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HOW TO SELECT AND WORK WITH A CONSULTANT: A CONSULTANT'S PERSPECTIVE

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ABSTRACT

This paper presents a discussion of the process of selecting and working with a simulation consultant, from the consultant's viewpoint. It is directed towards the new user of simulation services. It outlines and discusses specific issues which should be considered during the selection process and throughout the duration of the project. Helpful hints on the working relationship and examples of results from complete simulation studies are included.

INTRODUCTION

There are generally two types of new clients who seek simulation consulting services. One is the client who is new to the idea of simulation and may not even fully understand its capabilities. This type of client is looking for a one-time modeling effort or for someone to hold their hand in their first use of this technology. Much of the discussion in this paper is directed to this individual.

The second type of client may already have extensive in-house simulation capabilities, but find his resources too limited to handle all the work. This client usually knows exactly what he wants and how much he is willing to spend. However, his choice of consultants may be limited to those that use the same simulation language as the client.

The first type of new client clearly has a more difficult task in selecting a consultant. Not only are the simulation consultants unkown, but also the concept of simulation may not be clear. One question that I often ask during the initial contact with the client is, "Why do you want this simulation ?" My objective in asking this question is not to talk the client out of purchasing our services, but to obtain a better understanding of what his expectations are. The responses to this question are quite varied, often honest, sometimes humorous, and sometimes bewildering. I categorize these responses as either "fun" or "handle with care."

The "Handle With Care" Responses

These types of responses are generally received from new clients who are unfamiliar with simulation, and who are considering it only because it has been required by a second party or because they are desperate. For example:

> My Vice President was reading this article in Business Week about simulation and decided that we should have a simulation (with an animation) of our new production line;

or,

> We are bidding on a design contract for a new facility and the specifications require a simulation as part of the work.

The potential for a successful simulation project is there, but, at least initially, the client often is only interested in satisfying the requesting party. If this is the only goal of the client, the consultant will probably have difficulty in obtaining the necessary details and data, since the client's enthusiastic involvement and time commitment to the project is critical. If not handled properly by both client and consultant, such a project can result in unhappiness on both sides. In these kinds of situations, the success of the project is determined in the early stages and often depends upon the ability of the consultant to convince the client that a simulation can in fact be used as an important decision-making tool.

The desperate responses are typically:

> We have this new automated system that is scheduled to startup next month and we are wondering if it will perform as designed;

or,

> We have a new production system up and running, but it's not producing at the designed throughput and we don't know why.

In the case of the first response, I immediately assume that there is some indication that the system will not perform as expected, otherwise the client would have never called. In both cases the simulation project should have been carried out

months before. However, the second set of responses at least indicates that the client is interested in using simulation as a decision tool, even if it's a little late.

Any of the above situtations require that the client and consultant jointly develop a working agreement that will result in a successful project as defined by the client. In this type of environment, the consultant should bear the burden of assuring that the client fully understands what work is to be performed and what requirements are placed on the client.

The "Fun" Responses

The fun responses may be received from a client new to simulation, but at least the client has an understanding of when simulation should be used and an idea of what it can be used for. These responses take the form of:

> We are in the initial design stage of a new production system and want to check out our concepts before we commit to the equipment;
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> or,
>
> We have an existing operating system that is to be modified and and we want to be sure that the modified system will yield the planned performance.

These can be fun projects because the simulation can be used to evaluate the new or revised system and potentially impact the design decisions well before implementation.

SELECTING A CONSULTANT

Selection of a consultant by an inexperienced client would appear to be a rather chancy task. Clients who have extensive experience in contracting with simulation consultants may be hard to find and may be biased by their choice of simulation language. In recent years, many consulting firms have added simulation capabilities to their existing services, but only because many of their clients require it. The quality of these services can vary widely from one organization to another.

One method which can be used to determine the quality of a consultant is to ask for references. However, bear in mind that a good consultant will never give you a reference that would not result in a glowing response. Also, many companies that purchase simulation services are unwilling to discuss them with other companies.

Another method is to ask the consultant for a formal quote for the simulation project under consideration. In order to provide a quote, the consultant needs to fully understand the system to be simulated and the objective of the project. The interaction that takes place during this phase can often give the potential client an indication of the competence of the consultant, although this process can be very time-comsuming if quotes are requested from more than two or three consultants.

