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MANUFACTURING SIMULATION CONSULTANTS' FORUM

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ABSTRACT

Consultants, as an important segment of the manufacturing simulation community, have not had sufficient representation under previous WSC program formats. Consultant information has been limited to presenting project results and several "how to work with a consultant" sessions. By sharing their views and experiences, this panel highlights the role consultants play as technology transfer agents between the simulation software developers and industrial users. This panel also provides a "behind-the-scenes" look at some issues facing today's manufacturing simulation consultants.

1 INTRODUCTION

The intent of this panel is to establish a yearly forum from which manufacturing consultants can share their current thoughts, experiences, and views. As the advanced scouts and test pilots for the remainder of the simulation community, the value of this panel is clear. As scouts, they are the ones who introduce simulation to new industries and discover the first solutions to problems because their livelihood depends on doing so. As test pilots, they are normally the first to test new software releases, and are always requesting, demanding, and pleading with vendors for enhancements. Consequently, their current interests and experiences serve as a compass pointing to the simulation community's future.

2.0 THE PANEL

The selection criteria for panelists included a number of factors, but in general was aimed at constructing as varied a group as possible. This forum presents opinions and experiences from independent consultants that might not be heard otherwise. Panelist selection focused on product diversity because the different products tend to have different application niches and thereby insure a variety of experiences and perspectives.

The original forum plan was to select a general theme and an associated list of topics from which each panelist would choose. However, because this is the first forum, the panelists have chosen their topics independently. The remainder of this section consists of brief position statements from each of the panelists.

2.1 F. Bradley Armstrong

Simulation Projects - The Consultant's Contribution:

In the past few years, the advent of manufacturing simulators has put in question the role of simulation consultants. As a consultant, I find myself spending an increased amount of time justifying my existence because vendors tell clients the software does everything. Over time I have compiled a list of considerations. My topic presents some insights on what can go wrong if a consultant is not in the loop.

1. Can't see the forest for the trees

Plant staff may be too close to the problem and lived with it too long. They are prejudiced towards certain causes and solutions. A consultant brings a fresh, unbiased view to solve problems made difficult because of poor assumptions.

2. The straw that broke the camel's back

A typical engineer is already juggling more tasks than can be handled effectively. Adding simulation to an engineer's workload without giving relief from other duties will seriously jeopardize a project. The consultant is there to accomplish one task and is judged solely on his ability to complete it.

3. The blind leading the blind

A project with an inexperienced manager and analyst means neither fully understands what needs to be done and how best to accomplish it. This situation causes projects to be unpredictable at best. A consultant has been through the process before and knows what needs to be done.

4. I'll scratch your back if you'll scratch mine

Over time, the way a system actually works can deviate greatly from the way the system was designed to work. This deviation occurs because people in the system tacitly agree to overlook or ignore facts or situations in the interest of maintaining the status quo. A consultant acts as a catalyst to break traditional patterns and get plant personnel to see and discuss the system as it actually works.

5. The emperor has no clothes

Vendors *say* that anyone can build models using their software. Users *hear* that they can solve problems using the software. Unfortunately, building a model is not the same as solving a problem. The result is frustration and often "shelfware." Telling a user he can model does not make it true. A consultant brings the skills necessary for the job to the project.

6. A one legged man in a kicking contest

Internal projects associated with a particular area find that problems are beyond their ability to influence. Managers in other areas are usually highly skeptical of someone else's results and normally refuse to help. [Unfortunately, I have seen cases where model results have been wielded as a weapon]. Without support and visibility, the necessary changes remain undone. A consultant represents an impartial referee with the visibility and connections to make changes happen.

This set of considerations is not only important for clients to understand, but also for consultants. Everyone involved in a simulation project has a specific role and set of responsibilities. The consultant must understand and fulfill his if the project is to be successful. In fact, clearly defining roles and responsibilities for everyone on the project team is critical. [I leave a description of team composition and roles and responsibilities for next year's forum.]

2.2 Dan Brunner

The Simulation Consultant - Software Vendor Relationship:

2.2.1 Overview

In the specialized world of discrete event simulation, a triangular relationship exists among the simulation practitioner, the simulation consumer, and the software tool vendor. If the practitioner is a consultant, how close should the vendor-consultant relationship be? We address this question from the perspective of the consultant and the consumer.

2.2.2 Definitions

Among the three parties mentioned above, the *software vendor* is easiest to define. The vendor is primarily in the business of selling off-the-shelf tools for building and using simulation models.

Within our industry the term *consultant* has come to mean "a performer of simulation engineering services." In a broad sense this definition includes internal as well as external practitioners.

