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INCREASING RETURN ON INVESTMENT FROM SIMULATION (PANEL)

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ABSTRACT

Growth in the use of simulation technology has been less than expected. Today there are still many applications that could benefit from simulation, but that do not use it. As companies decide whether to use simulation, they need to consider the investment and all possible benefits.

In this panel, four simulation professionals from academia and industry answer two questions about Return on Investment (ROI) and simulation.

1 QUESTION NUMBER 1

The first question posed to the panel is "Is the simulation community doing a good job of selling our successes?".

1.1 Randall Gibson

I would have to conclude that the simulation community is *not* doing an adequate job of selling simulation successes. Too often I see management deciding not to commit to simulation for projects where it could be a significant benefit. Many of these managers have little understanding of the real capabilities of simulation; some have unrealistic expectations – which I believe have been fueled by our own industry's optimistic or overstated advertising of the capabilities of the software. I think the simulation community may have accidentally hurt itself by overstressing the importance of "ease of use" software, and not stressing the importance of the "engineering discipline" - training and experience - needed to properly employ such software, manage a project, and produce correct and appropriate results.

I believe we must revisit how to effectively communicate to management the simulation value equation:

Benefits – Costs = Value.

It's easy to identify the costs for employing simulation technology on a project, but often the benefits are harder to quantify or are primarily qualitative, making it difficult for managers to determine a tangible value.

For many applications, simulation modeling is largely an elective step or process - it's not absolutely necessary. Perhaps only in very large, costly, or very risky projects or undertakings is it really necessary to simulate to avoid unacceptable outcomes or mistakes. Current low cost desktop computers and powerful simulation products ALLOW us to apply the technology to smaller projects, but that doesn't change the basic issue – it is still elective for most of these projects. In order to get past this hurdle and increase the use of simulation, we will need to either further reduce the costs associated with simulation projects, or find better means of identifying and communicating the

quantitative benefits associated so that the value can be computed and be shown to be positive.

1.2 D. J. Medeiros

Certainly one important and widely understood measures of success is the return on investment in a simulation model. A review of the literature in simulation applications suggests that ROI for simulation, though recognized as important in some areas, is not widely used as a metric. The military simulation community is an exception; ROI has been measured for a variety of simulation models in applications including training, acquisitions, and testing (Worley et. al. 1996, Carter 2001, Olden et. al. 1999). Many of these applications have very large returns when the entire life cycle of the simulation model is considered. In the control systems area, significant ROI's have been reported for simulations (Wagner and Keane 1997) and for emulation models (Mueller 2001).

ROI has been reported for new systems or processes where simulation was used to model part or all of the "to-be" system. Application areas are quite varied; examples include a call center (Miller and Bapat 1999), a municipal court (Petrakis and Engiles 2000), an equipment rental business (Bowman et. al. 1998) and a supply chain (Benjamin et. al. 2001, Banks et. al. 2002). These cases present a difficulty in distinguishing the return on investment directly attributable to the simulation model from that on all the other activities of the project. Although the overall project ROI is of most importance in the particular instance described, it is less useful in estimating the return from using simulation in new applications.

1.3 Andrew Sudar

Simulation has been generating tremendous value for organizations for decades. The use and success of discrete event simulation in particular has expanded from use primarily within the four walls of a factory to include applications in healthcare, transportation, supply chain, and business process. With such broad use of simulation and a user base that continues to grow, why is it that simulation successes do not receive more acclaim?

In many organizations simulation successes may not receive due recognition due to the abilities and efforts that are put toward selling the benefits of the projects. Often times simulation analysts not only lack the ability to perform the proper upfront value analysis required but also fall short in having the skills to communicate that value when the project is complete. In addition, analysts are usually very time constrained and are not always able to dedicate the time and effort required to properly promote project results.

For corporations, selling successes with simulation must be done internally as well as externally. Conferences and other simulation community events are excellent events, but do little to sell the power of simulation within an organization. Avenues such as corporate intranet postings, company newsletter articles, internal knowledge exchange programs, best practices events, Kaizen processes, etc. must be leveraged to promote simulation and its potential impact on driving value. Simulation vendors must also do their part to support the organizations in selling successes.

Due to simulation's roots, simulation is sometimes looked upon simply as an engineering department tool. As such, individuals in organizations may have a very limited view of the types of problems that simulation can solve and hence the value that can be derived from projects.