The actual choice of consultant should be based on following five points:

1. Cost,
2. Flexibility,
3. Software,
4. Timing, and
5. Quality.

Cost is an obvious measure and in many cases the only one considered. Two different quotes can be easily compared if only the cost is considered. However, a low cost for an incomplete or incorrect simulation is not really a bargain. For example, if you call back a week after the project is over and request an additional run, what is the likely response? The cost of the paperwork required to obtain a new purchase order number may exceed the additional cost requested by the consultant.

Flexibility is a subjective measure that indicates the willingness of the consultant to alter the simulation model as more is learned about the system under study. Only rarely have I come across projects which have not resulted in at least minor changes, and often major changes, in the actual system during the simulation analysis. Many possible changes can be anticipated and included in the formal agreement between the client and consultant. For example, number of processors, number of AGVs, buffer sizes, etc, may be specified as a range of parameters which need to be considered. If the exact scenarios to be considered are known at this time, they may also be included. Unfortunately, the complexity of many systems is such that not everything can be foreseen. The unwillingness of the consultant to make changes or include important features that were not detailed in the formal agreement can cause considerable grief. In most cases, consultants are aware that a happy client is likely to be a repeat client, but there are always exceptions.

The software that the consultant will use to develop the simulation can become extremely important in the future. If the model is only going to be used for this project and never referenced again, the importance of the software choice is diminished. This, of course, assumes that the chosen software is capable of capturing the key elements of the system to be modeled. However, if the model is to be retained for future use or be the start of a simulation effort, the choice of software can become even more important than the cost of the project. The client should not assume that the software chosen by the consultant is the software that he should adopt for future in-house work. If this project is to provide the beginning for future

simulation activities, it may be worthwhile to first select a simulation language and then seek a consultant that will provide a model using that language.

Timing refers to the ability and willingess of the consultant to respond to the needs of the client in a timely fashion. This includes the preparation of the formal quote as well as the undertaking and completion of the actual project. Even companies with considerable experience and expertise in simulation occasionally find themselves faced with the need to contract out for a simulation model that should have been done yesterday. Worse yet is the situation where a consultant is in the middle of a large simulation study and the client finds that the actual project has been delayed, thus preventing the acquisition of information required to complete the study. Ideally, the consultant should be willing to postpone completion of the study. This of course assumes that appropriate financial terms have been worked out that are agreeable to both parties.

The final quality of a consultant's work is often difficult to estimate until well after the project has been completed and the results validated by the operating system. However, the quality of a consultant can take on many forms. Is the consultant knowledgeable in the area of the project? If so, he can often provide valuable insight to the design and evaluation process, if only by asking questions which cannot yet be answered. A good simulation consultant can often provide much insight to the operation of the system being modeled, even if these insights result in changes which require altering the model. Therefore, the quality of a consultant must not only consider the final product, but also the ideas that are generated during the modeling and analysis of the system.

Unfortunately there is no clear cut way to guarantee the selection of a competent consultant. Confusion in this area as well as the initial shock over the potential cost of a complete simulation model effort often results in the potential client simply not doing a simulation. The client should not think only in terms of what is the cost, but what are the potential benefits. For example, what are the savings if I can buy one less AGV; what will it cost me to alter the system after it is in operation; or what is the increase in profits if I can increase throughput by one percent. At the far extreme, one might ask the question, have we overlooked anything that might prove fatal to the system. Stories of multi-million dollar systems that have never really worked are fairly common, even though most are not documentable. If a system is doomed to failure, it is far better to be aware of it before massive expenditures have been made.

WORKING WITH A CONSULTANT

The working arrangement starts at the very beginning of the quotation process. At this stage the client and consultant must develop an agreement that includes the following:

1. Objective of the modeling process;
2. Definition and scope of the modeled system;
3. Level of detail of the model;
4. Analysis to be performed;
5. Documentation to be developed;
6. Type of report to be generated; and
7. Project milestones and duration.

