
AC 2011-2832: A "HIGH TOUCH, HIGH VALUE" APPROACH TO A PRACTICE-ORIENTED SYSTEMS ENGINEERING MASTER'S DEGREE PROGRAM FOR WORKING PROFESSIONALS

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A “High Touch, High Value” Approach to a Practice-Oriented Systems Engineering Master’s Degree Program for Working Professionals

Abstract

Graduate engineering education is experiencing a transformation. As engineers and their employers place increasing emphasis on life-long learning and professional education, many institutions have developed programs designed to make graduate education more accessible to working professionals. While many excellent programs reach working professionals through distance learning and on-line programs, other programs provide a “high touch” approach designed to engage students in “systems thinking” and collaborative learning that is difficult to achieve through distance or on-line formats. This paper describes the program structure, curriculum, program delivery concept, and results of the Accelerated Master’s Program in Systems Engineering at the University of Virginia, tracing its evolution over the past decade and the effect it has had on the students who have earned degrees through the program. The paper emphasizes the importance of continuing to offer “high value, high touch” programs to working professionals even while simultaneously expanding access to graduate education through Internet-based programs.

Motivation

An April 2009 Defense Science Board report regarding the United States Department of Defense strategic acquisition platform offered several important conclusions about the current DOD acquisition process and several observations and recommendations about how best to address them.¹ The notion that successful acquisition processes require “relevant experience” is woven throughout the report: “The Department needs to hire and assign individuals with proven records of acquisition success. ... Central to these improvements is experienced personnel in leadership, in the acquisition workforce, and, equally important, in the contractor base.” The DSB report further describes this lack of experienced leadership as a major contributor to current acquisition program problems, leading to difficulties such as:

- lack of sufficient up-front analysis of alternatives
- poor systems engineering support
- inadequate performance, cost, and value trade-offs
- poorly designed product development strategies
- poor management of technical risk
- growing requirements
- selection of inexperienced contractors
- poor contract incentives
- budget instability

At the same time this need for experienced leadership is growing, the popular press is labeling Systems Engineering as the “Best Job in America,” encouraging ambitious young men and women to pursue the opportunity to obtain the education and experience required to meet the needs of the DOD and other organizations that need the skills and understanding of large-scale

complex systems that systems engineers have to offer.² The challenge facing academic institutions that offer practice-oriented systems engineering advanced degree programs is to do so in a manner that gives working professionals the knowledge and “know-how” to be an effective leader as quickly as possible and accelerates the process of gaining relevant experience.

In essence, the questions are “How can more people get more relevant experience quickly?” and “How can academic institutions meet the needs for systems engineering talent and help individuals advance in their chosen profession?” This paper describes one approach to a practice-oriented systems engineering degree program for working professionals that offers promise for answering these questions.

Background and Context

Any discussion of systems engineering education begins with a discussion (or debate) about definitions of systems engineering. We begin with a discussion of a “systems approach.” C. West Churchman, a pioneer in systems engineering offers the following:

Systems are made up of sets of components that work together for the overall objective of the whole. The systems approach is simply a way of thinking about these total systems and their components.³

While simple to say, as systems have grown in scale and complexity, understanding the interactions of components in large scale systems sufficiently well to develop effective solutions is often elusive. Andrew P. Sage, another pioneer in systems thinking, expands Churchman’s definition, asserting that

Systems engineering is a management technology – which involves the interactions of science, the organization, and the environment, and the information and knowledge base that supports each.⁴

Sage goes on to say that, “to resolve large scale and complex problems, or to manage large systems of humans and machines, we must be able to deal with important contemporary issues that involve and require:

- 1) many considerations and interrelations;
- 2) many different and perhaps controversial value judgments;
- 3) knowledge from several disciplines;
- 4) knowledge at the levels of principles, practices, and perspectives;
- 5) considerations involving definition, development, and deployment of systems;
- 6) considerations that cut across the three different lifecycles associated with systems planning and marketing, RDT&E, and system acquisition or production;
- 7) risks and uncertainties involving future events which are difficult to predict;
- 8) a fragmented decision making structure;
- 9) human and organizational need and value perspectives, as well as technology perspectives; and

10) resolution of issues at the level of institutions and values as well as the level of symptoms.”⁵

