SCS

Celebrating over 70 Years of Simulation

Simulation in the Service of Society (1952-2023)

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The History of SCS

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Foundation

Over seventy years ago, John McLeod and a group of fellow analog computer users met in November of 1952 at Point Mugu, California to form a Simulation Society. John McLeod proposed the formation of an association “to increase the effectiveness and broaden the application of simulation” with the stated purpose being "to promote the advancement of simulation and allied computer arts.” Originally, society members, who were expert in the use of slide rules, banded together to share techniques for using analog computers. In 1952, John McLeod and other pioneers wanted to reach beyond analog computer concerns and beyond their own field of aerospace, in defining the purpose of their activities. They had the vision to realize that this was simulation, not analog computation, and that simulation was not going to be restricted to aerospace applications. An organization was formed, named the Simulation Council. It was agreed that it would hold monthly meetings organized by a five-member Steering Committee that would change from meeting to meeting. John McLeod of NAMTC, Point Mugu was the first Chairman of the Steering Committee, which also included Rick Anderson of the J. B. Rea Company, Albert Fulton of Hughes Aircraft Co., Walt Mitchell of the Navy Electronics Laboratory (NEL), and Lee Cahn from analog computer manufacturer, Beckman Instruments.

The group agreed to produce a monthly newsletter and John McLeod was appointed editor. This was the beginning of a lifelong commitment for both John and his wife, Suzette, who was appointed Council Secretary. John agreed to pay for the first three issues of the newsletter himself, to see if the idea would fly. John McLeod famously told the story of having trouble producing copies of the original Simulation Council Newsletters on a temperamental mimeograph machine in a bedroom of the McLeod home in Camarillo, California. From time to time the machine would decide to transfer more ink on to its operator than to the paper. Several times John's clothes ended up covered in ink. Always the problem solver, John carried out experiments that established that the ink could be washed from his skin, but not from his clothes. The remedy was obvious and the editor produced several issues of the Newsletter *au naturel*.

The second meeting of the Simulation Council was held at Truman's Restaurant in Westwood, California (north of Los Angeles) on the subject of Function Generators. The meeting attracted an attendance of thirty-seven individuals representing fifteen organizations. The organization remained informal, with no charter, no bylaws, no officers, and no dues - at least for a time.

From the Simulation Council to Simulation Councils, Inc.

By this time, the activities of the Simulation Council were becoming more widely known and admired. On June 28, 1954, just 18 months after the Simulation Council was formed, the Midwestern Simulation Council met for the first time at the University of Michigan. Dr. Robert M. Howe was appointed Chairman of the new council and the name of the original Simulation Council was changed to the Western Simulation Council. Less than six months later, on November 15, 1954, the Eastern Simulation Council

was established at a meeting at the Applied Physics Laboratory, Johns Hopkins University with Harold K. Skramstad of the National Bureau of Standards as its first Chairman.

Considering the difficulties involved in producing the newsletter as well as the growing and more widely distributed readership, a more convenient and effective way of publishing the Newsletter had to be found. The solution was an arrangement, starting with the March 1955 issue of the Newsletter, to publish the newsletter as a regular section in the journal *Instruments and Automation* (which changed its name to *Instruments & Control Systems* in February 1959). The last issue of the original newsletter was produced in February 1955.

The years 1955 and 1956 brought further growth in the developing network of councils. Four more councils were established, bringing the total to seven. The South-Eastern Simulation Council was created on September 30, 1955, at a meeting in the Arnold Engineering Development Center in Tullahoma, Tennessee. The Council's first Chair was W. K. McGregor of ARO Inc. This was followed in October 1956 by the Central States Simulation Council, chaired by James A. Pierce of Beechcraft Aircraft.

The organization had now grown to a point that demanded a more formal structure and, on June 3, 1957, the Simulation Councils, Inc. (SCi) was formed as a California non-profit membership corporation by Dov Abramis, George A. Bekey, and Norman L. Irvine. Until 1962 a Board of Directors led by its Chair guided the organization. In 1962 the title of this position was changed to President. The newsletter continued to appear in *Instruments and Automation* until December 1963. Volume 1, Number 1 of the new journal *SIMULATION* was published in the Fall of 1963 and was published monthly in two volumes per year until December 2001 when the Society's publications were redesigned.

The purpose of the newly incorporated organization was "to promote the advancement of simulation and allied computer arts by sponsoring meetings and informal discussions, by publishing reports of these meetings and papers, and by cooperating with educational and other organizations in activities that contribute to the advancement of simulation and allied arts." Membership in the organization had grown to nearly 2,000 by this time and it has subsequently fluctuated between about 1,400 and 2,000.

From SCi to SCS

The early regional council structure of the Society was built around local or regional meetings often devoted to a selected topic, and the publication of a monthly newsletter. Local meetings were the rule for the Western Simulation Council, but other regional councils tended to organize regional meetings with several presentations. National meetings were limited to events at the Spring and Fall Joint Computer Conferences. As the organization became more widely distributed, the need for activities and services with a greater national reach became more apparent. This need, which required the network of Simulation Councils to convert itself into a national society, was met first by a switch of emphasis from local and regional meetings to national conferences and, later, by adding new publications.

By 1972 the regional council structure covered not only the entire United States and much of Canada, but had also gained its first foothold in Europe with the creation of the United Kingdom Simulation Council (UKSC) in 1968. The Society was also the co-sponsor of two major annual conferences. A change of name seemed in order, and in 1972 the society started to do business under the new name **The Society for Computer Simulation** (SCS) although its legal name continued to be **Simulation Councils Inc.**

Conferences and Publications

The structural reforms of the 1970s produced an Executive Committee structure with specific VP positions devoted to Publications and to Conferences. In addition to ***SIMULATION***, SCS was producing the ***Simulation Proceedings*** series of hard back books, and additional occasional publications such as the ***Directory of Simulation Software***. In 1984 SCS President Walter Karplus launched a new quarterly publication, ***Transactions of the Society for Computer Simulation***, which featured papers of archival quality, in contrast to the more topical and news-oriented material in ***SIMULATION***. Additionally, Publications was responsible for post-conference sales of conference proceedings. This established the pattern for the publication's operation for the 1980s and 1990s.

Changes also occurred in the conference activities of the society. In the 1970s Lance Leventhal, SCS Technical Editor, proposed a multi-conference format that focuses on selected specialized topics operating as independent mini-conferences within the conference structure. The **Western Multi-Conference** (WMC) came first, and is still held each January. Next came the **Eastern Multi-Conference** (EMC), held in the Spring, which later changed its name to the **Simulation Multi-Conference** (SMC) and changed again in 1997 to the **Advanced Simulation Technologies Conference** (ASTC).

The multi-conference format has proved very successful. Well-established & strongly-supported topics could be combined with new or more specialized topics that attract less support and benefit from being part of a larger financially viable event. WMC based its early development on the success of its core track on Simulation with Microcomputers in the days when simulations using desktop microcomputers running primitive operating systems like CP/M and MS-DOS were a major challenge. EMC was built on the success of the Simulators conferences.

International Growth

The SCS council structure did not serve members outside North America until 1968 when the United Kingdom Simulation Council (UKSC) was formed and became part of SCi. In August 1964, during the 1964 Congress of AICA (the **Association International pour le Calcul Analogique**) - now known as IMACS (the **International Association for Mathematics and Computing in Simulation**), Ro Favreau, an SCi pioneer, spoke about SCi and the new journal ***SIMULATION***. Three years later, in 1967 at the next AICA Congress in Lausanne, Switzerland, fellow academics, asked John McLeod how to go about setting up a council and thus began the process of the SCi Board of Directors approving charters for new international councils.

By 1975 UKSC was able to organize its first UK Simulation Conference on the shores of Lake Windermere in the English Lake District. The formation of UKSC proved to be the start of an extended period of international growth through which the society transformed itself from a largely North American network of local groups into an international professional society. In 1985, a European office of the Society was established in Ghent. Creation of the European office produced an increase in the international membership of SCS and led to the creation of two annual European conferences, the **European Simulation Multiconference** (ESM) held in June and the **European Simulation Symposium** (ESS) in October. UKSC eventually became an independent organization from SCS.

The McLeod Institute for Simulation Sciences (MISS)

One of the most enduring legacies of the society may turn out to be the formation of the McLeod Institute for Simulation Sciences (MISS) in honor of its founder, John McLeod. Ralph Huntsinger of California State University, Chico (SCS President from 1986-88) first proposed the establishment of the McLeod Institute in the 1970s. The Board of Directors approved the idea in 1976 and later established the first MISS center at California State University, Chico. The MISS centers were created to collaborate on research projects, share software and expertise, arrange exchange visits, and collaborate in developing academic programs in the field of Modeling and Simulation (M&S).

Modeling and Simulation Network (M&SNet)

Established in 2003 to address a more specific focus, M&SNet was initially a world-wide consortium of 14 independent organizations and an active network of researchers, academicians and practitioners devoted to support the continuous improvement of the discipline of Modeling & Simulation and its applications. Its continuing mission is to search for innovative ways to use M&S as well as innovative domains of application and to disseminate M&S principles as well as theoretical, technological, and ethical knowledge. M&SNet, under the direction of Agostino Bruzzone, continues its aim of creating an evolving framework for sharing experience and knowledge in which participants have the possibility of effective cooperation & knowledge exchange for successful collaborations through its international meetings.

Reinventing the Society

The late 1990s were a time of rapid growth in the recognition and use of modeling and simulation as an enabling technology in a wide range of applications.

In 1993 the SCS Board of Directors (BoD) approved a structural overhaul of the BoD and the Executive Committee, and changed the focus of the Society to be more responsive to members and industry as a whole. One of the early outputs of the effort was the **SCS Mission Statement**, characterizing the society as an “international multidisciplinary forum dedicated to research, development, and applications of simulation”, which guided future SCS operations and growth.

In the rapidly changing environment of the 1990s, constant review of the society's status and strategic directions proved necessary, and in 1998 incoming President Axel Lehmann established a Council of Advisors charged with addressing the challenges facing the society and making recommendations for change. The Council was made up of leading figures in the M&S community who were not Society insiders, chaired by a Past-President of SCS. The Council of Advisors started work in 1999 and presented its report to the Board of Directors in 2001. As a result of its recommendations the Society first changed its name and mission statement to reflect the current emphasis on both modeling and simulation. The Society became **The Society for Modeling and Simulation International**, but retained the SCS logo, the acronym of **SCS** and its legal name, Simulation Councils Inc. for continuity. All publications were redesigned and were outsourced to Sage Publications with the introduction of a new journal ***SIMULATION: The Transactions of the Society for Modeling and Simulation International.***

Today

The 2000s have been very busy with SCS desiring to further the trend from only conferences to publications and meetings. In 2003 SCS started ***The Journal of Defense Modeling and Simulation***

(JDMS): Applications, Methodology, Technology, a quarterly refereed archival journal devoted to advancing the practice, science, and art of modeling and simulation as it relates to the military and defense. The primary focus of ***JDMS*** is to document, in a rigorous manner, technical lessons derived from practical experience. The journal also publishes work related to the advancement of defense systems modeling and simulation technology, methodology, and theory. The journal covers all areas of the military / defense mission, maintaining a focus on the practical side of systems simulation versus purely theoretical applications.

Professional Certification & Body of Knowledge

In 2000, the SCS Council of Advisors recommended a professional certification for simulationists. Admiral Fred Lewis, Executive Director of the National Training Systems Association, also called for certification in his keynote address at SCS's Summer Computer Simulation Conference in July 2000. Under Admiral Lewis' leadership, certification is now a reality. SCS members have contributed in key ways towards making this happen. Certification is granted to all members of the M&S community who hold sufficient credentials, which are based on education, work experience, and community standing, and who pass the certification exam.

Professional certification is just one aspect of SCS efforts to define and create a simulation profession. In 2023 a Body of Knowledge (BoK) was created by Tuncer Oren, Bernard P. Zeigler, and Andreas Tolk as Editors, with the help of the Simulation community. The BoK can be used in university curriculum and professional development programs.

Internationalization

SCS subsequently took steps to internationalize its activities by deciding to hold its flagship summer conference outside the US every year starting with Edinburgh in 2008. Since then, the conference has been held in Istanbul, Ottawa, The Hague, Genoa, Canada, and Berlin, as well as a variety of other international locations.

Conferences

Each year SCS has held three major conferences a year: the **Powerplant Simulation Conference**, which brings together the fossil and nuclear simulation community, in the winter; the **Spring Simulation Multi-Conference** (SpringSim) event, which covers a wide variety of simulation interests, held typically in April or May; and the **Summer Simulation Multi-Conference** (SummerSim) event, which also covers a wide variety of simulation interests, held typically in June or July. Each conference was designed to appeal to the Simulation communities domestically and internationally. In 2021 SpringSim and SummerSim were merged into a new event named the **Annual Modeling and Simulation Conference** (ANNSIM).

Membership

Membership with SCS offers benefits as SCS partners with other groups in the simulation community to offered benefits such as discounted registrations to events such as **Winter Simulation Conference** (WSC), **American Automatic Control Council Conference** (AACC) and American Association for the Advancement of Science (AAAS) events. SCS Members enjoy free access to all of its journals through Sage Publications, to Simulation books printed in cooperation with Springer Nature, as well as discounts on all printed SCS proceedings through Curran Publications. We also now offer developing country memberships and offer virtual sessions during our annual conference events.

Summary

In the more than half a century since the **Simulation Council** was formed, the organization that we now know as the **Society for Modeling and Simulation International** (SCS) has evolved from a small local group of aerospace professionals into an international organization with affiliations and activities wherever modeling and simulation is practiced. SCS survives & thrives because there are still many devoted members who are determined to have it remain so. Members have always been & continue to be key to the health of the Society. SCS may have lost some ground in being at the forefront of Simulation as the field continues to spread through more & more disciplines, but it continues to work to bring simulationists together through offering ways to publish papers on simulation in its two journals with regard to its use/impact in a wide variety of fields as well as offer opportunities to connect in person with fellow simulation professionals at its annual simulation events.