Stating the objective of the modeling process is key to understanding what needs to be modeled as well as how it should be modeled. This can often be simply stated by listing specific questions or information that the client expects from the model. For example, what is the effect of a limited repair resource pool? This requires that this limited resource be specifically modeled, otherwise the simulation would be incapable of addressing this question. Also, the order in which questions are to be addressed should be stated. Trying to determine the effect of all possible combinations of numerous factors, each at several levels, can be a very time-consuming, non-productive task. It might also be wise to leave sufficent leeway for the consultant in the analysis phase to exercise the expertise for which you are paying. If you don't, you may get what you ordered, but not what you wanted.

Definition and scope of the system to be modeled is best described by drawings, flowcharts or narratives of the material flow, descriptions of control procedures, and other information that needs to be considered in the development of an accurate simulation model.

The level of detail of the model should be stated. For example, are material movements to be modeled by simple time delays or must each material handler be included in the model? The level of detail agreed upon at this stage can greatly affect the total cost of the project. If the client has chosen a capable consultant, he would be wise to listen carefully to the advice given at this stage, as it could result in considerable savings and increase the probability of the project providing a valid model.

Since the analysis phase can often require more time and effort than the modeling phase, an understanding of who will perform that analysis must be reached. If the consultant agrees to perform the analysis, the type and completeness desired should be stated. There are cases where the client only wants a model to be developed and prefers to perform his own analysis. In other cases, however, a client who is under severe time restrictions or who does not have available computers may wish to have the consultant perform the analysis.

In general, the best way to conduct the analysis is by a joint effort. The expertise of the consultant in simulation and analysis combined with the client's knowledge of the system being modeled can often shorten the analysis time while

increasing the likehood of achieving the project objectives. This combined effort can be accomplished by face-to-face meetings or by conversations using the phone and a facsimile machine. Under any circumstances, the client should have the opportunity to ask the important "what if" questions. Again, the competence of the consultant becomes important, as the accuracy of the analysis is directly related to the accuracy of the developed model and the ability of the model output to provide the information needed to draw conclusions about the operations of the system.

Documentation of the simulation model is a time-consuming, yet necessary task. At a minimum, the consultant should provide sufficent documentation such that an individual trained in the language could easily understand the model, make minor changes to it, and use it for future analysis. At the other extreme, a detailed users' manual which leads the user through the use of the entire model can be developed. Generally the basic documentation is selected, since the development of a detailed users' manual can be costly for the client.

Final reports are very similar to documentation. They are time-consuming and costly to create and should be kept to the minimum required by the client. This normally includes the objective of the project, a brief description of the system, any simplifying assumptions, and a summary of the analysis. The analysis summary should also include key simulation output generated, plots of important data, and general conclusions. Large final reports are often filled with "boilerplate" and serve little purpose other than occupying space on the client's shelf.

The project milestones should be established such that they meet the requirements of the client, but allow the consultant to perform the work at a reasonable rate. Crash projects will always cost more, and often the results are not used until much later. The milestones should be easily identifiable and review meetings should be held if the duration is long. For a short project of two or three weeks, review meetings may actually hinder the progress. Also a payment schedule tied to the major milestones should be agreed upon by both parties. If the timing is critical, the starting date should be stated. In most cases, a consultant will key the starting date to the receipt of a valid purchase order and all data and systems descriptions required to start the simulation.

Obviously the above are only guidelines. Any consultant in business for any length of time has completed projects for good clients, prior to even receiving a valid purchase order. Some projects are even performed with only a verbal agreement as to what is required. There are even cases where the amount of analysis is left open ended because it's not clear what is required at the start of the project. However, the new client should try to have all bases covered, at least for the first few projects.

Also consider the possibility of a consultant working directly with the client's personnel to develop the model and later to assist with the analysis. This can yield a simulation model at a much reduced cost and provide valuable training for the client. It does require the commitment of the personnel by the client to the project, but allows at least a part of the expertise to remain with the client. It's also fun for the consultant, as he is involved in the interesting stages, but leaves the less interesting parts (documentation, report writing) for the client. In most cases, a good consultant is willing to make arrangements that are consistent with the client's needs.

HELPFUL HINTS

A successful project often requires constant communication between the client and consultant. Both parties should designate project leaders who are responsible to see that the project is completed on time. The project leader for the client should be directly involved with the project and have sufficient time to allocate. The project leader for the consultant should be the individual who will be doing the bulk of the modeling and analysis, but that individual should have sufficient experience to provide the required leadership.

