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HOW-TO SIMULATION: WHEN KNOWING WHAT TO DO IS NOT ENOUGH

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ABSTRACT

This paper argues that to achieve success, a simulation project must not only describe the future state of a business process, but also indicate the best way to reach that state. The paper also suggests how simulation may be used to guide such change program. Prototyping to select the best change approach is critical for success, given that organizations can move toward various future states along many different paths. By not analyzing implementation options, the traditional simulation project leaves management without a roadmap for the proposed change. The roadmap must be plotted by a dynamic management tool, a simulator that can analyze future contextual factors and determine how the chosen path must adapt to respond to new environments.

1 SUCCESSFUL SIMULATION PROJECTS ARE THOSE WHICH GET IMPLEMENTED

Successful simulation projects in business are those which are implemented, generate measurable results, and impact positively the organization's financial picture. To achieve these goals, simulation professionals must put as much emphasis and work in finding the best way to reach the future state as they already put on defining it.

A review of some of the best simulation textbooks and the better documented simulation methodologies reveal that the topic of simulation implementation is cursorily explained, providing at best a brief overview of the steps to be taken to migrate from as-is to to-be. In contrast, the same authors argue forcefully in favor of implementing the future state defined by the simulation: "a simulation study whose results are never implemented is most likely a failure" (Law and Kelton 1991), and "the implementation of recommendations to improve system performance is an integral part of the simulation methodology" (Pritsker 1986).

This implementation imperative is not limited to simulation projects, as it is a hallmark of successful process improvement programs such as Six Sigma. In fact, Six Sigma has been characterized as "TQM with a deployment plan," (Goldstein 2001) to explain that a focus on implementation contributes greatly to avoiding the failures of earlier quality improvement efforts, i.e., Total Quality Management (TQM). Similarly, the most advanced methodologies for application testing, such as the V-Model, look to ensure the realization of promised business benefits by testing the results of implementing an application against the business case that justified its development at the start of the project.

For these reasons, successful simulation projects, especially those that deal with business processes need a detailed, dynamic implementation plan. This paper suggests that an effective way to support the deployment of simulation results is to *use simulation itself*, along with other change planning and management tools, to provide managers with a means to determine the best course of action to take at each stage between the as-is and the to-be.

2 THE COMPLEXITY OF IMPLEMENTING NEW BUSINESS PROCESSES

Having acknowledged that an implementation bias is crucial for success, let us now look at the causes that make implementation a difficult endeavor.

The main reason for needing an implementation management tool is that organizations undergoing process improvement (supported by a simulation project) can reach the to-be following *multiple paths*, some of which will lead to success and others to failure, and that the choice of one such path must depend on the analysis of the current situation of the business and the impact of internal and external factors over time.

More over, when an organization launches a big scale, complex change initiative, it requires powerful direction tools that go beyond typical assessment and interpretation techniques, and must leverage the advantages of using predictive techniques such as simulation.

While simulation, Quality Function Deployment (Zultner 1998), and Six Sigma are being applied to the design of better business processes, their use has yet to extend fully into enhancing the implementation of those same processes.

In addition to facing uncharted territories, project managers in charge of implementing major change programs must address other sources of complexity.

Implementing new business processes is an arduous task because of the large number of components of a business and their numerous interdependencies. As indicated in Figure 1, these are the main categories of business process components:

- Operating strategy
- Procedures and processes
- Performance targets
- Cultural aspects
- Organizational structure
- Personnel skills
- Information technology (applications and technology architecture)
- Facilities and equipment.

Each component depends and influences others, generating an intricate network of relationships that explains the dynamic and usually unpredictable behavior of a business process.

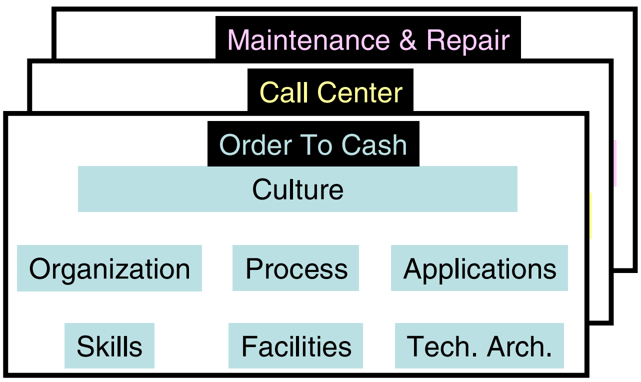

Figure 1: To-Be Business Processes And Internal Components

This degree of complexity is compounded by the role that the business process may play in the organization's big picture. That is, a business process may be at the core of the company (order to cash) or it may act as an enabler (human resources). For this reason, the implementation plan for a complex change program that involves two or more business processes must address dilemmas such as: which to roll-out first: the core process that will have an immediate impact on the bottom line, or the enabling process that supports core operations.