Sometimes in our discrete event simulation cocoon we forget that the term "consultant" may actually mean "giver of high-priced advice" to the general public. We hope our clients know the difference!

The simulation *consumer* is the user of the information and other benefits generated by the simulation effort. There may be several different consumers involved with a given simulation project. The simulation software user may be one of the consumers but is not likely to be the only consumer.

The simulation consumer is not always the *system end user*. Sometimes one organization wants to sell, or has sold, a product or system to an end user. The selling organization may undertake a simulation modeling effort before and/or after the sale is made. During this phase it is probably accurate to call the selling organization the consumer. Later, during the implementation phase, either organization or both may be the consumer.

This seller/buyer distinction can also apply inside a single organization when one group is promoting a certain course of action to another group and/or to management. Perhaps we should define the primary consumer as "whoever is paying for the simulation!"

2.2.3 Types of Vendor-Consultant Relationships

Consultants may be either external firms or individuals or dedicated internal simulation staff. Much of the discussion that follows applies in either case.

How strong a relationship should the consultant have with the software vendor? Consultants must ask this question as part of their basic business strategy. When a simulation consumer or an overloaded internal consulting department needs to choose a consultant, that individual or group should ask the same question.

Broadly, consultants can be grouped into three camps according to the closeness of their vendor relationship(s): vendor-employed, vendor-independent, and vendor-aligned.

The easiest to define is the *vendor-employed* consultant. Several of the more prominent simulation software vendors maintain their own internal simulation engineering staffs.

At the other extreme is the *vendor-independent* consultant. This consultant has no formal or informal obligation to cast a particular software package in a favorable light. In order to be truly independent a consultant should possess strong expertise in a variety of tools (possibly through the combined expertise of more than one individual -- we note this because it is sometimes asserted that no single individual can maintain expertise in more than a few tools).

If a non-vendor-employed consultant uses only one vendor's tools, then by definition it is *vendor-aligned*. The most direct type of vendor aligned consultant is the *vendor-affiliated* consultant, of which there are many actual examples. Such affiliations can range from friendly to contractual. In some cases money may change hands between the consultant and the vendor when a consulting customer buys software or a vendor referral signs a consulting contract.

There are less direct types of vendor alignment. A vendor-aligned consultant may be an individual consultant who chooses to work in only one tool because that is what he/she knows. Some consultants may hedge their bets by being somewhat aligned with two or possibly three vendors. Internal consultants can also be vendor-aligned in that they may work for a company or group that owns only one or a few tools.

2.2.4 The Consultant's Perspective

From the consultant's perspective, there are several potential advantages to being vendor-aligned. First is the possibility of the vendor passing on a significant flow of business referrals. There may be direct financial benefits of an alignment. Finally, by being dedicated to a particular subset of the tools on the market, a consultant may be able to win certain jobs by claiming superior expertise in that subset.

The corresponding disadvantages of vendor alignment are the advantages of vendor independence. The vendor-independent consultant can seek referrals from a wider variety of vendors and can pursue a wider variety of self-generated opportunities. By maintaining expertise in a variety of tools the vendor-independent consultant stays abreast of current technology and can choose and use the latest and/or most effective tool for a particular job. Also, an unbiased perspective can be a competitive advantage in some situations.

2.2.5 The Consumer's Perspective

The advantages to the consumer of choosing a vendor consultant or a vendor-aligned consultant depend partly on the consumer's circumstances. If the consumer is already committed to a particular software vendor's tools, then choosing a consultant most likely to be expert in those tools may be advantageous (so long as the consumer can stay on the lookout for other tools when the chosen tool is inappropriate, because a vendor-aligned consultant may not always know or be willing to admit to this). Also, for very large projects for which the tool has already been selected, direct or indirect access to the software vendor's programming

staff raises the hope of more rapid response to software problems and/or availability of custom enhancements.

For consumers not committed to a particular tool and not seeking help with extremely large and complex simulation projects, there are advantages to choosing a vendor-independent consultant. Independent consultants who are familiar with a broad spectrum of tools can help choose the tool or bless the consumer's choice without bias. They offer one-stop shopping for consumers who use multiple tools. The wider choice of available independent consultants offers the consumer other benefits such as more candidates for the work (leading to better pricing, perhaps) and a greater likelihood of having an office near the consumer.

2.2.6. Summary

Simulation consultants can be vendor-employed, vendor-independent, or vendor-aligned. There are valid business reasons for a non-vendor-employed consultant to choose to be vendor-independent, and also good reasons for such a consultant to form a relationship with one or a few vendors. From the simulation consumer's perspective, the decision as to which type of consultant to choose depends on the consumer's simulation history, the nature of the project, and several other factors. In a given situation either a vendor-aligned (or vendor-employed) or a vendor-independent consultant may be the right choice.