1.4 Bill Waite

While simulation technology and application activity is pervasive, powerful, and often successful, and while in many instances the success of simulation's use is effectively asserted and appreciated; nevertheless there are two senses in which the answer to the question as phrased must, unfortunately, be, "No".

On the one hand, it is something of a misnomer to refer to the "simulation community" at all. There is certainly the set of individuals who practice simulation. In addition, there are sets of individuals who develop and teach its technology's practices and sets of individuals who build and sell its asset artifacts (tools, etc). And, there are communities of interest very often found within one or another application industry domain or within other-than simulation academic disciplines. What does not exist, however is a clearly defined "simulation community" as used in the question. There is, practically, no clearly defined simulation profession, industry or marketplace. The assumption (as in the question) that such a monolithic community exists is in fact a necessary precondition of 'making the sale' in the sense expressed.

Taking as given a simulation community communicating to others the success of their efforts, the determination of the effectiveness of the sale depends on a clear appreciation of who we are trying to sell, what we are trying to convince them of, and what effect we want the 'sale' to have. Reasoning backwards, we assume that the effect we wish to achieve is the sufficient appreciation of simulation as an enabling technology that it is accepted gracefully into the wide variety of application domains and types of uses for which it is fit. On that account, we need to provide not just the assertion that 'simulation is good', but the business case whereby the target customer can come to understand how good the fundamental value of simulation can be for what needs to be accomplished in comparison to alternative investments. Finally of course, it is assumed that some cadre of 'decision makers' or simulation consumers is the sales target, without, very often, appreciating the positional role of such individuals in organizations or programs to

whom the sale should be directed and through whose actions it will be ultimately effective. A final challenge is that we must not succeed only at 'the point-of-sale', but we must establish the widespread appreciation of the value of simulation as a general profession, industry product or service predicated on a clear shared and public expression of what is 'simulation' and what is its relationship to allied offerings such as systems engineering software engineering, program management, etc. Within this context, and notwithstanding considerable pointwise evidence, I doubt we can state clearly and effectively what our successes are or precisely who should care or precisely why.

2 QUESTION NUMBER 2

The second question for the panel is: "What are the characteristics/commonalities in successful simulation projects?"

2.1 Randall Gibson

Based on significant industry experience, I believe that successful simulation projects in the commercial world have most or all of the following eight common characteristics:

1. **Experience**: the project is conducted by an experienced analyst (or team). This probably the single most important contributor to project success. Without this every project is at risk no matter the other characteristics. With this, you can make up for the lack of almost any of the other characteristics listed below.
2. **Continuity**: there is continuity of the project analyst (or team) throughout the project, and across multiple projects for the same client or industry. Also, there should be continuity of the customer project team and management throughout the project; changes here during the project almost invariably lead to problems.
3. **Buy-in**: the project has been "sold" at the (top) management level, to insure they are very aware of the project, requirements, and have a good appreciation of the potential benefits of the technology.
4. **Expectations**: the client management has been educated to have realistic expectations about what simulation models are, how they work, and what to expect.
5. **Participation**: there is significant client involvement during the project at key review points, in the problem formulation stage, and during the simulation analysis runs.
6. **Identifiable payback or risk**: the project includes resolution of a problem which has costs savings or avoidance that are at least 10x the cost of the simulation project, or significant qualitative benefits that are widely agreed upon
7. **Time**: there is adequate time to conduct the project properly, including testing, analysis, and simulating changes found (through the initial simulation analysis) to be necessary!
8. **Software**: the simulation software tool selected is appropriate to the problem, and well known to the analyst(s) conducting the project.

2.2 D. J. Medeiros

What benefits can be attributed to the use of simulation in a project? Perhaps the easiest category to quantify is cost avoidance. Simulation can substitute for costly experimentation with the real system (Miller and Bapat 1999, McCarthy and Stauffer 2001). Simulation can reduce debugging and installation time in the field (Mueller 2001, Schiess 2001, McGregor 2002). Simulation can reduce expenses for training including transportation, expendables, and operational costs (Carter 2001, Gordon 2000). In these cases, it is not difficult to estimate the ROI from use of a simulation model.

