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MANUFACTURING SIMULATION CONSULTANT'S FORUM

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ABSTRACT

Consultants are an important segment of the manufacturing simulation community because they are on the forefront of change and innovation. From their position they have much to offer the rest of the community. This session offers the panelists and audience the opportunity to share their thoughts and views on communication issues when conducting manufacturing simulation projects.

1 INTRODUCTION

This year's panel is organized around the theme: *Communication Issues in Manufacturing Simulation*. The intent is to share information on the different aspects of communication associated with simulation usage in manufacturing.

Webster's II New College Dictionary defines communication as: "The exchange of ideas, messages, or information, as by speech, signals, or writing". The dictionary also states that "in recent years the verb *communicate* has developed the meaning 'to express oneself effectively'."

In a strict interpretation, simulation can be considered as more of a communication tool than as an analysis tool because it does not provide answers to problems, but rather takes data and transforms it into information from which decisions can be made. This information is presented as an animation and statistical results. Over time, the swing has been toward animation as the format of choice, and this evolutionary process has had some interesting effects on the simulation project process.

2 THE PANEL

The panelists, as evidenced by their biographies, are a diverse group of experienced manufacturing simulation consultants. Each of the panelists has selected a question or statement related to the general theme and will moderate a discussion using their topic as a departure point. The remainder of this section lists the topics and a brief position or background statement.

2.1 Brad Armstrong: Simulation Project Team Communication

A basic value of simulation and animation as analysis tools is their ability to provide a common ground for people in different functional areas and organizational levels to exchange ideas and understand issues. Figure 1 illustrates the roles and defines the knowledge and perspective each type of team member contributes.

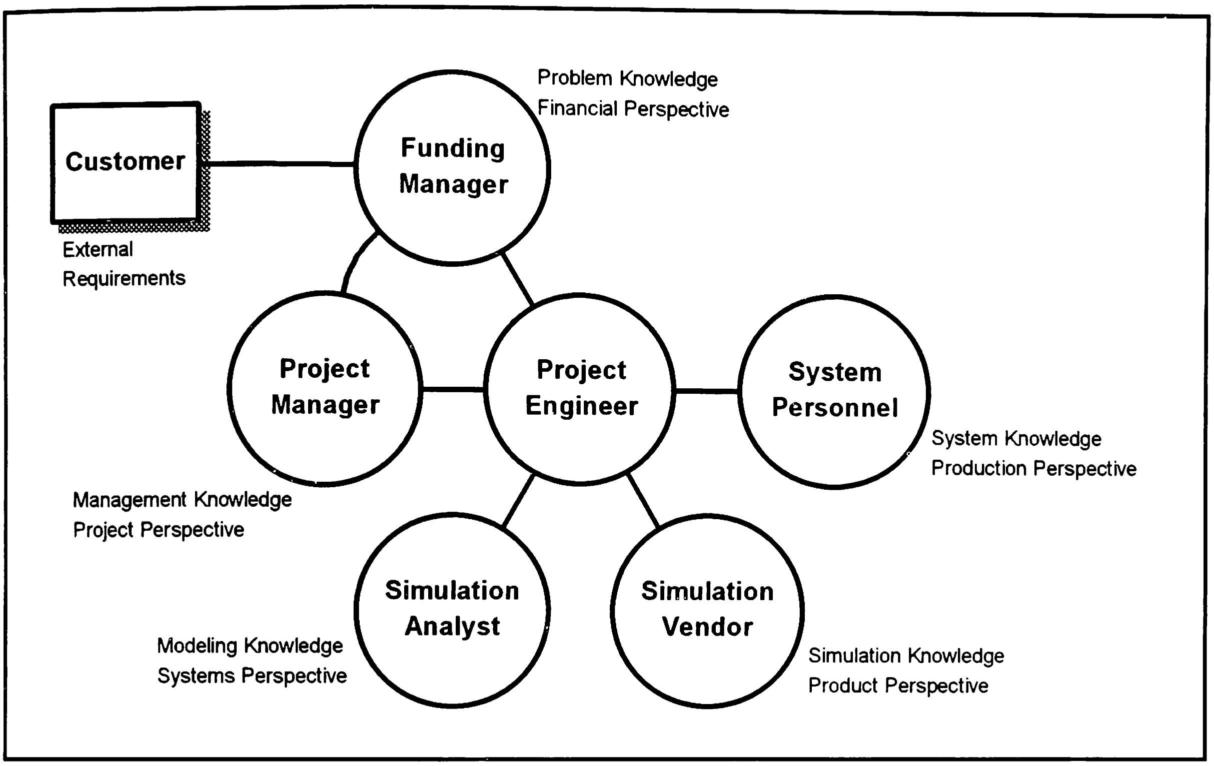

Figure 1: Representative Project Team

The structure of an organization lends itself to specialization with compartmentalized responsibilities and rewards. Simulation, and especially animation, allow individuals with different sets of knowledge and perspective to blur the organizational lines to achieve successful system solutions. Although each simulation project team differs in the number and type of people, I believe there are basic roles and responsibilities present in any team. In some cases, a single individual must play all of the roles; in other cases, each role will have one or more persons.

