2006-453: THE IDEALABORATORY NEEDS ASSESSMENT OF TODAY'S INDUSTRY PROFESSIONALS

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La Verne Abe Harris, PhD, CSIT came to Arizona State University with many years of industry experience in graphic design, information design, illustration, and computer graphics. Prior to coming to ASU, she was the art director of The Phoenix Gazette, the computer graphics production manager at Phoenix Newspapers, Inc., an editorial illustrator for The Arizona Republic, the creative director of a Phoenix advertising company, and the owner and consultant of Harris Studio, a computer graphics consultation and creative business. As the computer graphics production manager for Phoenix Newspapers, Inc., Dr. Harris managed an international, innovative, interactive computer-graphic department in a joint venture with McClatchy Newspapers of Toronto, Canada.

Dr. Harris is an Assistant Professor of Graphic Information Technology at Arizona State University in the Department of Technology Management. She is also a Certified Senior Industrial Technologist. She received her PhD from the University of Arizona in higher education with an emphasis in sociotechnology, and a minor in media arts. She received her Master of Technology in graphic communications technology and her BA in art education/commercial art from Arizona State University. Before she became an assistant professor in the fall of 2004, she was a lecturer in the College of Technology and Applied Sciences, an appointment she held for five years.

As a tenure-track professor, Dr. Harris has been published in several peer-reviewed journals. Dr. Harris is the 2005 recipient of the Electronic Document Systems Foundation (EDSF) grant, and her paper "The Personalization of Data for Print and e-Commerce" is nationally and internationally published for industry professionals and academics in higher education. Her paper, "The Leap from Teacher to Teacher-Scholar: the Quest for Research in Non-Traditional Fields," was awarded the 2004 Chair Award for the outstanding paper of the American Society of Engineering Educators Engineering Design Graphics Division. Graph Etiquette: A Paradigm for Presenting Technical Data (Harris & Sadowski, 2003) was published in the juried international Visual Communications Journal. Harris received the Frank Oppenheimer Award for Outstanding Conference Presentation for the 55th Engineering Design Graphics Division of the American Society for Engineering Education Mid-Year Conference in San Antonio, Texas for her paper Saving and Viewing CAD Graphics on the Web (Harris & Sadowski, 2001), which was also published in the juried Engineering Graphics Design Journal.

Dr. Harris served as the Chair of the ASU Commission on the Status of Women for the Polytechnic campus. She is currently the Chair of the Undergraduate Curriculum Committee for the College of Technology and Applied Sciences, and Region 5 Director for the National Association of Industrial Technology (NAIT). She is a member of the American Society of Engineering Educators (ASEE), Engineering Design Graphics Division (EDGD), International Graphic Arts Education Association (IGAEA), and Epsilon Pi Tau, a technology honor society.

The IDeaLaboratory Needs Assessment of Today's Industry Professionals

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Abstract

Industry professionals from organizations such as Motorola, Intel, Boeing, and Honeywell participated in a needs assessment survey through the IDeaLaboratory at Arizona State University to determine the innovation needs of today's industrial organizations.[1] The model of the IDeaLaboratory follows the Polytechnic campus outcomes of Pasteur's Quadrant — applied research.[2] Students become an integral part of the innovative thinking, discovery, learning, and assessment processes, because they become engaged in the design and technology research and solutions, just as they would in a corporate or government working environment. The IDeaLaboratory is interdisciplinary and content-independent. It is both a research and entrepreneurial unit. This paper addresses the roles that higher education, industry professionals, and organizational culture play in fostering innovation in organizations.

I. Introduction

Knowing how to think creatively and innovatively to evaluate and solve industrial problems has a direct relationship to the sustainability of economic growth in American and international businesses in the 21st century. What good is it to develop products, processes, and services that are of little value to society? What role should higher education play in the molding of the future industry professional? What do design and technology professionals need today to become more successful in their jobs? What does the organizational culture need to do to foster inventive thinking? The roles that higher education, industry professionals, and organizational culture play in inventive thinking and problem solving were addressed in a survey that originated from Arizona State University's IDeaLaboratory.[1]

The IDeaLaboratory is an interdisciplinary human-factor and usability engineering innovation laboratory at Arizona State University. The IDeaLaboratory fosters innovative thinking skills and problem-based learning that can be applied to real world industrial and engineering problems. It also assesses whether the technology-based solutions are successful or whether the innovator needs to go back to the drawing board. It was established to meet the need for innovative problem solving for university students, educators/trainers, and industry professionals. IDeaLaboratory partners include organizations, such as Motorola, Boeing, Intel, Honeywell, and google.com.

