Breakthrough Learning: How Experiential Simulation Can Accelerate Critical Business Process Adoption

TALENT DEVELOPMENT

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INTRODUCTION

Experiential Simulation is earning its place among leading learning practices with top companies across the world. Kim Armstrong, Ed.D., Program Manager of the Enterprise Engineering Curriculum at The Boeing Company, and Daniel J. Campbell, Ed.D., Sr. Instructional Systems Designer at Vangent, Inc., explain how using experiential simulation in systems engineering helped Boeing employees take what they learned in the classroom and apply it in their everyday jobs.

Armstrong explains that Systems Engineering (SE) represents a critical business process within the Boeing Company. "It will help enable and drive forward really great products," she says. Boeing has been working with SE for many years. "In the design and development of our product and the running of our business there is this bottom line impact of cost/schedule/performance/quality, and we can directly tie that to the implementation of systems engineering."

"Our customers came to us internally and said we have this need to implement and fuse systems engineering into the culture of the company and without that, we wouldn't be as successful." Boeing was lacking a consistent, holistic systems engineering approach, and because of that they began to see some negative impacts. Some of those implications included:

- Project-related: Longer cycle times, more re-work, additional customer contact time requirements
- Business-related: Potential loss of existing customers, lost bids, decreased profitability

They completed a thorough front-end analysis of the organization and discovered that without a holistic, consistent approach to systems engineering, the company was not going to continue to be successful. They partnered with Vangent and embarked on a journey of learning and improvement.

WHAT IS SYSTEMS ENGINEERING?

Boeing's definition of systems engineering is "an interdisciplinary collaborative approach to derive, evolve, and verify a life cycle-balanced solution that satisfies customer expectations and meets public acceptance." According to Armstrong, this definition places Systems Engineering more in the category of a business process that touches many stakeholders than an engineering discipline.

"It's more than an engineering approach; it really is a business approach. We stepped back and looked at why we wanted to embark on developing a learning program to touch this target audience."

THE BUSINESS OBJECTIVE AND THE LEARNING OBJECTIVE

Boeing's business objective was to become a recognized industry leader in Systems Engineering applications by focusing greater attention on SE practices within the organization.

The learning objective was to "modify the efficiency and order mindset of the engineer learner audience from a narrow engineering focus to an orientation of adaptability and openness within a larger system with a wide variety of stakeholders."

But Boeing's objectives came with challenges, both in terms of business and learning. However, it was the challenges that really pushed the organization in determining their path to success. The obstacles included:

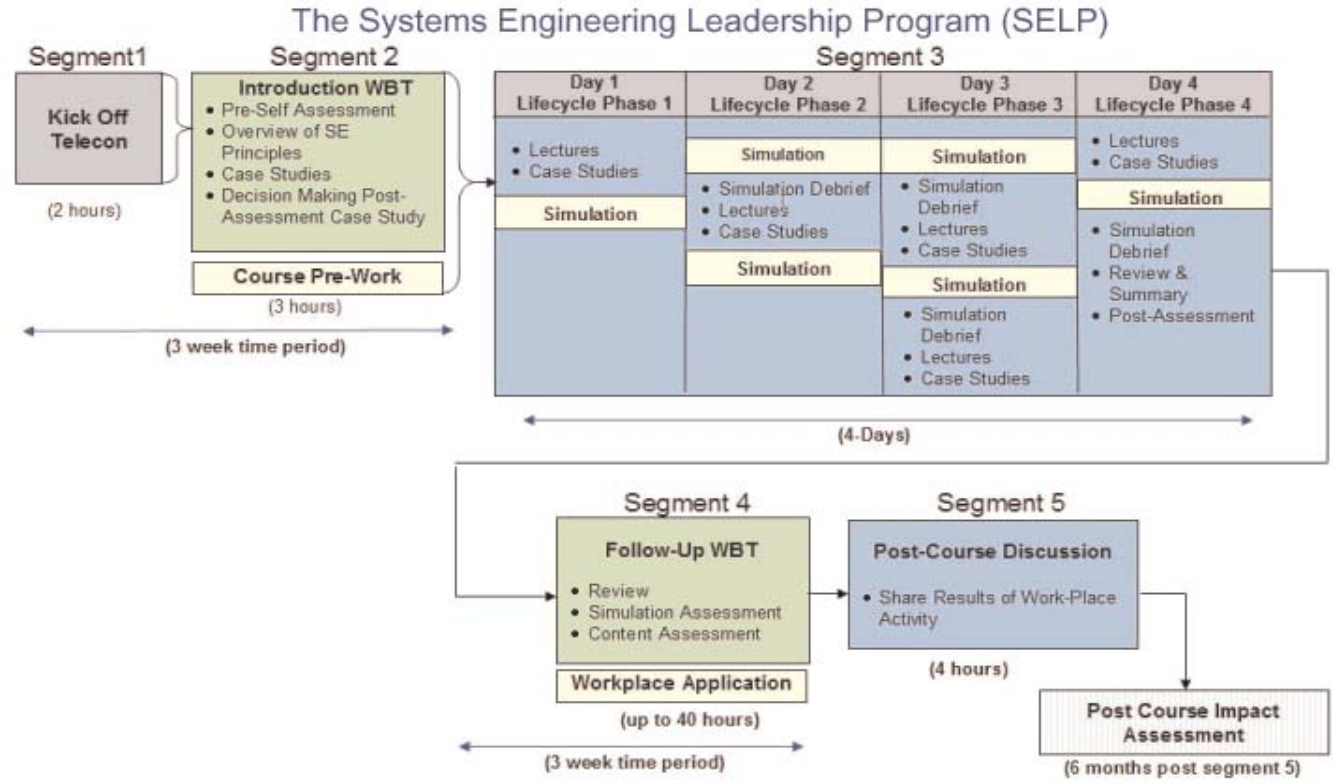
- Achieving consistent SE implementation across the organization
- Long-tenured engineers operating with a singular engineering framework of reference. Armstrong notes, "We wanted to get them to move away from that and really expand and broaden their mindset."
- Effectively teaching an abstract concept to people outside the engineering organization
- Ensuring that the audience (program managers, leaders) could apply newfound skills and knowledge to their projects
- Training more people faster

Armstrong says the major challenge was ensuring "that our audience could actually go back and apply what they learned in the program to their project or organization."

THE SOLUTION: THE SYSTEMS ENGINEERING LEADERSHIP PROGRAM (SELP)

"We had a large target audience that didn't really understand that the value of systems engineering was critical." They needed to understand that they had a responsibility and a role in the company's system engineering solution - the business process. The solution came to Boeing after a very in-depth, needs-analysis process. Armstrong says that it took three to six months to do front-end analysis of the

Figure 1



very large target audience, which amounted to approximately 50,000 people.

"We wanted to develop a learning solution that would really help us infuse not only the value of systems engineering, but ultimately could help Boeing be recognized as an industry leader in systems engineering." The program came in five segments, as illustrated in Figure 1.

Segment 1 consisted of the first interaction, meeting the instructor or facilitator, and an introduction to concept. Armstrong says it was a nice way to start teaming and networking, as this would play a key role in the impact of successful implementation of the program.

Segment 2 gave participants about three weeks to complete a three-hour, web-based training program. The purpose of the individual training program was so that "when everybody steps into the classroom session there is a level set in terms of knowledge they all share - a common vocabulary and understanding of Boeing's application of systems engineering, including self-assessment." The option was provided for individuals to test out if they possessed an understanding of systems engineering.

Segment 3 is when participants came together for four consecutive days in a "classroom session" which was broken down into four "lifecycle phases" - one for each day. Each day was interspersed with "business simulation," which also included lectures, discussions, and case studies.

The key part of this phase, in addition to the learning, was the opportunity to apply what is learned in the simulation. The attendants can apply what they're learning to their jobs within the organization upon completion of the program, explains Armstrong. "We have them do some introspective pieces: journaling, identifying a workplace project or application of the content."

On the fourth day, the participants complete a post-assessment and identify what is it that they're going to do before they come back to Segment 5. Essentially, they must determine how and where they will apply this new knowledge in their program or their organization.

