Managing Change

with Business Process Simulation

David Profozich

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For my wife and best friend, Linda, who not only puts up with my frenetic life but who also champions my cause.

Foreword

Since the beginning of time, man has sought to change the world for the better. However, as our technology has advanced, our systems have become more complex, and the consequences of change have become more difficult to analyze. Additionally, many of today's ideas for changing and improving the world are both time consuming and costly to implement. As a result, we require reliable and accurate methods for testing out these ideas before making a large investment in time and money. This is the case whether we are trying to design better transportation, communication, or manufacturing systems—or trying to find better ways to deliver a service.

Simulation is a tool that we use to predict performance and to understand the impact of change. It offers many important and well-recognized benefits. It allows us to test out system designs before they are built, and it reduces the risk and time associated with implementing new systems or changing existing ones. To those familiar with the technology, it is inconceivable that any significant new system would be designed and built, or any existing system significantly modified, without the benefit of simulation.

Although its use has grown over the past 40 years, major investments still are being made in new or modified systems without benefiting from the predictive power of simulation. Sometimes these systems lack the initial capacity that their designers intended, and they must be modified after they are built. Certainly this is costly and time consuming and can cause significant delays in bringing new systems online. However, a more common occurrence—often done unconsciously to avoid the risk and cost of having too little

capacity—is to design systems with excess capacity. Although these oversized systems initially perform up to specification, they make inefficient use of resources and are far more costly than they need to be. A simulation study often can save significant capital resources by removing the risk factor and allowing the designers to size the system properly and uniformly to meet the requirements.

The book on simulation that you are holding has been in the making for many years. Its genesis goes back 40 years, before Dave Profozich, the author of this book, became an integral part of this growing simulation industry. The foundations were laid when the first researchers and users developed and applied simulation technology to predict the performance of their new or changed systems. Since then, thousands of researchers, developers, and (most importantly) talented users have been weaving together a fabric of knowledge, tools, and application experiences bringing this technology to the point where it is poised for sustained and rapid growth into the broad-base market. Up until now, however, this fabric has lacked one very important thread—a book that explains the concepts, benefits, and methods of this emerging technology in a clear and concise way to the broad base of nontechnical readers. That is precisely the role of this book.

It is only appropriate that Dave Profozich be the one to add this important thread to the simulation technology fabric. He has spent over a decade analyzing the simulation market and communicating the benefits of this technology to an ever-expanding audience. He is well acquainted with simulation users in a broad cross section of industries and applications. He is an excellent communicator and spokesman for the technology. In addition, he has been an integral part of the growth and success of this industry.

It is also only appropriate that this book be written at this time. Simulation tools have evolved over the past 40 years from rudimentary language-based modeling systems to very powerful and flexible graphics-based simulation and animation environments. The tools are becoming dramatically easier to learn and use, thereby lowering

the barrier to new users. Ease of use, along with the widespread availability of powerful personal computers, has led to the rapid expansion of simulation technology in enterprises throughout the world.

The application domain of simulation also is expanding rapidly. In the past, the most dramatic changes in enterprises occurred on the factory floor. Today, change is occurring in all parts of an enterprise. Entire business processes are being revamped to leverage the explosion in communication and computer technologies. People throughout the enterprise are facing the challenge of predicting the performance of new and changing systems.

Dave's purpose here is to bridge the gap between the simulation-specialist and the many pragmatic, nontechnical analysts who need to understand and use this technology to solve real problems. He begins by explaining the core concepts of simulation—including random processes and abstract models—in terms of simple everyday experiences. He then draws on his own vast experience in the industry to discuss in detail the compelling benefits of simulation technology.

Dave focuses next on the transition of simulation from a highly specialized technology to one that is widely used by business analysts and engineers as part of their standard suite of tools. He analyzes the barriers that this technology presents to the pragmatic, nontechnical user and shows how these barriers are falling to the rapid pace of simulation-technology development. He supplements his analysis with personal testimonials from managers and engineers in some of the leading companies throughout the world. He also shows how this technology relates to and augments neighboring technologies, such as optimization, spreadsheets, and static flowcharts.

In closing, he presents a strategy for implementing simulation and offers a vision for the future of the market. His suggested implementation strategy is founded on observations of many successes and failures over the years. As a seasoned champion of this technology, he understands its limits as well as the keys to making it successful in a wide range of applications and enterprises.

This book about the emergence of simulation technology into the mass market is in itself an important element in that emergence. Dave brings simulation technology to the pragmatic, nontechnical user in a way that is understandable and compelling. In doing so, he is not only describing the emergence of simulation technology, but he is also playing a critical role in the emergence that he describes.