II. Demographics

The responders of the IDeaLaboratory needs assessment consisted of a convenience sample, who ended up being male industry leaders representing the generation of the "Baby Boomers" — those born after World War II from 1946 to 1964. Approximately 64 percent were in their 50s with the remainder of the participants equally divided into the 40s and 60s age brackets. In the next decade we will see more than 12,000 in the United States turning 50 on a daily basis.[3] This calculates to over four million each year.

These 40- and 50-year olds can boast about being the best-educated generation in history.[4] The focus team members were no different. Over half had a 4-year university degree, with just under half having graduate degrees. Almost 20 percent had doctoral degrees.

The participants who responded to the income survey question made over $100,000 annually. Over half were employed in the technology business, with a few employed in engineering firms, and one employed as a defense contractor. Almost half were engineers. The rest had the following job titles: program manager, project manager, chief engineer, or quality and mission assurance director. They represented companies such as Motorola, Boeing, Intel, and Honeywell. Over half were from the Phoenix area of Arizona and the rest were located in Tucson.

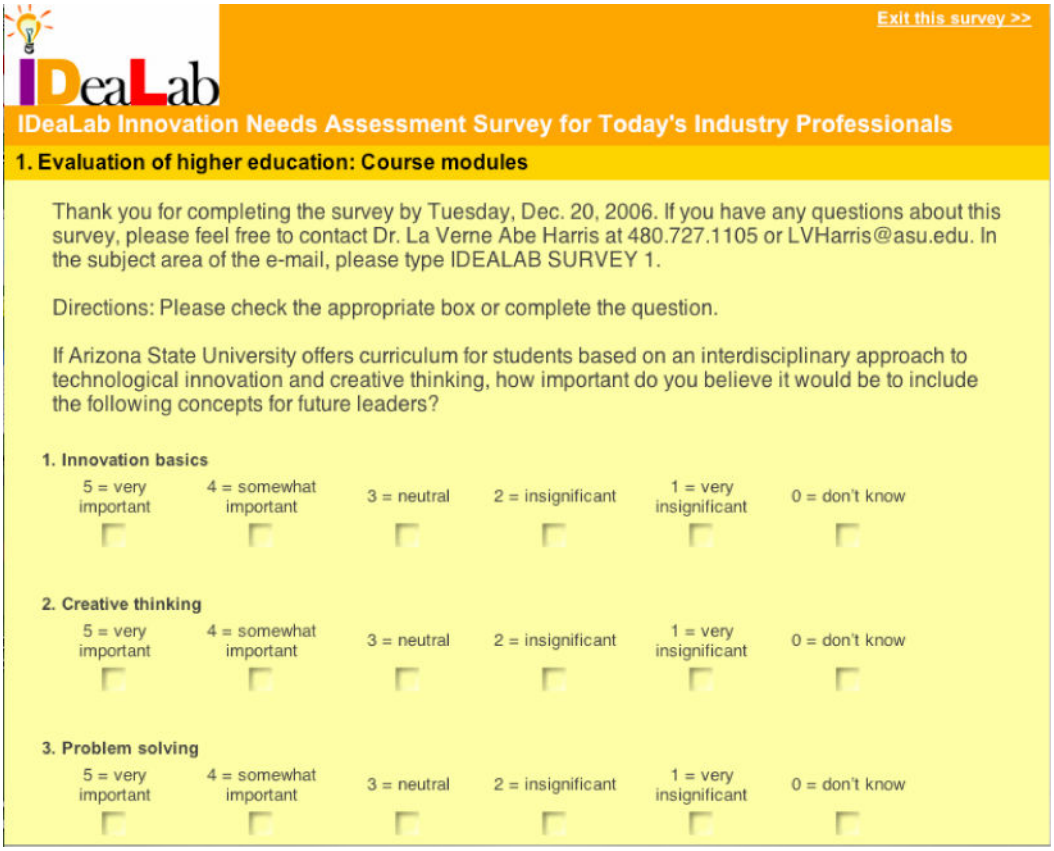
But these healthy "aging hipsters" are not necessarily retiring early. They plan on working longer than the generation of their parents. Slightly over 80 percent of the focus team had over two decades of experience in their field.

