THE SIMULATION EXPLORATION EXPERIENCE EDUCATION OPPORTUNITY IN HIGHER EDUCATION
Preparing College Students to Thrive in Chaos

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ABSTRACT
An issue in higher education today is that while the demand for distributed simulation expertise keeps growing, not enough experts are teaching the subject in our colleges and universities. This matters because a well-prepared workforce is essential if we are to apply distributed simulation—as we must—to the hazardous, difficult, risky, even life or death complexities of the 21st Century. The Simulation Exploration Experience (SEE) with government, industry and academia support, enables international inter-university student-teams to learn simulation by doing it, study HLA and its standards, work collaboratively with other dispersed and diverse student teams, gain needed skills, learn about employer expectations, discover possibilities and gain confidence. The SEE model suggests potential for Modeling & Simulation (M&S) collegiate research and education in distributed systems, perception, communication, the tensions between rules and disruptive innovation, collaborative teamwork, the economics of simulation, and the purpose of M&S higher education itself.

Keywords: Collegiate level simulation education, virtual collaboration, virtual tutoring, simulation employability

1. INTRODUCTION
As a technical and educational initiative, the Simulation Exploration Experience (SEE) offers college and university students a rare opportunity to become more employable by becoming more skillful in the field of simulation. Since 2011, a partnership of government, simulation industry, professional associations and academia has championed, challenged and created collaborative college-level modeling and simulation education. Each year, with faculty support, ten or more highly dispersed inter-university teams design, develop, test and execute a student-driven simulated lunar mission.

With faculty advisors, SEE student teams participate through university classes, independent study, research assignments, and capstone courses, even, inter-departmental and other team projects. SEE is enriched by participating faculty, industry mentoring, technical forums, audio-visual meetings, special tutorials, and one-on-one support from National Aeronautics & Space Administration (NASA) and industry experts.

Led by NASA, SEE joins students, faculty, and simulation professionals in building knowledge, skills, career confidence, and capability through real-time application of distributed simulation. In the past five years, SEE has engaged 18 university departments in 16 universities in North America and Europe in this distributed simulation experience. In addition, students from Israel pursued research in scenario development and High Level Architecture (HLA) visualization, as an alternative to design of specific space vehicles or moon equipment. Interest has also developed in Southeast Asia with teams in South Korea and Japan. Only the 2011 earthquake, tsunami, and nuclear disaster caused the team from Japan to withdraw. Within the U.S., through the American Indian Higher Education Consortium (AIHEC), 5 tribal colleges continue to support SEE infrastructure, research, 3D-modeling, branding, team recognition programs and demonstrations. SEE has and continues to contribute to post-graduate education and preparation for permanent employment.

This paper addresses SEE as a significant contribution to international higher education in modeling and simulation and as an on-going exploration of how best to educate ourselves and students, as an admittedly “error-prone specie”, to survive and succeed in a precarious natural universe in which we have embedded potential for technological disaster. This scenario is what Harvard educator Christophe Dede says calls for education to teach students “to learn to thrive in chaos.”

2. THRIVING IN CHAOS

SEE began with a simple idea. Interest college students in modeling and simulation as a profession, have them learn simulation interoperability and standards by "doing"

Figure 1: Chaos at the Heart of Orion (NASA, 2008)

them, prepare them and, in the process, help them discover possibilities.

A small group of industry and government simulation experts, first discussing the concept at a 2009 Simulation Interoperability Workshop (SIW), recognized the need for graduates prepared to work in the field. They were aware that college graduates, looking for post-graduation work, had seldom learned to actually do distributed simulation, which is increasingly at the heart of the complex systems that define the twenty-first century.

The Simulation Interoperability Standards Organization (SISO) supports teams with free standards, industry members (The AEgis Technologies Group, ForwardSim, Pitch AG, and VT-MAK) have offered free software licenses, and NASA proffers content, supporting systems and project management. All provide mentors, present tutorials, and support project planning. SISO sponsored the first event in Boston, in 2011, at the Spring Simulation Multi-conference, followed by the Spring2012 SIW, both co-sponsored with the Society for Modeling and Simulation International (SCS).

