Proceedings of the 2001 Winter Simulation Conference
B. A. Peters, J. S. Smith, D. J. Medeiros, and M. W. Rohrer, eds.

SIMULATION IN GOVERNMENT: VALIDATING BUSINESS STRATEGY

Shelly Shrader

Accenture
2929 Allen Parkway
Houston, TX 77065, U.S.A.

ABSTRACT

Due to regulation linking budgeting to performance and other government initiatives, government agencies need to quantify the benefits of proposed business strategy. This need can be satisfied by discrete event simulation. This paper details the approach used on a recent government project to assess the impact of proposed changes to a system and to provide a business case for change. The benefits of using a prototype development approach are also discussed.

1 INTRODUCTION

Government agencies need strong cases for action before spending taxpayer money. Government today has a need to evaluate their business strategy, and quantify the benefits of proposed projects, prior to implementation. They are tasked with assessing policy or program changes in detail, from a holistic view, before moving forward with the project. Agency managers want a compelling story to show senior management. The Government Performance and Results Act of 1993 is one reason for the focus on project measurement.

The Government Performance and Results Act (GPRA) requires all federal government agencies, with few exceptions, to integrate results into the budgetary decision processes. A key requirement is the performance plan. The performance plan is linked to the budget request process. An agency must quantify performance goals by which the project will later be measured in a performance report. This requirement, quantifiable performance goals, is one easily satisfied by using discrete event simulation.

Historically, only the military branch of government used simulation extensively. Today, simulation can be used to give all government executives the power to validate strategy before implementing it. Simulation can quantify outcomes to support business cases for action.

For this project, we partnered with a government agency to use discrete event simulation to assess current and future volume scenarios and measure the effects of a proposed strategy. The results of the project provided a strong business case for the project to be approved. This paper will discuss the approach used to carry out this project and build the as-is and to-be simulation models.

2 APPROACH

We used a rapid prototyping approach during the three phases of the project, as seen in Figure 1. We started with developing the process map for both the as-is and to-be situations. After developing an initial process map, we quickly began coding the simulation model. Coding actually began while the process maps were still being refined and validated. This led to iterative loops between developing the maps and coding the model. Sometimes this feedback loop was initiated by a question in coding the model, such as when a business rule was not well understood or documented on the maps, or was initiated during validation of the process maps. Similarly, there were iterations between coding the model and collecting data. This was usually when we discovered that the data was available on a more or less detailed level than originally thought. Finally, data collected would cause updates or rework to the process maps.

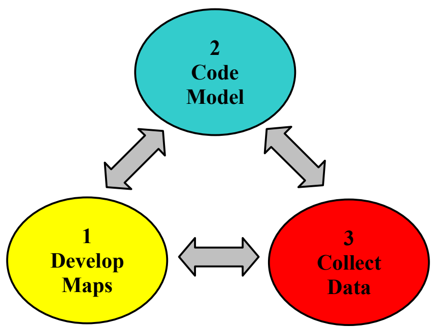

Figure 1: Iterative Approach

There are many benefits to using a prototyping approach for a simulation project. These include:

- having a "deliverable" to show the government agency early in the life of the project,
- gaining government agency feedback on the model and animation more quickly, and
- enhancing credibility and trust with the government agency.

The government agency feels more comfortable seeing progress quickly, in contrast to months of development with no visible (to the government agency) sign of progress. With simulation, we often try to prepare clients for the lack of intermediate results, the "all or nothing" myth of the simulation model. While it's true that there are no intermediate statistics or outputs to provide, seeing the animation take form and develop can excite the client and allow them to both visualize and affect the completed model.

2.1 Developing Process Maps

The first phase of the project was to develop universally accepted process maps. This phase involved several 1-2 hour meetings with two system experts. Shortly after each meeting, updated process maps were distributed to all meeting participants, serving as the point of discussion for the next meeting. The process maps showed all processes, inputs and outputs, processing times, resources, and business rules or assumptions, as shown in the sample process in Figure 2. These process maps were used as the "blueprint" for coding the simulation model.

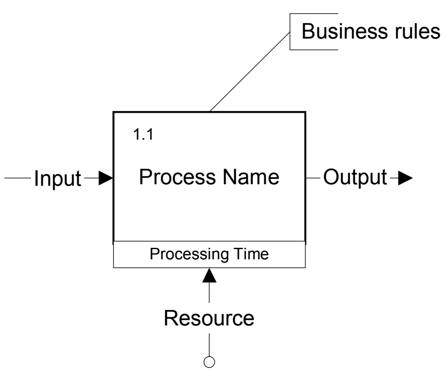

Figure 2: Sample Process on a Process Map

An important part of developing the process maps is remembering to abstract the process to a reasonable level of detail. We aim to build a model of the system, not replicate the system reality. In this project, trying to replicate reality led to complicated maps that did not add additional value to the project. An example of adding unnecessary detail is including a process which is only nanoseconds long in a model where all other processing times are in terms of minutes. The nanosecond process should be aggregated up into another process.

