The Future of Simulation

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As of 1980, simulation languages were reasonably popular in manufacturing, computer and communications modeling, and military and government applications. Large organizations in the US were using the technology and many universities were teaching simulation. In the 1980s and into the early 1990s, many software developments occurred that define the current status of the capabilities that are available. Making much of this possible was the rapid improvement in graphics and processing power of the PC.

Simulation, in the US, is one of the three top technologies used by Industrial Engineers, Operations Researchers, and Management Scientists. It is no longer the “technique of last resort.” It is an indispensable problem solving methodology. These statements can be attributed to the fact that real systems are random and cannot be analyzed easily with static modeling tools.

There is a steady progression of simulation users. But growth in simulation use is not accelerating. Even though simulation is widely accepted as a tool, it is used in only a small fraction of the cases where it can have a significant impact.

In order to accelerate the growth, the complexity of using the tool must be reduced. But that is a great challenge. It is not to be accomplished at the expense of flexibility and robustness. Also, simulation is a time consuming process. In some cases, decision makers cannot wait for the answers to emerge. It should also be mentioned that interpreting simulation results can be difficult. However, there are excellent output analysis tools in the marketplace. I just wish that they were used more often!

Each year for the past four years, I have organized a panel on the future of simulation for the Winter Simulation Conference. Interestingly, I asked the panelists to address the future in seven areas in 1997. But, when I formed the panel in 1998, only two of those seven areas were prevalent. This can be used to show that the future of simulation is not unknown, it is unknowable. I can only say that simulation will be customer-driven and market-based.

There is great interest in the future of simulation as indicated by the size of the audience attending the panels at WSC. Each year, it has been the most highly attended session (other than the plenary address) and the session is always on the last day of WSC.

With this background, here is what I see in the future of simulation. First, there will be better and tighter integration of simulation software and other software for the exchange of data. Data exchange standards for material handling systems have been developed by Engineering Animation Incorporated. Also, XML (Extensible Markup Language) provides rules, guidelines and conventions for designing text formats for data. XML is a large and growing community. Eventually, some group will want to develop XML standards for manufacturing and material handling.

There will be tighter implementation of simulation software with control systems and controls emulators to test controls at various levels before implementation to drastically reduce testing and de-bugging.

Another area of growth is the component-based simulation environment. It includes libraries of pre-built icons that allow simulation models to be built much faster. I see component-based simulation as more attractive than object-oriented simulation since the latter is just too hard to implement for most practitioners. Develop an object-oriented simulator that requires no hard coding and is completely menu-driven and I will use that.

There are many possibilities for simulation using the web. There are two possibilities that have some potential. They are running the model on a client computer and remote access. Both of these depend on Java.

Every where that I go, people want to talk about the simulation of logistics systems. That is this year’s hot topic. Why? Because logistics involves new processes that need to be understood. Why? Because simulation is
very useful in helping to understand a new system and logistics systems are new.

Simulation-based scheduling has been very profitable for a number of simulation vendors. In that case, the simulation model is embedded. It is hidden. We need to find more opportunities to embed simulation in software.

Three years ago, optimization using genetic algorithms and tabu search were in their infancy. Today, virtually all of the discrete-event simulation software sold in the US has some form of optimization. There are still lots of problems associated with its use. For example, it takes a lot of time. This is a fertile area for research.

There are some developments that I predict will go nowhere, at least in the simulation of manufacturing and material handling systems. One of them is HLA (high level architecture). It’s just not worth the effort, and the models run ever so slowly.

Another area that I see as headed nowhere, at least in manufacturing and material handling, is parallel and distributed simulation (PADS). To properly use PADS, the model has to be dissected and partitioned to the computers that are being used. That is time consuming. An easier way to handle this problem is to distribute the replications on a local network then reassemble all of the results.

Each year for the past few years I have organized a mini-track (four sessions) on the future of simulation for WSC. For WSC 2001, there is the familiar panel session that has drawn such a large crowd. There are sessions on emulation, data exchange standards, and optimization. That should tell you something about what I see in the future.

I have thought a lot about the next great application area for simulation. Is it parcel and letter handling? Is it health care? Maybe it is pharmaceutical and chemical manufacturing? Perhaps it is mining and mineral processing. Or, is it printing and publishing? Or, perhaps we can do more with mid-sized manufacturing. You tell me and we can both become rich.

In summary, letting the mind wander allows for many future possibilities. But, my predictive abilities have not been that good in the past. Don’t bet on what I am telling you about the future of simulation.

Biographical Sketch

Jerry Banks is Senior Simulation Technology Advisor, AutoSimulations, a Brooks Automation Company, in their Atlanta, Georgia Office. He retired in June, 1999 as Professor, School of Industrial and Systems Engineering, Georgia Institute of Technology. He is the author, co-author, or co-editor of eleven books, several chapters in texts, and numerous technical papers. He is the editor of the Handbook of Simulation, published in 1998 by John Wiley. This book won the award for Excellence in Engineering Handbooks from the Professional Scholarly Publishing Division of the Association of American Publishers, Inc. He is the co-author, with John Carson, Barry Nelson, and David Nicol of Discrete-Event Systems Simulation, Third Edition, published by Prentice-Hall, Upper Saddle River, New Jersey, published in 2000. He is also author of the text Getting Started with AutoMod published by AutoSimulations also in 2000. He is the co-author of Introduction to SIMAN V and CINEMA V, published by John Wiley, New York, in 1995. He is also the co-author of Getting Started with GPSS/H, Second Edition, published by Wolverine Software Corporation, Annandale, Virginia, in 1995. Other titles include the co-authored text Forecasting and Management of Technology published in 1991 and the single-authored text Principles of Quality Control published in 1989, both by John Wiley, New York. He was a founding partner in the simulation-consulting firm Carson/Banks & Associates, Inc. located in Atlanta. The firm was purchased by AutoSimulations, Inc. in May of 1994. He is a full member of many technical societies including IIE for which he served eight years as that organization's representative to the Board of the Winter Simulation Conference, including two years as Board Chair. He is the recipient of the INFORMS College on Simulation Distinguished Service Award for 1999 (see http://www.informs.org/Prizes/sim/JerryBanks1999DSA/Winner.html).