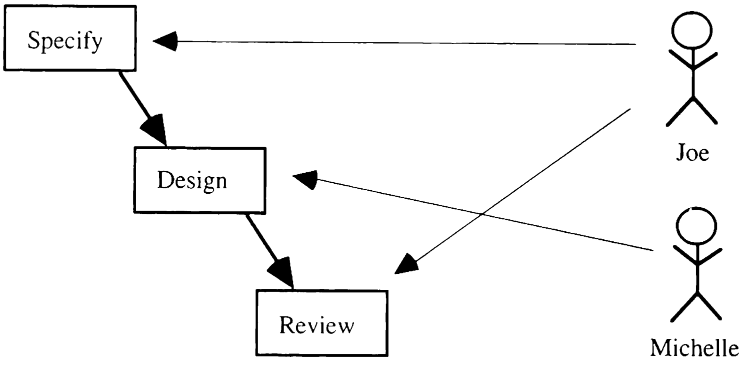

Figure 2: A Separation of Process and Resource

5. Since any model is likely to have more tasks and more people than can be understood easily at once, there must be an easy, natural, and visual representation of composition hierarchy. that can be easily navigated by a process analyst.

Once the model is built, the tool must allow the easy construction of several kinds of telltale statistics. Each model and each organization has different pathologies, but in the past we have found the following kinds of analysis and resulting statistics (as well as many others) to be effective in dislodging established paradigms:

value analysis
Each task in a model either adds value to the end customer, or it does not. Sometimes the total time and money spent on the latter non-valued-added tasks is in itself startling.

time analysis
If the total time spent on a process is deemed to be excessive, where is the time spent? Often the answer is highly counterintuitive to the process inhabitants.

cost analysis
If reducing cost is the major driver of the reengineering, where is the money spent? Again, the answer to this question is often eye-opening.

ability analysis
What are the abilities needed to perform each task? If these are summed across all work done in a process, a quantitative aggregate ability profile can be obtained. How does this compare to the abilities actually present among the people in the organization? Mismatches here can show process inhabitants that the work is very different from their entrenched viewpoint of it, and can lead to acceptance of outsourcing, or changes in the hiring and promotion policies.

cost of quality analysis
While this analysis is familiar to quality gurus in manufacturing, there is an interesting twist in the business process world: How long are particular groups of people spending resolving the quality problems created by others?

3 VARIANCE IN BUSINESS PROCESSES

In addition to being more contentious, business processes exhibit more variance than manufacturing processes do. Variance is not unknown in factories, but the degree of variance in business processes is much greater in the white collar world. Sometimes process inhabitants have difficulty even conceptualizing what they do as part of a process with predictable variations, rather than as activities that are completely dependent on today's issues and contingencies.

For instance, the time taken to do an individual task can vary due to variance in the level of detail of the actual work done. In a model of a process of creating an advertisement, the task of a marketing manager reviewing a draft print advertisement may take 10 minutes if she likes and approves everything, or may take 2 hours if she has many issues, concerns, and proposed changes.

3.1 A Matrix of Variance

Variation in business processes can be categorized along two dimensions:

- **What varies?** In the example just described, the time of the task of reviewing an advertisement varied.
- **Why does it vary?** In the example just described, the time varied due to the level of detail of the actual work done.

Together these two dimensions can be viewed as a *variance matrix*, shown in Table 1. Each cell in the matrix represents a single aspect of a business process that can vary due to a specific cause. We have seen business examples of all of the sensible (unshaded) cells of this matrix. The time and difficulty of building a model of a given business process will depend on how much variance exists in the process, and how difficult the varying model components are to collect, model, and validate.

The horizontal axis of the variance matrix identifies the various reasons that a model component might vary from one job to the next. The first two reasons, job type differences and variations in the details of a job within a single job type, are related concerns. When modeling business processes, we classify the jobs into *job types*. For example, we might want to distinguish between the creation of a print advertisement and the creation of a direct mail advertisement. These distinctions are typically coarse grained, with each job type representing a different collection of tasks to complete its work. The coarse grained job type classification also allows the modeler to collect statistics separately for different job types.