2.3 Mark A. Contesti

Communication: The Key to a Successful Simulation Project

2.3.1 Overview

Real world projects no matter how valiant the effort fall short of perfection. Identifying and managing these project shortfalls will lead to better simulation projects and a more satisfied client. It is proposed that managed communications provides the means to identify issues or shortfalls as early as possible in the project. This provides the client insight as the project progresses and allows for incremental acceptance of this process. For the consultant it provides a simple recipe for success.

2.3.2 Introduction

It has been our experience that 99.9% of client dissatisfaction stems from unfulfilled expectations. Managed communication is the key to avoiding this pitfall, and a dissatisfied client.

Expectation can be managed by the consultant only if all client issues are understood While it is not possible to garner all issues in one meeting, it is possible to obtain the required insight if a communication plan is in place and time is taken to follow it.

2.3.3 Project Steps - When to Communicate

The following is an outline of the basic steps of a typical simulation project identifying the key junctures where client-consultant communication is critical.

Basic Project Outline:

- Project Line-up (Kick-off)**
- Develop Functional Specification Client Approval
- Construct Simulation Model
- Client Validation and Model Approval**
- Analyze Simulation Model/Write Report
- Present Results and Review with Client**

Those items marked with a double asterisk (**) indicate the critical junctures where client-consultant communication must be managed with care.

2.3.4 Client Support

The importance of the client's role cannot be overstated. Without the cooperation of the client no consultant no matter how good can be successful. If left to work in a vacuum a consultant will quickly realize the futility of the effort and lose motivation. The following are suggestions for the client to follow:

- Have concise objectives
- Determine what data is currently available, be prepared to gather proprietary information as soon as possible
- Be prepared to discuss systems operations
- Don't rush the line-up meeting, take your time, be sure that all issues have been addressed
- Read the functional specification carefully, mistakes here can be magnified
- Take time during the model validation to look at the details, ask questions
- BE INVOLVED

2.4 Jason Duff

Simulation and the A&E Industry:

The production growth experienced in the United States during the 1980's has slowed. No longer do companies freely build new production facilities as they desire. This change in economic mindset has generated two recent changes in facility growth opportunities. First, companies have become more selective of facility

projects. Second, competing architectural and engineering firms have found themselves searching for discriminating services and market entry strategies. This has created a strong need for the simulation consultant as a member of an A&E firm's facilities marketing and project team.

Simulation analysis has proven to be an excellent market entry strategy for these facility opportunities. With few exceptions, the majority of companies that express an interest in simulation or facility layout and analysis services are ultimately involved in some form of major facility project. These projects include facility consolidations, facility redesigns, expansions, or green-field facility installations. In each of these instances, simulation provides critical process insights that can be used as a discriminator for establishing the client's confidence, which is required to acquire the facility project. These insights can also be used to research any potential new facility designs or ideas.

These developments have generated a new approach to facility designs, I. e., designing from the inside out. Too often facility buildings are simply shells in which a process is placed as efficiently as possible. Through an inside out design, processes are characterized/optimized and facility design is modified based on the interactions between process and facility. In addition to providing a new approach to facility design, this concept is in-line with the latest A & E approach of providing a turn-key or design/build facility service.

In today's competitive marketplace, evaluation of a process or facility layout prior to making critical facility or investment decisions can prove invaluable. in order to develop or maintain a competitive edge, companies must use their money wisely, invest in facilities that will efficiently produce a product in a timely manner while allowing for sufficient future growth and expansion. Simulation is proving to be an extremely effective tool to accomplish these goals.

2.5 Barbara Werner Mazziotti

Creating Data-Driven Models

2.5.1 Introduction

One of the primary benefits to using simulation consultants is the savings in model building time and accuracy. Despite the perceived ease-of-use of any simulation language or package, it is very difficult to be a once a year model builder. It takes time to remember the details of the building blocks, their specific functionality, and perhaps even the syntax of the statements. Besides, plant engineers want and need to generate answers and don't need to spend time debugging models. Simulation consultants can help solve this problem by building flexible, data-driven models for plant personnel to exercise and analyze.

Data-driven models are best suited to address a set of situations that can be grouped into a class of systems yet differ in scope and/or the details of processing times or part routing. If, for example, a simulation specialist worked at the corporate offices of a multi-plant manufacturing organization; such a person could aggregate the commonalties of the plants and devise a single model with variables or parameters that could be used to configure the model to many specific situations. Intricate details of scheduling or control logic options could be incorporated, providing great model accuracy that could easily be mis-modeled or omitted by the casual simulation user.