Yet, "simulation has a value beyond economics" (Gordon 2000). Some benefits are much more difficult to quantify, but are clearly of great value. Simulation can improve the results from a project. It can be used to test scenarios that aren't practical to test in the real world, such as a fully loaded material handling system with a specific product mix (Schiess 2001), a call center under a high demand scenario (Miller and Bapat 1999), a complete supply chain (Banks et. al. 2002), or the effect of investment alternatives on plant capacity (Saraph 2002). There is more opportunity to analyze and evaluate problems because the model can be rerun, perhaps slower than real time. More alternatives can be studied in a shorter amount of time, leading to improved solutions.

Another type of benefit that is difficult to quantify is the unexpected insights that simulation of a system can provide. A process might be less important than previously believed (Bowman et. al. 1998). Improvements to specific processes may not result in the needed system improvement (Benjamin et. al. 2001). Simulation may capture "tribal knowledge" that is otherwise unavailable (Knoll and Heim 2000).

Simulation costs include design, implementation, VV&A, and experimentation (Carter 2001). We can reduce the denominator in the ROI equation by reuse of simulation models or components (Ewing 2001, Carter 2001). Other opportunities to reduce costs include software with built in problem specific modules or features, and software that simplifies experimentation, optimization, and analysis of results.

How can we, as simulation practitioners, demonstrate the value of simulation? We can create a business case for simulation by calculating ROI for our models considering the cost avoidance category of benefits. We can attempt, where feasible, to quantify benefits in the other categories discussed above, or at the minimum describe such benefits.

These efforts will reward us in providing greater visibility for simulation technology and more opportunities for its use.

2.3 Andrew Sudar

Prior to even reaching the point where a successful project's results are communicated, from the onset the project must first be given the opportunity to succeed. In order to maximize the chance for a successful project that drives value and can gain visibility within an organization, a few essential elements must be in place.

The first element to enabling a successful project is management support. In one sense this means management must be willing to dedicate the proper resources to the project. Some basic skills required for simulation analysts could include prior simulation experience, sound statistical knowledge, process knowledge, database experience, and the ability to operate within the organization, to name a few.

Beyond committing the right resources, management must also be willing to take a role in the project and continue to drive the team toward results. This could mean removing any barriers that may exist for the team such as gaining access to key individuals in the organization (IT, Finance, Knowledge Experts, etc.), allocating the right amount of the simulation analyst's time to the project, or simply supporting and representing the project team to other levels of management or other parts of the organization.

The last key element for enabling a successful project is clearly defining the project plan. A well defined project plan goes beyond the traditional functional specification. It must include additional items such as a communication plan, travel plan, value analysis and measurement plan, and solution maintenance plan.

With simulation solution vendors continuing to add features and functionalities that allow for even broader use of their tools, it is imperative that simulation projects are positioned for success from the inception of the engagement all the way through to communicating the value delivered at the project's completion.

I believe the following attributes, qualities or circumstances are markers for success of simulation programs:

2.4 Bill Waite

I assume what is being asked is equivalent to: What attributes determine the success of simulation projects and what values of those attributes correlate with positive successes? I further assume that a simulation program is not just the development of a simulation asset but instead the development/ use of simulation in support of some useful activity.

- The fundamental role of simulation in relationship to systems engineering, testing, etc. must be established early in the program and made a living part of the program strategic guidance.
- There must be a 'simulation' line item in the master program plan
- There must be an expert advocate / execution agent to lead the simulation activity (not just a software guy or the fellow who looked the wrong way during a meeting). If there is going to be distributed collaborative simulation, an integration agent who has no vested interest in the components is invaluable
- The chief detriment to successful simulation development or application is 'requirements management' – including needs for simulation on the program and requirements for the simulation assets themselves
- Investment cost in M&S development, VV&A, Data acquisition, and use cost must be budgeted. What cannot be supported by the budget cannot be executed.

3 SUMMARY

Although simulation success stories exist, there is still a need for simulation practitioners to do a better job of presenting their successes. Expanding the area of application, or in other words, "selling" simulation is about understanding the return so that the investment can be made.

Tangible as well as intangible benefits of simulation projects should be enumerated to fully understand how simulation adds value. As stated by the authors, there are many elements required for successful simulation projects. Simulation analysts must pay attention to these elements while continuing to promote their successes.

By adopting a greater focus on ROI, simulation practitioners can help expand the use of the simulation discipline. Practitioners must continually help educate management of the benefits of simulation. Without management understanding and commitment, simulation will not reach its full potential as a decision technology.

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