The Winter Simulation Conference:

The Premier Forum on Simulation Practice and Theory

INTRODUCTION

The Winter Simulation Conference (WSC) is the premier international forum for disseminating recent advances in the field of system simulation, with the principal focus being discrete-event simulation and combined discrete-continuous simulation. In addition to a technical program of unsurpassed scope and high quality, WSC provides the central meeting place for simulation researchers, practitioners, and vendors working in all disciplines and in industrial, governmental, military, service, and academic sectors.

From another perspective, the Winter Simulation Conference is the result of a remarkable collaborative effort that has been led entirely by volunteers for over four decades and that is based on a unique, longstanding cooperative arrangement among seven major professional organizations. In this article we discuss these aspects of WSC.

OVERVIEW OF THE CONFERENCE

The Winter Simulation Conference features tracks devoted to leading-edge developments in modeling, simulation, and analysis methodology and to mature simulation studies and lessons learned in a diversity of simulation application areas. Moreover, WSC offers an invaluable educational opportunity for novices and experts alike, with a large segment devoted to introductory and advanced tutorials. These tutorials are carefully designed to address the needs of simulation professionals at all levels of expertise and are presented by prominent individuals in the field. Provided to each registrant at the beginning of the conference, the *Proceedings of the Winter Simulation Conference* contains complete documentation of the full technical papers presented during the conference as well as two-page abstracts for the vast quantity of posters shown. Also it might be worth mentioning that the WSC belongs to the avant-garde of conferences by offering their readership open access to their proceedings. The open access online proceedings date back to 1968 (in addition to the proceedings being listed in IEEE and ACM online services). Rounding out the attractions of WSC are poster sessions, a Ph.D. colloquium, several social gatherings, as well as meetings of numerous professional societies.

HIGHLIGHTS OF WSC 2014

WSC 2014 will be held in Savannah, Georgia, at the Westin Savannah Harbor Golf Resort & Spa and the adjacent Savannah International Trade & Convention Center. The hotel and convention center are located on Hutchinson Island along the scenic Savannah River, across the river from Savannah's landmark Historic District, where restaurants, shopping, boat tours, trolley tours and horse-drawn carriages are available. The theme of the conference is "Exploring Big Data through Simulation."

KEYNOTE SPEAKER

Dr. Robert Roser, Scientific Computing Division Head, Fermi National Accelerator Laboratory, will speak about the recently discovered *Higgs Boson* particle and the critical role that simulation played in the discovery. He is one of the world's leading experts on

experimental particle physics. Dr. Roser received his Ph.D. from the University of Rochester in experimental particle physics. He was a member of the CERN team that discovered the *Higgs Boson* particle on July 4th, 2012. He was also a member of the Fermilab team that discovered the *Top Quark* particle in 1995.

TITANS OF SIMULATION

Dr. John Swanson is the founder of ANSYS, Inc., one of most successful simulation companies in the world. He is an authority and pioneer in the application of finite-element simulation methods to engineering. ANSYS was formed in 1970 to market engineering simulation solutions for aerospace, automotive, biomedical, manufacturing, and electronics clients. Dr. Swanson served the company as president, CEO, director, and currently serves as an advisor.

Dr. Richard Fujimoto is a Professor and Chair of the Computational Science and Engineering Division of the College of Computing at the Georgia Institute of Technology. Prof. Fujimoto's research is concerned with the execution of discrete-event simulation programs on parallel and distributed computing platforms, including mobile systems, cluster computers, and supercomputers. He led a working group that was responsible for defining the time management services for the Department of Defense High Level Architecture (HLA) effort (IEEE Standard 1516).

SCOPE AND LAYOUT OF THE PROGRAM IN 2014

In recent years the WSC program has been organized into broad subject-area categories (or tracks) that reflect the current state of the simulation field as well as the mix of interests and professional orientations of conference attendees. The WSC 2014 program contains many of the recurrent tracks as well as some newcomers.