Meet the McLeods

(The article below was originally published *Instruments and Automation*, Volume 28, No. 4, April 1955)

John H. McLeod, Jr., Head of the Functional Simulation Branch, Guidance Div., Naval Air Missile Test Center, Point Mugu, Calif., has been publishing the now well-known Simulation Council Newsletter since November 1952. This was shortly after he sparked the formation of the first Simulation Council. The primary purpose of the Newsletter is to report on the Council discussions.

The high value of the Newsletter stems from the fact that simulation technique opens a new frontier for industrial, as well as military and engineering, instrumentation. And the technique is most apparent from the discussions of those engaged in simulation. It is in recognition of this fact that Instruments and Automation will, beginning with this issue, publish monthly the Simulation Council Newsletter. This will make the Newsletter avail- able not only to all present subscribers to the Newsletter but also to nil subscribers to Instruments and Automation. The Newsletter now reports the discussion of the Western, Midwestern, and Eastern Councils, plus those of the Industrial Analysis and Control Council; meetings of the Association for Computing Machinery, the IRE, PGEC, and others concerned with computers and simulation are also covered when possible.

The Newsletter and Bob Lowry, former Secretary of the Midwestern S. C., were instrumental in the forming of the Midwestern and Eastern Councils, which are now headed by Dr. Milton Warshawsky of WADC and Dr. Harold Skranstad of the National Bureau of Standards, respectively.

McLeod was born in Hattiesburg, Mississippi, February 27, 1911. He graduated from Tulane University in 1933, with a degree in mechanical and electrical engineering.

His experience includes the application of Automatic Control Instruments as Field Engineer with Taylor Instrument Companies, and their design as Research and Development Engineer with Leeds & Northrup Company. Since 1947 he has been concerned with the automatic stabilization and control of guided missiles, and the analysis and Synthesis of control systems by means of analog computer techniques at the USNAMTC, Point Mugu.

He has presented papers at two Cyclone Symposia, the Typhoon Symposium, the 1954 National Association of Computing Machinery Convention, the American Rocket Society's 1954 Fall Meeting, and the recent Louisiana State University High-Speed Computer Conference.

Your editors believe that you will enjoy Mr. McLeod's literary style, as well as benefit from the great insight that his reports give to the new technique of simulation.

McLeod tells us "The most appropriate picture to use with any mention of me is that of Suzette and me, because it was Suzette who suggested the Newsletter and whose hard work made it possible." Thus, we invite you to meet both John and Suzette.

Note that Mr. McLeod first worked in industrial instrumentation - and from there entered the "then-new" field of analog computation, where he discovered completely new and different techniques and procedures for instrumentation. In the brief time from 1952 to 1955 the new techniques were perfected and standardized, commercial equipment became available, basic circuits were developed for hysteresis and other nonlinearities, the great potentials of simulation for industry became apparent, and the new techniques became ready for the industrial field. The appearance of the Simulation Council Newsletter in Instruments and Automation thus marks the beginning of a new era, the introduction of simulation techniques into the industrial instrument field. Mr. McLeod has returned from whence he started; the tide of events has turned full-circle.

John McLeod, editor of The Simulation Council Newsletter
and Suzette McLeod - whose inspiration and work made it possible.

Past President Contributions Through the Years

Reflections from the 25th Anniversary

R.M. Howe (1956-1957)

My memories of SCi (Simulation Councils, Inc., the predecessor of SCS) begin, as with most old timers, with the Simulation Council Newsletters, written and distributed by

John and Suzette McLeod as reports of the West Coast meetings of the original Simulation Council. In re-reading the initial issues of the magazine *SIMULATION*, which appeared in the fall of 1963, I was reminded that the first Newsletter started with the November 1952, issue as a report on the organizational meeting of the Simulation Council. It was several issues later that my colleagues and I, in what was then called the Department of Aero- nautical Engineering at the University of Michigan, got onto the mailing list, and began to receive the monthly Newsletter.

In those early days of the Newsletter, content was taken up with reporting analog computing techniques and experiences, since at that time analog systems were, by and large, the only computers capable of real-time simulation of dynamic systems. Since we had already been involved with analog hardware and aerospace simulation applications at the University of Michigan since 1947, our interest in the Newsletter was quite understandable. It must have been early in 1954 that I was contacted by John McLeod about the formation of a Midwestern Simulation Council, and I agreed at that time to become the first MWSC chairman. What had until that time been the only Simulation Council then became the Western Simulation Council. This was shortly followed by the formation of additional Councils, the Eastern, Central, Rocky Mountain, and Southwestern Simulation Councils (I can't recall the exact order). The regional councils held multiple meetings each year with a format similar to the original Western Simulation Council. Summaries of the various Council meeting presentations and discussions were then reported in John McLeod's monthly Newsletter. Sometime in the mid ‘50s (again I can't remember exactly when and my own files for that time period have long since vanished) a national Simulation Council, incorporated as SCI, was formed with me as the first national chairman. I seem to recall that Stan Rogers played a major role in this move, and we began to have National SCi Meetings. Stan also became the first publisher of the *SIMULATION* magazine, with John McLeod as editor. As noted above, the first *SIMULATION* issue appeared in the fall of 1963, and the magazine has continued all these years as the primary publication of SCi and now SCS.

Ben Clymer first asked me several weeks ago to write some comments about the problems and problem associated with the initial years of the Midwestern and National Simulation Councils. I must say that I can't remember many problems, although I'm sure we must have had some. I do recall being impressed with the enthusiasm shown by all the initial SCi members, as reflected by the attendance at the regional Council meetings, the number and quality of meeting presentations, and the willingness of SCi members to accept administrative and organizational tasks associated with a new society outside the umbrella of the traditional computer and technical societies of the time.

I believe that much of this enthusiasm stemmed from the uniqueness associated with real-time simulation that emphasized analog, and later, hybrid computation, as opposed to non-real-time scientific simulation and data processing using the digital computers of the ‘50s. We really had a close-knit, almost

club- like group of enthusiasts in those formative years of SCI, and it was always a pleasure for me to attend and even preside over the initial MWSC and National meetings.

Now that simulation, including real- time, is considered such a vital part of all aspects of today's technology, we should occasionally pause and remember the early contributions made by the several hundred SCi zealots of the ‘50s under the leadership of John McLeod, Stan Rogers, and others. In fact, the wide acceptance in recent years of computer simulation presents, in my opinion, one of the most significant current challenges to SCS. Almost every scientific and technical society has their own specialized simulation meetings and, in some cases, publications associated with simulation. In this environment it becomes more difficult to identify unique roles for SCS. It also becomes harder to duplicate the enthusiasm of those early zealots.

I believe that the important roles of SCS do include the continued promotion of new areas for computer simulation, the lending of perspective to the powers of simulation, and the sharing of simulation science and technology across the multidisciplinary community through publications such as *SIMULATION* and the Transactions of The Society for Computer Simulation.

I also believe that we can learn some- thing by reexamining the motion behind much of the pioneering effort in simulation four decades ago, especially in the academic community. In particular, I refer to the use of simulation as a laboratory tool to teach college and university students insight into the behavior of dynamic systems and as a substitute or supplement to working with actual hardware in laboratory courses.

At the University of Michigan this was certainly behind much of our original development of analog computer hard- ware and applications beginning in 1947. During that time period we were faced with creating meaningful laboratories for courses in nonlinear systems, automatic control, and guidance and navigation. There was no way we could afford, much less test and run, the actual hardware systems in their entire configuration. Real-time simulation, including hard- ware-in-the-loop, was the only answer. I believe that our civilian and military graduate students from those early days, at least the ones who are still around to testify, will confirm the effectiveness of this approach.

I can still remember a lecture in 1951 at the University of Michigan by Claude Shannon, the famous scientist from the Bell Laboratories, who remarked that he never really understood the behavior of dynamic systems until he was able to observe "real-time" solutions generated by electronic differential analyzer (analog computer) simulations. In the engineering schools across the country, we have been criticized in recent years, and rightfully so, for eliminating too many laboratory courses and doing a poor job of teaching many of the remaining lab courses.

Clearly the current availability of high-performance, low-cost digital computers with appropriate software, interfacing, and graphic outputs for real-time and hardware-in-the-loop simulation offers us the opportunity to revitalize our laboratory courses. I firmly believe that this approach will significantly enhance the educational experience of our students, as well as provide tremendous motivation to both faculty and students. Per- haps this is another area where SCS can serve a promotional role. It may also help rekindle the simulation enthusiasm of the early SCi zealots.

Jack Sherman (1960-1962)

It was, I think in the spring of 1956 that Bob Bemer, of the newly formed Lockheed Missile Systems Division in Van Nuys, California, nominated me for the position of Chairman of the Board of the

Simulation Council. This was, at that time, the only Simulation Council in existence in the whole world! It had about forty or fifty members. It had been established about two years earlier in the Wagon Wheel Motel in Oxnard, California. I had been at that meeting, held in the late summer or fall of 1951, as a protege of the founder, John McLeod. Bob and I were employed by the U.S. Government at the United States Naval Air Missile Test Center at Point Mugu, California.

In December of 1952 I left Pt. Mugu and went to McDonnell Aircraft in St. Louis, Missouri, and in August of 1954. I joined Lockheed at Van Nuys. I was, I believe Chairman of the Simulation Council from July 1956 through June 1957. In, December of 1956 Lockheed opened the first of its new facilities on the San Francisco Peninsula at Palo Alto. This was the Research Division, which at that time included all the scientific computing functions. I was transferred from Van Nuys to Palo Alto in September 1956. I guess that makes me Simulations Councils first commuting Chairman.

I do not recall exactly when and who replaced me as Chairman [it was Maughan Mason in 1962), but my next Simulation Council activities revolved around three foci:

1. Attempting to get SCi (after we had more than one council, we went plural, incorporated, and became known as Simulation Councils, Inc.) acknowledged as a sponsoring member of the joint Computer Conference activities. (These were the folk who put on the EJCC and WJCC shows.) A number of people in SCi were the folk who put on the IRE (Institute of Radio Engineers), AIEE (American Institute of Electrical Engineers), or putting on the technical sessions and exhibitions. In particular, Stan Rogers was a member of AIEE and I was a member of IRE. These two organizations later merged to become the IEEE (Institute of Electrical and Electronic Engineers).
2. Organizing a committee to set standards for the emerging Analog Computer industry.
3. Establishing a Technical Society Publication to report the technical activities of SCi members and to distribute news of our various meetings and conferences.

I have been told that I was Chairman of the Board of SCi for two years, January 1961 to December 1962. I believe we changed the title to President about that time. It was during this period that the above-described activities were coming to fruition. The first issue of *SIMULATION* was published in the Fall of 1963 and it contained, among other things, an article entitled "Definition of Terms Used to Specify General-Purpose Analog Computer and Methods of Measurement." This was the result of a three-year effort of a committee commissioned by Dr. Hans Meissinger, Chairman of the Western Simulation Council on November 10, 1960, and consisting of Dick Blosser, Bill McLean, Bill Comley, Jerry Reich, and myself. We had determined that it was impossible to establish standards that, if adhered to, would not inhibit the development of the technology. Hence, we decided to rather rigidly define the terms used to measure the performance of the open so that we would not hinder future development.

In 1961 AFIPS (American Federation of Information Processing Societies) was formed by the ACM, the IRE, and the AIEE to be the U.S. Representative to IFIP (The International Federation of Information Processing Societies) and to take over the activities of the ACM, IRE, and AIEE in the managing and hosting the former JCC's (Joint Computer Conferences). These conferences had become quite large and prestigious and, in addition to pro- viding a forum for technical papers and an exhibition of the latest computer technology, became a large source of funds for the sponsoring societies. The very day (or rather night as it was 11:45 pm) that AFIPS was formed, Stan Rogers and I presented SCI's application for membership.

In 1962 SCi was accepted by AFIPS as an affiliate member. It wasn't until 1966 that SCi was elected a full member of AFIPS. The fact that we were publishing a fully refereed technical journal, *SIMULATION*, and that our members were primarily fully qualified professional people, made our acceptance by AFIPS possible. In 1969 AFIPS, ACM, IEEE-CS (IEEE-Computer Society), and SCi became the joint sponsors of the JCC's (Joint Computer Societies). This meant that we had a proportionate share of the surplus revenues generated by the JCC's.

In 1963, I became the Director of Publications for *SIMULATION* and held that position until about 1968. During this time, I represented SCi on the AFIPS Board of Directors for several years. When AFIPS set up the JCC Board in 1969, I represented SCS on that board for the next eight or ten years. (That's where all the action and all the money was!!) During the '70s and early '80s, the AFIPS Conferences generated enormous amounts of surplus revenues of which SCS received a share. If it had not been for the large infusion of capital from AFIPS (several million dollars!!!), I doubt that SCS would be here today. Unfortunately, AFIPS could not survive some of the internal political machinations among its principal members and it could not adapt to the changing demands of the market place. Hence, shortly after its 25th anniversary it faded away.

After I retired from Lockheed Missile & Space Co. in 1988, I donated much of my early technical reference material to the Charles Babbage Institute at the University of Minnesota. Consequently, I have had to rely on an increasingly unreliable memory to concoct the story related above. Some of the dates may be incorrect, but the main events are essentially as I related them.