C. Dennis Pegden
CEO/President, Systems Modeling Corporation

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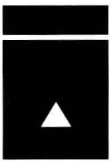

Introduction

The art of progress is to preserve order amid change and to preserve change amid order.

Alfred North Whitehead

When I began my career in the simulation industry 10 years ago, I shared the belief that some managers in the corporate world still maintain today—that business process simulation is exciting, compelling, even fun. . . but hard to use and often more trouble than it's worth. Over the years, I've heard stories about the rise and fall of exciting, yet complex technologies such as neural networks and artificial intelligence. At times I wondered if the technology that I had bet the early part of my career on would fall into the same abyss that these did.

In 1996—after nine years of wishful thinking and hard selling—I became absolutely convinced that business process simulation would emerge as a technology for the mainstream. And now that is exactly what is happening. Companies all over the world are making strategic investments in business process simulation. Companies in all industries ranging from electronics to warehousing to fast-food restaurants are making it a key part of their planning methodology. The world's premiere management consulting firms are also positioning business process simulation within their technology arsenals. Many software companies are launching new products in this market. And while dramatic advances in business process simulation-software technology have accompanied many complementary advances

in information technology, the basic ideas that established this market as a successful small niche decades ago prevail today as business process simulation approaches the mainstream business analyst.

This book was written for the business manager or business analyst who wants to understand those ideas that are central to business process simulation. Perhaps you have been aware of the technology for years but have never completely understood it. Maybe you are considering making business process simulation part of the way you manage your business. Or possibly you have heard that your competitor is using the technology and you would like a sneak peek at what it is all about. If you desire a complete perspective on this exciting technology, you have come to the right place.

From the day I began writing, I maintained that I would write a book about this sophisticated technology that was easy to read—the kind of book that a business professional could complete during a single business trip. I hope you will conclude that I have achieved this goal. At times, I may take you a bit deeper than you would like, but I do so to give you an appropriate foundation, so that your perspective on business process simulation is well rounded and technically valid. You will read much more about what simulation can do rather than about how the technology works internally—though I've sprinkled in a bit of the latter to do justice to the science of business process simulation.

What Type of Simulation?

Before going on, let me clarify something. Various types of simulation technology exist in the world today. In fact, you may already own a copy of simulation technology in your home. SimCity®, the popular game from Maxis that sells for less than $35, allows you and your children to build and manage a new metropolis. You are given a plot of barren land to zone into industrial, residential, and commercial areas where people work, live, and play. After you lay roads, subways, highways, and railroads, you can "simulate" your city—

watching it grow as citizens populate it. Albeit interesting, this is not the kind of simulation technology that has motivated this book.

Other forms of simulation are also outside the scope of this book. For example, flight simulators used by pilots to develop their flying skills are not part of my definition of simulation. Neither is the simulation technology that is used to understand the development and growth of markets and the behaviors of its consumers. In the process industries, chemical simulators that capture such information as heat exchange and the behavior of various control valves are also outside the domain of this book, as are various other simulation tools used to study robotics, kinematics, and ergonomics at a machine or operator cell level.

In financial markets, analysts on Wall Street have been using for many years a technology known as monte carlo simulation to study the behavior of stock prices. Monte carlo simulation is also used by physicists to study surface roughness and kinetic ordering. It was used by the father of the hydrogen bomb (Edward Teller) to study the atmospheric effect of nuclear weapons. Reportedly, there was some early concern that the "H-bomb" might ignite the nitrogen in the world's atmosphere, extinguishing all life in a worldwide firestorm. Simulation showed that the concern was unfounded. While monte carlo simulation has some similarities to the technology that I write about here, it is clearly in a class of its own.

Still another form of simulation that has gained some acceptance in the business and academic worlds is continuous simulation. Continuous simulation is used to represent systems whose state changes continuously over time, such as environmental systems, the level of water in a reservoir, or the temperature of an ingot in a furnace. Again, this form of simulation—although occasionally used in an integrated fashion with the subject matter of this book—is not my motivation.

This book focuses on the type of simulation some people refer to as business process simulation or discrete-event simulation. ("Discrete-event" implies that events occur at specific discrete times

as a result of other events.) This technology allows organizations to create computer models of existing or proposed systems in order to study their performance. Using these models, analysts conduct "what-if" scenarios in order to determine the best possible way to implement a business application. Thereby they save companies millions of dollars by helping them identify the best ways to manufacture products, deliver superior customer service, configure warehouses, and design telecommunications systems. This approach has wide application in many industries in both manufacturing and service sectors.