Finer grain distinctions between different jobs can also be important. For example, among the jobs classified within the "print ad" job type, there may be some that are completely new ads and others that are variations of existing ads. Even though all of these jobs are classified as print ads, there are real differences in how the work is done from job to job within the classification.

Variance also results from different people doing the same thing. Organizations differ widely on this dimension. In some organizations, there are explicit or implicit standards for how processes are accomplished. Many financial back offices have standard settlement process, for example. In other organizations, individuals are free to find their own best methods, and there are many differences from individual to individual or across geographic locations. Many creative processes also provide great leeway for individual differences.

Table 1: The Matrix of Variances

		Why does it vary?				
		Job Type	Job Details	Job Volume	Who	When
	Task Time	Different types of jobs take differing amounts of time.	Jobs with different requirements and details take differing amounts of time.	Faster work due to time pressure. Slower work due to fatigue.	Experts work faster, or sometimes more slowly and carefully.	Jobs are sometimes rushed before lunch or at end of day.
	Tasks Performed	Different types of jobs follow different process steps	Jobs with different requirements and details follow different steps.	Steps are skipped due to time pressure.	Experts do things differently than novices. Individual have differences way of doing things.	Different processes for night shift.
	Error Rates	Different types of jobs have different frequency of errors.	Jobs with different requirements and details are of varying difficulty.	Errors can result from to boredom, time pressure, or fatigue.	Experts make fewer errors. Careful people make fewer errors.	Error rate increases after 3 martini lunch.
What varies?	Job Volume	Different job types are started at different rates.	Jobs with different requirements and details are started at different rates.	▨	High customer service levels invite more repeat business. Poor service drives business away.	Volume varies over time or with other business cycles.
	Who	Individuals have preferences, expertise, and availability.	Individuals have preferences, expertise, and availability.	Additional resources can work due to pressure of increased volume.	▨	Different people are available at different times.
	When	Some job types are more frequent on certain hours of the day, days of the week, months of the year.	Some smaller differences are more frequent on certain hours of the day, days of the week, months of the year.	Shifts can be extended or added with extra volume of work.	People prioritize their work differently.	▨

Variance can also be triggered by when something happens. For example, some trading desks have special processes for trades that take place at the end of the day to ensure that everything is handled before key people leave work. At other organizations, there are monthly or annual cycles or predictable crunch periods. For example, accounting firms in the U.S. typically do not look for new clients in March or early April due to the peak service requirements for existing clients at that time.

The vertical axis of Table 1 shows what can vary in a business process, due to the causes shown on the horizontal axis. Note that "Who", "When", and "Volume" are each both a source of variance and a result of variance. For example, the task time often depends on who is doing the task. Different people take different amounts of time to do the same thing, due to differing levels of experience and expertise, or differing levels of familiarity with the problem at hand. On other occasions who does the task is dependent on details of the job being worked on, for example if the job is at a branch office in Orlando, it cannot be worked on by people in San Francisco.

Process models exhibit far more variance in far more different combinations of causes and effects than in manufacturing processes. This "Law of Business Process Variability" follows naturally from the logic of automation: anything variance-free can be automated. Hence in a manufacturing process, variances result from machines wearing down or their performance degrading over time with well known symptoms and results. People and hence business processes are far less predictable but are needed to perform for the ever-changing remainder of unautomated work.

3.2 Modeling Variance

Variance is often important to model because (as in other simulation models) variance in the details of the process can lead to variance in the results of the work being performed. In addition, failure to model variances can lead to credibility problems and undermine the simulation satyagraha in action.

Unfortunately modeling variance is time-consuming. Hence in modeling a business process, one crucial design trade-off is choosing which of the many varying attributes to model as variant. In our practice, we have four methods of modeling varying attributes:

abstract	Model the varying attribute in an abstract manner that represents all of the possibilities.
likely case	Model the most likely case as the only possibility.
several cases	Model the few most likely cases stochastically.
distribution	For continuous quantities (e.g. task time), model as a stochastic continuous distribution.

