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A PRACTICAL LOOK AT SIMULATION PROJECT MANAGEMENT

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ABSTRACT

While the management of a simulation project has many of the characteristics of traditional project management, it also has a number of unique issues that must be addressed. This paper will address the common, the not-so-common, and the treacherous aspects of simulation project management. A simulation specific series of steps will be presented. The paper also includes examples of past projects, the issues that arose, and how they were resolved.

1 INTRODUCTION

There are many books and articles written each year on project management. The purpose of this paper is to focus on the application of project management skills to the simulation realm. Subsequent sections will discuss typical phases of a project and the challenges presented in a simulation project. These phases include specification, data collection, model build and verification, model validation and experimentation.

2 SPECIFICATION

The foundation of a solid simulation project is the specification. This document serves to define the boundaries, expectations, and definition of when a project is considered to be complete. While it is easy as engineers to want to jump right in and start solving a problem by building a model, the planning and time taken in this phase is the key to a well-executed simulation project.

2.1 Project Boundaries

Simulations come in all shapes and sizes. As part of defining the scope of your modeling efforts, boundaries must be established to show where you model will start and stop with respect to the world. If you are modeling a manufacturing facility, these boundaries might be the dock doors that supply raw materials and ship finished goods. If you are modeling part of a manufacturing process, your boundaries could be the inbound and outbound materials for a specific department. By declaring the boundaries of the model, it helps avoid confusion in the project scope. Your customer will not think you are modeling the trucks leaving your supplier's facility if you have defined the boundaries of your model as the dock where the parts arrive.

2.2 Expectations

Another aspect of the project that specification can clarify is the expectations of each party in the process. As the modeler, you will have expectations on the data required to build the model and what is required from the customer. Your customer, in turn, will want to know the software being used for the model, the level of detail planned for the model, and an expected completion date for the project. Putting these things in black and white avoids potentially difficult discussions later in a project.

2.3 Project Completion

Simulation will expand to meet the time allotted. There are always more experiments to run. There is always another idea that can be tested. Projects that drag on usually because no one defined what "success" would look like for this project. As part of the specification, create an objective statement that brings closure to a project based on a finite condition. Do not list as an objective a desired throughput rate or cost target. The system may never be able to achieve those goals. A better approach is to define the number of scenarios that will be evaluated or a range of conditions that will be examined. If the system performance does not meet the goals of the group, another project can be defined to take a fresh look at the system. Remember, discrete event simulation models are excellent at evaluating competing ideas and quantifying the differences between these ideas. It is not an optimization tool that will drive you to an ideal solution. Set limits on the experimentation at the beginning to avoid a project that will never end.

2.4 Sign the Specification

While this might seem like an extreme step, it forces the people in the group to be sure they have considered the data carefully and it often exposes a key player that you did not know. If the parties involved must get approval or a signature from someone not in the room, you can make sure they are on board with all aspects of the project before starting down an incorrect road. Many times I have seen data reconsidered when the topic of signing the specification is discussed. This step will give you more confidence in the your data and make changes during the project less likely.

3 DATA COLLECTION

During the specification phase everyone is typically optimistic about the direction of the project and eager to offer their opinion on how things ought be modeled. This eagerness often disappears when it comes time to provide the data. Whether it is cycle time information on how long a specific task will take or downtime information about the frequency of repairs on equipment, customers typically do not like their data or they want to explain how their new system will not have the same problems that the old system is currently experiencing. Try to have these conversations during the specification phase but it is likely that the true nature of the data will not reveal itself until the project has started.

3.1 Document the Source

Keep track of the sources of the data used in the model. This can be as simple as the date and sender of an email or as complex as the process used to massage raw data into a suitable format for your model. This history will help you avoid back tracking to ideas that have been tried in past modeling efforts.

3.2 Promote Sensitivity

When people are unsure about their data, present the idea of sensitivity analysis. You can run versions of the model with double or half the downtime that the model is going to initially use. If the output varies dramatically in these scenarios, money can be spent to collect better data in those areas. It is a practical way to make sure your time and your customer's money are well spent.

4 MODEL BUILD AND VERIFICATION

The model build phase of a project used to be quite lengthy. The coding of models was difficult and the time required often dwarfed the other phases of the projects. Recently, as computer have become faster and data is more tightly integrated, the model build portion of the project can be more interactive. Simulation practioners should embrace this trend. Using tools like Web Ex and GoToMeeting brings us closer to our customers than ever. Involve them in the process. This will give them more confidence in the results and help avoid misconceptions on how specific areas of the model are supposed to perform. This type of interaction has traditionally been reserved for the model validation phase but it will serve you well to keep your customers involved in every aspect of the project.

4.1 Start with the Complex

Almost every simulation language gives you many ways to model the same system. As the modeler, you need to decide what approach will be taken. Given this flexibility, the best place to start building a simulation model is at the most complex section of the model. If you leave the complex pieces until the very end, you will often make the modeling more difficult or the code more complex. By starting at the center of problem, the structure often presents itself quickly and the rest of the model can fall into line with the approach taken in the most difficult area.

4.2 Rely on the Specification

It is easy to add too much detail into a model. The abstract nature of discrete event simulation is often the source of its power. Refer back to the objectives in specification often when building the model. Avoid unnecessary clutter in your model. For example, if your entire model stops for breaks and lunches, it is probably not necessary to model the stoppages. If someone provides complex CAD data that does not add to the accuracy of the model, do not include it unless one of the goals of the project is to communicate the look and detailed operation of an area. As the modeler, it is your job to provide the proper level of abstraction to answer the questions posed to the model. Do not think that more detail is better. You can make it harder to see the true nature of the problem by cluttering your model with too many things.