Maughan Mason (1962-1964)

You are all here to participate in a very special 40th Anniversary National SCS meeting, the 1992 Summer Computer Simulation Conference. Have you ever wondered how SCS became the sole sponsor of the SCSC? Let me give you, my view. A number of years ago, when Bob Brennan was president of SCS, we used to walk during lunch. There had been a couple of SCSCs under the joint sponsorship of several of the founder societies. There was a school of thought holding that SCS should run the SCSC by itself, since the other sponsoring societies, societies were waning in enthusiasm. Bob was concerned about the financial commitment - you know, a president really has to worry about making a decision that will sink the society. Having been involved in several Spring and Fall Joint Computer Conferences, I felt SCSC was not only an outstanding technical forum but was also a tremendous financial opportunity for the society. I tried to convince Bob to go ahead, but he still half dragged his feet. I suggested that SCS could have half the conference, and I would the other half! That is, each would pay half the expenses, and we would share in the surplus. Bob asked if I really meant it. I told him I would jump at the chance. He was convinced, and he took the whole conference for SCS! While thinking about this discussion with Bob, I remembered another situation when I was on the other side. I was SCi president (in those days we often wrote it SCi, because the Inc. didn't seem important enough for a capital letter) during the period when the *SIMULATION* was being launched. We published a trial issue in Fall 1963. Having an ad in this issue was a MUST for all analog companies, because this issue would be saved even if no follow-on publication took place. The issue was a huge success: it didn't take many smarts to see that regular issue follow-on was an obvious next step. We all expected to reach monthly publication eventually; the only question was initial frequency: quarterly, bimonthly, or even (shudder) monthly. Remember how a president worries about killing the society? To put it mildly, I was concerned about overextending our resources. However, Stan Rogers and Jack Sherman had the vision. They gently but firmly, and most important of all, persistently talked and argued and taught and cajoled, and finally convinced me.

Thus, I was fortunate to be involved in two pivotal decisions for Sci. In one I was responsible and timid, while in the other I was a bold advisor.

P.J. Hermann (1964-1966)

Ben Clymer has given me an assignment to write a review of my time as President of Simulation Councils Inc., now known as the Society for Computer Simulation. I was first elected president very late in October 1964 at the Fall Joint Conference, served for two years and was replaced at the FJCC in early November 1966. A collection of these reminiscences is to be published in *SIMULATION* sometime later this year.

A little bit of time should be spent on “setting the stage," of reviewing the situation that existed, as it transpired and led to my election as president. In 1951, graduated with a Master of Science degree in Theoretical and Applied Mechanics from Iowa State College (now Iowa State University) in Ames, Iowa. On September 10, 1951, I started work in the computer applications group of Goodyear Aircraft Corporation in Akron, Ohio. Goodyear had, a couple years earlier, gotten into the business of designing, developing, and marketing an analog computer, GEDA, the Goodyear Electronic Differential Analyzer. The company also had an applications group and it was to that group to which I was assigned.

I remained with Goodyear until August 1960, almost all of it with the applications group. The computers were analog devices. Digital computing began to come in during the '50s and our group got the company assignment for the engineering applications of digital computing, but the main thrust was still simulation using the analog computer or simulator, if one prefers to be more of a purist. The context to be understood is that simulation was being done by the analog computer and that, during the decade, digital computation was beginning to make inroads with little or nothing in the way of simulation being done with digital computation.

Early in the ‘50s, probably in late 1952, we in the computer applications group began to get word of the formation of a group on the west coast, the Western Simulation Council. As time went on more of these regional, and independent, simulation councils were formed, including the Midwestern Simulation Council (MWSC) for us in the region around Ohio. Goodyear, being a manufacturer and marketer of analog computers as well as a user, decreed that there should be a technical presence of the company in the MWSC. By this time l had been made leader of the applications group and, so, I was made that technical presence. It was a very interesting assignment mostly because of the people with whom I got to associate and the variety of companies that were involved. Aerospace was represented by McDonnell Aircraft Co. and North American Aviation in addition to Goodyear. There was United State Steel, Caterpillar Tractor Co., Standard Oil of Ohio, University of Michigan, and others from time to time. And, of course, there were the many vendors in addition to Goodyear.

Before long it became clear that there might be a need for a national organization to tie all of these regional simulation councils together. The first rumblings I heard were at the First National Simulation Conference in the old Baker Hotel in Dallas, Texas in January 1956 I believe. That’s where some of the names began to become people. John McLeod, Stan Rogers, Ro Favreau, and others became something other than names that continued to crop up in the Newsletter of the Western Simulation Council that John McLeod was putting out.

It was out of that meeting in Dallas that the National Simulations Councils, Inc. got its start. I'm not familiar with when SCi actually came into being. But, come into being it did, and each of the regional organizations was represented on the Board of Directors.

My first meeting on the Board was at the Fall Joint Computer Conference at the Sheraton Hotel in Philadelphia, December 4-6, 1962. It was a daylong meeting and turned out not to be the most pleasant of experiences. Get a bunch of engineers in a meeting and we have what I have come to know as the "creation of administration entropy." There was a lot of talk and not an impressive creation of useful action. I don't remember what the topics and issues of discussion were, I don't even know who the president was. I do remember getting impatient. In later years it became clear that this is the way that Boards of Directors operate and one might as well lean back and endure if not enjoy. The 1966 FJCC was held in San Francisco during the week of November 7. My short, curt note on the meeting was that I was replaced as president of SCi at the Annual Meeting of the SCi Board of Directors.

Thus, my tour of duty as the presiding officer of SCi was completed. I was still a member of the Board and of the Executive Committee. But travel support restrictions put an end to participating in any of the meetings. My three years as vice-president and president of SCi were interesting and very eventful. I must also admit that I was not able to keep on top of all the things that went on with the society. My major concern was to try to see that the organization ran well and that members of the Executive Committee and, to some extent, of the Board of Directors, got the inputs that were needed to make reasonably intelligent decisions on the operation and direction of the society.

John McLeod, Stan Rogers of CONY AIR, and Jack Sherman of Lockheed-Sunnyvale were the prime movers in this upgrade of SCi. As I recall, we appointed Stan Rogers to be the Executive Director of SCi with primary responsibility of running the office and the day-to-day society operations. We had an office in La Jolla, California and we authorized hiring of an office staff to run the office and to run the details of getting *SIMULATION* published and distributed to the membership. Jack Sherman was appointed, as I recall, Director of Publication charged with getting *SIMULATION* properly run and, especially, with some help from Stan, to get financial support for the journal through advertising. John McLeod was appointed Editor of *SIMULATION*.

And then there was Suzette McLeod. Being as observant as I was, I was never really sure just where she fit into the official hierarchy of SCi. I recall her as always being there, if not physically present then as a force behind the scenes. I'm sure that she did a lot of the early editorial work. And, I had the feeling that the folks in the La Jolla office knew who she was and what she was doing for the society. But, for some reason, she never seemed to have that recognized, official position. In the beginning of the Western Simulation Council, it seems to me that she was mentioned as a driving force about as much as John was. Generally, I suspected that SCi would have gotten going even without her contribution. But I also can't escape the thought that SCi was quite a bit her creation, too.

But, for a little dinky national technical society in the mid 60's SCI, and now SCS, the Society has kept going awfully well! I treasure the memories of having been a part of its beginnings.

James Wolle (1966-1968)

My involvement with SCi spanned ten-plus years, from the latter part of the '50s through most of the 1960s. I started as Vice Chair- man of the Eastern Simulation Council, then became Chairman, then Representative from the Eastern to the SCi Board of Directors. The next step was the SCi Executive

Committee, then Vice Presi- dent, then President of SCI. Finally, I served as SCI's Representative to the AFIPS Board of Directors and Executive Committee.

While on the SCi Board, it voted for a trial publication of a journal. Later it voted to continue the publication. The journal publication was regarded as absolutely necessary for SCi to become a viable force in the computer industry. However, the financing of the journal publication became a major factor during my tenure as SCi President.

At the same time, I became President, Joe Manci was elected Treasurer. Joe had some background in accounting practices, and he brought a strong dedication to the Treasurer's job. He took a leave from the Air Force and spent a week or so at the SCi office in La Jolla reviewing the accounting procedures. He changed the accounting from a single entry to a double entry system. While accomplishing this he discovered clerical errors which had been made when posting invoices. The bottom line was that SCi was broken but didn't know it.

When apprised of the situation, I called an emergency meeting of the Executive Committee, to which I invited Alex McKenna (SCI Office Manager) and Jack Sherman (responsible for publishing the journal). Alex and Jack, working with Joe, developed all the facts and figures needed for the meeting. They also pro- vided a potential course of action. After hours of discussion, the Executive Committee approved a plan for recovery which reduced the journal production costs, reduced our budget allocations for special projects, and held the line on member dues. Accordingly, the remainder of my presidency was spent closely monitoring the financial situation and trying to properly allocate the reduced pot of money for special projects.

Throughout my involvement with SCi and into my service on the AFIPS Board I worked for GE Aerospace as the Manager of a simulation facility. In 1967, CE moved me from simulation to system engineering. At this point the AFIPS Nominating Committee asked if I would run for AFIPS Vice President. However, CE would not support me. That ended my technical society activities.

George Rahe (1972-1973)

I'm pleased to be of a little help in providing information about the Society during my term as President. I had a stroke some seven years ago while I was temporarily in Washington, D.C. When I returned to California years later, all of my files and records had been thrown out along with a set of journals I had inherited that dated back to when Noah was reporting from the ark.

Those who served with me were a very active group. The Vice President was Ralph Huntsinger, who was a younger professor from one of the California State colleges. Others included Robert Gold and Frank Rieman of TRW. My apologies to all the others whose names I don't remember who also contributed. I remember especially John and Suzette McLeod, without whom none of this would have occurred.

In those days the IEEE Computer Society or ACM was trying to throw SCi out of AFIPS and out of sponsorship of the Fall and Spring Joint Computer Conferences. In an attempt to make SCi more attractive to junior faculty, in hopes of attracting academic participation, and to halt the plan to get us out of AFIPS, we proposed changing the name of the Society to remove the "Inc." The "Inc." made it look as if the efforts by faculty for the Society were not academic pursuits, but rather were just another consulting con- tract or private company of the faculty member.

In the same vein we instituted two other scholarly activities. One was to conduct conferences on a single topic of interest to those in simulation. Two such conferences were conducted at that time. For the first, in the summer of 1972, the topic was the mathematics of large-scale simulations. The second, conducted in the winter, had as its topic recent and present developments in urban planning and gaming. These conferences produced bound hard-cover proceedings for future reference in these critical areas. It was hoped that this effort would result in a reference library of simulation techniques.

The second activity was the creation of the tutorial series "Simulation Today," which was intended to provide the members with a snapshot view of techniques of prospective interest in simulation as tool to keep members current about emerging technologies. "Simulation Today" was centerfold in *SIMULATION* every month for a long time. It was highly valued by the readers.

Stewart Schlesinger (1979-1982)

When I took office, I made frequent trips to the SCS central office, then located in "compact" facilities in La Jolla, California. The staff was small and struggling to get the *SIMULATION* Journal out on time and conduct other society business with minimal resources. The office was managed by a very young man, Chip Stockton, under the watchful guidance of the Society consultant, Romeo Favreau. However, Chip sought greater advancement potential at a larger society, and left SCS to join IEEE.

Our Society needed a new office and operations manager. After advertising locally in the San Diego, area, Ro Favreau interviewed various prospects, and Charles Pratt was selected as office manager. That job later evolved into the Executive Director and chief operating officer position. Under Charlie Pratt, the central office was built up and assumed additional responsibilities in support of greatly diversified conference activities.

Other changes that occurred at SCS during this period were:

(1) embracing the concept of digital computers as the likely replacement of analog computers in continuous system simulation;

(2) broadening SCS conferences (specifically the Summer Computer Simulation Conference) to freely include discrete as well as continuous system simulation;

(3) accepting as president of the Society, someone with primarily a digital computer background.

Carl W. Malstrom (1990-1992)

As most recent past president I feel in a somewhat awkward position to present a reasonable overview and observations of the significance of my term as president. I believe time is required to put a patina of proper perspective on such things. I will review some activities and accomplishments but I am concerned that they, being recent, will appear stale news rather than significant contributions. Indeed, the significance is yet to be determined. I have learned over the years that significant positive outcomes from one's actions result from both conscious planning and serendipity -the passage of time transforms both into apparent wisdom and insight.

The most critical issue we faced during my two years, and one we will continue to struggle with in the future, is financial viability of the Society. This flies directly in the face of recessionary economic times, changing business conditions and the loss of outside fund sources, such as AFIPS, on which to fall back.

We have had to develop and need to continually refine a mind-set that is business-like, with a proper degree of pragmatic planning and tracking that allows us to live within realistic budgets and develop additional sources of income producing services. I see an understanding and vitality for addressing these challenges by a cadre of volunteers that is unprecedented in the history of the Society.

I believe that the way we do business as a Society is on the verge of a paradigm shift. The business climate along with electronic information exchange through extensive world-wide networking is going to drive this shift. We as experienced users and developers of electronic information hardware and software should be in the fore front of applying our knowledge as agents of change and be readily adaptable to what such changes will bring.

For instance, in conferences, major segments of our traditional attendees from aerospace, government and other business industries are less able to travel due to changing business pressures. Computer simulation and computational science is now well enough recognized to be fully integrated into specific disciplines. Thus, the "uniqueness" and "specialty" of the tool that we once relied on to attract attendee interest, has diminished in recent years. We must adapt.

In publication, there is tremendous budgetary pressure on libraries to reduce and specialize in their serial holdings. Our publications are considered "serials" in the library" marketplace" and we are feeling the impact of reduced library subscriptions. This situation, coupled with the fact that technical publications delivery is headed for a revolution in the near future, brought on by at least two developments: first, electronic data communications and national and international "data highways" are now in place or are soon to be implemented; and secondly, customers are appreciating the convenience and flexibility of in- formation access through electronic means. We need to be repositioning ourselves to exploit new" publications concepts in this new age.

At this point I will list what l believe are some of the highlights of the two years 1 served as President. This is a bit of an ego trip, but I hope you will indulge me.

• We conducted numerous successful conferences during this period, in the U.S.A., Canada, and Europe. Successful conferences were a major contributor to our financial viability.