Segment 4 consists of a three-week period for participants to spend up to 40 hours working on applications, "taking what they've learned and applying it someplace in their business or organization." There is also a short follow-up, web-based training which "reviews what they learned during the four days" and provides them with the opportunity to assess the content of the program and the simulation.

Segment 5 is considered the "Post-Course Discussion." All of the participants and the staff come back together into the classroom for half of a day to share the results of their workplace activity, says Armstrong. "They have to be accountable."

THEORETICAL FRAMEWORK

"The overreaching purpose of the theoretical framework that helps us make sense of the very diverse pieces within this curriculum is Bloom's Taxonomy," says Campbell (see Figure 2).

Oftentimes in training programs, there is no real chance for applying the knowledge learned. "In this particular curriculum, we wanted to make sure they had the opportunity to apply and then analyze that application."

As the participants move into Segment 4, they've had the practice of application and analysis. They will get more application and analysis as they approach their workplace applications, but now they start to synthesize. Campbell says they begin to ask, "How do all the pieces fit together?"

Finally, in Segment 5, they come back and work with the group and their mentor or facilitator, and they evaluate how well they have grasped the material in this program.

SYSTEMS ENGINEERING SIMULATION

The systems engineering simulation covers the entire program lifecycle, interspersed throughout the four-day classroom session. "We chose the simulation approach because learners have to take responsibility with their decision making. They can experience the positive and negative consequences of those decisions," explains Campbell.

The result is that learners gain very valuable self-assessment skills and decision-making skills. The

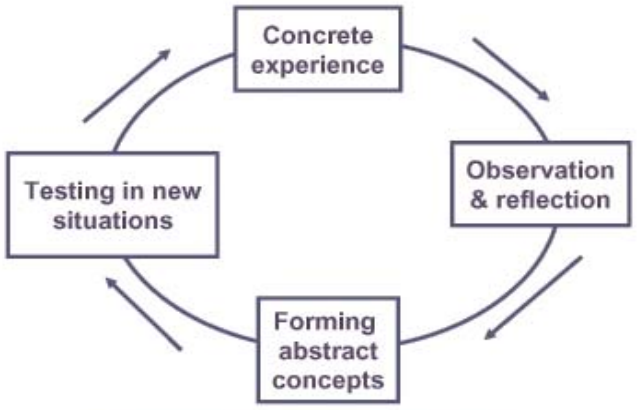
Figure 2

Bloom's Taxonomy
(Bloom, 1994)

The six categories of the taxonomy are arranged by levels of difficulty. Campbell explains that this helps the learner build basic knowledge in early web-based training and then helps them to understand how that knowledge will be used later.

In Segment 3, he says, learners continue to gain more knowledge and understanding and start to apply the knowledge to the simulation. "The simulation is really the heart and soul of this curriculum."

Figure 3



Kolb's Experiential Learning Circle
(Kolb, 1984)

"Experiential Learning occurs when individuals participate completely in the learning process and control its nature and direction. The learning activities are primarily based upon direct confrontation with practical, real-world problems, and learner self-evaluation is the principal method of assessing progress or success."

simulation also enforces key concepts that were taught during the lecture part of the classroom session and challenges the participants to use the generic principles they were learning. Campbell also notes that the simulation "allows learners to apply previously acquired knowledge and skills to control an environment that pretty closely replicates a real-world situation."

The simulation was laid out on the framework of Kolb's Experiential Learning Cycle, as shown in Figure 3.

SIMULATION CONSTRUCT

The simulation itself was made up of computer-based courseware, learning team discussions and activities, and large group presentations. During the learning team discussions and activities, participants would break out into individual groups, each group with a laptop, and run the simulation from a CD-ROM. During the large group presentations, the teams would use supplied presentation templates to present their findings to the larger group.

SIMULATION FOCUS

The real focus of the simulation is about a business process. It's not about engineering. "We may be talking about systems engineering processes, but we're really talking about business process," says Campbell.

There are two keys to simulating a business process in a virtual business world, he explains. "People have to know who to communicate with and what to communicate to them." Vertical communication is the communication that happens up and down the chain of command. Horizontal communication, Campbell says, is "critical because it's getting people to communicate on cross-functional teams." For example, different products teams (avionics, engine, electrical, etc.) all must communicate with each other to avoid serious problems with the aircraft.