In summer 2011 LIOPHANT Simulations (www.liophant.org) began leading reprises and demonstrations in Europe. In 2014 (Genoa University) and in 2015 (Pitch) presented SEE demonstrations and presentations at SISO Day at ITEC (International Technology Education Conference). The Kennedy Space Center (KSC) Center for Life Cycle Design leads outreach for SEE and, each year, demonstrates data capture from the event at the "NASA Place" booth at I/ITSEC, the Interservice/Industry Training Simulation and Education Conference. SCS hosted SEE in 2014 and 2015.

3. THE SEE ENTERPRISE

SEE is an anomaly in today's environment; it is independent, using in-kind, "insane dedication", donations, and much appreciated *management* support, SEE has thrived and survived in the absence of dedicated project/program funding. It is supported and led by NASA in execution of its responsibilities under U.S. Office of Management and Budget Circular A-119 (OMB, 1998) to support the use, as well as the development, of voluntary consensus standards. Within SEE, as in space exploration, NASA uses High Level Architecture (HLA) Evolved software and accompanying standards that include HLA. SISO is the IEEE sponsor of M&S standards, recognized under OMB A-119 international organizations.

An industry/government and academic Executive team builds and maintains an electronic scaffold supporting the faculty, students, and industry supporters. NASA and industry volunteers provide a structure for communication, resources, and systems. The SEE Technical team provides faculty advisors and student teams with the tools and advice to do the job. Faculty present the theory and practice of modeling and simulation interoperability and visualization, with a focus on distributed simulation. Industry and government HLA experts support development, testing, and execution of the work performed by the student teams under the direction of faculty advisors.

Figure 2: Screenshot taken from NASA Visualization Engine, used for Simulation Visualization

By 2013, after hundreds of hours of research, the program leaders affirmed, along with Simon Taylor, Ph.D., leader of the Modelling & Simulation Group (MSG) in the Department of Computer Science, Brunel University, London, that there "were too few experts teaching distributed simulation." (Taylor 2014). The SEE mission, to increase employability of college students for work in the field of modeling and simulation, became, "To Champion, Challenge and Create Collegiate-level modeling and simulation education". The emphasis broadened beyond technology to address project management. The first event in Boston, call "SmackDown", included student teams from the U.S., France, and Italy. Additionally, a team from Israel used the experience to study HLA visualization and scenario development. (Originally named 'SmackDown', the official name was changed to the Simulation Exploration Experience (SEE) in 2014 in order to focus on the experience as a student collaboration in which success depended on teamwork rather than on a competition with only a single winner.) Of note, over the past 18 months, some faculty have independently assigned 20-25% of the students' grades to participation in SEE.

4. COMMUNICATION AND PERCEPTION

4.1 Communication

As SEE has matured as a higher education experience, the Executive team looked increasingly at issues of perception and communication among these diverse and dispersed teams. Our student teams, from differing cultures, nationalities, and languages, require continual, consistent attention to communication among all the participants.

Even short distances between people lead to degradation of communication. SEE, conducted in English, addresses a major challenge in the integration of diverse plans. Students submit a 50-word (or less) summary of what they plan to do and with whom the team will interact. These synopses are unfailingly clear and concise. The students participate actively in audio-visual conferences and test sessions. Nonetheless, vigilance is necessary because it is easy to overlook different perceptions that exist among them or, to assume that what is transmitted is what is understood.

In the beginning, the teams depended on email and telephone to communicate. In 2013, Milton Chen, Chief Executive Officer of VSEE.com, joined as a partner, providing free audio-visual internationally. Communication and interactivity improved greatly by his generosity. Tag-up meetings via VSEE.com, for issue resolution, status reporting, and testing, give all members of the teams opportunity for steady communication.

The SEE website, www.exploresim.com, has grown since 2011. Led now by faculty and alumnae from the Institute for American Indian Art, it reflects how SEE increasingly represents integration of Art into the traditional STEM (Science, Technology, Engineering and Math) fields to join the emerging education model STEAM (Science, Technology Engineering, Arts, and Mathematics). This involves recognition of the connections and contributions of the arts (liberal, fine, applied and performing) with STEM in 21st Century education.

The website includes the SEE Starter Kit, (a digital toolkit developed by the University of Calabria working with the NASA Johnson Space Center (JSC)), tutorials on HLA (Björn Möller, Pitch), recorded presentations from Dr. Mikel Petty, faculty advisor from University of Alabama, Huntsville, and links to free resources, including software. E-mail still proves effective for communication across time zones, but SEE relies increasingly on its online Technical Forum, using VSEE.com, that offers and facilitates archival support, tracking data, and both peer-to-peer and mentoring support.