- **Big Data Simulation and Decision Making –** This track focuses on Big Data, an emerging field of work that leverages the volume, variety, and velocity of data in order to make better decisions. Recent Big Data simulations have been focused on a variety of domains, including atomic physics, weather, power grids, traffic networks, and urban populations. Policy makers, investors, planners, physicians, supply chain managers, military leaders, teachers, and administrators face the challenge of making numerous decisions on a regular basis. In a world that is increasingly complex, it has become virtually impossible to take well-informed decisions by simply relying on intuition and/or static rules of thumb. The challenge is compounded by the availability of large quantities of dynamically-changing data that must be analyzed and understood as well as the tightening of deadlines. In such a setting, simulation can serve as a practical platform for organizing the data, generating and evaluating various scenarios, and supporting the decision making process in a methodological fashion. This track therefore focuses on the role of simulation in supporting decision making in the presence of complex data. The track deals with methodologies developed for processing complex data and creating simulation based approaches for decision making, as well as the deployment of the methodologies in various fields in engineered, social, and natural systems.
- **Introductory and Advanced Tutorials** — These tracks feature expository presentations on current or emerging simulation practice. Introductory tutorials are designed for newcomers who are interested in the basics of simulation. Advanced

tutorials are oriented toward more experienced professionals who do not necessarily specialize in simulation research, but nevertheless seek the latest modeling, simulation, and analysis tools and techniques for advanced applications in a particular industry or discipline. Special-focus sessions within the Advanced Tutorials Track give practitioners and researchers a survey of recent fundamental advances in the theory of simulation modeling and analysis.

- **Analysis Methodology** — Simulation analysis covers a variety of mathematical, statistical, empirical, and computational methods. The Analysis Methodology track includes papers on input, output, and model analysis. Input analysis tries to improve the quality of the inputs (random variates, distributions, etc.) to a simulation. Output analysis aims to meaningfully interpret simulation outputs to draw informative inferences regarding the underlying simulation model. Model analysis deals with the efficiency and appropriateness of a simulation in providing useful estimates. The main focus of this track is on how to obtain better input, estimates, or inference by using efficient approaches or algorithms. We also welcome suggestions for sessions on emerging topics. Nonconventional methods are of particular interest.
- **Modeling Methodology** — This track is interested in methodological advances with respect to the theory and practice of Modeling & Simulation. These advances may include approaches to model development, data capture, model building, verification, validation, experimentation and optimization. Contributions to the advancement of the technology and software used to support modeling are also welcome as are contributions featuring guiding or unifying frameworks, the development and application of meaningful formal methods, and lessons learned. All modeling paradigms are accepted and supported. If you have an idea for a special session or a panel discussion of particular interest to the WSC participants, please send an email with a short description and references to the work of relevant experts to the track chairs.
- **Simulation Optimization** — This track is interested in papers on both theoretical and applied aspects of simulation optimization. In particular, it welcomes papers with methodological elements, e.g., analyzing properties of specific simulation models that lead to new or improved optimization techniques, or developing new computational algorithms for decision-making under uncertainty spanning multiple areas of application. It also welcomes papers on specific applications from areas such as healthcare, network applications, communications, financial engineering, and energy systems, where new or existing simulation optimization techniques are developed or applied.
- **Agent-Based Simulation** — This track is interested in theoretical, methodological, and applied research that involves synergistic interaction between simulation and agent technologies. Contributions to the track are expected to use agent-based models of complex adaptive systems and self-organizing emergent phenomena with applications to fields such as biomedical sciences, business, engineering, environment, individual, group, organizational behavior, social systems, and intelligent transportation systems. Also of interest are contributions that demonstrate the use of agents as support facilities to enable computer assistance in simulation-based problem solving (i.e., agent-supported simulation), or the use of agents for the generation of model behavior in a simulation study.