The first two methods **abstract** and **likely case** are far easier to model, verify, and validate, and hence we often start with one of these two methods. In many cases, more detail about the variances is required. Task times in particular are usually modeled as distributions.

If the actual tasks performed vary and it is important to model this variance, **several cases** is the only practical method. In this situation, the models uses branches that are either probabilistic, or dependent on attributes of the job. For example, the process shown in Figure 3 uses probabilistic branching with 50% of the jobs follow the tasks in the top path, 35% follow the tasks in the middle path, and 15% follow the tasks in the bottom path.

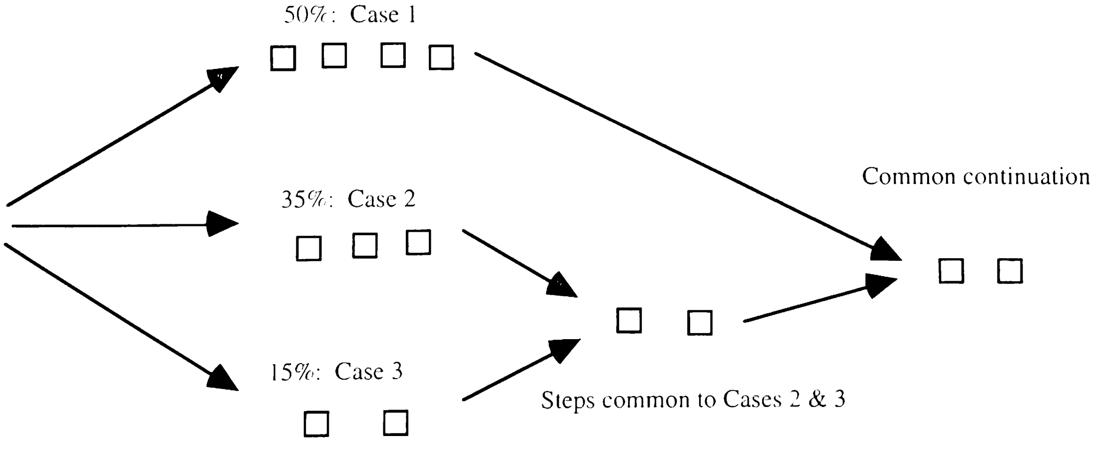

Figure 3: Modeling by Probabilistic Cases

4 CONCLUSIONS

Business processes are inherently variable across many dimensions simultaneously, so organizations perform them with their most flexible resources: people. Staffing business processes with people both adds to process variance, and make changes to the processes contentious and political. The extent of both politics and variance make the successful use of modeling and simulation for the redesign of business processes difficult and dangerous. We have found that the tools developed for manufacturing simulation are inadequate for addressing these difficulties. As a result, Coopers & Lybrand Consulting has developed and refined the modeling and simulation tool SPARKS™ over the last six years to address situations common in business process reengineering.

The techniques used in modeling manufacturing domains are also no match for the difficulties and danger of BPR. We have developed a methodology and an evolving community of practice around the use of simulation satyagraha for finessing the inherent and high stakes politics surrounding BPR. Change techniques developed to free a people from oppression are a good match with simulation technologies, and the result can be used to free all practitioners from the limitations of our established ways of thinking and acting.

5 ACKNOWLEDGMENTS

We wish to thank our clients, the SPARKS™ modeling community worldwide, our leader in these efforts Dorothy Yu, and the visionary behind the marriage of simulation and satyagraha, Helen Ojha.

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AUTHOR BIOGRAPHIES

DAVID BRIDGELAND is a Senior Associate in the Advanced Technology Group of Coopers & Lybrand Consulting. He has reengineered many organizations, using modeling and simulation. His current work involves using management flight simulators to speed the implementation of organizational change. He can be reached at 617-478-3959 or via dave@world.std.com.

STEVEN BECKER is a Managing Associate in the Advanced Technology Group of Coopers & Lybrand Consulting. He is responsible for developing and applying tools and methods to support BPR initiatives. He is currently involved in rolling out SPARKS and the corresponding application methodology to Coopers & Lybrand offices worldwide. He can be reached at 617-478-3253.