Also, implementing new service systems tends to be less predictable than setting up new manufacturing systems, because both what is served and the resource used to perform the service are human, who have "much more complex and unpredictable behavior than parts and machines." (Harrell et al. 2000) For the purposes of this discussion, we define a manufacturing process as one where about 80% of a product's or service's value is generated by machines, and we say that in a business process 80% of the value is created by human activity (Harry and Schroeder 2000).

Importantly, systems dynamics (Sterman 2000) shows that real-world business structures behave in complex ways due to characteristics such as:

- Too many interacting factors
- Tightly coupled system elements (such as the business process components listed above)
- Unanticipated, unplanned-for feedback loops in response to managerial action
- Time lapses that obscure the presence of underlying cause-effect relationships.

To make things worse, simulation projects of import usually have a scope that goes beyond incremental improvement, and into the substantial redesign of the way to operate a business. The newly designed process likely will require new technology, new skills and a new organization to better serve customer needs. Accordingly, rapid and disruptive change may characterize the business atmosphere until the organization reaches, one way or the other, the future state (Batteau 1999).

Having listed many reasons that make implementing a new business process (defined by simulation) a difficult task, we must turn now to look for an approach that will let project managers navigate with certitude toward the desired future state.

3 PROCESS MANAGEMENT IS THE ANSWER TO COMPLEXITY

The complexity factors listed above have the potential to create uncertainty during the implementation of a simulation or process improvement project. This uncertainty is likely to evolve into a chaotic transition if the organization embarks in a broad program of change such as reengineering or Six Sigma, where it may launch several projects at once, each with its own goals and duration. To respond and move forward, the organization must adopt a process management mentality that will guide it through the transition.

Process management, which focuses on managing processes across the organization and replaces the old approach of managing individual functions, (Pande et al. 2002) brings a methodology to ensure the continuous assessment and improvement of implementation efforts. Process management includes tasks such as:

- Defining processes and process owners
- Measuring process performance

- Analyzing data to refine implementation control mechanisms
- Controlling performance through periodic monitoring of key indicators.

By helping managers keep the pulse of the implementation and react quickly as needed, process management supplies the roadmaps (see Figure 2) and tools needed to implement the projects, and helps answer some change program burning issues:

- What to change first, second, and so on?
- How to ensure all steps build on each other?
- How to attain critical mass?
- How to build momentum?
- How do we know we are beyond the 'valley of despair'?

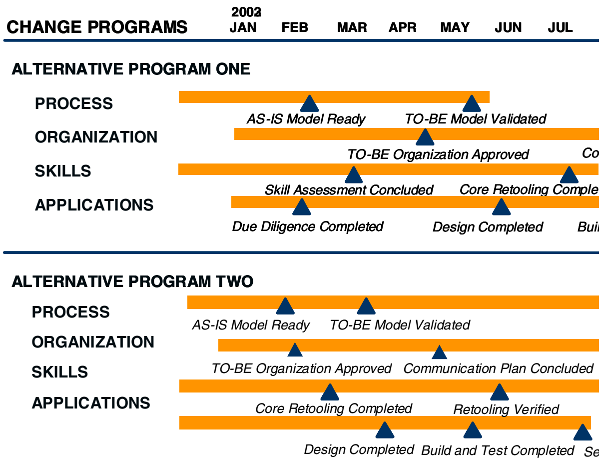

Figure 2: Alternative Courses Of Action – Which One Is Viable? Which One Is The Best?

The task of managing process improvement implementations can be aided with a dynamic management tool that enables what-if *implementation scenario* analysis, in the same way that traditional simulation enables new process design and sensitivity analysis.

Given that human systems display all the complexity and dynamics described before, the planning tool that management requires must be based on the concept of learning as a feedback-loop, so that the tool continuously keeps managers in touch with the real world, where the implementation is happening.