The simulation relied on both horizontal and vertical stakeholder communication by using common business communication tools such as email, voice mail, Internet research, and phone conferences.

Email - Learners are able to click on emails like they are real. When opened, the emails are very realistic and contain information critical to interactivity, i.e. attachments, links. Learners had to open these to gain what they needed to successfully complete the simulation.

Phone calls - Another type of activity involved phone conversations. Participants retrieved a phone number from a website linked in previous email and were instructed to call for more information. Learners would call and hear phone conversations.

Voice mail - Learners would have to listen to voice mail which would contain more information necessary for successful completion of simulation.

Phone conferences - The learning teams listened into phone conferences between groups of individuals discussing various aspects of the program or project which once again provided more information that the learners would need to successfully complete the simulation.

Simulated Internet research resources - "After we provided the learners with information they would

need at each stage of the program lifecycle, we would then direct them to break out away from the computer part of the simulation and do a learning team activity."

The team activities included doing trade studies within the simulation. The first time they are given instructions on how to proceed (see Figure 4), "as they progress into the fourth phase of the simulation, we again direct them to a trade study without giving them any instructions." The idea is that they learned how to do it the first three times.

After the team activities came what Campbell refers to as "Decision Points." This is when the participants would re-engage with the computer portion where they would encounter a decision point that asked the learner to take one of three different options. "When the learners choose one of these options, the next thing that they're going to see is immediate feedback. It won't tell them if they are right or wrong, but will see the consequences of their actions." Learners are told what the implications of their decisions are and they are given the opportunity to reconsider or continue.

DEBRIEFING

After the simulation, the learners come back into the classroom, and each learning team reviews their answers to the simulation. This debriefing is a very critical part of the program, explains Campbell. Debriefing promotes "a shared concrete experience, reflective observation, abstract conceptualization, and active experimentation." It holds the learners accountable. Campbell points out that "each particular answer could be right depending upon their thought processes, how they got there."

Figure 4

Simplified Trade Study

	Weighting	Prototype-GE303-M507X		Prototype-M503-M507X		Prototype-M507X	
Assessment Criteria*		Value	Weighted Value	Value	Weighted Value	Value	Weighted Value
Cost			0		0		0
Schedule			0		0		0
Risks			0		0		0
Total	0	0		0		0	

Double click inside the table to enter data.

Assign a weighting factor to each consideration (costs, schedule, risks). Remember, there is no magic formula for assigning these weighting factors. The weighting is a subjective call made by the experts - that would be you! (Total weighting must equal 1)

Evaluate each design option against each consideration using a comparison scale of 1 to 9, with 1 being the least favorable and 9 being the most favorable.

Multiply each value by that lines (consideration) weighting to obtain the weighted value.

Total the weighted values for each design option.

* Performance not included in the Assessment Criteria because all three options end up with same engine and consequently the same performance.

TYING THE THEORIES TOGETHER

"What the simulation really did for us is it provided a bridge in Bloom's Taxonomy between the lower level knowledge and understanding to the higher levels of synthesis and evaluation." They wanted the learners to use Segments 4 and 5 for synthesis and evaluation, but they understood that in order for the learners to synthesize and evaluate what was learned, they needed some sort of a bridge; a way to apply and analyze what they were doing during segment 3 - the classroom environment. "The simulation acted as that bridge for us," says Campbell.

CONCLUSION

According to Armstrong, "the goal of the program was to bring these folks together and to help Boeing become known as the industry leader in systems engineering." Boeing met that goal because the program has received industry as well as internal recognition. Armstrong says that the learning impact has been positive, and the company has reached the target audience of the program. The application of concepts is having a positive impact on all the aspects of the organization that it set out to reach, and those who participated are committed to using what they learned.

Armstrong quotes an anonymous Boeing employee who participated in the program: "By applying a good risk management tool and the risk management techniques taught in the class, we now have the capability to provide the information to support the revised contracting process ... We took a process from engineering and reapplied it to satisfy a contract requirement."