• Publications were of high quality and distributed on or near schedule. Our journals are still the primary "voice" of the Society, and they enhance our image more than any other vehicle.

• We participated in the dissolution of the American Federation of Information Processing (AFIPS). This action which took place on October 13,1990 closed the door on an almost thirty-year relation- ship with this umbrella organization that we co-founded with IEEE and ACM. AFIPS was once a substantial and influential organization in the industry that conducted the Sprint Joint, Fall Joint and National Computer Conferences. These conferences produced a lot of visibility for the Society as well as additional in- come in their heyday. This event is particularly significant for me since I served as the SCS Representative on the National Computer Conference Board of Directors for about nine years. The final distribution of AFIPS assets were accomplished in such a way that it maximized the return of SCS equity and resulted in

$87K back to us. An interesting side light on this momentous AFIPS Board meeting was that Walter Karplus and I were both there representing SCS. Walter as our official Society Representative and I as a backup and interface with the IEEE-CS, ACM, DPMA and other society presidents. At the time of the meeting the ISA had no one there who could officially represent them and I was asked to be their proxy

representative to the Board for this meeting. Therefore we (SCS) had the opportunity to cast two votes rather than one for the dissolution. A mixed "blessing" to say the least.

• We successfully launched and integrated a new regional council, the European Simulation Council, into the Society. This council represents all Europe including what was the autonomous UK Council. The membership, activity and enthusiasm brought by this Council and its volunteer leaders are tremendous.

• We also established the European Chair in Simulation Sciences on behalf of the Society at the University of Ghent with Chi Vansteenkiste as Chair holder. Another chair should follow shortly in the UK

• The McLeod Institute for Simulation Sciences has expanded and now has several branches at universities around the world.

• The Society adopted a new set of fully revised Bylaws that are structured to better serve us in the years ahead.

• A Society Personnel Committee was put in place during my first term to continually address areas of staff /volunteer interface, general personnel issues and to aid our Executive Director. I think this is an important functional addition to our committee and management structure.

• At the beginning of my term I instituted a Planning (FFT)Session preceding each formal Executive Committee meeting for the purpose of helping the Executive Committee addressed the many outstanding issues that face our Society both not and in the future. These meetings are to allow for wide ranging discussion and brain storming by the group in order to identify and address Society problems, directions, and solutions. From these meetings I believe come continually revised tactical plans along with timely and important ideas for revising the strategic plan. My reasoning for establishing this came from the fact that there had been insufficient time in regular Executive Committee meetings to address both the procedural and philosophical aspects of Society business. The inevitable mixture of the two in an agenda designed for only the procedural side had, at times, produced conf used and frustrating meetings. My hope is that this adjunct to the Executive Committees activities will continue since I believe it will produce anon- going thought process which can pro- duce "dynamic and living plans" for the Society at a very minimal implementation cost. I dubbed these as our "FFT" Sessions derived from the expression "You can't see the Forest for the Trees," the idea being that we need to be continually enhancing our vision of both the forest and the trees.

Next, I would like to present some further thoughts on strategic directions for the Society.

• Publications - The publications of the Society are our life blood. They, along with conferences, produce a large part of our operating funds. But, more importantly they are the voice and image of what we are. It is vital that they be strong in presentation and technical content as well as financially viable. The publications process needs to be guided by a capable, dynamic and responsive Edito- rial Board. Worthy technical material from all aspects of the field and all venues needs to be properly reviewed and published in a timely manner. These are not just the responsibilities of one Vice President but rather that of the Board of Directors and the total membership.

• Conferences - We must continue to strive to strive to develop and conduct the best and highest quality conferences possible. In the process they should also generate a reasonable financial return to the Society for the efforts expended and the opportunities provided. We should strive for a high level of

technical content and a maximum return on investment for the attendee. These activities are extremely dependent on volunteer participation and support/

• Curriculum/Computational Science/High Performance Computing - These may appear to be dissimilar topics but I will attempt to show that there is a significant relationship. Simulation curriculum definition for higher education is a very important area for our profession that is not being addressed very well at this point. There is a need for such a model curriculum, and its development is a natural activity for which our Society can be a leader. In relation to this issue there is currently a lot of interest and activity around the country in the field of Computational Science and the definition of a curriculum in this area. I con- tended, however, that there is a very strong kinship and overlap between what we have been doing as "simulationists" over the past forty or so years and what is now identified as Computational Science. I would, therefore, like to see us establishing ourselves as a strong presence in the Computational Science (spelled *SIMULATION*) community and bringing together the common areas, both in curriculum and applications. Another area of relationship is with regard to High Performance Computing (super-computers) which are the primary tools use to solve complex and demanding simulations of the real world is in our sphere of interest also. Some of us started out on the "supercomputer" of the ‘50s and 1960s -the Electronic Differential Analyzer or Analog Computer. Funda- mentally, things have not changed that much over the years. We are still trying to develop, understand and solve models of the world's most demanding problems and match them with the most powerful and best tailored computing systems available for their solution, the result being to improve our understanding of nature and the universe.

SCS on the world scene -SCS has put much effort into being an international organization. We have affiliations with many sister societies and related organizations around the world. We established an Autonomous Member Council in the UK, early on, and more recently a European Council. Part of our motivation has been to have a world-wide membership base of full paying members. It is important to remember that while pursuing this goal there are accompanying responsibilities to this diverse membership. For one, member services must be provided in a reasonable, acceptable and affordable manner. Another is that the governance of the Society must include representation and leadership opportunities consistent for all members. These can produce stressful forces on limited resources for a society so strongly rooted in North America. Let me quickly add to these cautious comments that I believe our international and particularly our European and Pacific Rim activities are vitally important to our Society. The strength of the European Economic Community and the potential for a great deal of simulation-based activities there involving SCS, make this an important growth opportunity. We must also look at new and continuing opportunities for cooperation with other simulation-based organization in Europe, Asia, Australia and other parts of the world including the Americas. As a practical matter, I do not think we can "do It all" on the world scene but I do believe we can continue to provide a strong and cooperative leadership role.

I continue to be enthusiastic about our Society's future, and I am impressed with allows us to work with continued goodwill and friendship in carrying out complex and potentially contentious Society business. I consider this ability of the organization to offer a strong combination of personal and professional fulfillment a unique Society asset to be greatly prized.

Reflections from the 40th Anniversary

Q.B. Jordan Chou
(1992-1993)

I could take this opportunity to join with others in patting ourselves on the back for having forty years of high growth and change in an industry that still hasn't seen the limits to its potential and growth. However, I think a more somber message is what I'd like to share with you . . . our most important asset!

You'd think that after four decades of experience, The Society for Computer Simulation would have enough longevity and knowledge to be at the cutting edge of the industry and to be in demand by those in industry, government, and academia we seek to serve. Well, if anything, a truer statement might be that we've learned that we aren't! Four decades of our riding the wave of technological advances (complacency, if you will) has taught us that the technology of simulation has advanced at a faster pace than we've been able to accommodate or to assimilate in our daily operations! Only in recent years, has the Society recognized that it isn't the ONLY source of high-quality technical information about the techniques, applications, and methodologies of computer simulation and modeling. Our sister societies have done credible jobs in serving their members with simulation in- formation related specifically to their members' technical field. The "tool" of simulation is no longer so esoteric or formidable that its "mystery" alone could be expected to draw the interests and membership of working engineers and scientists to the SCS ranks. In one sense, our "niche" has changed dramatically and relatively recently in the past decade to make it a bigger challenge for we as members and leaders of The Society for Computer Simulation. The challenge? To rejuvenate and advance the Society; to make it important and MORE service-and quality-oriented and meaningful enough that professionals WANT to join our team because they HAVE TO HAVE the information and services we can provide.

Unlike our sister organizations, SCS doesn't have a "profession" or discipline to fall back on. That's one of the unique aspects of The Society for Computer Simulation: our purposes and missions, while NOT aligned with any particular profession, ARE aligned with the power and techniques and applications of an important and highly cost-effective TOOL used by all the technical disciplines. Even though The Society for Computer Simulation is celebrating four decades of existence, we dare not become complacent enough to expect that another four decades of success or survival may be ahead of us!

One of my main focuses for this year is to help bring the Society into the 1990s and especially to help it posture itself for the next millennium. In order to do that, we must take a hard and realistic look and introspection of the Society as it used to be, as it is now, and where it could or should be in the future. The process of self-examination and commitment to future changes in our ways of doing things is called Strategic Planning. In recent months -beginning at this year's Summer Computer Simulation Conference a group of individuals has come together with a singular commitment: to research, develop, recommend, and to implement an ongoing, long term, strategic planning philosophy and activity. Under the able leadership of Senior Vice President, Mitch Sisle, the Strategic Planning Committee team is composed of twelve to fifteen individuals who have done some work on behalf of the society in the past or present. In all cases, these people are expected to be activists and/ or leaders of the Society in the commitment to the process of strategic planning. As a team, the SP Committee may be serving for two years or more in just the act of planning for the future.

One key element of the strategic planning process is the gathering of data, data that can be written or verbal, statis- tical, opinions, wishes, complaints, needs, etc. Many of you, as readers of this journal,

past, present, or future members of the Society, will be asked to help us in our collection of data. If you receive a solicitation or call from one of the committee members to help us by giving your opinion, please take the time to participate. Some data gathering will occur over the coming two-three months. Your opinions can truly make a difference in how The Society for Computer Simulation changes to meet your needs in the future.

In the competitive environment we share with so many other organizations, SCS has to change. I cannot predict what changes may be recommended by the SP committee as a result of its deliberations and data gathering, but I would urge you to participate in the process of bettering the Society and making it more valuable to you and your colleagues. Let your opinions and needs be heard by your elected representatives or by the committee members themselves. Headquarters will be happy to provide you with the name and address of the Director or Vice President most appropriate to your location or relevant to your comments or opinions. The Society for Computer Simulation has stood the test of time for forty years. I'm certainly optimistic that its key strength - you and you r fellow volunteers and members -will set a course for the coming decades that will enable the Society to grow and change. After all, the importance and usefulness of computer simulation and modeling has grown at a pace equal to the innovations in technology, hardware, and software itself!

Reflections from the 50th Anniversary

Bruce Fairchild (2000-2002)

Fifty years ago, simulationists in Southern California began SCS for a stated purpose: "To promote the advance of simulation and allied computer arts." While the purpose has not changed, our tools and techniques certainly have. Our first members, who were expert in the use of slide rules, banded together to share techniques for using analog computers. Now our technical interactions seldom mention either slide rules or analog computers.

The slide rule and analog computer continued as computational resources for engineers through the 1960s as they planned and designed to put man on the moon. Though digital computers were available in those years, they were too slow for simulation. Engineering work that was done on early digitals was as tedious as programming the analogs, requiring coding in machine or assembly languages. Compilers became widely used in the '60s and SCS spurred development of continuous simulation on digital computers by establishing the specification for the Continuous System Simulation Language in 1967.

Simulation changed to implementations almost entirely on digital computers through the '70s. In the mid '80s, faster computers and wide availability of color graphic displays encouraged development of iconic interfaces. The '90s saw the development of complex reusable blocks of code for special applications, especially iconic code and code for large distributed implementations.

SCS has been a vital part of simulation through the last five decades of change, and this continues to be so. As I assumed the presidency in 2000, we had the benefit of a report of a Council of Advisors convened by Axel Lehman, my immediate predecessor. These advisors, Roy Crosbie, California State University, Chico (Chair); John Illgen, Illgen Simulation Technologies; Dennis Pegden, System Modeling Corporation; Ramana Reddy, University of West Virginia; Michael Rya n, Consultant; and Brian Wells, Raytheon Corporation; recommended several changes.

The Council of Advisors recommended we change our name, especially to include "modeling." In July 2000 we adopted "The Society for Modeling and Simulation International" while retaining the familiar SCS logo for continuity.

The Council of Advisors recommended we change our membership structure. This has been done in three significant ways. Steve Branch, our Executive Director, explained the new individual member cost and benefit options in Volume 1, Number 1 of M &S Magazine. New offerings have been defined for Institutional Members. A Technical Council organization has been codified in our Bylaws to complement our traditional geographical region organization; starting this year, each Technical Council has a seat on the Board of Directors.

The Council of Advisors recommended that we increase our Internet presence. We have done so with regular distribution of SCS Simulation News via e-mail, and web publication of M &S Magazine. We have merged Simulation and Transactions. Bernie Zeigler, as Vice President of Publications, led these efforts and described the changes in Volume 1, Number 1, of M &S Magazine.

The Council of Advisors recommended professional certification for simulationists. Fred Lewis, Executive Director of the National Training Systems Association, also called for certification in his keynote address at the Summer Computer Simulation Conference in July 2000. Under Admiral Lewis' leadership, certification is now a reality. SCS members have contributed in key ways to making this happen. This

year, certification will open to all members of the M&S community who hold sufficient credentials based on education, work experience, and community standing, and who pass the certification exam.

Professional certification is just one aspect of SCS efforts to define and create a simulation profession. A profession also needs a code of ethics, a body of knowledge, university curriculum, professional development programs, and accreditation for both formal and continuing education. Last July, during the week of SCSC, Bill Waite chaired a Simulation Summit where leaders of simulation organizations met to discuss these issues. Several initiatives are underway.

A clear conclusion of Sim Summit was that there are too many venues for simulationists to gather. As a step to alleviate this proliferation, SCS and SISO, the Simulation Interoperability Standards Organization, are co-locating our ASTC and SIW conferences next spring in Orlando. There, by registering for either conference, you will be able to attend both.

Over the last couple of years, SCS has also undergone change in several operational ways. We significantly improved the way we monitor and control our financial records. We contracted for Sage

Publications to publish the new merged Simulation on our behalf, with electronic access for subscribers. We substantially revised the management of our European operations.