Efforts to clarify project planning and communicate team roles and responsibilities led to the publishing in 2015 of LIFT-OFF, a guide for Faculty Advisors and Student Teams (Elfrey 2015). A pdf document, it contains information on authoritative support for SEE activities. Guide sections list Faculty Advisors, Industry Team members, and members of the NASA/industry Technical Team and the Executive Team. LIFT-OFF also contains authoritative information on resources (both funded and in-kind), and includes free access to NASA's Distributed Observer Network (DON), a simulation visualization engine. A section on Student Teams lists Requirements and Roles, and a Plans-in-Action section describes the scenario process, schedule, and lunar mission event conducted each Spring.

Even with this infrastructure in place, the task of communication is never complete. Plans for 2016 address improving the process, with intent to strengthen and verify two-way communication. Experience has proven that when teams are so highly dispersed, it is easy for information to be lost. The SEE 2016 teams, drawing on lessons learned from SEE experience and other virtual teams, will adhere to an adaption of Star Dargin's (Dargin 2015) Corporate Education Group's list of Best Practices for Managing Virtual Teams in a form appropriate to the SEE enterprise:

1. "Develop and use a communications management plan and team operating agreements.
2. Slow down to speed up. Take the time upfront to understand all the environments and cultures you are working in.
3. Select appropriate technologies for team interactions.
4. Create a virtual personality and presence by exploring your strengths, weaknesses, and natural tendencies.
5. Be a great host/hostess. Create places where the team looks forward to and can meet for unplanned interactions.
6. Run effective virtual team meetings. … create, foster, and reinforce engagement and interactions frequently."

4.2 Perception

Because post-graduation can seem uncertain and ambiguous to college students, the SEE Executive team takes responsibility to bring some clarity and certainty to post-college planning and action. Often, students do not know where to begin, or how, or the value of what they have learned and done (for example, strengths as a learner, roles in student governance, summer and other work, extracurricular activity as well as learning HLA and highly distributed teamwork). They may not see how these attributes connect with employment. Students rarely have insight into employer expectations or what opportunities exist or who can help. Ambiguity is compounded because most open jobs are never posted. Despite all the technology available, there is nowhere an efficient or effective employment system.

SEE teams participate in a planning model that requires further definition and communication. SEE does provide students opportunity to explore their own preferred skills, learn about options (perhaps never considered) and talk with people doing work of interest. Within SEE teams, students determine who wants to do what tasks. This can involve s a process of increasing conscious awareness not only of skills but also of their preferred skills. SEE opens our teams not only to the possibilities presented by the mission, but also opportunity to see the possibilities that the simulation profession offers. Simulation is truly trans-disciplinary – inclusive of physicists, engineers, computer scientists, modelers, graphic artists, project managers, mathematicians, psychologists, writers, and systems analysts, as well as specialists and domain experts in innumerable fields. Applications range from aerospace to zoology, time- and resource-saving, and, especially, hazard reduction, injury prevention and life-saving occupations.

SEE enables students to start or build a professional network, increase information resources, and build credibility and visibility. SEE currently enables students to expand their self-knowledge, options, and resources. What is needed, perhaps, is to provide a focus on strengths, specific targets, and truly helpful support that can lead to effective action and enhanced "life after college."

Changing perception is a hallmark of simulation. Simulation, done well, results in an "Aha!" reaction as people perceive what was previously abstract, confusing, ambiguous or unknown. The last century has brought proof, as a basis for cognitive science, that perception of reality is internal, mental, not absolute or external, and is shaped by our experience, history, language, culture, health, biases, and, even, prejudices, as well as knowledge how much of what we are aware of happens outside our awareness (Bennett 2015).

A demonstration, long popular in introductory psychology and familiar in training exercises, shows us that some "illusions", such as the distorted room and chair demonstrations (Ames 2015), in Figure 3 below, can be so strong that our brains, even with conscious effort, cannot change or control them. We see 3 chairs in the top row. But the demonstration shows us, in the bottom row, that they are merely disjointed lines and not anything like chairs. But when we look again and again, knowing they are not chairs, we see 3 chairs. No matter the effort we make, we see those 3 chairs.