Organizations that follow a process management approach and support it with simulation implementation tools will be more successful at analyzing the changing context of an implementation effort and adapting their plans to respond to new environments.

4 PROTOTYPING THE CHANGE APPROACH

A useful definition of simulation states that "simulation is the imitation of a dynamic system using a computer model in order to evaluate and improve system performance" (Harrell et al. 2000).

Business process simulation practitioners go beyond this definition when they not only evaluate and improve the current system, but take on major process improvement projects to design the prototype of a future system that can operate at a much higher level of performance or provides entirely new capabilities. The need for implementation support is more acute in these cases than when dealing with small improvement projects.

Traditionally, most simulation projects in business conclude by delivering a final report that describes the future state of a system based on experiments run on a model of future operations, ignoring the implementation work that must follow to reach success (see Figure 3).

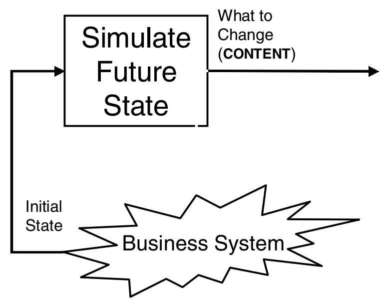

Figure 3: Traditional Simulation Project Scope

In this situation, the project follows a methodology to build and validate a conceptual model, design, build and verify the simulator, run experiments with the simulator to analyze system sensitivity, and present results to the target organization. If done well, the team will have produced valuable content recommending what to change to improve the business system.

Even though, as indicated before, a few methodologies include a brief overview of implementation steps, most simulation projects actually downplay or skip any implementation plans. This approach, which may be sufficient to implement small-improvement projects or projects with a stronger manufacturing emphasis than a focus on business processes, will prove woefully unsatisfactory in the case of large, complex implementations. Examples of such complex undertakings include the overhaul of billing and invoicing processes into an end-to-end order to cash process, or the transformation of help desks from being cost centers to becoming revenue-generating contact centers.

So we propose a more forward-looking simulation project scope such as that in Figure 4.

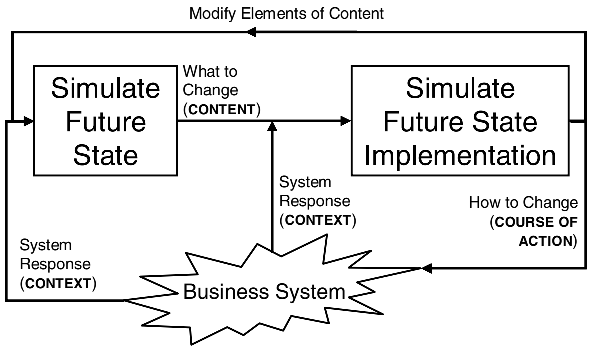

Figure 4: Complete Simulation Project Scope

The complete simulation project scope includes a *second simulator* at the heart of "Simulate Future State Implementation," that can analyze the future environment and adjust the implementation plan on the fly, serving as a dynamic management tool, to be used by project leaders during the implementation phase.

The flow of information and control in Figure 4 is as follows:

- The activity "Simulate Future State" creates a blueprint for the future state (to-be), a document of *what to change*, which makes up the content of the project. To develop this blueprint, the project team applies knowledge of the initial system state, which includes internal and external factors. Some internal factors are: culture, politics, internal stakeholders, and organizational structure. External factors such as competitors, customers, suppliers and the environment also shape the definition of the TO-BE.
- What to Change: Coming out of "Simulate Future State," business process components describe a blueprint of the future state, with the difference between it and what the organization has in place today representing the implementation gap.
- The activity "Simulate Future State Implementation" takes the future state's business process components and the implementation gap to generate the implementation plan or, *how to change*. This plan describes how to move towards the future state *from any point along the way*. Typical elements of the course of action include: project scope, which may be reduced under organizational stress, or modified as needed; tasks and deliverables, which may need to be re-sequenced or altered in other ways; communication plan to keep stakeholders informed of progress as needed; training plan to bring personnel to a baseline skill set; knowledge management tasks to capture current project lessons learned, and to learn from previous projects; metrics and targets, and milestones or tollgates to document progress and plan the next phase. That is, the implementation plan provides a dynamic roadmap that spells out the best course of action to reach a feasible future state given the current situation, past experience, momentum, and desired goals.
- System Response: As the implementation team performs the prescribed activities, team leaders continually listen to the business system for responses to the change program. This system response provides the feedback needed to adjust the implementation plan so that it can be executed successfully.