Finally, in their discussion of systems analysis and design, Gibson, Scherer, and Gibson answer the question “What is ‘systems engineering’?” in a “broader and more modern sense,” including both what is often called *analysis* – taking apart into constituent elements – and *design* – combining elements into a functional new whole. Thus systems engineering, from this perspective, includes not only the analytic element but also development of recommendations for the solution of the problem at hand. Moreover, they argue that systems engineering includes policy analysis in addition to technical or analytical aspects, reflecting the fact that complex systems inevitably involve trade-offs that involve underlying values articulated through written or unwritten policy.⁶

The essence of this brief background is that systems engineering *is not* a set of tools, a methodology, a checklist, a technology, or a process, yet systems engineering often requires analytical tools, methods, checklists, technology, and processes. Rather, it is a way of thinking – *systems thinking* – that reflects an understanding and appreciation of *goals* (value-driven objectives), *complexity* (in terms of system components and their interactions – technology, people, institutions, economics, legal/regulatory considerations, social/cultural context) and *metrics* (ways to observe and measure system performance relative to system level objectives) that lead to *solutions that meet needs*.

Given this perspective, how can academic institutions best prepare and equip working professionals to become effective systems engineers and the leaders that modern organizations need to deal with the increasing complexity, intense competition, and rapidly changing environments where systems are conceived, designed, developed, deployed, employed, and, eventually, retired, recycled, reused, or replaced?

Overview of Existing Programs

Practice-oriented systems engineering advanced degree programs come in many flavors. Systems engineering graduate programs for working professionals are proliferating with the growing demand for systems engineers and the realization by academic institutions that professional degree programs offer an opportunity to generate revenue during a time of decreasing resources and increasing program costs. Among the many institutions currently offering practice-oriented systems engineering graduate programs, available to working professionals through some combination of classroom and distance learning formats, are:

- Cornell University (www.systemseng.cornell.edu/dl_home.html)
- George Mason University (seor.gmu.edu/msse/msse.html)
- Johns Hopkins University (www.epp.jhu.edu/graduate-degree-programs/systems-engineering)
- Old Dominion University (www.eng.odu.edu/enma/academics/systemsengr.shtml)
- Penn State University (www.worldcampus.psu.edu/MasterInSystemsEngineering_SystemsEngineering.shtml)
- Rensselaer Polytechnic Institute (www.rpi.edu/ewp/distance/course_masters/pdf/mscsys.pdf)
- Stevens Institute of Technology (www.webcampus.stevens.edu/system-engineering.aspx)

- The George Washington University (nearyou.gwu.edu/accel-se/index1.html)
- University of Maryland (www.enpm.umd.edu/grad/ense.html)
- University of Maryland, Baltimore County (www.umbc.edu/gradschool/programs/sys_eng.html)
- University of Virginia (www.sys.virginia.edu/accelerated)
- Virginia Tech (www.eng.ncr.vt.edu/ISE/Programs/isePrograms1.html)

Typically, these programs offer courses at times and in places convenient to working professionals pursuing an advanced degree while continuing to work full-time. Classroom-based programs typically offer courses in the late afternoon or evening or on weekends, accommodating work schedules and permitting students to take classes at their own pace. In some cases, these classrooms are located at or near the employees' place of employment or in a remote center affiliated with the school that offers the program. In some cases, classroom-based programs deliver content via televised lectures given simultaneously to multiple classrooms (as well as to a live classroom) by a full-time systems engineering faculty member; in other cases, courses are taught by experienced adjunct faculty who live and work in the areas where courses are taught. Other programs use Internet-based technologies to deliver either live streamed content or on-demand archived content to students or use Internet-based courseware to deliver course content and to interact with students using web-based instructional technologies.

Content and curricula vary but most practice-oriented master's degree programs require 30 to 36 hours of coursework, including an individual or team project. Most do not require a thesis. The degree granted may be a Master of Science in Systems Engineering, Master of Engineering in Systems Engineering, or a Masters in Systems Engineering Management. Most programs require that applicants have an engineering or similarly technical undergraduate degree and have completed appropriate undergraduate level mathematics and related courses prior to enrollment.