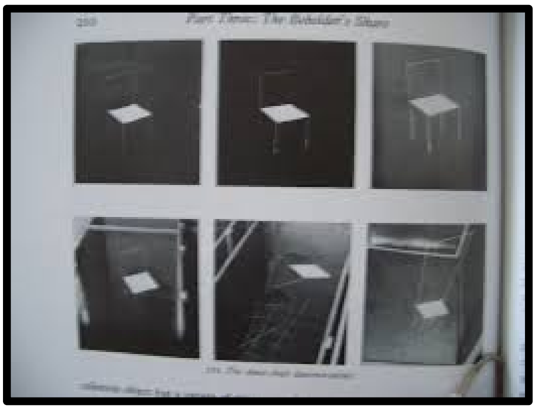

Figure 3. Distorted chair illustration

Another example, "A New Ambiguous Figure" of either an old or a young woman (below – it is both!) (Boring 1930; Fisher 1968) reminds that perception, especially within a pluralistic multi-cultural team, means that we can never assume that we perceive the same event in exactly the same way.

5. VIRTUAL COLLABORATION

SEE exemplifies virtual collaboration. It serves as laboratory and model for space exploration by global corporate, inter-Agency and Inter-governmental similar enterprises. Originally, when called SmackDown, the program was, often, described as "co-opetition", maintaining the usual college competition concept as a precursor to corporate competition. SEE teams do maintain a sense of competitive pride, of wanting what they do to be the very best. But the overriding sense is of teams cooperating to develop and present a simulation of lunar mission events.

Indeed, the highlight of every event is when the teams conduct testing for the simulated mission. Suddenly, they help one another and join in to troubleshoot, collaborate. What has become increasingly evident is that complex simulation projects, like space operations, are a team sport requiring trust, openness, interaction and a balance of risk and responsibility. This teamwork may seem almost impossible to achieve, but it happens every time. Anyone working on space exploration knows that if you do not collaborate in space, you shall, most likely, die. It is a

Figure 4. A New Ambiguous Figure

situation of everybody wins when nobody loses. One team working on SEE infrastructure stated, "Only when you utilize each unique piece of the puzzle can you realize the whole picture." (Tompkins 2012).

In 2014, KSC developed the new Technical Forum for posting status, questions and concerns. Students credited it with providing them with valuable timely information and enabling them to get answers from one another thus making collaboration that much more effective.

SEE tools support collaboration with distant partners, enabling them to both see and talk with one another. In 2014, two SEE inter-continental participants who had only worked remotely and never physically met, were, by chance, both at the AEgis Technologies Group booth at I/ITSEC, when one recognized the other from prior VSEE online meetings. Such a happening, a factor in strengthening collaboration, would, otherwise, have been impossible.

NASA provides faculty advisors with access to the KSC Distributed Observer Network, built on a Unity game engine, that NASA uses to display (using 3-D models) the virtual lunar mission elements and activities that the teams create using HLA and other distributed simulation standards. Having DON to work with enables the teams to see and correct mistakes early in the process, test ideas and work more confidently with one another. SEE also serves as a test bed for DON.3, which NASA will be releasing in late 2015.

6. BALANCING RULES AND DISRUPTIVE TECHNOLOGY

It is easy when working with visualization of simulation to become enthralled with the technology. Simulation's amazing promise can lead us to thinking that only what is new is valuable. Yet we do not always need cutting edge tools. A simple sketch, rather than a million dollar presentation, often provides exactly what people want and need to know. The question that SEE tries to perpetuate and address is, "What is the appropriate technology for what we are trying to do?" Sometimes it is the latest technology. Sometimes it is not.

A mature technology is so simple that, as Buckminster Fuller remarked, it seems like magic. Today simulation is amazing, but not yet magic. Switching on an electric light is an example of magic. So, too, is reading and writing, technologies which, when new in Attica Greece, were resisted by some who saw it reducing human ability to memorize, think and display intelligence. Neil Postman (Postman 1985, 1993) reminded his students and audiences that a technology is not without ideological bias, and that it is not always evident at the beginning, who will win and who will lose. With the best of intentions, a technology may have consequences that were not only unintended but harmful. These lessons are common and, even, expertise is not enough. It is important that SEE participants keep this in mind.