4.3 Model Structure

Naming conventions and structure make the reuse and verification of models much easier. By relying on standards and being consistent in your approach to modeling, you will find it easier to review a past model and quickly know the operation and how you had intended to model the system. These naming conventions also make it easier for others to work with your model. It is recommended that you pick a standard naming convention for entities and code segments in your model. These will be like your fingerprints when review past projects and assessing their application to a new project.

4.4 Verification

The modeler needs to be responsible that his model is functioning in the manner he intended. This is the purpose of Verification. It is listed with the model building because it is often a very iterative process. It is best to verify aspects of your model in isolation. If you are reading in data sets or generating data using distributions, look at these inputs and outputs without any influence from the model as a whole. You can verify them again later once the model is complete but if the model is constructed well, the second check should largely be a formality.

5 VALIDATION

As mentioned earlier, try to involve your customers in every aspect of the simulation. Frequent review meetings during the model build phase will avoid major conversations during the validation phase. This phase is when the project team decides if the model reflects the system you are analyzing well enough to run experiments and answer the questions posed early in the project. You need to defer to your customer's opinion in many cases for the validation phase. They will most likely know the system better than you but may not be able to articulate why the model does not seem correct. As the modeler you need to work with them to determine why the model may not be correct.

5.1 Methods of Validation

To validate a model of an existing system, you can compare the outputs from the real world to the outputs from the model as a way to determine the accuracy of the model. If the model is brand new, rough capacity calculations using a product like Excel and interviewing system experts on the team are ways to find inconsistencies. If their expert can point to an output from the model and say the real system would not produce that statistic, this gives the modeler a place to ask questions and find out what aspect of the system is not understood correctly.

5.2 Insulating the Results

Do not bring preliminary experimental run results to a validation review. It is best to have the customer validate the model before experimentation begins. This way, the customer is not influenced to change the model to get the desired results. Once the model is considered valid, then begin experimenting and providing results to the group.

6 EXPERIMENTATION

A valid model is the starting point for experimentation. During the specification phase, the objectives of the study were discussed. This is when the model is used to answer those questions. For example, if the number of forklifts required to support dock operations is an objective for the study, the model could be run through several iterations while varying the number of forklifts. These results can be reviewed with the customer to determine the best way to operate the dock area. In this case, the model will give a statistical view of the operation of the model. This must be interpreted by the modeler to make the proper decision. In the example above let's assume that three forklifts require an 85% utilization to keep up with production and four forklifts required a 65% utilization to support production. The policies in place at the customer's site may determine that the system uses four forklifts since 85% leaves very little room for recovery if one of the forklift is out of commission for a period of time.

6.1 Document the Path

Potential ideas to improve the system are often generated when viewing the model for validation and verification purposes. Document the source of an idea so it can be reviewed when necessary. This essentially documents the path taken to arrive at the conclusion of the project. The ideas that are discarded often show management the effort taken to arrive at a conclusion. This process helps management make a decision about implementation more quickly than a simple presentation of an answer. Without the whole range of experiments to consider, management will often play devil's advocate to determine if all plausible ideas were considered.

6.2 Use Video

Most engineers do not have access to the commercial software used to build most models. Any AVI or MPG file of the model in operation is an excellent way to document a project and get exposure for the modeling efforts of a project. This is also very useful when a model comes back after a multi-year hiatus and the modelers needs to assess what has changed between the model and the real system.

7 EXAMPLE PROJECTS

7.1 Model Specification Life Cycle

Unlike many traditional projects, simulation projects tend to have a long life. Many times customers have called many years after the conclusion of a project to discuss a model that is being used to approve a new capital purchase or address operational changes in their facility. We have one project with a large truck manufacturer where the specification document has survived over a 15 year period. It serves as an excellent catalog of the project history and the evolution of the equipment in the customer's facility. It now incorporates every major capital change to the system over the past 15 years and all of the simulation data and results that drove those decisions.

7.2 Controlling the Scope

Simulation is a very powerful tool. The first time that it is applied in a specific organization or department there is a tendency for projects to drag on. By asking questions that need to be answered in the specification and designing a framework to answer those questions during experimentation, endless experimentation can be avoided.

This was demonstrated to me very clearly when I first started doing simulations. A new paint shop was being designed for an automotive customer. We were brought in to simulate the design and assess the feasibility from a cycle time and throughput standpoint. Engineers from the design house would provide me with drawings and we would meet weekly to review the layout and discuss the system. When the project started I would diligently model every layout provided to me. Inevitably, when I arrived at the next review meeting, the layout had been changed dramatically for other reasons and my simulation was rendered irrelevant to the conversation. This continued on for a month until I figured out we needed to specify the model and decide what questions needed to be answered. This eventually led to a good outcome on the project but a lot of time was wasted building models that never saw the light of a customer review.

8 SUMMARY

Simulation projects often bring together a disparate group of engineers who are responsible for the operation of a large complex system. The simulation is often a focal point since it can serve to get everyone on the same page when it comes to the goals and shortcomings of specific system design components. The challenges of coordinating these efforts was reviewed in the paper and examples were provided to aid the reader in identifying common and uncommon pitfalls.

ADDITIONAL READING

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AUTHOR BIOGRAPHY

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