Armstrong adds that the program "exceeded everyone's expectations. It is not just a training class. It is an experience. It is a program. It is a direct, purposeful, meaningful experience." In fact, the program won the Brandon Hall Research Excellence in Learning award in 2007. Armstrong notes that Boeing is proud of recognition outside its own company, and that the retention and application of the concepts taught in the program are strong six months later.

Based on the Human Capital Institute webcast "*Breakthrough Learning: How Experiential Simulation Can Accelerate Critical Business Process Adoption*" of January 16, 2008

PRESENTERS

Kim Armstrong, Ed.D.
Program Manager/Enterprise
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Dr. Kim Armstrong is Boeing's enterprise engineering curriculum leader and Program Manager for several enterprise engineering learning programs. Kim's focus has been on designing, developing, and implementing cost-effective engineering, manufacturing, leadership, and information systems training programs. Kim is the lead for enterprise engineering training/curriculum, CBT/WBT design and development, and the focal for e-Testing and Test/Evaluation writing. Recently, Kim was part of the team who won Gold for Best Blended Learning Solution from Brandon Hall and is a finalist for an industry award in leadership development program with Corporate University Exchange.

In addition to training and development activities, Kim is the focal for Boeing Long Beach high school internship program (Career Exploration and Preparedness Program) and a member of the Atlanta University Consortium team working with Spelman College/Clark Atlanta and Morehouse College. Kim has worked in the broadcasting industry as a recording/audio engineer. Kim holds an AA degree in Telecommunications (from San Bernardino Valley College), a BA degree in Radio-TV engineering (from California State University Long Beach - CSULB), a Masters degree in Education - Instructional Systems Design (from CSULB), a Masters degree in Interdisciplinary Studies - Multiculturalism, Curriculum and Development (from CSULB), a teaching credential for adult education, Senior Professional in Human Resources certification, and a Doctorate in Education specializing in Organizational Leadership (from Pepperdine University). Outside of Boeing, Kim spends a great deal of time in the local community. Kim is a graduate of Leadership Long Beach and teaches in the Professional Studies Department at CSULB. Kim also serves on several boards for local non-profit organizations [including: The Port of Long Beach Port Ambassadors, the Long Beach Youth Council, For the Child, Girl Scout Council of Greater Long Beach, Mentoring-A Touch From Above, and the Jaguar Academy of Finance/Technology]. The most fun is when Kim volunteers as a veterinary assistant at the Aquarium of the Pacific.

Daniel J. Campbell, Ed.D.
Sr. Instructional Systems Designer
Vangent, Inc.

Dr. Campbell has over 15 years of experience in Instructional Systems Design, Training Delivery, and Project Management for commercial, government, military, non-profit, and higher education organizations. He has experience in competency modeling, needs analysis, and planning and managing the design, development, and deployment of web-based training (WBT), instructor-led training (ILT), and blended learning solutions.

Dr. Campbell has been an integral member of Vangent learning development teams whose work has been honored by Brandon-Hall Research (Excellence in Learning Gold Award for Best Blended Learning), and Bersin and Associates (Learning Leaders Awards). In addition to his work with Vangent, Dr. Campbell serves as adjunct faculty with the University of Phoenix, Axia College.

Dr. Campbell earned a BS in Technical Management from Wayland Baptist University, an MA Ed in E-Education from University of Phoenix, and an Ed.D. in Educational Leadership from University of Phoenix. His dissertation research established the first research-based competency model for the specific role of e-learning Instructional Systems Designer. Dr. Campbell's research is scheduled to be published in the first half of 2008. In 2007 he presented at the Association for Educational Communications and Technology annual convention, and will be presenting at the E-Learning Guild 2008sm Annual Gathering.

MODERATOR

Joy Kosta
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As Director of the Talent Development Community at The Human Capital Institute, Joy brings twenty-five years of experience in multiple facets of organi-

zational development, human resources and business management with an emphasis in customer satisfaction, service quality, process improvement, and applying the Malcolm Baldrige Criteria for Performance Excellence. As founder and President of Performance Partners in Health Care, a company dedicated to building better patient experiences, she has authored several curriculums in leadership and staff development, and co-authored with Harold Bursztajn, MD Senior Clinical Faculty member, Harvard Medical School, *Building a Treatment Alliance with Patients and Families*.

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