Even though animation is currently seen as the key to effective communication, assumptions have been the best method historically and still remain important. The problem with relying too heavily on an animation is that often the discussions they invoke are not documented. This approach results in group consensus during the meeting, but the lack of a permanent record promotes misinterpretation and faulty remembering that can cause significant problems later in the project. This effect is proportional to the number of people involved which, in turn, is proportional to the size and complexity of the system being modeled.

A detailed set of assumptions completely defines the project in a form understandable to all project team members. For the Modeler, simply stating an assumption is often not enough when conveying information about the model. Often the other team members will not understand the implications associated with a given assumption until the final results are presented with catastrophic results. To avoid this undesirable outcome, the assumption should be stated along with a justification for making the assumption, the possible consequences of using the assumption, and alternative assumptions that could be used. This greater level of detail should be used for key assumptions that either have serious consequences or are controversial. An example is shown in Figure 2.

<u>Assumption</u>: Equipment downtime is not important.

<u>Justification</u>: No downtime data is available and all of the line personnel (Joe, Betsy, and Sue) say down time rarely occurs.

<u>Consequences</u>: If down time is important, the model results will overestimate manufacturing capability and give optimistic results.

<u>Alternatives</u>: Collect down time data and evaluate its importance.

Figure 2: Example of a Fully Documented Assumption

2.2 Bennett Foster: The Model Purpose

Do you see both greater interest and less skepticism about modeling as a result of animation - and does this put even greater responsibility on the simulation developer to properly define model goals, scope, and level of detail at the onset of a modeling project?

Animation has taken simulation from a buyers market to a sellers market in some corners of the business world. The glitz of animation and menu driven data input tends to blunt the skepticism which many of us encountered, before the days of animation. However with this often ready acceptance of simulation modeling comes a possible trap. Years ago the client would always demand that the consultant be very specific on:

1. what the model would do
2. the type of questions the model could answer
3. the types of data that go into the model

Because the prospective user often wasn't sure that the kind of modeling we were describing could even be done. Now we may occasionally find a client who has decided that (s)he "wants one of those" - before the modeling work is fully laid out.

There are at least two different tasks facing the simulation consultant at the beginning of a simulation modeling project:

1. the responsibility (which has always existed) of properly defining modeling objectives, scope, and level of detail.
2. the need to manage expectations for a generation of users that has grown up with "Nintendo" and "Excel" (or "Lotus") - and automatically assumes that simulation models will come with a variety of advanced control logic and i/o features which are expensive (if not impossible) to develop inside current modeling tool and hardware environments.

2.3 Randall Gibson: Simulation Modeling: Caution - Some Programming Required"

The recent emphasis on ease-of-use by many simulation software vendors can be misleading, even dangerous. While it is true that many simulation software packages have become relative easier to use, i.e. to operate or employ, that must not be confused with the other activities involved in "using" the software. Activities such as the level of effort, training, and experience required to correctly specify, design, construct, debug, test and verify a model, and then produce correct results. For anything other than a trivial problem, these activities have in the past -- and still do -- require experience and the ability to program the solution.

A broad definition of programming would be the ability or discipline to think logically and organize complex activities into a structured, logical procedure or unified sequence of operations. Any real world system sufficiently complex to require or benefit from analysis using a simulation model will necessitate programming the system logic and interrelationships in order to produce a useful model.

Simulation practitioners, their managers and future clients will do well to keep this in mind, and not be lulled into false expectations about how quick and easy creating valid models will be.

2.4 Charles Kerns: The Role of Simulation Software as a Communication Aid

If we properly develop our product and services, if our client organization accepts this new technology, and if the way they do business, and the nature of the service they supply, radically change will any of us ever imagine that we could have done work any other way? My company is a simulation software supplier that has been spun-off from an Engineering firm with expertise primarily in the process industries. We supply a process simulator that our parent company and clients use throughout the design process. Our clients' design cycle includes the following phases:

1. Advanced Planning (an architectural technique)
2. Conceptual Design
3. Detailed Steady-state Mass Balance
4. Control Design
5. Transition to a dynamic model
6. Staging and Testing
7. Building an Operator Trainer
8. Installation and Start-up

In the past each of these phases results in a paper deliverable that is human tested and which is used to perform the next phase of the project. Problems accumulate and are fixed at the end of the project. By integrating these phases through a simulation based design tool we can build an operating model that can have layers added to it and be tested as the project proceeds, so that the system can be modeled and its performance can be tested and demonstrated.