However, true expertise is a goal for participating. SEE respects the rules that underlie success in simulation. Not only are students expected to obey the laws of physics, but also to follow directions, and respect both requirements and deadlines.

Recent research states that it takes 10,000 hours to become an expert (Gladwell 2008). SEE endeavors to support that path, with advisors to encourage, probe, question and offer feedback. Knowing that it takes more than practice "to get to Carnegie Hall", SEE mentors are motivated, perhaps, by the story that Aristotle told, that practice gives us our best and our worst flute players.

6.1 The "Two Sigma Problem" and Virtual Tutoring

B.S. Bloom's early studies (Bloom 1984) pointed to the value of tutoring, and startled educators, reshaping the traditional bell curve with no tutored students failing. In particular, he saw results pointing to the great value of peer and self-tutoring, a factor evident in SEE. Student teams, solving problems they have raised and, even, created, find themselves explaining the situation to themselves before, even, raising it in the SEE Technical Forum.

With SEE, the cadre of tutors starts with the students tutoring themselves individually, then one-another.

Students who discuss challenging problems, as Bloom noted, tend to converge on solutions through the process. Originally thought of as "Peer Instruction" (Mazur 1997), more recent research (Crouch 2001; Lazr 2008) suggests that it is the group give-and-take that opens people to better answers.

With SEE, such collaborative support may be down the hall or across an ocean. Also, with SEE, expert tutors - industry and government - are available, as requested, to supplement the classroom. SEE provides tutorials on HLA, standards, NASA systems, and more. Through various professional associations, the SEE Executive Team seeks to expand that cadre. SEE as a virtual internship or apprenticeship might be examined to augment and reinforce learning, establish useful behavior for employment and reflection on the individual and societal purpose of education. The SEE team aspires to more conscious support of learning and simulation; industry already brings students in contact with professionals who are excited by simulation, intrigued by its challenges, and eager to inspire others. Programs intended to improve the process of tutoring suggest the efficacy of talking through problems, especially with mentors. Although citing that tutored students all succeeded, Bloom called it a "problem" because tutoring is expensive and there are too few of them. SEE provides an effective and economical tutoring alternative.

7. SEE AND STATE-OF-THE-POSSIBLE

The discussion to this point has focused on the components and activities that make up the SEE Enterprise. In each of the sections described above are elements of the organization, structure, and infrastructure comprising SEE. Not one of the sections by itself addresses or describes a process, procedure, activity, or method that is new or unique to engaging in simulation and modeling activity. Yet the SEE enterprise is arguably unique. It began as an experiment to explore the feasibility of putting together a set of program activities designed to "champion, challenge, and create" more effective ways to give students of modeling and simulation real experience of what it means to be a simulationist – loosely described as one who practices simulation using the M&S tools, processes, methods, and practices available from academia and industry. Driving the experiment was the belief of early SEE proponents that M&S education, in particular education about distributed simulation, was broadly lacking in providing students with opportunity to learn, by actual hands-on work, what is really required in execution of actual M&S-based projects.

What has evolved since first envisioned in 2009 is a comprehensive endeavor that combines many elements – described in the sections above – that together comprise a state-of-the–art process for transfer of learning from academia to the domains of industry and government, in which M&S use grows continually for addressing and solving evermore complex problems in many, many disciplines. It is the fusing of technology, art, and ideas, coordinated through a customized communications and collaboration framework, and applied to a specific problem space amenable to solution using simulation, that is arguably the state-of-the-art in learning practical use of distributed simulation and modeling.

Typical workplace experience for students involves either summer internships, or participation in a specific project that the student can contribute to; in either situation, the student is most likely to exercise those skills learned in academic classes. Only by happy accident is a student exposed to new and different aspects of M&S. SEE, in contrast, expands that experience, by *intentionally* focusing on design conceptualization and work via collaborative effort to literally enable separately conceived and developed models and simulations to operate together, efficiently and effectively, in the same virtual world. SEE focus is on lunar simulations and modeling of space operations in deep space beyond. But the principles of design, development, test, integration, and operation must all be employed to yield a working simulated lunar mission as designed by the student-faculty teams, working with NASA and industry partners.