- **Hybrid Simulation –** Simulation methods enable stakeholders to analyse and evaluate strategies for effective management of complex systems. It is therefore not surprising that an increasing number of studies have used techniques such as Discrete-event simulation, Monte-Carlo simulation, System Dynamics, Markov Chain Monte-Carlo methods and Agent-based simulation to make better and more informed decisions. However, such techniques have frequently been applied in isolation. The complexity of systems and their multi-faceted relationships may mean that the combined application of simulation methods, or hybrid simulation, will enable synergies across techniques and will provide greater insights to problem solving. The aim of this track is therefore to solicit papers that focus on combining techniques (e.g., discrete and continuous). In particular, the papers must demonstrate the need for hybrid simulation and how this approach could be used for modeling and simulating complex systems. The hybrid simulation studies may relate to application areas such as healthcare, manufacturing, supply chain and logistics, military, disaster response, environment and sustainability.
- **Scientific Applications –** This track invites papers describing original work that advances the state-of-the-art in computer-based simulation for all areas of scientific computing in science and engineering, such as astrophysics, advanced chemicals and materials, nano materials, nuclear fission/fusion systems, condensed matter physics, quantum physics, computational biology, climate change, meteorology, geology, oil exploration, power storage and alternative fuels. Sub-areas of interest spanning scientific computing applications include fluid dynamics, thermodynamics, fracture mechanics, electro-magnetics, quantum mechanics, molecular dynamics and biochemical pathways. Of added interest are new methodologies, tools, and techniques for asynchronous and mathematical methods in traditional scientific computing problems. Algorithms, formal methods, analysis systems, frameworks, case studies, literature surveys, and performance analysis studies are all of interest. Both sequential as well as parallel execution are within scope.
- **Healthcare Applications** — This track addresses an important burgeoning area in which simulation can provide critical decision support for operational and strategic planning and decision making that individual providers (doctors/nurses, clinics, hospitals) face, as well as for policy issues that must be addressed by larger administering systems (e.g., insurance companies and governments). Traditionally, this track has been broad in focus, incorporating discrete event, system dynamics, and/or Monte Carlo simulations, with a variety of applications. A common thread is the use of simulation tools to provide insights or to inform decisions for improved health care outcomes. Also welcome are new modeling tools that address challenges with the conceptualization or implementation of health care systems.
- **Logistics, SCM and Transportation** — The nature of highly dynamic and complex networks of supply, intralogistics, and distribution leads to decreasing transparency at increasing risk. Therefore, managers who are responsible for supply chain management and logistics require effective tools to provide credible analysis in this dynamic environment. In order to facilitate the discussion of the best applications of simulation in this area, this track includes papers in logistics simulation, supply chain simulation, and simulation for planning, analyzing, and improving logistics from the intralogistics view to global supply chains.

- **Manufacturing Applications** — This track is interested in research and case studies using simulation in industrial applications found in the automotive, aircraft, and shipbuilding industries, among others. Simulation is a well-established model-based methodology for analyzing dynamical inter-dependencies in manufacturing systems. Manufacturing applications relate to the model-based analysis of (i) all production and logistics processes within a company or along a supply chain and (ii) all phases of a system life cycle, such as system acquisition, system design and planning, implementation, start of operation, ramp-up, as well as the operation itself. A contribution has to describe the aims of investigation, the investigated system, the simulation model, the experimental plan, the simulation findings, and any implementation results. Additionally, specific challenges like system complexity, data collection and preparation, or verification and validation may be pointed out.
- **Military Applications** — This track is interested in papers that describe the application of simulation methods to problems in the military domain. It is a recurrent and highly popular part of WSC, and includes a wide variety of topics, including methodological developments, distributed simulation, high level architecture, graphical techniques, and simulation studies referring to battlefield and evaluation of strategies.
- **Project Management and Construction** — This track presents innovative research as well as practical application papers that apply computer simulation to complex project and construction management problems. Specific topics include distributed simulation, visualization, worker behavior, sustainability, input and output modeling, validation and others. Also, diverse modeling paradigms for project and construction management are also welcome, such as discrete event simulation, system dynamics, agent-based modeling, and multi-paradigm simulation.
- **Business Process Modeling** — This track focuses on computer simulation of business systems with the objective of understanding the basic methods and tools in this fast growing area. In today's uncertain world, the simulation of business systems is one of the most powerful tools available to support the decision-making process. Whether these decisions concern capacity planning, logistics, or financial analyses of complex financial instruments, first understanding, then modeling and finally mitigating risk is crucial to the competitiveness of the firm.
- **Homeland Security and Emergency Response** — This track includes papers reporting methods and applications of simulation to Homeland Security and Emergency Response. Applications may be in any area related to homeland security such as critical infrastructure, transportation security, bio-defense, and/or may address any phase of the emergency response lifecycle, i.e., preparation/training, response, recovery and mitigation.
- **Environmental and Sustainability Applications** — This track focuses on the usage of modeling and simulation technology for analysis and improvement of environmental and sustainability impact. We are interested in papers reporting about models, methods, tools, and applications relevant to the evaluation and preservation of natural environment and resources, and the quality of life. This track covers environmental and sustainability modeling and simulation in a wide variety of application areas, including ecological systems, natural disasters, renewable resources, sustainable manufacturing, infrastructure, and human-environment