Relying on humans to mentally model a system's performance, communicate problems, and develop and demonstrate solutions to others using dead paper models is difficult and costly. Using sophisticated simulation tools to demonstrate, communicate, and evaluate a system's performance has and will continue to be developed as technology develops. I have given you a glimpse into an area where developing simulation technology is helping create the future. We have come a long way. We have a long way to go. This and other uses of simulation are some of the areas where simulation community is helping to create the way we have been modeling for some time now.

2.5 Darrell Starks: Animation: The Double Edged Sword?

Some believe that animation has been the best advance and worst advance in the simulation technology area. Let us first address the idea that animation has caused problems in the area of simulation. Those of us who were brought up on simulation starting in the 1970's saw animation as challenging our statistically correct simulation analyses. By refusing to change our paradigm, we saw animation as corrupting the simulation user by allowing the user to make decisions based upon what the user saw on the screen instead of considering the massive amounts of output that a simulation generated. And to our credit we were correct in that many in our profession caused the users and decision makers to equate animation with simulation. We were correct in fearing that users and decision makers would use the one observation of the experiment from the animation to make critical decisions. Therefore animation was allowed to be misused initially because some of us refused to see the great benefits that animation would have provided.

That leads to the fact that animation has become one of the best features of simulation and the simulation project. First animation allows the model builder to more quickly verify and validate the models and thus allows the analysis phase of the project to begin more quickly and to be done in more depth. And the animation does in effect allow analysis. That is, animation provides "qualitative" analysis. It allows the user to visualize the system and perhaps eliminate some of the more outlandish scenarios. It allows the user "play" with the model in a visual environment and quickly view what might happen in a particular scenario. But after the user has established a set of feasible scenarios it is still the quantitative analysis using the output statistics over n replicates that must be used as the foundation for critical decisions.

And finally the most useful purpose of animation is that it allows for communication among all participants in a simulation project. It gives everyone, especially those not familiar with simulation and modeling, that "warm fuzzy" feeling that the Modeler has truly captured THE SYSTEM and therefore gives great credibility to the output statistics. Animation has allowed us in the simulation community to become the Merlin's of the 21st century using animation as our "crystal ball".

3 SUMMARY

For a consultant, using simulation and animation present a never-ending cycle of communication challenges. Starting with the need to sell the tool and ending with gaining acceptance of project results, a consultant often struggles with over- or under-selling.

The word "communicate" when talking about simulation immediately evokes thoughts of animation and two of the panelists focused on this aspect. However, there are other, broader communication issues. Two other panelists sent messages to the people who purchase simulation software and services. The first focused on software capabilities and the second on being clear about project goals. Lastly, there is the issue of the simulation team itself and its organization.

A common issue raised by the panel is the consultant's use of animation when communicating with untrained participants. There is no doubt that animation has drastically changed the focus and approach used when performing simulation projects. The question becomes whether the change is for the better or not. On the positive, it has made it possible to sell the need and results effortlessly. On the negative, it has led people to abandon other communication aids and techniques because they are seen as unnecessary.

As well-trained consultants who have spent considerable time and effort becoming specialists, we tend to have a protective view towards simulation and its usage -- maybe too much so. For the salesman in each of us, animation is dream come true. For the analyst in us, it is a potential nightmare and we suffer pangs of conscience over its potential misuse. Regardless, it is clear that although software alone may be able to give people a pretty picture, without a well-defined process to behind it, solutions are still hard to achieve and no amount of hype is going to change that fact.

REFERENCES

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AUTHOR BIOGRAPHIES

F. BRADLEY ARMSTRONG is a Fellow Engineer at the ABB Power T&D Transmission Technology Institute. Prior to joining ABB, he founded the consulting firm Simulation Engineering Associates. He has also worked for Hughes Aircraft Company, Pritsker Corporation, and General Dynamics. He received a B.S. in Mechanical Engineering from the University of Texas at Austin and an M.S. in Industrial Engineering from Purdue University. He will receive an M.S. in Integrated Manufacturing Systems Engineering from North Carolina State University. He is a professionally registered engineer , a senior member of IIE and a member of SCS. His current interests include generic modeling, experimental design, and World Class Manufacturing.

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