  Elements of the system response include: the voice of the enterprise (employee), voice of the customer, and voice of the market.
- Modify Elements of Content: It is possible that the system response indicates need for major changes not only on how to migrate to the future state, but even on what is a feasible future and how it should look like. In these cases, specific elements of the plan (speed or sequence of process improvement, choice of technology, and so on) are sent back to the drawing board to be redesigned.

As the project moves through the implementation phase, managers use the *implementation simulator* periodically to create virtual worlds where they can study the sensitivity of the business system that they are modifying. This second simulator allows an analysis of an accurate virtual system as it responds to the introduction of the future state prescribed by the first simulator.

The concept for the second simulator is described in Figure 5.

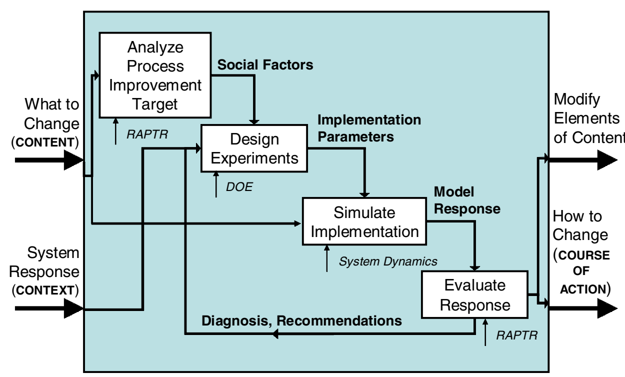

Figure 5: Details of "Simulate Future State Implementation"

The internal workings of the activity Simulate Future State Implementation in Figure 5 is as follows:

- The activity "Analyze Process Improvement Target" uses a change management assessment and planning tool similar to RAPTR (Batteau 1999), to describe in detail the social factors that characterize the organization target of the process improvement project. Some of these factors include: workgroup innovativeness, commitment to the organization, commitment to the people, value given to learning, mentoring, organizational values, middle and line management commitment to change, and trust.

- "Design Experiments" takes the above factors along with the observed system response to define the most efficient combination of conditions to feed the implementation simulator in order to cover as broad an experiment space as possible, while keeping the number of simulations manageable.
- "Simulate Implementation" takes the content of change, that is, the future state as defined by the first simulator, along with the implementation parameters for possible environments where the new business process may operate. A systems dynamics-based simulator is the right choice here, because it can be used to model and experiment with complex systems, and provides the rapid response that an implementation management tool must have.

  The task output, Model Response, contains performance indicators to describe the impact of implementing the new business process in the simulated state of the organization. Some performance indicators of interest are: demonstrated ownership of the change, demonstrated leadership activities, and learning curve progress.
- The task "Evaluate Response" uses a knowledge base of responses under studied conditions, and rules-based reasoning for anthropological interpretation (Batteau 1999) in order to provide a diagnosis of the organization under study, and recommendations for course correction which are fed back to the implementation simulator via Design Experiments to analyze the implementation under different conditions.

This implementation simulator approach allows for successful learning in a complex system, which offers a much better chance for success than the alternative of looking at the implementation phase as a "black box" where anything can happen and over which there is no control.

5 CONCLUSION

This paper has presented a broader definition of the scope of a simulation project, one that looks beyond the final report that traditionally marks the end of the simulation effort. This broader scope is a response to the urgent need to support the implementation of the results obtained from a traditional simulation project, recognizing that true success is reached only when simulated results are implemented in the real world.

To support the difficult task of implementing new business processes, we propose the need for an implementation simulator. This management tool would have at its core a systems dynamics-based simulator, supplemented by organizational assessment and change planning tools, some of which have already being built, fielded and demonstrated their usefulness.

Applying the implementation simulator concept, process improvement teams will know not only what to do to reach a future state of higher performance, but also will know how to get there despite the inevitable changes in the organization and its environment.

Finally, it is the hope of the author that simulation professionals will see the need to expand their reach beyond the creation of effective simulators and into the tasks of implementing the results that they have worked so hard to create.

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