This enforced integration of academic endeavor, problem-solving, and practical application to address problems of the kinds faced by industry and government is the unique value provided by SEE. In five years experience, SEE leadership has not found any comparable program.

8. METHODS

One of the main purposes of this paper is to illustrate the benefits enabling an methodology for learning distributed simulation, technical collaboration, and teamwork as an integrated endeavor, and also to make the argument that education in simulation at its best includes learning of systems design, concept exploration and visualization, systems interfacing and integration, and use of the tools that enable testing and interconnection of simulations and models geographically distributed.

The SEE methodology employed is interwoven throughout the sections above. In this section, a more concise description of methodology is provided. The last section addresses benefits and outcomes expected to accrue to SEE participants.

8.1 METHODOLOGY

The methodology employed for each year's project is straightforward. The sequence is presented here in bullet format. The culmination of the project is a ninety minute live online demonstration of the developed models and simulations, with some teams at the selected venue, and others participating remotely via Internet. All is coordinated through a NASA SEE server and VPN, conducted in accordance with a scripted storyline. This is called the Main Event ('ME'). In the bulleted list below, the nominal timeline for development and execution of the ME is show in brackets in this format: (ME – x), with 'x' the number of months prior to the ME.

Preparation.

- SEE Executive and Technical Committees contact previous year's participants to assess/obtain commitment for current year effort. In parallel, outreach is conducted to inform and invite new teams to participate. (ME-11)
- SEE Website, on-line resource, and model repository contents are reviewed and updated by industry and NASA volunteers. (ME-10 to -2)
- A core faculty advisor team is identified (2 to 4 faculty); this group identifies and forms a "SEE Student Team Coordinating Working Group (STCWG)". (ME-10)
- Initial team tag-up meetings are conducted using VSEE.com, to organize the new year's project work. (ME-9)

Event Development

- University teams investigate and decide on what simulation activities they will perform for the SEE event. Faculty advisors create event concept of operations, working with the STCWG, for consideration by Executive and Technical teams. (ME-9 to -4)
- NASA and industry partners contacted, software licensing and use of DON3 engine arranged for participating teams. (ME-8 to -4)
- Executive committee outreach conducted to attract event sponsorship; committee also initiates discussion with various organizations to determine venue and dates for SEE event. ME-8 through -4)
- Executive committee develops update of the SEE LIFT-OFF Guide; Technical Committee updates on-line resources (Federated Object Models (FOMs), Federation Agreements, etc.). [Note: LIFT-OFF Guide provides event timeline, lists team requirements (submission of deliverables, etc.), and provides a comprehensive listing of resources available to every team, which includes a schedule of offered online tutorials on topics relevant to team project work.] (ME-6; update, ME-4)
- Faculty advisors assign teams to subgroups for coordination of model, simulation, and scenario development. (as teams form, ME-7 to -4)
- Developed scenario elements are integrated by combined Executive and Technical Committee effort into a workable scenario script and story line. (ME-6 to -4)
- Individual teams develop and test (standalone) developed models/simulations. Advice and mentoring is available via NASA and industry volunteers. NASA also makes available specific testing services; an example is an automated service to review and assess FOM issues. (ME-7 to -4).
- On-line tutorials made available to teams (ME-6 to ME-2)

Testing and Execution

- Technical committee initiates bi-weekly and weekly online tag-up meetings to address integration and interface questions and technical issues (ME-3 through main event minus 2 weeks)
- Weekly online tag-up meetings conducted for network integration and testing of all teams' models, and to test operate within the NASA Environment Federate. Technical feedback and advice provided as needed to individual teams. (ME-3 continuing until 2 weeks prior ME).
- Executive Producer collects team event activity descriptions (a required team deliverable), and refines ME storyline and sequence of simulation activity demonstrations be shown as elements of ME. (ME-4 to ME-2)
- ME storyline and simulation/model changes frozen, to support final integration testing. (ME-2. Some modification allowed to support testing and integration across network and to align to ME storyline).
- ME posters, flyers, brochures, and posters developed for distribution. (ME-5 to -3)
- Detailed ME schedule developed to guide events at selected venue. (ME-4 to -2).
- Final integration testing and rehearsal of ME timeline and storyline. Weekly online sessions. (ME-1; complete 2 weeks prior ME)

Main Event Execution

- NASA hardware infrastructure packaged for shipment to venue. (ME-two weeks).
- Teams (those participating locally at venue) travel to site, set up and conduct verification testing and rehearsal on site. Remote teams participate via Internet and VSEE.com.
- At venue site, NASA staff and teams conduct final set up, integration testing, and rehearsals.
- Support staff distribute flyers, demonstration materials, and brochures to interested audience
- Main Event conducted (typically day 2 or 3 of conference schedule)

- Team debrief follows event, with assigned staff determining participant awards
- Awards Ceremony conducted.