There are ways change is still necessary. Financing the things, we do continue to be difficult. Our new publications are now expected to contribute substantially, but during the transition we prepared four different publications simultaneously. Largely due to the proliferation of competing conferences, maintaining and growing attendance at SCS meetings is currently the most important and most difficult issue facing the Society.

As we celebrate our 50th Anniversary year, we continue to examine what we do well and how we can improve as the only membership organization devoted exclusively to simulation. We are now organized both geographically and technically. We have a membership publication, an archival journal, an electronic newsletter, and web access to publications. We conduct several conferences each year covering many different simulation topics, primarily in North America and Europe. We have strong academic content, as well as industrial members and participants, as evidenced by the several centers of the McLeod Institute.

I wish to thank all those who have made all this happen: those members and others who contribute to our publication, conference, and membership activities; members of our oversight Board, who direct us with insight and concern; office staff in San Diego who implement everything; and especially the 2000-2002 Executive Committee who spent uncounted hours managing change.

If you are reading this and are not now a contributing part of all this fun and progress, please act to join in. First sign on as a member, then learn enough about SCS to determine how your participation can best benefit you. Discuss your involvement with those who now lead SCS. You will find information and contacts at www.scs.org.

SCS is well positioned as simulation continues to change in the 21" century. I have been privileged to be part of the changes over the last several decades and honored to have served as President of SCS for the 2000-2002 term.

Carl W. Malstrom (1990-1992)

I may be an old-timer in the Society but I don't feel like it. In fact, I am not sure yet what I want to do when I grow up! But, in July when we got together for the 50th celebration in San Diego it was pretty obvious that most of us "old-timers" have reached those "timeless" years where nobody can tell how old you are anymore.

When John McLeod and associates met in November of 1952 at Point Mugu, California to form a Simulation Society, I was just out of high school and working as a draftsman in a large boiler manufacturing plant in Chattanooga, Tennessee. The Korean War was in full swing and the draft was looking pretty certain. In order to insure serving in the US Air Force rather than being drafted, I enlisted for four years in August of 1953. This was a strange time in our country, the middle of the McCarthy era, and I recall having to sign my name or initials 53 times during the process of being inducted to the USAF declaring I had not been associated with numerous organizations I had never heard of. This is further verified by a 1955 article in the Oxnard Press-Courier about John McLeod rejecting a Russian request for copies of the Simulation Council Newsletters.

It would be seven more years before I would get out of the service, complete college, and be working as an engineer at the Martin Company, Orland o Division, in the analog simulation lab. The Air Force provided good technical training and experience, the GI Bill for going to college, and the opportunity to meet and marry my wife and have a baby on the way when we got out. Going to college, working, and raising a family was a challenge over the next three years. While in college I got the opportunity to build a Heath Kit, 10 amplifier analog computer for the engineering school, but I really didn't have much idea how it worked or how to use it. I recall getting Granino and Terry Korn's book on analog computers from the library, which I thought might help, but I have to admit it was over my head at the time. I also recall thinking that I would probably never get to meet these illustrious people, who, it turns out, I have gotten to know very well over the years. When graduation was near; my major professor arranged a meeting for me with Floyd Nixon, the principal scientist for the Martin Company. As you may recall, Floyd was one of the founding members of the Society in attendance at the first meeting at Point Mugu. He had established the state-of-art analog simulation laboratory at the new Orlando Division. He also felt strongly that the simulation la b was the best place for an engineer to get started in the aerospace business. He recruited me for the staff there and as they say, "the rest is history."

In 1960 as a new engineer in the simulation lab, I wanted to learn as much as I could as fast, I could about using these modern and complex Goodyear GEDA-A14 analog computers for missile system simulation. I started reading (and saving) John and Suzette McLeod's Simulation Council Newsletters, which came in the Instruments &Automation magazine. This was a good place to learn how others were approaching simulation and some of the "tricks of the trade." This also allowed me to get acquainted (by name at least) with the many leaders in the field who were defining and shaping the future of simulation. At the time, as with the Korns, I had no idea that I would ever get to meet, converse with, and become colleagues and friends with people of such caliber and stature.

I joined the Society in 1962 and started becoming active in the Southeastern Regional Council (with the support to the Company) during the 1960's. During this period, on the national scene, there were invitational "Blue Sky" meetings being held each year in Breckenridge, Colorado to discuss the impact and future of simulation. I really wanted to attend these meetings but had not progressed to a sufficient level to get invited. By working through the regional council, I spearheaded an effort to formally propose to the SCS executive committee that this meeting be held in different regions of the country starting in

southeast. My employer, the Orlando Division of Martin Marietta Corp. (new name), was the host and I served as the Arrangements Chair. The meeting was held at Sanibel Island, Florida in 1969. By having the opportunity to make this proposal to the executive committee I was provided valuable exposure to the Society leadership that started my long tenure in its national governance.

In 1979 I was offered the opportunity to represent the Society on the National Computer Conference (NCC) Board of Directors. At that time the NCC was the preeminent showcase for computer technology and one of the largest technical shows in the country. SCS enjoyed a unique position as one of the owners of this conference, which resulted in significant revenues being generated and returned to the Society for several years. The NCC was also co-owned by the American Federation of Information Processing Societies (AFIPS), which as the name implies is an organization of all the country's computing related societies, large and small. Working in this politically charged environment turned out to be a crucible for me to gain very useful political and diplomatic experience. The NCC lasted until the late 1980s and AFIPS was disbanded in 1990, a casualty of political intrigue and the inability to keep pace with the accelerating change in technology. The foresight and posturing of our early Society leaders put us in the position to enjoy the prosperity that came from this association. I am pleased that I had some part in the process.

In closing let me say that my 40-year membership and participation in the Society has generated an on-going series of high points in my career. The associations, friendships, and collegiality are things I value and cherish greatly.

Mitch Sisle
(1994- 1996)

I was involved with Hardware-in-the-Loop (HIL) Simulation for 37 years. When our team completed our first HIL Facility at Raytheon Company, Bedford, MA in 1971, we had a strong desire to publish. The facility was for the Sample Data System (SAM-D) that evolved into PATRIOT and included several HIL firsts. We looked around for a conference that would be of interest. Our colleagues suggested the AIAA Guidance and Control Conference in Key Biscayne, Florida in 1973. The late Richard Baldwin and I published Guidance System Evaluation Techniques for SAM -D. The paper was more application oriented than facility design. I published again at the AIAA (professional society) Guidance and Control (G&C) Conference in San Diego, California in 1976. The paper was titled Analysis and Evaluation of PATRI OT Guidance and Control. Once again, a paper was written dealing with facility application instead of facility design. We were not reaching the correct audience.

In 1980 I met Dr. Willard Holmes of Missile Command at Redstone Arsenal in Huntsville, Alabama, and he made me aware of SCS. Ed McCarthy and I prepared a paper for the SCSC in Washington in 1981. The paper was titled An Active Missile Hardware-in-the-Loop and it was presented in the group dealing with Training and Research Simulators. Bruce Fairchild and Bill Wade headed this group. They encouraged me to contact other HIL facilities and try to get a session dealing with HIL facility design. In 1982, at the SCSC in Denver, we had three papers dealing with HIL facilities. It looked like I was making progress. The session grew into a group dealing with Missile Simulations. We were now getting HIL papers from the Radio Frequency Simulation System at Redstone Arsenal, Eglin Air Force Base, China Lake, Pacific Missile Test Center at Point Magu in California, Hughes, North American, and others. We began grooming an HIL community that could take on panel discussions and other activities. We were able to have discussions

dealing with HIL design activities and operations, and we could compare productivity and cost of many facilities. This common sharing led to other improvements in all facilities and helped to improve efficiency. SCS has and will be a vehicle to develop forums for many simulation disciplines.

I feel that forming local chapters and improving regional activities is a main building block of a strong SCS. I always felt that the local chapter was where SCS members could encourage junior engineers to write papers for conferences and SCS members could offer to co-author papers with their peers.

In 1986 I became Chairman of the Eastern Simulation Council. My goal was to build a strong Boston Chapter, as well as to support other local chapters in the Eastern Council, and move on to a regional activity. The first thing I did was to successfully get funding from Raytheon to form a local chapter. The money was needed to run monthly meetings. I worked with Joe Cynamon, Buckley Pierstorff and Marilyn Kloss to plan meetings at Raytheon, Mitre, Digital and Boston University. We scheduled speakers at these monthly meetings such as Ed Mitchell of Mitchell and Gauthier Associates, Larry Michaels of Applied Dynamics International, and Springer Cox of GPSS.

In October of 1989 we planned a n Eastern Mini Conference in Princeton, New Jersey that was a great success. We reached our attendance goal and made a better- than- expected profit. Thirty-seven people attended, and included in the conference was a tour of the John Von Neumann National Supercomputing Facility in Princeton. There were two presentations on new computer simulation capability of Silicon Graphics Incorporated and Bolt Beranek and Neumann Computer. The conference also included two tracks: one for simulators chaired by Bill Wade and the other for Radar, Missiles, and Validation chaired by Buckley Pierstorff. The Mini Conference idea was never carried forward by the new Council Leaders. I do however give the South Eastern Council credit for continuing their fall regional conference all these years. I am hoping that the new Technical Councils can develop Technical Council Conferences.

I believe that members of organizations should be recognized for outstanding accomplishments. Carl Malstrom, SCS President in 1991, asked me to develop an awards program for SCS. The program would recognize people for their technical accomplishments as well as for dedicated service to the society. I worked with Carl Malstrom, Keith Klukis, Roy Crosbie, Ralph Huntsinger, Tony Sava, Joe Cynamon, Wayne Ingalls, Chip Stockton, and a few others. We developed the current Awards and Recognition Program and made our first set of presentations at the 40th Anniversary of SCS in Reno in 1992. The first group of recipients included: Dr. Roy Crosbie and Dr. Stewart Schlesinger receiving the Distinguished Service Award, Dr. Edward Mitchell and Mr. Les White receiving Distinguished Professional Achievement Award, and Roger Smith and Dr. Annie Saylor receiving the Outstanding Contribution Award.

The McLeod Founder's Award, designed by Carl Malstrom, is SCS's highest award for professional contributions and is a tribute to John McLeod. This prestigious award provides recognition for the simulationist selected to receive it. John McLeod was honored by the Society in 1994 and was presented this honorary award by Carl Malstrom. Ben Clymer was the first recipient of the McLeod Founder's Award for Distinguished Service to the Profession. This award was presented to his son Mark by Carl Malstrom at the WMC in Las Vegas in 1994. I presented the McLeod Founder's Award to General Paul Gorman at a ceremony hosted by the Institute for Defense Analysis in Alexandria, VA on October 24, 1994. This was the second of the Founder's Awards. Additional recipients include Bob Howe in 1996, Granino Korn in 1997, and Bernie Zeigler in 1999.

SCS's highest award for service is the Presidential Award. The two recipients are Vince Amico in 1997 and Roy Crosbie in 2002.

Steve Branch and I have implemented the Modeling and Simulation Hall of Fame, unveiled at the 50th Anniversary. john McLeod is the first inductee. The program will be supported by a committee consisting of one representative from key/involved major simulation-minded societies (i.e., SCS, SISO, NTSA, EuroSim) plus members of the Hall of Fame.

I think SCS has been very successful in recognizing members and simulation professionals for their efforts. President Jordan Chou 's key focus was to institute a comprehensive strategic planning initiative for the Society in the near-term and to help SCS move forward into the 21st century. As Senior VP in the fall of 1992, I was given the responsibility of organizing and enacting such an initiative. I had a strong committee that included Chip Stockton, Keith Klukis, Bob Judd, Robin Kirkham, Axel Lehmann, Wayne Ingalls, Norm Pobanz, Hamid Vakilzadian, Bruce Fairchild and Alexander Verbaeck to help with the implementation of a Strategic Plan. The first step was to develop a mission statement: SCS is an international, multidisciplinary forum dedicated to research, development and applications of simulation. With the statement above as its focus, the Strategic Planning Committee proposed a series of sweeping changes that were expected to improve the Society.

The plan was presented to the Board for approval in July of 1993 in Boston. By a close margin, the SCS Board of Directors approved adoption and implementation of a strategic plan that called for a major restructuring of the society's leadership that began in July of 1994. The plan included major changes to the election process for Executive Committee, the structure of the Board of Directors, the nomination and election of Board of Directors, and alignment to three business areas: Conferences, Publications, and Membership.

I was the first President operating under this new structure and it did work. I think the new structure has allowed SCS to be more responsive by adjusting to business changes more quickly.

SCS is currently going through trying times, but a lot of changes have been implemented in Publications, Membership, and the structure of councils with the formation of six technical councils. These changes will result in a more profitable and stronger Modeling and Simulation Society. The changes came about through the efforts of Axel Lehmann and Roy Crosbie with the Advisory Council. We have seen 50 years of operation and I feel that we can expect SCS to reach new peaks in the future.

Simulation Through the Years- 25 Years

Look around you by John McLeod

This article was originally published in the November 1977 issue of *Simulation* & was entitled *Simulation in the Service of Society*.

In line with the theme of the Silver Anniversary issue of *SIMULATION*, I would like in this Newsletter to take a brief look back, comment on the state of simulation as I see it today, and rather than gaze into my clouded crystal ball in an attempt to predict what simulation will be like in the future, to indicate some of the things I believe we must do if simulation is to become anything more than the rather esoteric art-form it is today.

Although experience has shown that readers are seldom writers, I hope to be provocative enough to elicit some comments--for publication or just for my own edification.

A Nod to the Past

The evening of November 7, 1977, will mark twenty- five years of real time that have passed since that meeting in the Colonial Inn in Oxnard, California where I organized and which resulted in the founding of what is now the Society for Computer Simulation. I will dwell little on the past, as simulation is anything but a has-been. After pushing it for 17 years I have spent the last eight years trying to keep up--and occasionally urging caution. Computer modeling and simulation are now being used for practically everything, including some things for which they shouldn't be. More on that later.