Where data for processing times was not readily available or its validity was questionable, we relied on the system experts' knowledge to provide a minimum, most likely, and maximum delay time for use in a triangular distribution. As soon as the process maps began "converging" to acceptance at about the third or fourth iteration, we started coding the simulation model using Rockwell Automation's Arena 4.1 software.

2.2 Coding the Model

The second phase of the project was coding the simulation model. In coding the model, we focused on keeping the model flexible for future updates or changes. To do this, we made extensive use of variables and expressions in place of values. This included using variables or expressions for all arrival rates, processing times, delays, entity attributes, staffing levels, batch sizes, resource seize rules, and resource capacity and schedules. This aided in the prototyping approach since it was easy to change staffing levels or resource seize rules, usually without any changes to the model logic. While useful as the model itself changed, this flexibility was even more vital when it was time to run scenarios. It kept all avenues for experimentation open with minimal to no model logic changes. This flexibility will also aid in the future extension of the model to add a Graphical User Interface (GUI), allowing the government agency to run further experiments themselves.

The simultaneous validation of the process maps and building of the simulation allowed us to show the government agency the basic simulation - with "dummy", false data - early in the project. During a site visit with our system experts, we showed them a small model and animation consisting of one of the multiple system locations. Although not quite representative of the system due to inaccurate data, the experts were able to point out additional business rules they did not articulate or did not notice on the process maps. "A picture is worth a thousand words," and in this case the animation served as a better validation tool than many more meetings looking at process maps. The opportunity to see a working model and animation early on led to many benefits, including the one already mentioned.

- The government agency became much more involved and excited about the project. The animated model became a focus for additional project recognition.
- The government agency developed a sense of ownership due to feedback they gave us on the animation. This included changes to entity colors for mnemonic purposes, additional statistics to animate, and important outputs to capture.
- The demonstration helped "validate" the process maps. The government agency could see where

the animated process was performing different from the real system, such as that documents should be output only once per shift rather constant throughout the shift. This type of detail was easy to overlook on the process maps.
- Feedback was received and incorporated in a scaled down model. The initial model only included one single system location. Making changes to the single location was much easier than reworking all locations. Once the single location logic and animation was verified, the other locations were easy to add with a lowered chance of rework.

After incorporating feedback on the initial single location model, the model was expanded to simulate all system locations.

2.3 Collecting Data

Much like the other phases, the data collection phase also followed an iterative approach. Initially, the model was built using mostly false data – allowing the government agency to see the model logic in action in the animation. After seeing the initial model run, the government agency was then much more vested in helping identify and collect the necessary data.

There were many obstacles to collecting data. There was a lack of data available electronically. Of the data readily available, much of it was on printed reports only. An additional obstacle was that data from previous years was not always useful due to recent system changes. We also had the complication that data we needed was not always available in the form we needed (such as monthly figures versus weekly data), or from trustworthy sources.

Due to the difficulty of obtaining valid data, for many activities we relied on the system experts to provide parameters for a triangular distribution. The experts, with years of experience with the system, readily could provide this information. These distributions and parameters were scrutinized during the model validation stage of coding the model. When building the as-is simulation model, we were able to compare the model outputs with the expected results. Then, we could isolate any activities that appeared incorrect in terms of expected queue behavior or entity wait time, and go back to our system experts for any updates or verification of the distribution parameters.

3 RESULTS

With the simulation model, we were able to assess the impact of proposed volume changes to the system. We were able to provide the government agency quantified performance measures specific to their system in addition to resource utilization, queue behavior, and cycle time statistics. These statistically valid performance measures supported the government agency's business case for proposed system changes, and satisfied the GPRA requirements.

In addition to providing quantified numbers for the business case, we provided the government agency with a run-time version of the animation. This gave the government agency the ability to show the animation to upper management, and thus gain enhanced credibility and visibility for the project. This animation has generated much interest among other government agencies.

Among the many benefits simulation provided, this project provided the government agency with a better understanding of their system processes. The process mapping and data collection phases uncovered recent system changes that were previously not documented. The data collection phase, in particular, provided insight to performance discrepancies among different system locations.

Based on the initial model results, we also ran additional "what if" scenarios to assess staffing needs. This identified the number of staff needed for the system, and the breakdown of staff by function. At the time this paper was written, additional experimentation is planned to provide further system insights.

4 CONCLUSION

As government agencies move into the future, additional emphasis will be placed on following best business practices. This includes rigorous examination of proposed strategy, and increasing need for quantifying project benefits. This trend is caused both by regulation and government initiatives. The use of discrete event simulation as a technique for assessing strategy and proposed projects will continue to grow to meet this need.

In partnering with a government agency on a simulation project, a prototyping approach should be considered. This allows for iterations to develop process maps, code the model, and collect data. Using this approach will result in a quicker development of the model with higher client satisfaction.

ACKNOWLEDGMENTS

The author would like to acknowledge Mark Grabau for his encouragement to write this paper.

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AUTHOR BIOGRAPHY

SHELLY SHRADER is a consultant in the Decision Integration practice at Accenture. She received both her B.S. and M.S. in Industrial Engineering from Texas A&M University in 1997 and 1998, respectively. Her email address is <`shelly.shrader@accenture.com`>.