In spite of this trend of working longer, there will still be a significant number of jobs vacated each year. That brings us to the next question: What type of employees do these Baby Boomers want to eventually replace them?

III. Methodology

An online survey was conducted December 9 through December 20, 2005 with a select focus team of 14 industrial leaders *(Refer to Figure 1)*. Data were gathered using a multi-method approach — both qualitative and quantitative. A Likert scale was used, as well as open-ended questions. The questions were grouped in several categories: (1) evaluation of higher education (course modules and curriculum); (2) evaluation of employees (skills and success); and (3) evaluation of organizational culture (priorities, inventive thinking, decision making, meetings and roadblocks).

Figure 1. Screen shot of first page of survey



IV. Findings

Evaluation of higher education

Course modules

Fourteen modules were presented to be included in a university course on innovative thinking: (1) innovation basics, (2) creative thinking, (3) problem solving, (4) product development, (5), team building, (6) sales, (7) marketing and branding (brand awareness), (8) consumer product purchase patterns and understanding the consumer, (9) technology change and management, (10) intellectual property and law, (11) finance, (12) valuation of new technology, (13) commercialization planning, and (14) technological ethics. The most important modules, according to the IDeaLaboratory focus team, are problem solving and creative thinking *(Refer to Figures 1 and 2).* The basics of innovation are perceived third in significance *(Refer to Figure 3).* Almost 86% believe that valuation of a new emerging technology is "somewhat important" and 7.1% perceive it to be "very important." Slightly over 70% perceive technological ethics to be "very important" (21.4%) or "somewhat important" (50%). One participant added that "skills are needed in gathering innovative ideas from introverted engineers." One suggested that a history of past innovations would be beneficial to include in a course module. Another added that risk assessment and management could be included in the problem-solving module, and product obsolescence could be included in the product development module. The preference for course delivery is as a hybrid — a combination of online and face-to-face meetings.

Figure 1.

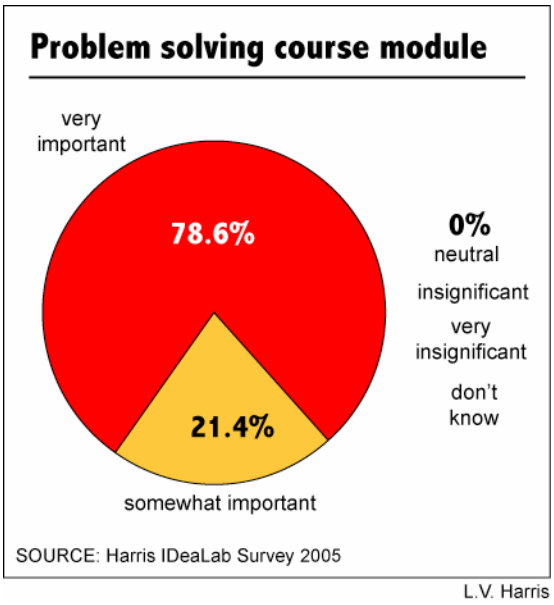


Figure 2.

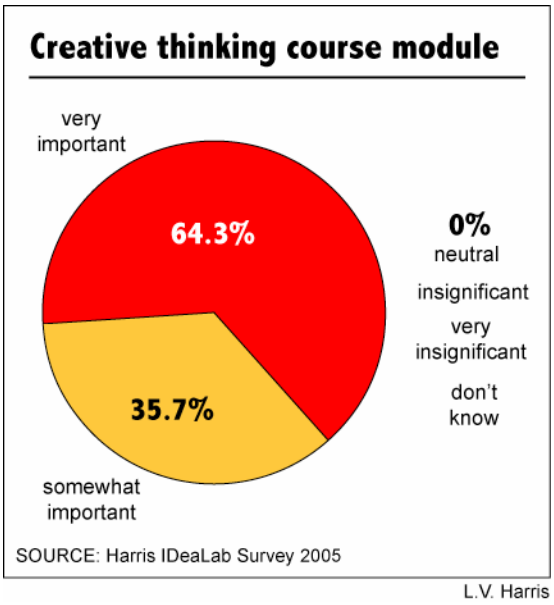
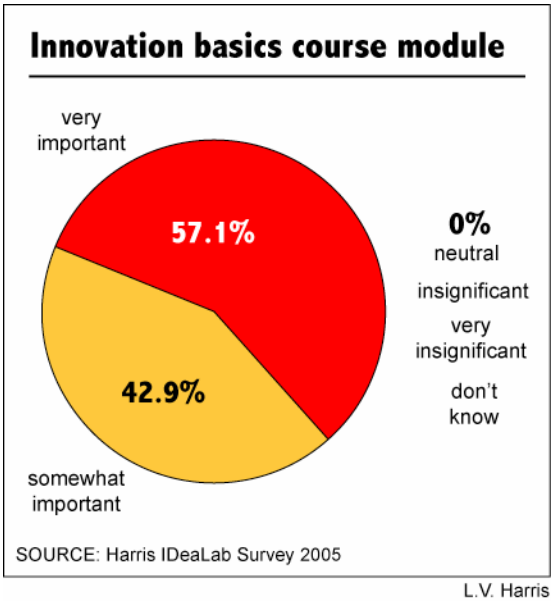