interaction. Furthermore, research on environmental and sustainability impact such as new ideas, concepts, methods, tools, and standards are welcome.

- **Networks and Communications –** This track focuses on technologies for modeling and simulating computer and communication networks, networked systems and applications, wireless and mobile communications, and social networks.
- **Serious Games and Simulation –** This track is concerned with the intersection of games and simulation, in the areas of business, management, entertainment, education, art, military, and medical fields.
- **Simulation Education** — This track includes papers that discuss approaches to teaching simulation at education levels ranging from K-12 to graduate and professional workforce levels. The track also encourages papers that demonstrate the use of models and simulations in teaching subjects other than modeling and simulation. Also welcome are case studies which address practical problems that arise in simulation education or in the use of simulation as a learning tool.
- **MASM (Modeling and Analysis of Semiconductor Manufacturing)** — A conference within the WSC, consisting of a set of tracks focused on semiconductor manufacturing ranging from methodological advances to elaborate simulation studies. MASM seeks high-quality research at all levels of semiconductor manufacturing. At the operational level, improved equipment and process control and optimized scheduling and material handling system policies must be studied. At the tactical level, better capacity planning and qualification management are expected. At the strategic level, demand planning, factory economics and supply chain efficiency must be improved to support the business. Moreover, better integration of decisions taken at the three decisions levels is becoming a must.
- **Vendor –** This track provides a means for companies that market modeling and simulation technology and services to present their innovations and successful applications. The track is open to companies that have paid for exhibit space. Each vendor gets a 45-minute time slot for each booth reserved.
- **Industrial Case Studies** — This track serves as a multidisciplinary forum for industrial professionals to share what they have learned modeling real world problems using simulation. The applications are open to all areas including, but not limited to, manufacturing, logistics and distribution, healthcare, mining, port operations, aerospace, and food services. The track will consist of 30-minute presentations, which should include time for questions and answers. The presentations should focus on a specific problem where simulation was utilized to conduct an analysis and provide recommendations for potential solutions. Interested case study presenters will submit a two-page extended abstract for consideration via the WSC submission site. A full length paper is not required. The extended abstract should describe the problem, the simulation methods used, the results, and the impact/benefits of the project. A short abstract limited to 150 words must also be submitted. The abstracts will be reviewed and those case studies selected for presentation at WSC will have their extended abstract appear in the final program of WSC and on the WSC Archive website.
- **Ph.D. Colloquium and Poster Session** — The Ph.D. Colloquium addresses Ph.D. students that are within one year of their graduation (planning to graduate by Dec. 2015). Students close to graduation will be given an opportunity to showcase their work during a short presentation session in the Colloquium (apart from the regular

tracks). All Colloquium students will then participate in the Colloquium Poster Session. Presenting your Ph.D. efforts to your peers and supporting society members will give you valuable feedback, support your research with additional ideas and parallel ongoing work, and introduce you to a network that can be very helpful with your career once you graduate.