9. ECONOMICS, EDUCATION AND EMPLOYABILITY

"The U.S. Bureau of Labor Statistics (BLS) estimates that job opportunities for software developers are expected to rise by 22% between 2012 and 2022. Career paths for simulation and game developers include chief technology officer, systems consultant, or information systems manager. Developers may also be promoted to project managers or systems analysts." (Study.com 2015). It is this sort of reporting that generated the initial interest in developing the SEE enterprise. NASA and industry experience in recruiting new talent to its programs generated the original idea of "Smackdown", now SEE. Graduates entering the "simulation" market come equipped with a variety of traditional academic degrees. Yet "the (simulation) profession draws on expertise in a number of areas and does not fit neatly into any single category." (De Aennle, 2009). What has been missing from most educational programs is a mechanism for providing students practical experience in the execution of real projects entailing use of distributed modeling and simulations tools, techniques, processes, and teamwork. SEE evolved to provide such experience; it offers students one aspect of that critical bridge between academic learning and working successfully on real-world projects: working in a team environment, taking a project from idea formation through design, development, testing and execution. This SEE process can be, in a real sense, considered the equivalent to a summer internship; in many ways, participating in an SEE event really is a concentrated internship, a hot-bed experience, under the combined guidance of NASA and industry experts working with the student team and faculty advisors.

10. EXPECTED OUTCOMES

For the major investment parents and students make in a college education, employment is an obvious desired outcome. But there is more. Our schools also educate students to be responsible citizens, prepared to serve the society.

Specifically, in terms of collegiate-level simulation, the educational purpose of SEE includes not only individual employability but growing understanding of the potential for simulation as a field for research, an industry with untapped value and a curious player in our understanding and mastery of perception and communication.

Simulation supports dynamic interactive problem solving. It offers insights into challenging conundrums, and helps people see things that have been difficult, complex, and sometimes impossible to grasp. Simulation employs models - illusions of reality - to get closer to the truth of the matter and to better understand what was not previously understood. Like acting, it opens minds to possibilities: how a bacterial illness progresses, how an accident or a crime really took place, how to improve a product or process or, even, how best to explore space. Simulation begins with, to quote Shakespeare, "airy nothing", but can evolve to enable large dispersed teams working over decades to discover options and negative probabilities, strengths as well as weaknesses, and true support within available resources. With simulation and modeling help, large teams can establish great, complex multi-decadal enterprises never imagined or conceived before. Some think of simulation as merely software, but this dimension of understanding, reusing, and repurposing ideas and finding what is important says that simulation plays a special role in both betterment and beginnings. It starts, continues, and completes many a yet-to-be defined issue. Such narratives include Utopias, transformative tools, pioneering, industrialization, equality of opportunity, individual worth and technology's place in it all.

Narratives change, as some fallacy becomes obvious and society accepts new truths and narratives. Until that happens, the story resonates in one form or another. Buckminster Fuller, in Spaceship Earth, joined those, like native Americans, First Nation, who remind us that we are stewards of the resources that sustain our lives. The famous Big Blue Marble picture of Earth, snapped by an astronaut returning from the Moon to Earth, remains a reminder of its fragile beauty, and has often received credit for reviving the Environmental interest sparked by Rachel Carson.

SEE does not prescribe a narrative. In studying and performing simulation, however, students consider options and possibilities that may emerge from beneath the scenario and technology they are immersed in. In this simulation exploration *experience*, students narrate and work at a confluence of science, digital technology, dedicated mentors, teachers and a great story. They are—perhaps almost unaware—that they are imagining a truly awesome, history-changing, future when humans, finally, for the first-time, move off the planet.

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practical simulation experience that it has come to be. Mr. Waite served as SEE Industry Chair from its inception unless his sudden and untimely passing in July 2015.

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