Since the Society for Computer Simulation (Simulation Councils Inc.) is the only technical society in the United States devoted exclusively to modeling and simulation, its history is inextricably inter- twined with progress in the field. And while the history and progress make an interesting story, have told what I know of it elsewhere, notably in the Fall 1963 issue of *SIMULATION* (the first by that name, its predecessor having been a mimeograph publication called the *Simulation Council Newsletter*) and in an article "Simulation Today--And Yesterday'', the first of the *SIMULATION TODAY* series, published in the May 1972 issue of *SIMULATION*.

I don't want to repeat other historic details, but do consider it fitting that the participants in our founding meeting be honored by republishing their names and affiliations here. They were:

- Lee Cahn - Beckman Instruments Inc.
- R. Douthitt - Computer Research Corporation
- Floyd E. Nixon - Glenn L. Martin Company

- E.T. Mahar – Globe Aircraft Corporation
- R. Mayne, L.E. Stilwell, C.A. Wiley - Goodyear Aircraft Corporation
- R. Favreau, A.S. Fulton, H. Low, B.D. McVey - Hughes Aircraft Company
- E. Ackerlind, R.S. Anderson, J.B. Rea - J.B. Rea Company
- W. Abern, E.D. Bush, R. Chapin, R. Gilpin, O. LaPlant, J. McLeod, S. McLeod, J. Pappas, J. Pollard, W. Sedlack, J. Sherman, D. Teague, W. Uplinger - Naval Air Missile Test Center
- H. Englander, F. Fisher, D.M. Lowe, W.P. Mitchell - Naval Electronics Laboratory
- R.M. Hendrickson - Northrop Aircraft Company
- E.H. Jacobs, C. Nisson, L.L. Philipson - Rand Corporation
- L.A. Snow - Snow Electric Company
- R.L. Baddorf, R.D. Chamorro, E.J. Jagger - University of Southern California

The Spread of Simulation

As indicated by the affiliations of those listed above, the first Simulation Council was a creature of the aerospace industry, still the most powerful proponent of simulation, and with good reason: there is no other practical way to design, test, and train personnel for advanced aircraft and space vehicles--and the aerospace industry had government financial backing.

From aerospace to other industries based on the "hard" sciences was a natural and comparatively easy transfer of simulation know-how. To the best of this writer's knowledge, "technology transfer" next made simulation available to the life sciences again for compelling reasons--simulation allowed experiments to be performed on computers, experiments which in many cases would have killed experimental animals (perhaps ending the experiment prematurely) or subjected human patients to undue risks.

Furthermore, some measurements could be made with impunity on models that would severely perturb a living physiological system, while others could be made on models that could not be made at all on living systems.

Sometime later simulation technology was transferred to the area of the social sciences. Here the problem that simulation was called upon to alleviate was not one of the immediate risk to human life, but of time and human frailties. Social systems are characterized by long time-lags. They are intractable with respect to normal experimental procedures because even if experiments can be devised to study the reactions of a segment of society, irreparable damage is often done to that segment before the experimenters -- bureaucrats, social workers, politicians -- can be convinced they have made a mistake.

The use of pesticides containing DDT and the building of the Aswan high dam, with its unforeseen consequences for the Nile Valley and the Mediterranean, are cases in point.

Simulationists cannot predict the future. But by compressing the time-scale, simulation predict the probable reaction of a segment of society and its environment to alternate courses of action, provided all assumptions and data upon which the model and the simulation experiment are based are valid--and remain so during the time-frame of the study.

As Applications Change

In considering the aforementioned transfer of simulation technology it is interesting to note the varying difficulties inherent in the study of different fields.

In the early days of simulation in the aerospace industry the primary problem was, as it remains today, the complexity of the simulation, the system to be simulated. Anyone familiar with the Apollo Project realizes that simulationists were called upon to model in detail not only the spacecraft, but also the ground control stations, the world-wide tracking stations, and the communication network which tied them all together.

I have had the good fortune to witness many aspects of such simulations, and even with all the talent available I consider it a little short of a miracle that the project managers and their teams were able to "get it all together" at one time. But somehow they did, and thus simulation helped show others how to get the real system components coordinated and working as a unit.

The success of the Apollo Project is attested to by the fact that there are no corpses of astronauts on the noon -- or floating in space. The crew members of Apollo 13, which blew an oxygen tank on the way to the moon, owed their lives directly to the fact that simulation was used to diagnose the problem--at first no one knew what had happened--and to devise a procedure for getting the astronauts back alive.

Aerospace systems are extremely complicated, but obtaining the data to develop the required models has been a relatively minor problem, as simulation has usually been employed to generate specifications during system development. Then when hardware became available, performance data could be derived from measurements upon it.

Simulation in the life sciences poses a different problem. Not only are many measurements difficult if not impossible to make with current technology; taking a measurement changes the characteristics of the object measured, and nowhere does this present nature of a problem than in the life sciences. Furthermore, even if sufficient data can be gathered, there remains the question of how the information concerning one subsystem relates to that which describes another: how the respiratory system interacts with the circulatory; how is the endocrine related to the central nervous system; etc.; etc.

Under the circumstances it is surprising that it has been possible to develop useful models in the life sciences. But reference to the literature proves that simulationists in that field have made great progress--vital progress, one might say.

Shifting to the social sciences, we find that one of the problems still concerns data, but in many cases too much data. Moreover, the data has frequently been gathered by different agencies under differing circumstances and for different purposes. In many, if not most cases it is also "soft", to say the least.

But the real problem with societal models is that they involve people. Unless the model is open- ended (if it is, it won't represent any realistic system of which I am aware) there will be people in the feedback loops. Now when we consider that people are non-linear, noisy, time-varying, learning systems, some of the difficulties attendant upon the modeling of societal systems can be appreciated.

Nevertheless great progress has been made in the modeling and simulation of social systems also. Harold Guetzkow, the Gordon Scott Fulcher Professor of Decision-Making at Northwestern University, was working in the field in the '50s, and his Inter-Nation Simulation model has been the inspiration for many variations and improvements by Guetzkow, his students, and others to this day.

The "ART" TODAY- A PERSONAL VIEW

Whether we are "in the act" or "in the audience" we are witnessing convulsive changes in computer technology in general, and simulation methodology--and applicable equipment--in particular. I use the word "convulsive" because I believe there will be a period of flailing around before we can expect to see our art and science settle down to a steady course, upwards or otherwise. There are cross-indicators of progress.

Dichotomies and Concomitances

Divergent tendencies can be recognized as the big computers get bigger while the small ones are getting smaller (but more powerful)--the ILLIACS and the micros. In the meantime, what is happening to the minis? They are unquestionably growing more powerful and, if extended memories and I/0 are included, larger. Will they be the CPU's of the future?

On the other hand, convergent tendencies can also be recognized in both the computer and simulation fields.

One of the hottest controversies in industry and government (and law) today concerns the interrelation of computation and communications. To me this seems senseless; if we look closely enough, the fields are inseparable. Is the automatic routing of long-distance telephone calls a computer or a communications function? Who cares? Only the responsible bureaucracies--and those whom they regulate. Certainly I don't. But I do care that humanity would be better served if those same organizations ceased their squabbling and got together as a single field of technology to serve the public. But then, what would happen to the lawyers?

When it comes to hardware--and software, for that matter--my crystal ball is clouded. My concern is not with legal aspects, but with the actual and potential applications of simulation: what can it do for us--and for humanity?

Those of you who try, as I do, to keep up with the voluminous literature of simulation, are well aware of actual applications, and the implications for bigger and better simulations in the future.

But what do we mean by "better" and what must we do to make them so? I have some ideas. (Do you?)

A Look Ahead--What We Must Do

Let me now note some aspects of computer modeling and simulation which I believe simulationists must give more attention to in the future, if we are to realize the potential which simulation offers.

1. Establish credibility outside our field.
2. Improve communications within our field, with potential users, and with the public.

Just two things!? Yes, but each is a case of gross aggregation.

To improve credibility will require that we develop a methodology for modeling, simulation, and analysis that is acceptable to our colleagues to the extent that they will use it, and that is comprehensible to our present and potential customers, to the extent that they will believe in it. Quite an order!

Simulationists are rugged individualists who are happily wedded to their own methods. But so long as simulationists are unable to agree as to how modeling, simulation, and analysis should be accomplished, the potential customer will have reason to wonder if we know our business.

Credibility also raises the issue of the validity of the model: does it represent the system modeled--the simuland--to the degree necessary to fulfill its intended purpose? Even if it does, having a valid model is not enough.

For the results of a simulation study to be credible, the simulation experiments for which the model is used must also be planned and executed in such a way as to make the results meaningful in the context of the purpose of the study. Random parameter juggling is fun and can be enlightening, but it will not establish credibility in the eyes of skeptics.

Further, the establishment of credibility demands that the analysis of the results of simulation experiments be as rigorous as possible. Simulationists, being human, have built-in biases: the selection of data sources (particularly in the case of "soft" data); the design of the model (what does the modeler consider important?); the design of the simulation experiments (are they designed to explore a question objectively, or to support an a-priori position of the simulationist or his client? Such biases are inherent in simulation studies, but if in fact is realized it can be dealt with by observing certain precautions.

These precautions require proper documentation of the simulation study from inception to conclusion. Besides including enough information to allow the experiment to be repeated by the investigator's peers, information that will reveal biases must be included so that the biases can be recognized, their influence judged, and the experimental results weighted accordingly. This means that the documentation must include but not be limited to:

1. The objective of the study.
2. A natural language description of the simuland as the modeler understands it.
3. A record of every assumption arbitrarily made or required:
    a. To reduce the verbal description of the system to a mathematical model. This must include sources of and reasons for selecting the data used.
    b. To program the mathematical model to run on the computer.
    c. To devise simulation experiments that will address significant questions pertinent to the study.
    d. To reconcile actual with expected results.
4. An a posteriori justification of all previous assumptions, and of any additional ones which might be required to explain the results.

A careful consideration of the foregoing factors by any concerned observer should reveal all hidden biases and allow an evaluation of their possible influence on the results of the study.

Such procedures should improve credibility outside our field.

But we still must improve communications. As a start we must do all in our power to assure that the meaning of a message received and interpreted by the receiver has the same meaning to him as was intended by the sender. This seems obvious, yet there is confusion in our own field. How then can we expect to not to confuse the public and, most importantly, our potential customers?

Communications among simulationists, and especially between simulationists and those whom we would influence, or merely inform, can be improved greatly if we will:

1. Speak and write so that our meaning will be clear to all, not just some "in" group.
2. Make clear what simulation in general--or a specific model where appropriate--can be expected to do, and what it cannot.
3. Avoid overselling. Promise only what can be delivered, and deliver what is promised--on time and at the agreed price.

In the interest of improving clarity, I have editorialized on the need for consistency in terms and definitions elsewhere, so here I will merely illustrate the point with a few examples.

I consider "verification" the process of assuring that a computer program runs as intended, whereas the purpose of "validation" is to assure that the computer model represents the simuland to the degree necessary for the study at hand.

Some writers reverse the foregoing meanings.

In the context of a simulation study I use the word "implement" to mean the putting into effect of the recommendations derived from a simulation study. Others use the word to mean getting a program to run on a computer.

Some writers use the same word to mean both of the foregoing.

Recently another element of confusion has been introduced into our vocabulary. For some 20 years a hybrid system has been understood to be one involving continuous (analog) and discrete (digital) signals. Now we have the term "all-digital hybrid", which to me is an abomination! To be sure, there is a growing need for a term to refer to all-digital systems which process some of the information in parallel and some serially, but why use a term long-established to mean something else? How about a straight-forward descriptive term like "parallel/sequential system"?

Now my concern is not that some simulationists and simulation writers attribute meanings to words that differ from mine. I'll change if I find that I represent a minority. My point is that until one meaning is accepted and understood by all, there will be confusion within our ranks. And that confusion will be obvious to others.

Inconsistency in the use of terms is of course only one obstacle to clear writing. There are others, but as books have been written on the subject I will lecture no more here but turn my attention to my second point.

I am distressed, even frightened, by those who imply, and those who seem to believe, that simulations can predict the future. Of course simulationists know that is not true, so I am concerned with others--experts in other fields who might use simulation as a tool or who might use simulation results in decision-making. I am also concerned with the image of simulation in the minds of the lay public.

We must present simulation as a tool for gaining insight and exploring possibilities. I even advise caution in selling simulation as a means of answering "What if ... " questions. Simulations do not give "answers". Answers may be deduced by an analyst based on a simulation study, but simulation runs give only results, not answers, per se.

Furthermore, in addition to the "if" in the question of primary interest to the investigator, there are other "ifs" that must be considered. The results of the simulation will only be meaningful:

1. If the data are valid.
2. If all assumptions are tenable.
3. If the analysis of the results is free of bias.

Concerning my third point, I can only urge that all simulationists and their representatives try to adhere to the admonition, "Thou shalt not oversell." But that is not easy. Most "sellers" of simulation honestly believe that their model will do what they say it will. Only experience--and more unhappy experiences, I am afraid--can be expected to guide the overenthusiastic.

I have a friend who might say the foregoing is a "Minority Report; it deserves no further consideration." Certainly it is a minority report--a minority of one. But I hope others will find in it some food for thought, if not agreement. So I close with the question:

What would YOU advise to improve our technology and its acceptance?

OTHER VIEWS - FROM BOOKS

We have often encouraged the view that simulation is a tool which might best be used in combination with others. One does not build a house with a hammer alone. That point of view is emphasized by two books we recently received, one on methods for problem solving and the other on artificial intelligence.

Tools for Thought by C.H. Waddington (who was, until his death in 1975, Buchanan Professor of Animal Genetics at Edinburgh University). New York, Basic Books Inc., 1977. A somewhat tutorial survey of analytical methods. It begins with a discussion of applicable philosophies, works up to and through "The Classical Scientific Method", and concludes with a chapter on system modeling, with emphasis on "The World as a System".