- **Poster Session** — The Poster Session offers a timely venue to present and discuss new modeling and simulation research through a forum encouraging graphical presentation, demonstration, and active engagement among Winter Simulation Conference participants. An initial "Poster Madness" presentation session will give the poster presenters an opportunity to introduce their work to the community in a fast-paced presentation session. Presenters will have 2 minutes and up to 4 slides (including a title slide) to present their work. These successive presentations will set the stage for more in-depth discussions during the subsequent Poster Sessions. The Poster Sessions and the preceding Poster Madness presentation sessions are currently planned for Monday following the technical presentation sessions, and will conclude prior to the Monday evening General Reception. Poster presenters will submit an abstract and a 2-page extended abstract describing their work for consideration via the WSC submission site. Templates and instructions for authors for the extended abstracts are available in the WSC Author Kit. Additional information regarding the presentation format will be sent to accepted presenters after the decisions are made. Poster abstracts will appear in the final program and extended abstracts will appear in the WSC Simulation Archive.

PUBLICATION AND REVIEWING PROCESS

Each year the final program consists of high quality invited and contributed papers. The papers are organized in thematic tracks. Each track is organized by a track coordinator, or pair of coordinators and will involve a reviewing panel to ensure all papers, contributed and invited, are thoroughly peer-reviewed.

Because several hundred libraries worldwide obtain the *Proceedings of the Winter Simulation Conference* online through the ACM Digital Library http://portal.acm.org/dl.cfm or the IEEE Xplore Digital Library www.ieee.org/products/onlinepubs/pub/about_xplore.html, the WSC *Proceedings* is well established as the primary archival outlet for rapid dissemination of leading-edge developments in system simulation. Unlike many other conferences, at the WSC, a dedicated group of proceedings editors checks the final version of accepted contributed and invited papers before they go into print. Thus, an additional, final review, mostly referring to formatting and English, takes place.

Since 2000 the complete text of each full technical article in the latest WSC *Proceedings* has also been made freely accessible online via the INFORMS-SIM Web site www.informs-sim.org shortly after the close of each conference. The WSC is thus one of the pioneering conferences as all proceedings dating back to the year 1968 are online via open access available. Growing acceptance of electronic media for archival purposes meant also that, beginning in 2005, hard-copy distribution of the *Proceedings* to conference attendees was discontinued; instead each attendee is now provided with a CD or USB flash drive of the complete *Proceedings*.

The extraordinarily high quality of the WSC *Proceedings* is a direct result of the intensive, closely coordinated efforts of the Program Chair, the track coordinators, the referees, the *Proceedings* coeditors, the *Proceedings* publisher, and also the web master. The WSC web page can be found at www.wintersim.org.

ADMINISTRATION OF THE CONFERENCE

From its inception, WSC has been distinguished by its broad base of interest and sponsorship. Currently, the following professional organizations are full financial sponsors for WSC, providing working capital for each year's conference, and sharing equally in conference surpluses or losses: Association for Computing Machinery/Special Interest Group on Simulation (ACM/SIGSIM); Institute for Operations Research and the Management Sciences Simulation Society (INFORMS-SIM); Institute of Industrial Engineers (IIE); and The Society for Modeling and Simulation International (SCS). The conference also has three technical sponsors: American Statistical Association (ASA); Institute of Electrical and Electronics Engineers/Systems, Man, and Cybernetics Society (IEEE/SMCS); and National Institute of Standards and Technology (NIST). The WSC sponsor organizations appoint representatives to serve on the WSC Board of Directors. In 2012 the WSC was conducted in cooperation with the German Association of Simulation (Arbeitsgemeinschaft Simulation - ASIM).

The WSC Board of Directors is responsible for long-term administration and policy making for the conference. The board's primary goal is to maintain a high-quality program with low registration fees while keeping WSC on a sound financial footing into the foreseeable future. Generally each board member serves for eight years, giving WSC stability and continuity.