If the timing is critical, the client must realize that when the consultant requests information, it is often required before the work can continue. Don't expect the project to be completed on time if important data or decisions are not given to the consultant in a timely manner. Also, both parties should be aware of the unavailability of key personnel for extended periods, such as vacations, during the life of the project.

During the course of a long project, many things can change. If the design of the system is altered, the client should inform the consultant as soon as possible to avoid unnecessary work. It's hard to get excited about a project when you find that the work you have been doing for the last two weeks was wasted, particularly if you know that the client was aware of the changes two weeks ago. The same is true for the consultant. New findings that might suggest a design change in the system should be reported as soon as possible to give the client the maximum amount of time to react.

Finally, the consultant should remember that the client is the one paying the bill. At the same time, the client should remember why the consultant was retained: because of the expertise he could provide.

POTENTIAL OUTCOMES

Don't assume that you know what the outcome of a simulation study will be prior to its undertaking. Many studies

are straightforward and yield very predictable results. However, a successful study may reveal that a system will not produce as designed. Remember that the purpose of most studies is to determine the viability of a plan of action or new design.

Most simulation studies are rather boring to talk about because they resulted in changes which provided increased throughput, less machines, smaller buffers, etc. The interesting studies are those which yielded something out of the ordinary.

For example, an analysis of a new automated system required the development of control strategies and vehicle fleet sizing. After an extended analysis we came to the conclusion that the system could not produce at the design rate. The best that we could do was 85 percent of that capacity. Reluctantly, we reported our results to the client. Much to our surprise, the client was pleased as this system was feeding several other systems which only required it to operate at 75 percent of the design capacity.

Another study involved changes to an existing automated system with the objective of reducing the number of shifts required to achieve a stated throughput from three to two. Again, it was found that the resulting changes would not produce the desired results. As in the previous study, the client was pleased as the specified changes would have cost several million dollars.

Some projects do result in a redesigned system which provides improved performance at a decreased cost. The objective of a recent project was to evaluate the control logic developed to route parts to parallel machines in a high-speed assembly system. It was found that the proposed logic would not work at the rates required by the system. After many long phone conversations between the two project leaders, a new logic was developed which easily handled the required rates of assembly. Interestingly, the resulting logic was much simpler and cheaper to implement.

Of course there are the success stories that have led to nowhere. A number of years ago I conducted a large study for a client which involved a complete redesign of a new automated system. Just prior to the client releasing the purchase orders for the equipment, there was a sizeable drop in sales of the product that was to be produced on this new line. Even though the simulation study was a success, the system was never implemented.

Then there was the simulation study conducted by a client which resulted in a high speed automated assembly system which could not produce at the required rate. Subsequent analysis using a new simulation model showed that the original model had been correct, however the data used was at fault. In this case, the problem was due to overly optimistic uptimes on the automated equipment. A good consultant would have at least considered higher failure rates, even if only to warn the client of the potential impact.

There is one example that comes to mind where a simulation study was not performed because the objective was to determine if the addition of a second machine would increase the throughput and the cost of the study would have exceeded the cost of the machine. Someone decided that it was cheaper to purchase the second machine and see what would happen.

Finally there are the quotes which a client does not accept because he feels they are to costly, followed by an implemented system that failed to function properly. Often the time and cost required to redesign the system far exceeds the proposed cost of the simulation. Of course, many systems are designed and implemented without the benefit of simulation and not all are failures. But is it worth the chance?

CONCLUDING REMARKS

The selection of a simulation consultant is the responsibility of the client. Some ideas have been provided which might make the process a little easier for the client new to simulation.

Once the consultant has been selected and a project undertaken, both parties must contribute to the success, or failure. The working relationship becomes extremely important, particularly if the timing is critical. If the consultant wants your business, he'll do his part.

AUTHORS' BIOGRAPHY

Dr. Sadowski is currently Vice President of Systems Modeling Corporation in charge of consulting and user-education services. He was previously on the faculty at Purdue University in the School of Industrial Engineering and at the University of Massachusetts. He received his bachelors and Masters degrees from Ohio University and his Ph.D. from Purdue. Dr. Sadowski's research interests are in Manufacturing and Production Systems with emphasis on modeling, control, and applied scheduling.

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