As an indication of the author's style, and what I consider clear thinking, I quote from a discussion of The Limits to Growth:

> *"*If one were foolish enough to take its computer projections to be serious predictions of what is going to happen, they appear rightly pessimistic, foretelling catastrophic events such as halving the world's population. There is still sufficient Victorian optimism around--the belief that bigger and more costly always means better--for a lot of people, even many who should have known better, to get very hot under the collar and try to bury the whole enterprise under a fog of ridicule. It is therefore important to try to get some idea of what computer simulations of complex situations cannot be expected to do in the present state of the art.*"*

Artificial Intelligence and Natural Man by Margaret A. Boden (Reader in Philosophy and Psychology, University of Sussex). New York, Basic Books Inc., 1977. A 537-page fine-print tome which got a bit deep for me, but those better versed in philosophy and psychology than I will find its treatment of

the use of computer models and simulation, as aids to study in these fields, interesting, and probably enlightening.

To illustrate the thrust of the book I quote:

> *"*Artificial intelligence is not the study of computers, but of intelligence in thought and action. Computers are its tools, because its theories are expressed as computer programs that enable machines to do things that would require intelligence if done by people.
>
> "I make no basic distinction of principle between 'artificial intelligence' and 'computer simulation'. There is admittedly a difference in emphasis between workers who try to make a machine do something, irrespective of how humans do it, and those who aim to write a program that is functionally equivalent to a psychological theory. In a computer simulation, every thought process posited by a certain psychological theory has a corresponding process specified in the program. Computer simulations are thus directly parasitic upon some prior articulated theory about human psychology, whereas other programs are not."

Simulation - as it has been, is, and should be by Tuncer I. Oren

This article was originally published in the November 1977 issue of *Simulation*

One of the characteristics of simulation nowadays is that it is ubiquitous. Table 1 provides some figures about different aspects of simulation. For example, there are 23 associations or groups specializing in simulation. As is apparent from their names (Table 2) they differ widely in scope, application area, regional coverage, etc. Over 80 special bibliographies cover different aspects of simulation. There are over 1300 doctoral dissertations written in North America (mostly in the USA). This number is increasing by about 200/year. In Europe, over 50 have been written in France alone. NTIS (National Technical Information Services) in the USA makes available annually over 300 new titles in simulation in hardcover or microfiche editions. Over 300 books exist on simulation (mostly written in English). There are about 18 periodicals and over 100 conference proceedings on simulation. Every year there are about 12 simulation conferences or symposia. Simulation terminology comprises about 1000 terms. Simulation is used in over 200 application areas such as agriculture, earthquake, engineering, history, music, missile, and social sciences. Over 100 techniques such as bond graph, finite difference, relaxation, or variance reduction are used in different types of simulation. Well over 300 abbreviations and acronyms denote existing simulation software. Over 20 simulation languages or packages exist for combined system simulation alone. In a recent article 18 of them were reported [3]. Hundreds of simulators exist. [2]

How have we reached this state of versatility in simulation? By doing experiments on models instead of on real systems. Simulation studies may be classified in many different ways:

- Goal of experimentation-e.g., computation (with or without optimization), insight, or learning (simulation games in early stages and simulators in late stages of learning to en- force the learned concepts)
- Type of application area-e.g., artificial intelligence, ecology, education, job shop, transportation
- Type of system-e.g., adaptive, control, fuzzy, hierarchical, large scale, nonlinear
- Nature of the model-e.g., physical (scale model, analog model), or mathematical (with constant structure or with time-varying structure) with the model specified by differential equations (ordinary-stiff or not-or partial), finite difference or algebraic equations, or as a finite-state machine, or as a Markov chain
- Nature of the relationships-deterministic, stochastic
- Time set of the model-discrete, continuous, mixed
- Ratio of simulated to real time-e.g., compressed- time simulations, real-time simulations
- How the state of the model is updated-e.g., by analogy, by computation
- Device used to do the computations-e.g., manual simulation, computerized simulation (digital, analog, hybrid)
- Way of accessing the computer in computerized simulation-e.g., on-line simulation, interactive simulation, conferencing simulation, distributed simulation
- Simulation executive (time structure of the simulating software)-e.g., time slicing, significant (critical) event, process, activity

Table 1 - Some figures (approximate) about different aspects of simulation

Associations	23
Bibliographies	80

Doctoral dissertations	over 1300
NTIS documents	over 300/year
Books	300
Periodicals	18
Proceedings	over 100
Conferences/symposia	12/year
Special terminology	100 terms
Application areas	over 200
Techniques used	100
Abbreviation/acronym used to denote simulation software	over 300
Simulators	100s

Table 2 - Associations or groups specializing in simulation

ABSEL	Association for Business Simulation and Experiential Learning
ACM/SIGSIM	Association for Computing Machinery - Special Interest Group on Simulation
AERA/SS	American Educational Research Association - Special Interest Group on Simulation Systems
AICA/ASDS	Associazione ltaliana per il Calcolo Automatica - Working Group on Algorithms and Simulation of Discrete Systems
AIM/GTSC	American Institute of Aeronautics and Astronautics - Ground Testing and Simulation Committee
ASTM/E-21	American Society for Testing and Materials - Committee E-21 on Space Simulation
ASU	Association of SIMULA Users
BSS	Brazilian Simulation Society
GLOSAS/Japan	Global Systems Analysis and Simulation Association – Japan
IEEE/CS/TCS	Institute of Electrical and Electronics Engineers - Computer Society - Technical Committee on Simulation
IFIP/WG7.1	International Federation for Information Processing - Technical Committee on System Modelling and Optimization (TC7) Working Group on Modelling & Simulation (WG7.1)
IMACS	International Association for Mathematics and Computers in Simulation - formerly AICA (Association Internationale pour le Calcul Analogique)
ISAGA	International Simulation and Gaming Association
JSCS	Japanese Society for Computer Simulation
NASAGA	North American Simulation and Gaming Association
NGA	National Gaming Association
SAGSET	Society for Academic Gaming and Simulation in Education and Training
SCS	The Society for Computer Simulation
SSG	SIMULA Standard Group
SSRC/CSCP	Social Science Research Council - Committee on Simulation of Cognitive Processes
SSS	Scandinavian Simulation Society
TIMS/CSG	The Institute of Management Sciences - College on Simulation and Gaming
WSO	World Simulation Organization

Some of the early simulation studies were not even called simulations. For example, the well-known Nobel laureate and Dutch econometrician Tinbergen used to have a water-flow analog model of

Holland's macroeconomy. He used the analog model until it was discarded in the mid-50s. To the people who complained that the model leaked, Tinbergen's answer was "So does our economy."

Nowadays the situation is completely different. Computerized simulation and some of its messages are well spread about. For example, the first report of the Club of Rome has sold over four million copies in Benelux countries alone.

In addition to the continuation in the future of the successful use of simulation in traditional application areas, I hope that:

1. Simulation models will be comprehensible, especially to those who will be affected by the implications of particular models. Comprehensibility is paramount in the rational selection of models in a participatory democracy.
2. If a simulation program is to be used several times, a list of questions answerable by the model will be part of the documentation provided to the user.
3. Adequate methodology will be developed and implemented for newly emerging multidisciplinary modelling. In the future, the methodological aspect will become crucial as more and more people try to model large-scale multifaceted systems.
4. Advanced modelling concepts will be used to simulate complex phenomena. For example, behaviorally anticipatory models have definite advantages over classical feedback models, especially when time delays are large. [4]
5. Robustness will be taken into account in modelling large-scale systems. [1]
6. New simulation software implementing advanced concepts in modelling and model manipulation will be part of computer-assisted model building, handling, and documentation systems. Some of the algorithmic model manipulations may be done for consistency checks, decomposition, simplification, coarsening, elaboration, or comparison of models. [5]
7. Simulation software will be much more independent of simulation hardware.

ACKNOWLEDGEMENT

Originally, the invitation was extended to the Computer Centre and Computer Science Department, Dutch Agricultural University, Wageningen, The Netherlands, as an academic corporate member of SCS, to contribute to this article. Since I was part of that group for a year (where spent my sabbatical leave and enjoying an intellectually stimulating professional environment), I would like to express my appreciation for the trust they have shown in me by asking me to write article on their behalf.

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Simulation Through the Years - 40 Years

The Birth of SIMULATION by Stanley Rogers

John McLeod had been publishing his *Simulation Councils Newsletter* in *Instruments and Automation*, but the Newsletter was sandwiched in with a lot of ads. That made it awkward to clip out and preserve useful items for future reference. Nobody was happy about that, and we all wanted our own publication. The obstacles were formidable: not much money, no experience, no expertise. Then Lady Luck smiled on us. I had a chance meeting with an acquaintance and mentioned our problem to him. His response was, “Would you like to meet a talented young Danish graphic artist? He is producing a very attractive monthly magazine for a local architectural organization." My acquaintance arranged the meeting with Hans Jorgensen, who said he would give us costs for all phases of producing a monthly. He would get his figures from the local companies that did the typesetting, printing, binding, and mailing for the architect-just the info we needed to evaluate our prospects.

The Board of Directors was very skeptical that SCi could afford a respectable monthly publication, but wanted to get the cost data. I thought we should start small. So I asked Hans to get the figures for a 16-page monthly. I had excellent rapport with him because I had studied printing in school and had worked in a small print shop. Hans and I spent a great many hours talking about every aspect of the project. I kept key members of the Board informed, especially Jack Sherman, who shared my enthusiasm for it.

Hans had great faith that he could show the Board that a 32-page monthly could be produced at a cost low enough that, with reasonable income from ads, the project could fly. He prepared a presentation to the Board, complete with a dummy of the magazine and his proposed design of the cover and graphics for the inside pages. The Board liked everything except this checkboard cover design which Han’s thought would instantly identify *SIMULATION* in any random assemblage of technical magazines. The Board agreed that would be nice, but would he please do another design? He did, everybody liked it, and it also was instantly recognizable.

Meanwhile, John and others let the manufacturers of analog computers know that we were considering the new magazine and needed to estimate how much advertising support we could expect from the industry. It appeared likely there would be enough for us to go ahead. But the skeptics on the Board were not so sure. The Board ruled that we could print one issue only and see how it went. Jack Sherman was named Director of Publications, and he named John as Editor and me as Publisher.

The simulation industry's response to that first issue (Fall 1963) far exceeded anything we had dreamed. The number of pages in Vol. 1, No. 1 had to be increased from 32 to 40, and we finally had to print 4000 copies. Advertising receipts not only paid for the first issue but also left us with enough money to print the January 1964 issue.

If memory serves me right (the foregoing is all from my fallible memory), Jack Sherman decided that the response meant that we were de facto in the business of publishing *SIMULATION*. After consulting SCi's attorney to determine the scope of his authority, Jack pushed the start button. He directed us to lease larger offices so we could do our graphics in house under Hans’s direction. And he told us to go to work on the January 1964 issue, which we did.

One sidelight gave me a lot of pleasure: *SIMULATION* became widely known for its elegant graphics. The **American Institute of Electrical Engineers** and the **Institute of Radio Engineers** told me they could not afford such a high-quality magazine, so how could we? They gave me their production costs for comparison, and I gave them ours. They simply did not believe my figures. Our costs were the lowest, though only by a little. Good design does not have to be expensive. I have not seen *SIMULATION* for a number of years, but have heard its graphics have been "modernized" and otherwise changed. I hope not too much. There were many financially rough times for us in the first 15 years of publication, but the money problems of *SIMULATION* ended the day SCi became a full participating sponsor of the National Computer Conferences, as Jack mentions in his article. Unfortunately for me, that day came after I became Publisher Emeritus. Nevertheless, I was very pleased to hear the good news.

Incidentally, Hans also designed our logo, which after years of use have established as the Society's instantly recognized symbol. For the record, I was the Society's Secretary for many years and, at times, also Treasurer or Assistant Treasurer. Until 1978 I was responsible for running the La Jolla headquarters office and, of course, for our publication.

Simulation Through the Years- 50 Years

The Simulation Industry in Search of Recognition by Vince Amico and Lorraine Amico

INTRODUCTION

Simulation is reported to be a multibillion-dollar industry that employs thousands of scientists, engineers, and technicians. Professionals in the simulation business, after pioneering and promoting the field for more than half a century, certainly recognize the increasingly important and diverse role that simulation plays in our modern lives. Labor markets impacted by substantial expenditures for simulation products and services, including, for example, the greater Orlando area in Florida, certainly understand the importance of modeling and simulation to all economic sectors.

Despite the bold claims of economic significance, simulation companies and professionals in the workforce may be totally invisible to those who are not intimately knowledgeable about simulation goods and services. In 1997, it was first observed that modeling and simulation technically was not classified as an industry in government reports used by policy makers. (Ref 1) Nor can information on the simulator business be found in career development materials available to students and job seekers.

Over the past three years, a dialog bas ensued concerning the recognition of simulation in the economy. A number of leaders in the field believe that this recognition is crucial to further advance the simulation profession and more closely align the diverse simulator application domains. Of particular concern is the availability of data needed to determine the number of employees who are potential candidates for the Modeling and Simulation Professional Certification Program. (Ref 2)

Most recently the dialog has gained momentum through the efforts of Dr. John Hitt, President of the University of Central Florida (UCF), who has corresponded with Elaine Chao, the U.S. Secretary of Labor. The academic community, including UCF, has begun to offer advanced multidiscipline degree programs to prepare future workers with simulation- specific skills. From this perspective, information is needed on the number and types of businesses conducting simulation work; the goods and services that are designed, developed, and produced; and the number and characteristics of employed simulation professionals.