BRIEF HISTORY OF THE CONFERENCE

Although in some sense the origins of the Winter Simulation Conference can be traced to certain computing seminars held in the late 1940s, the impetus to hold a national conference on the scale of the current WSC took shape in the spring of 1967. The Conference on Applications of Simulation Using the General Purpose Simulation System (GPSS) was held November 13-14, 1967, at the Hilton Hotel in New York City. The general chair was Harold G. Hixson, an operations research analyst with the Air Force Logistics Command and the system simulation project manager of SHARE (the IBM scientific users' group). The program chair was Julian Reitman, a prominent user of GPSS in the Norden Division of United Aircraft Corporation and a leader in IEEE. The publicity chair was Arnold Ockene, an IBM employee responsible for marketing and support of GPSS. Acting entirely on their own initiative, these individuals arranged for ACM, IEEE, and SHARE to cosponsor the conference, which had a planned attendance of 225 and an actual attendance of 401. To provide a permanent record of the 1967 conference and to set the stage for a follow-up conference in 1968, Julian Reitman edited a special issue of the *IEEE Transactions on Systems Science and Cybernetics* (Volume SSC-4, Number 4, November 1968) that contained some of the papers presented at the 1967 conference.

Because of the technical and financial success of the 1967 conference, a second conference was held December 2-4, 1968, at the Hotel Roosevelt in New York City. Julian Reitman served as general chair and Arnold Ockene served as program chair for the Second Conference on Applications of Simulation. In addition to the original sponsors, the 1968 conference gained sponsorship from Simulation Councils, Incorporated (SCi, now

known as SCS). The scope of the 1968 conference was expanded to include papers on any simulation language or any aspect of simulation applications; and as a result, the 1968 conference grew to twenty-two sessions with a total of eighty papers. Sessions on statistical considerations, development of new languages, and tutorials on new languages complemented the applications sessions; and attendance jumped to 856. To provide a complete record of the papers presented at the second conference, the 1968 conference committee published a 368-page *Digest of the Second Conference on Applications of Simulation*.

Much of the structure and many of the traditions of what is now known as the Winter Simulation Conference crystallized during the period 1969-1974. The Third Conference on Applications of Simulation was held December 8-10, 1969, at the International Hotel in Los Angeles. In addition to the previous sponsors, the 1969 conference also gained sponsorship from the American Institute of Industrial Engineers (now known as IIE) and The Institute of Management Sciences/College on Simulation and Gaming (TIMS/CSG, now known as INFORMS-SIM). The *Proceedings of the Third Conference on Applications of Simulation* totaled 513 pages, and it established the basic proceedings format followed in all subsequent years. In 1971 the official conference title was changed to 1971 Winter Simulation Conference: Fifth Conference on Applications of Simulation. Although there are no surviving records of conference attendance for the period 1969-1973, it is widely believed that the attendance at WSC '71 was approximately twelve hundred - the largest attendance of any WSC to date. The Operations Research Society of America became a sponsor of the conference in 1974, but in that year conference attendance dropped to 463. It should also be noted that WSC shares a common heritage with the Summer Computer Simulation Conference (SCSC), which has traditionally concentrated on continuous system simulation. Timed to minimize competition with the 1969 predecessor of WSC, the Conference on Applications of Continuous System Simulation Languages was held June 30-July 1, 1969, at the Sheraton Palace Hotel in San Francisco with sponsorship from ACM, IEEE, SCi, and SHARE. Harold Hixson, one of the "founding fathers" of WSC and an active member of SCi, also served as the general chair of this predecessor of SCSC. Whereas multiplesponsorship quickly became a distinctive feature of WSC, the development of SCSC followed a completely different path; and ultimately SCS became the sole sponsor of what Hixson called WSC's "twin sister" conference.