Figure 3.



Curriculum

According to the perceptions of the survey participants, career success could have been made easier if their college education had prepared them with a broader technical background, and a more in depth set of business and leadership skills. Almost half of the participants were engineers who believed they were lacking in overall business skills in operations management and finance. They stated that an undergraduate course in applied statistics would be beneficial for the future engineering and technology leaders. The experience of applying project management skills, such as establishing production schedules and developing a project with a team of students, was missing from their college education. A higher level of leadership skills, which includes team building, people management, office politics, writing and speaking skills, was also missing from their college curriculum. One participant said that he would have liked to have had a systems level modeling and simulation course before entering the workforce.

The IDeaLaboratory focus team made a number of suggestions that should be incorporated into a university design and technology program to produce more successful ideas and/or innovations for an organization. The symbiotic relationship between technology, human capital, and business

is a reoccurring theme. One team member wanted a "better connection between technology, the customer concern that it addresses, and the business case for the investment." Achieving a balance between emerging technologies and business realities is important. To do this effectively, university graduates need to be able to apply a framework to evaluate design concepts and technology without "reinventing the past, repeating mistakes, or creating problems that have already been created and solved." Lectures from well-known innovators should be a part of the capstone experience in the IDeaLaboratory — both in-person and via audio-video media. Respondents recommended that students should not only learn the logistics of how to communicate successful ideas, but also the strategies of how to get ideas heard and presented to higher-level management.

The business case for pursuing technical innovation ideas should be included in a university design and technology program; however, the economics of a technological decision is not the only important element. An organization's human capital — open-minded creative team players and risk takers — should be valued.

One team member stated that he believed it was a "bad trend" to require students to apply for their final two years of a 4-year design or technology degree. Students who are not accepted into the last two years would have to begin another degree program. Another said that the Computer Science Engineering curriculum needs to include more physics and mathematics to better prepare future employees.

The most important lessons learned from higher education, which led to the career success of the survey participants, was how to deal with ambiguity, how to move forward in the face of adversity, and how to solve problems. The underlying foundation of the career success was a solid university general education covering English, math, and science.

Figure 4.

Evaluation of employees
Skills

Specific skills and factors in an employee are perceived by others to lead to the future success of the company. Those assessed were (1) team skills, (2) leadership skills, (3) creative thinking, (4) organization skills, (5) presentation skills, (6) attitude, (7) critical thinking, (8) technical skills, (9) people skills, (10) completing a task that is started in a timely manner, and (11) understanding your organizational culture. The top factor leading to success is attitude. The second most important skills are team skills, people skills, and

completing a task that is started in a timely manner.

Success

According to the industry leaders, the most important behavior that a new employee lacks when beginning a job at a company is common sense, logic, or what is called "engineering intuition." New employees are lacking direct product development experience on basic product knowledge and design methodologies. They suggested that perhaps an internship or applied education would improve this lack of experience. The survey respondents perceive new employees as having difficulties with their communication skills. They view new employees as not knowing how to communicate ideas diplomatically, and lacking skills in working on interdisciplinary teams. Being able to define the problem that needs to be solved, along with taking the initiative to move the plan in the organizational process, are important for the success of the new employee, according to the industry leaders. One IDeaLaboratory focus team member said that new employees need to know "how to plan your work and work your plan."