2.5.2 User Interfaces for Data-Driven Models

If a generic model is created by a modeling expert, it is possible to teach a potential user how to "edit" the model to make changes and run experiments. This still requires familiarity with the simulation product and specific knowledge of how to rebuild, relink, or just rerun the amended model. The potential danger here is direct access to the actual model logic without safe-guards. What if the user deletes something accidentally? What if the user forgets which items to click on to edit some data and only partially updates a scenario? There is still room for errors. The preferred method of presentation is to completely remove the user from the actual model and to provide a simple user interface that requests *system specific* information and not *simulation specific* details. A wonderfully effective tool, that I recommend, is Visual Basic. With this product a simulation consultant can quickly create a Windows application that requests user input and writes out configuration information for a generic simulation model to read in.

2.5.3 Controlled/Guided Output Analysis

Just as data-driven input can simplify the scenario definition process, a predefined framework for output analysis can minimize interpretation problems. With knowledge of the specific goals of a company or knowledge of the critical factors in a class of systems, a consultant can pre-select output statistics and analysis strategies for the end users. This reduces the burden on the plant engineer and allows him or her to focus on the details of the system and answering the questions at hand.

3 SUMMARY

As shown in this paper, the world of simulation for the consultant encompasses many different aspects. In general, there is a complex interrelationship between the vendor, consultant and client. The nature of this relationship is a function of a broad set of factors including:

- Place in the consulting spectrum (single plant through multi-industry)*
- Products used
- Education
- Training
- Geographical location

*As part of one topic, an initial classification scheme for simulation consultants was included. This scheme can be extended to include other types of simulation consultants such as academic consultants and industry consultants (who work for industry consortiums).

Assuming this first panel merits a place at next year's conference, I would be interested in hearing from consultants and others in the simulation community who have comments, ideas and suggestions to improve this forum.

AUTHOR BIOGRAPHIES

F. BRADLEY ARMSTRONG is a Fellow Engineer for Asea, Brown, Boveri in the Engineering and Manufacturing Productivity Center where he is an internal consultant for simulation and world class manufacturing methods. He also is the owner of Simulation Engineering Associates (SEA). Prior to forming his own company, he was a Senior Staff Engineer at Hughes Aircraft Company where he worked as an internal simulation consultant. He also worked as a Senior Systems Analyst for Pritsker and Associates, and as an Operations Analyst for General Dynamics. He received a B.S. in Mechanical Engineering from the University of Texas at Austin in 1981, an M.S. degree in Industrial Engineering from Purdue University in 1986, and is completing an M.S. degree in Integrated Manufacturing and Systems Engineering. He is a professionally registered engineer in North Carolina, California, and Indiana. He is a member of IIE and SCS. His current interest is in using simulation, statistics, and GUI tools to build Focused Analysis and Training Environments.

DAN BRUNNER founded System Flow, an independent simulation services firm in March, 1993. Prior to founding System Flow he was with Wolverine Software Corporation where he managed simulation services, technical support, training, and product marketing activities. He received a B.S. in Electrical Engineering from Purdue University and a Master of Business Administration from The University of Michigan. Mr. Brunner served as Business Chair of the 1992 Winter Simulation Conference and is General Chair of the 1996 Winter Simulation Conference. He is a member of IIE and SCS.

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JASON DUFF has been a simulation consultant at Sverdrup Technology for the past four years. He had previously worked one year as an independent consultant. He received a B.S. in Systems Engineering and an M.S. in Industrial Engineering from the University of Florida. He is a certified ProModel trainer. His current interests include the design and analysis of high volume manufacturing facilities using advanced CAD/CAM tools and simulation.

BARBARA WERNER MAZZIOTTI is currently the Manager of Simulation Services at the Textile/Clothing Technology Corporation. For the past 4 years, Mrs. Mazziotti has been challenged with bringing the technology of process simulation to the apparel and textile industries. In this position she has focused on creating data-driven, flexible simulation models and animations for non-expert users. In addition to conducting seminars on simulation and production systems, she has completed projects with more than 20 retail, apparel and textile companies. Prior to $[TC]^2$, Barbara was on the consulting staff at Systems Modeling Corporation, teaching SIMAN and CINEMA, managing projects and doing analysis for a variety of industries and applications. Barbara began her career at General Motors as a Simulation Project Engineer for a group of metal stamping and automotive assembly plants. Barbara has a B.S. in Operations Research and Industrial Engineering from Cornell University and is completing an M.S. in Industrial Engineering at North Carolina State University. She is a member of SCS and a senior member of IIE.