By 1975 the ad hoc nature of WSC's administration had completely broken down, and the conference with multiple sponsorship planned for that year did not take place. The rebirth of WSC in 1976 was largely due to the initiative of Robert G. Sargent and the work of Paul F. Roth, Harold Joseph Highland, and Thomas J. Schriber. Sargent, a professor at Syracuse University and then the IIE liaison to WSC, advanced the idea of reviving and stabilizing the conference by enlisting the National Bureau of Standards (NBS, now known as NIST) as an additional cosponsor of a 1976 Bicentennial Winter Simulation Conference. Roth was then an NBS employee and chair of ACM/SIGSIM; and he convinced his superiors at NBS of the merits of Sargent's proposal. Highland, then a professor at the State University of New York at Farmingdale, agreed to be general chair for WSC '76. Schriber, a professor at The University of Michigan, agreed to be program chair for WSC '76; and Sargent agreed to be associate program chair. With a Board of Directors and a set of bylaws in place to ensure timely planning and continuity in the operation of future conferences, the Winter Simulation

Conference was given a new lease on life in 1976.

Throughout the 1980s, WSC grew and evolved to address the constantly changing interests of the simulation community. Since 1984 each WSC has featured an exhibit area in which vendors may demonstrate their software products to interested attendees. Instead of the traditional two-volume, softbound format for the WSC *Proceedings*, beginning in 1984 the *Proceedings* was published in a one-volume, hardbound format. In 1985 the American Statistical Association became a WSC sponsor. In 1986 the program was substantially expanded with the addition of two tracks devoted to software tutorials as well as a track devoted to manufacturing simulation. TIMS/College on Simulation (now INFORMS-SIM) began sponsoring the Ph.D.-student colloquium in 1988.

Since the early 1990s, the pace of innovation and change in WSC has accelerated substantially. To provide a timely forum for rapidly developing areas in the simulation field, recent conference committees have added the following new tracks and mini-tracks to the program:

- 1992—Construction Engineering and Health Systems
- 1998—Future of Simulation and Logistics, Transportation, and Distribution
- 1999—Business Process Modeling and Semiconductor Manufacturing
- 2000—Simulation Education
- 2001—Telecommunications
- 2002—Risk Analysis and Simulation-Based Scheduling
- 2004—Homeland Security/Emergency Response, Biological/Environmental Simulations, Agent Based Modeling, Virtual Reality/3D Visualization, Simulation Case Studies, and Titans of Simulation
- 2005—Six Sigma & Simulation and one-day Introduction to Simulation for Management program
- 2006—Computational Systems Biology, Dynamic Data-driven Simulation, Simulation-based Scheduling, and the preconference "Simulation 101" short course
- 2007—Cross-Fertilization
- 2008—MASM (Modeling and Analysis of Semiconductor Manufacturing), and “Simulation Around the World”
- 2009—Introduction of an expanded education track
- 2011—Simulation Optimization, Environmental and Sustainability Applications, Agent-based Simulation, Quality/Statistics/Reliability, and Railroad Applications
- 2012—Applications in Social Science and Organizations, Embedded Simulation, Performance Issues in Simulation Software, Simulation Methods and Tools
- 2014—Big Data Simulation and Decision Making, Hybrid Simulation, Serious Gaming and Simulation

Many of these new tracks and mini-tracks have attracted a sufficiently large constituency to become a permanent part of the WSC program.

Beyond the expansion of the WSC program in recent years, other innovations have improved both the scope and quality of virtually every aspect of the conference. Since 1990 the review process for contributed papers has been strengthened and formalized,

with written referees' reports being provided to the author(s) for every contributed paper. The poster session was introduced in 1993. The conference Web site <www.wintersim.org> made its debut in 1995; and the Web site has rapidly become the primary vehicle for dissemination of information about the conference - including electronic versions of the Call for Papers, the Author Kit, and the Preliminary Program as well as an online registration facility. Although the WSC *Proceedings* was published in both hard-copy and CD versions beginning in 1997, the increased size of the hard-copy *Proceedings* forced a return to a two-volume, softbound format beginning in 1998, and the hard-copy *Proceedings* was discontinued in 2005. Traditionally the WSC *Final Program* simply provided the locations and times of all technical presentations and other events of interest to attendees. In 1999, however, the content of the *Final Program* was substantially expanded to include abstracts not only of all *Proceedings* papers but also of all presentations in the Ph.D.-Student Colloquium and all posters in the Poster Session; and this was achieved without sacrificing the convenience of the *Final Program* as a pocket-size guide to the conference. A major milestone in the development of WSC was also reached in 1999, when the conference gained corporate sponsorship for the first time.