Industry leaders participating in the survey believe that if a new employee is on the management track, the over-riding element to his or her success is "Politics 101" and people skills. A future manager should be open-minded, a team player, and make significant contributions to the organization. He or she must have clear and understandable thought processes with the ability to communicate ideas with a positive and "can-do" attitude. The ability to influence others, lead a team, and listen to others to get customer satisfaction, produces a successful outcome. The new employee needs technical competency. Later business awareness becomes a priority for management success. Understanding the engineering and business processes that "people in the trenches" do on a daily basis, along with leadership and people skills, results in an employee on the management track who is respected by coworkers.

The survey participants summarized their perspective of an ideal manager. They stated that a manager is not necessarily a leader in an organization, just as a leader is not always the manager. The ideal manager is a leader with people skills. This is a goal-oriented, organized, lifelong learner, who is self-motivated and creative. This is a person, who has the management qualities and technical knowledge of objectively analyzing problems, while inspiring the team and generating respect. It is a person who takes the responsibility for the morale of the employees, and establishes and maintains an effective working environment for those he or she manages. Micromanagers are perceived negatively. An ideal manager is a coach and a person who can delegate responsibility to others. It is a person who removes roadblocks from the employees, not creates them. Listening with a non-critical ear to those above and below in the chain of command is critical. This of course takes energy, vision, ethics, and character, which are not usually taught in an engineering or technology college course.

Evaluation of organizational culture
Priorities

According to the industry leaders, the top area of an organization that needs innovation training is the research and development department. Forty-five percent of participants said it was their

top priority. Mission assurance (quality and risk management) is the second priority. The third priority is the marketing department.

Inventive thinking

Approximately 73% of the focus team sees the need for employees to learn to think more inventively in their organization. About one-third responded "yes" and the rest said "somewhat." One participant stated that in order to make this a reality there would have to be some company buy-in. Another said that risk-free organizational culture to try new ideas would create a fertile ground for innovation. Still another suggested that getting public and company recognition for thinking "outside of the box" would encourage inventive thinking. Compensation structured to reward innovation would create an organization of employees who are motivated, according to one industry leader. Another suggested that employees who team with customers early in the project, and who envision more than just past concepts and designs, have the potential to be inventive thinkers. The survey participants stated that many employees today are lacking the tools, techniques, and training to know how to think creatively and innovatively, and suggested that on-the-job training would be beneficial. One participant perceived that "most company managers today don't listen or pay attention to people regarding innovation, so it really doesn't matter."

Decision making

About 82% of the focus team sees a need for employees to learn to make decisions more effectively and efficiently in their organization. Forty-six percent perceive this need to be paramount. To make this a reality, there should be training, coaching, and mentoring in the decision-making process. Experience, of course, is the tried and true teacher of decision making; that is, if the person learns from his or her mistakes. How effective decisions are made, how situations are evaluated before making decisions, what to consider in the process, and how to communicate the decisions, should all be part of the learning process. An organizational culture that rewards effective and efficient decision making, and one that has the least amount of bureaucracy, is the best environment for sound decisions to thrive.

Meetings and roadblocks

Industry leaders suggested there is a need to run more efficient and effective meetings in most companies. Sixty-four percent of the focus team stated that the biggest problems with meetings are that they are not well facilitated, not well planned, and there are too many of them with no purpose. The successful companies have "short meetings that are to the point."

Some suggested that the organizational roadblocks that limit a company's ability to initiate, design, and apply new value-added ideas are lack of resources and time constraints. Some perceive the finance people as "more risk adverse and less likely to take chances and be innovative," and the purchasing department as not being responsive and having too much control. Budgets are set aside for "blue sky" thinking time. There seems to be not enough time to properly evaluate ideas. The risk is often higher than the reward. Poor communication skills on

both the part of the customer and employee, an inflexible management structure, and ideas that are not a good match to the business and markets, are roadblocks to inventive thinking.

Sixty percent of the IDeaLaboratory team perceived that managers in their company "somewhat" trusted their employees to take new initiatives. Only 10% answered "yes." Whether the organizational culture is in place to make this a reality is another story.

V. Conclusion

The IDeaLaboratory innovation needs assessment survey for today's industry professionals[1] produced a number of findings that can be used to develop a robust Polytechnic interdisciplinary curriculum at Arizona State University. The need for the college student to learn to think innovatively, as well as for the industry professional to be trained on creative thinking and problem solving has been determined. The implementation of this curriculum will be a small step toward the sustainable economic growth of American and international businesses in the 21st century.

VI. References

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