The objective of this article is to give some insight into how and where simulation fits into the industrial and occupational structures of the U.S. economy. Based on the findings, several issues are raised to focus the discussion of how to increase the recognition of simulation. The SCS, in conjunction with other modeling and simulation organizations, should take several steps to support future industry growth, the development of a skilled simulation workforce, and a strengthened image of modeling and simulation in our economy.

THE STRUCTURE OF THE U.S. ECONOMY

Currently, over 9.3 million business establishments employ 132.2 million workers in the U.S. economy. Businesses are classified into 1170 detailed industries by the North American Industry Classification System (NAICS). The Standard Occupational Classification (SOC) groups job s into over 820 occupations.

Business establishments are continually transforming the workplace and the labor force to meet the demands of the global economy. The NAICS and SOC, by necessity, are dynamic also. The federal

government is making a concerted effort to update these classification structures to reflect the evolution of workforce skills and business processes and products. In 2005 the industrial and occupational classification systems will be revised to assure that data are useful for analyzing the current structure of the economy and projected trends.

INDUSTRIAL CLASSIFICATION IS HIERARCHICAL

U.S. business establishments are divided into 20 industry sectors by the NAICS. Five sectors in NAICS are largely manufacturing industries and fifteen are entirely service industries. Industries within each sector are grouped according to product ion criteria. (Ref 3) In the design of the NAICS, attention was given to developing production-oriented classifications for new and emerging industries; service industries in general; and industries engaged in the production of advanced technologies.

Within manufacturing, the sub-sectors generally reflect distinct production processes related to material inputs, production equipment and employee skills. Businesses that share basic processes and use closely similar technology to produce similar goods/services a regrouped in the same industry. For example, Electronic Equipment, Appliances & Component Manufacturing is a new NAICS code. It brings together industries producing computers, communications equipment, and semiconductors because there are inherent technological similarities among their production processes and it is likely that these technologies will continue to converge in the future. The production distinctions become more narrowly defined as the industries become more detailed.

Businesses in the Services Sectors sell the expertise, knowledge and skills of their employees. Most of these industries have production processes that are almost wholly dependent on worker skills rather than on equipment and materials. Individual industries are defined on the basis of the particular expertise and training of the service provider. For example, offices of engineering services are grouped into a single industry.

WHERE ARE *SIMULATION* BUSINESSES FOUND?

Since the late ‘90s, it has been generally accepted that no single "simulation industry" can be found in the NAICS or in its predecessor, the Standard Industrial Classification (SIC) System. To identify where simulation businesses are located in the NAICS, the NCS and the NTSA conducted limited membership surveys in 2001. (Ref 4) In the surveys, businesses were asked to indicate what industry code(s) they use to report their activities to the government. Companies were encouraged to report multiple NAICS codes to describe their workplace. Twenty businesses that are thought to be fairly representative of the full membership of each association responded to the surveys. In 2001, the survey results were reported and recommendations presented to the membership of the organizations. (Ref 5)

The survey results show that business respondents report their simulation activity under 20 different NAICS codes. Only 6 codes had a significant number of respondents. These six codes are divided between manufacturing and service industries. Of the NCS/NTSA survey respondents, the largest number (65%) reported employment in the Industrial and Commercial Machine and Equipment Manufacturing Industry and the second largest number (53%) reported employment in Computer Systems Design and Related Services Industry. The identified codes could be considered to represent the industry groups where a major portion of simulation activity is taking place. Table 1 shows available information on employment, payroll, establishment, and shipment/receipt value in simulation-related industries.

It shows that the simulator-related-industry codes, as identified in the NCS/NTSA surveys, accounted for:

- Roughly 8.7 million employees out of the total 132.2 million U.S. employees in 2001, or about 12.6%.
- Of this, 3.6 million or 2.7% are employed in manufacturing and 5.1 million or 9.9% in services industries.
- Approximately 8.0% of the total 9.3 million business establishments in 1997. Of that, less than 1.0% was in manufacturing and 7.4% was in service establishments.
- Of the 10 industries identified, five including the one manufacturing code that actually references electronic teaching machines and flight simulators, SIC 3699, have employment levels too small to disclose.
- Over $367.7 million worth of goods and services. Manufactured goods shipped were valued at $102 million and services receipts were valued at $265 million.
- An estimated payroll of $115.6 million with $15.6 from manufacturing and $100.0 from services industries.
- The actual numbers for simulator-specific activity in each area above is a subset of these figures because establishments in the related codes may conduct non simulation activities as well.

Clearly simulation is a complex economic activity that has a presence in both the manufacturing and service sectors. According to all indicators, simulation activity appears to be greater in the services sector when employment, number of establishments, value of goods and services and payroll figures are compared. It should be noted that service industries are expected to account for a large share of the fastest-growing industries. So, services industries that are simulation specific should be expected to follow that trend.

FOUR OCCUPATIONAL LEVELS DESCRIBE JOBS

The SOC system classifies jobs where work is performed for pay or profit. (Ref 6) Within the four occupational levels, occupations are combined into 23 major groups, 96 minor groups, and 449 broad occupations. At each of the levels, occupations requiring similar job duties, skills, and education or experience are grouped together.

Occupational code revisions for the SOC are done every five years under the auspices of the U.S. Office of Management and Budget. It is anticipated that the next major SOC revision will begin in 2005. The occupational titles developed by the Department of Labor that replace the Dictionary of Occupational Titles are updated annually.

Note: NEC: Not Elsewhere Classified

Table 1

SIC	Industry	#Emps.	#Locales	Shipment /Receipt Value	Annual Payroll
	Total Nonfarming	132,213			
	Total Manufacturing Sector	17,698			
35	Industrial Machinery & Equipment	2,013	56,383	407,393	74,550
355	Special Industry Machinery	156	4,781	D	D
3559	Special Industry Machinery (NEC)	D	2,467	D	D
357	Computer & Office Equipment	355	2,018	108,867	11,099

3571	Electronic Computers	203	563	66,331	4,282
358	Refrigeration & Service Machinery	198	2,277	39,317	6,800
3589	Service Industry Machinery	D	1,165	7,596	1,460
3599	Industrial, Commercial Machine, Equip. (NEC)	299	24,637	28,968	10,032
36	Electrical & Electronic Equipment	1,612	17,104	348,559	58,256
369	Equipment & Supplies	130	1,701	D	D
3699	Electrical Equipment & Supplies (NEC)	D	691	D	D
	Services Sector	41,024			
73	Business Services	9,628	397,264	528,515	211,484
737	Computer/Data Processing Services	2, 193	103,278	224,114	75,805
7371	Computer Programming Services	538	31,624	38,300	18,417
7373	Computer Integrated System Design	235	10,571	35,270	11,341
7379	Computer Related Services (NEC)	D	28,762	21,541	9,313
738	Misc. Business Services	1,825	94,653	88,561	30,008
7389	Business Services (NEC)	D	69,376	62,276	17,597
87	Engineering & Management Services	3,525	292,162	302,005	121,659
871	Engineering & Architectural Services	1,060	82,153	108,622	43,518

WHERE DO SIMULATOR PROFESSIONALS FIT?

NCS/NTSA survey respondents identified all the relevant occupation codes they used to classify their workforce on government data collection instruments. The survey results indicate 18 different occupational codes are used. Of the 18 codes, 12 had a significant number of respondents. The largest number of responses was reported in three closely related computer occupations. The largest number of businesses reported using the Computer Software Engineers Applications Occupation (94%), Computer Programmer Occupation (82%), and Computer Systems Analyst Occupation (71%) to describe their workforce. The next occupation used was Electrical and Electronics Engineers reported by 65% of the businesses.

The 12 codes fall into four major occupational groups that include managers; computer occupations and mathematicians; architects and engineers; and life, physical, and social science occupations. These codes could be considered to represent the occupations where a majority of simulation professionals work. In reviewing the occupational codes used, it is interesting to note that there is no occupational title that contains the word, "simulation;" although simulation is referred to in some definitions.

Table 2, that lists the simulation-related professions identified by the NCS/NTSA survey results, shows that:

- The occupations where simulation professionals work make up about 2.2% of total employment.
- There were roughly 3.1 million employees in the detailed NCS/NTSA identified occupations. The actual employment number for simulator workers is a subset of this because all workers in these codes do not have simulator-related job descriptions.
- The life physical, and social science group is among the smallest occupational groups in terms of employment.
- The identified occupations, except mathematicians, should see favorable job growth over the next ten years.

- Eight of the 10 fastest growing occupations are computer-related, commonly referred to as information technology occupations.

Table 2

Occupation	#Employed 2000*	%Total	Outlook to 2010
Total, all occupations 770	129,739.0	100.0	
Management Occupations 30	7,782.7	6.0	
- Computer/Info System Mgr.	313.0	0.2	Grow much faster than avg.
- Training & Devel Specialist	204.0	0.1	Grow about as fast as avg.
Computer/Math Occupations 16	2,932.8	2.3	
- Computer Programmer	585.0	0.4	Grow about as fast as avg.
- Computer Software Engineer, ADDI	380.0	0.3	One of fastest growing jobs
- Computer System Analyst	431.0	0.3	One of fastest growing jobs
- Data Base Administrator	106.0	0.1	One of fastest growing jobs
- Mathematician	3.6	0.0	Declining
Engineering Occupations 31	2,279.7	1.7	
- Aerospace	50.0	0.0	Grow as fast as avg.
- Electrical/Electronic	357.0	0.3	Favorable growth
- Industrial	126.0	0.1	Grow as fast as avg.
- Electrical/Electronic Tech	519.0	0.4	Grow as fast as avg.
Life/Physical & Social Science 39	1164.0	0.8	
- Physicist & Astronomer	10.0	0.0	

    - By 2010, employment in the Computer Software Engineer occupation is expected to double to 760,000; and Computer Systems Analyst occupation is expected to rise by 60% to 689,000.

The examination of the occupations where simulator professionals arc found indicates that a relatively small proportion of the workforce could be classified as simulation professionals. However, of the occupations closely linked to simulation, many are among the fastest growing occupations in the U.S.

ISSUES

After examining the available government information on industries and occupations, it is clear that there is little specific data that isolates simulation from other related activities.

The analysis does demonstrate the complexities of defining simulation in the economy. In doing so it raises several issues. These issues are meant to stimulate a discussion on how simulation fits into the economy.

- How can a "simulation industry" be described when there is broad activity embedded in both manufacturing and service industry sectors? What does the proportion of simulation in manufacturing compared to the proportion in services indicate? Can simulation be characterized as a new and emerging industry?
- How significant is the overall simulation business in the economy? What do the proportions of simulation employment to total employment for detailed manufacturing industries indicate? For services industries?
- What can be said about simulation within each industrial sector? Is it homogenous or heterogeneous? Is there a detailed industry within each sector that is dominant?

- What is the level of specialization? What are the distinct manufacturing processes and/or products that are unique to simulators? Are simulator businesses engaged in the production of advanced technologies? In the services sector, what are the distinct areas of expertise and/or knowledge that are uniquely provided by simulation businesses?
- What is the coverage of simulation activity in that the economic significance, the specialization, and the coverage of simulation activity warrant simulation being considered for more specific inclusion in the industrial classification system. (Ref 7)

Research into occupational titles should further explore the four identified occupational groups. The NCS/NTSA survey recommendations as reported in the NCS survey report that call for the development of one or more occupational descriptions to define job requirements for simulation professionals should be examined. Information should be prepared to inform the OMB's Standard Occupational Classification Policy Committee that will recommend changes in the SOC definitions and placement of new occupational codes. The analysis should take into account the criteria established for revising the SOC.

CONCLUSION

At a time when society is beginning to realize the major role being played by simulation, an opportunity exists to advance the recognition of modeling and simulation activity in economic terms. While the magnitude and characteristics of simulation activity are still largely unknown, simulation businesses are known to be both in manufacturing and services industry sectors. The simulation workforce is distributed largely among management, computer/mathematical, engineering, and scientific occupations. The debate should begin now about how to define modeling and simulation in more specific industrial and occupational terms. The Society for Modeling and Simulation together with other professional societies should take the lead role in spearheading the effort to prepare for 2005 when the industrial and occupational coding structures will be revised.

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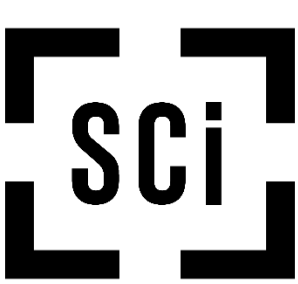
BIOGRAPHIES

Vince Amico started his career in simulation when he joined the Special Devices Center in 1948 as a Project Engineer in the Flight Trainers Branch. He was promoted to Branch head, Division head, and then to Chief Engineer of the Special Projects Office. In 1969 he was selected for the Position of Director of Engineering at the Senior Executive level. He was assigned to the position of Director of Research in

1979. He retired in 1981. Since then, he has done consulting, taught short course on simulation, and presented Papers at SCS and I/ITSEC Conferences. He has been a member of the Board of SCS and also served as VP, Conferences. He is a member of AFCEA, AIAA, NDIA, and SCS. He holds B of AE, MBA and MSE degrees. He is a member of Tau Beta Pi, Alpha Pi Mu, and Sigma Xi, The Research Society of America. He is the Industrial Affiliates Coordinator for the School of Computer Science at UCF. He has been a founding member of the Board of Directors of the National Center for Simulation and is now the Co-Chair of its Technology Committee.

Lorraine Amico Grace has analyzed literacy, workforce, and information policy at the national, state, and local levels for the past 25 years. Ms. Grace conducted research and policy analysis at the National Governors Association from 1981 until 1995. Prior to joining NGA, Ms. Grace was employed as an economist and researcher at the state and local levels in Florida. She has written numerous publications in the areas of literacy, human resource planning, system integration, performance management, and information policy. She participated in several advisory groups for statistics, workforce, and education agencies. As a member of the American Statistical Association, she served on the Government Statistics Committee. Currently she owns a small consulting business. She was awarded a Master of Science degree in sociology from Florida State University in 1974.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