With the advent of the new millennium, WSC introduced a totally web-based system for submission, review, revision, and final delivery to the publisher of all technical articles handled by the *Proceedings* Editors. Moreover, since 2000 the complete text of each technical article in the latest *Proceedings* has been freely accessible on-line via the INFORMS-SIM Web site ‹http://www.informs-sim.org› shortly after the conference; and currently this website contains the contents of the *Proceedings*. These developments have significantly enhanced the attractiveness of the *Proceedings* to authors who seek the broadest, most timely dissemination of their work to the worldwide simulation community. As one measure of the growing stature and global scope of the conference, we note that in 2005 approximately 30% of WSC authors were based outside the United States, whereas in 1992 the comparable figure was only 10%.

In the year leading up to WSC ’03, the WSC Board of Directors undertook in April a fund-raising effort titled “Patrons of WSC”. The donated funds were dedicated to the establishment of an independent WSC Foundation <www.wscfoundation.org> whose trustees will manage the fund. During 2003, the board also established the Board of Directors' Award to recognize individuals or organizations for longstanding, distinguished service to the conference; and the first such award was presented to Dr. C. Dennis Pegden. The award has since been given to Richard E Nance (2004), James R. Wilson (2005), Thomas J. Shriber (2007), and Deb Sadowski (2009). Completing a busy year, the National Institute of Standards and Technology (NIST), which had been an unofficial sponsor of WSC since the 1976 Winter Simulation Conference, became recognized as an official sponsor of the conference in 2003.

In 2004 WSC emerged from a period of severely constrained budgets and limited growth that began shortly after the attacks of September, 11, 2001. The WSC '04 program featured a presentation-only "Case Studies" track designed to showcase leading-edge examples of simulation practice. WSC '04 also introduced the "Titans of Simulation" mini-track to provide leaders of the field with a high-visibility forum in an extended luncheon session that would complement the addresses given by the keynote and military keynote

speakers.

In 2005, the WSC program was further expanded with the addition of a one-day "Simulation for Managers" workshop designed to introduce simulation modeling to business decision makers. WSC '06 featured "Simulation101", an intensive preconference workshop for newcomers to Monte Carlo and discrete-event simulation. WSC '07 introduced a 'Cross Fertilization' track, where leading researchers in disciplines closely related to simulation presented on critical topics.

For the first time in 2008, the Winter Simulation Conference incorporated another conference. MASM (Modeling and Analysis for Semiconductor Manufacturing) Conference, the leading modeling and analysis conference for global semiconductor manufacturing and supply chain operations, ran as two complete tracks within WSC '08.

Since 2010 the submission, reviewing, and program generating process of the WSC is managed via the submission and review management system for conferences and applications Linklings: https://ssl.linklings.net/conferences/wsc/.

In 2012, the conference moved outside the United States for the first time, to Berlin Germany. The modeling methodology track, which historically hosted all methodological research that did not fit into the analysis track, was split into two methodological tracks, the modeling methodology track and the simulation methods and tools track. Also in 2012, an oral presentation for posters (2 minutes each) – the Poster Madness - was introduced and the length of written poster publications has significantly extended. In 2012, under the guidance of Jeff Smith the web appearance of the WSC was entirely renewed to include detailed information about the content and the scientific committee of each track on the web.

In addition to attaining a high level of maturity and professionalism over the past four decades, the Winter Simulation Conference has grown steadily in attendance. Over the past five years, conference attendance has averaged more than 675.

CONCLUSION

Further advances in system simulation will require coordinated improvements in education, methodology, and software and hardware development together with innovative, intelligent applications of simulation technology. By providing a common, broad-based forum for the diversity of professional interests held by the members of its sponsoring organizations, the Winter Simulation Conference will continue to serve as a catalyst for the interactions between simulation professionals in academia, government, and industry that are essential to future progress of the field. With the preservation and extension of its long-standing traditions, WSC should also provide a model for other conferences that are based on collaboration among several large professional societies.

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