According to *Reengineering the Corporation* (Hammer and Champy, 1993), the real power of information technology is not that it can make the old processes work better, but that it enables organizations to break old rules and create new ways of working—that is, to reengineer. Business process simulation technology enables organizations to engineer and reengineer business processes effectively. It allows them to think "outside the box" to determine new ways to run a business. Business scenarios that differ dramatically can be easily explored and compared with a computerized model.

As the market for simulation grows, business professionals are coining various terms for the emerging technology. As you might expect from the title of this book, I formally prefer to call it business process simulation. Others refer to it as dynamic modeling, process modeling, or process mapping. For simplicity sake throughout the remainder of the book, I will stick to the simple "handle" of *simulation* since it clearly serves the purpose well.

Why Should You Use Simulation?

As the cover title suggests, you should use simulation technology to manage change. Chances are you are working for a company that invests in new facilities, new equipment, and new processes. In the past, you may have used some form of information technology, such as a spreadsheet or CAD (computer-aided design) tool, to aid in managing business process changes. These changes may have taken

the form of facility upgrades, consolidations, or new process design. However, you may have never used a tool that truly allows you to capture the dynamics of your business environment in a flexible, breakable, changeable model. Simulation allows you to do exactly that.

By using simulation to manage change, you should ultimately realize the most significant benefits that any information technology can deliver—dramatic improvements in business performance and profitability. Each business scenario that you evaluate offers its own cost-for-performance alternative. You can rule out alternatives that do not meet your business objectives, and you can explore tradeoffs in your implementation strategies in terms of their effect on your overall profit and customer-service performance.

You should also use simulation technology to reduce risk. A simulation model of your business will allow you to eliminate—or at least mitigate—much of the uncertainty that you repeatedly experience when facilitating changes. Gaining a high degree of confidence that your business decisions will succeed is an invaluable benefit of utilizing simulation.

Simulation combines the friendliness of a spreadsheet, the methodology of flow diagramming, the visual benefits of a CAD system, and the intelligence of a facility manager's instincts to help managers make excellent business decisions. It will save you money by helping you avoid inappropriate investments. It will give you confidence in your decisions. When used effectively, it can dramatically improve your bottom line.

Book Overview

To help you develop an appropriate perspective, the first two chapters of this book are presented in the form of short stories. Chapter 1 introduces the concepts of randomness and variability—core ideas upon which simulation technology has been built. Chapter 2 emphasizes the concept of converting an existing "as-is" business environment to a much better "to-be" configuration.

Chapter 3 describes how organizations quantify the value of simulation technology. The focus is on identifying a positive return on investment (ROI) from simulation applications; however, many of the "soft" intangible benefits of the technology (including animation) are also discussed.

Chapter 4 examines the rapid growth in acceptance that the simulation market is experiencing. It features statistics and testimonials that suggest that simulation is emerging as a key technology for corporations around the world. Many quotes and application stories are provided from companies such as Ford, Motorola, Nike, and UPS, along with other testimonials and supporting information from the U.S. government, leading universities, and several international firms.

Simulation's value relative to "neighboring technologies," such as spreadsheets, business diagramming, optimization, and scheduling, is discussed in Chapter 5. These technologies are generally used to solve related problems. This chapter helps clarify the benefits of simulation relative to these tools, and it suggests ways that a simulation strategy can be integrated with them.

Chapter 6 presents a strategy for successfully using simulation technology. It offers advice on when to use simulation, what to do within one's firm before starting a project, and a step-by-step implementation strategy for embracing simulation. The chapter concludes with a recommended strategy for propagating the use of simulation throughout an enterprise.

The final chapter—Chapter 7—suggests what may occur in the future as simulation spreads more aggressively, becoming a mainstream technology that is used by millions of business analysts. Items discussed include market verticalization, real-time system integration, and Internet-enabled applications.

Acknowledgments

Many individuals have helped shape my perspective on this technology—quite a few more than I will mention here. C. Dennis Pegden, CEO/president of Systems Modeling, has had a profound influence on me since he hired me in 1987. Dennis has an uncanny way of simplifying complex subjects to the extent that, after talking with him, I often wonder why I had not figured them out much earlier. He is not only a deep thinker, but an excellent businessman and good friend as well. John Hammann, executive vice president of Systems Modeling and my business mentor of eight years, has helped me translate much of my youthful enthusiasm into a professional perspective. John's unique style and sense of humor have provided great motivation to me over the years. Others at Systems Modeling, such as Deborah Sadowski (the heart and soul of Arena®) and Randy Sadowski, have made unique contributions to my learning process. Lynn Barrett, my primary editor and graphics designer, has also helped tremendously.

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I would also like to recognize several students at the University of Pittsburgh—Andrew Wuertele, Martin Meckesheimer, and Fred Hensel—who built a few simulation models for me early in the process. Their enthusiasm for the book helped me get the project off the ground.