For the programs listed above, current program costs (tuition and fees) range from approximately \$11,500 to \$49,300 with a median cost of approximately \$26,000. In most cases, tuition and fees include instruction, technology fees, application fees, diploma fees, and other similar fees. Total costs may vary depending on the number of credit hours attempted during a given semester since some fees are per course and others are per semester. Typically, courses are offered on a schedule similar to the regular academic schedule of the host institution (i.e., semester length courses).

Most systems engineering curricula include courses that teach systems engineering concepts (problem definition, objectives/requirement determination, performance measurement/testing, etc.), quantitative analysis (risk analysis, optimization, simulation), systems engineering management or project management, and a culminating individual or team-based design experience. Some curricula offer domain-specific courses that give students exposure to systems engineering practice in particular technologies or application domains (e.g., aerospace, communications, financial systems, health systems).

Most programs are designed to allow students to progress at their own pace, taking courses as they are offered and as work schedules and other commitments permit. Most programs geared

toward working professionals are completed in as few as 18 months to as long three years, depending on how often courses are offered and the student's desire to complete the program.

Program Evolution and Distinctives

Given the growing need for and interest in systems engineering, one can easily see why practice-oriented advanced degree programs in systems engineering are proliferating. Modern Internet-based technology makes “virtual presence” almost like being there – and these technologies and our ability to apply them effectively continue to advance. Some technologies and related pedagogies promote collaboration and interaction that come close to what can be achieved in a classroom setting. Several of the programs listed above have outstanding capability in this area and have made great strides in advancing systems engineering education by making quality advanced degree programs accessible to more practitioners in virtually any location where Internet access is available.

The questions remain: “How can more people get more relevant experience quickly?” and “How can academic institutions meet the needs for systems engineering talent and help individuals advance in their chosen profession?” While the distance learning and on-line models may answer the “more people” part of the question, it is not clear whether or not they can be equally effective in helping individuals gain relevant experience quickly – the kind of experience that leads to the *systems thinking* capacity needed to deal with the large scale complex systems and related problems that we face in every domain – health care, finance, education, communications, transportation, energy production and distribution, agriculture, national security, advanced manufacturing, global logistics, criminal justice, and a host of other domains, and all within the context of scarce, diminishing, or endangered resources that must satisfy the needs of a growing population.

After years of thoughtful consideration and deliberation about this challenge, the faculty of the Department of Systems and Information Engineering at the University of Virginia launched an innovative approach to systems engineering education for working professionals. The program, first labeled “Executive Master's Program” and, in 2003, renamed “Accelerated Master's Program” or AMP, was designed with following concepts in mind:

- 1) A solid, well-conceived, well-integrated, and rigorous academic curriculum centered on systems analysis, problem solving, information technology, and decision analytics.
- 2) Well-qualified full-time systems engineering faculty who know how to teach working professionals and can bring the same intellectual capacity to the program as is found in the research-oriented graduate program.
- 3) A balanced program that delivers both systems engineering concepts and business sense.
- 4) Case-based and team-based pedagogy that develops critical thinking skills and encourages team work, individual and group learning, and mutual support and assistance while ensuring individual accountability.
- 5) An accelerated, intense schedule that delivers a 33 credit hour program in one calendar year.
- 6) A cohort model in which 30-40 students form professional relationships that are maintained throughout the program year and beyond.

- 7) A delivery model with two “weeks-in-residence,” one at the beginning of the program and another at the end, as well as twenty weekends (all day every other Friday and Saturday), divided into four ten-week periods with two courses completed each period.
- 8) A residential component where members of the cohort learn, study, interact, dine, socialize, and live when the program is in session.
- 9) A “hands-on” philosophy where students have access to teaching assistants, administrative support, and other resources designed to enable students to focus on learning.
- 10) A comprehensive tuition that includes all program costs – tuition, books, meals, lodging, and fees so that cost are predictable and stable throughout the program.
- 11) Frequent interaction with experienced practitioners and academics who relate their experiences through seminar presentations and other forums.
- 12) A culminating design experience at the end of the program where students demonstrate their understanding of systems engineering by applying their skills to a problem involving large-scale complex systems with a real-world client.

Taken together, these concepts are designed to accelerate both the schedule for obtaining a degree and, more importantly, the rate at which students gain the experience, knowledge, and know-how to become the leaders needed throughout government and industry. The program began in 1999 as an 18-month program but shortly thereafter, on the advice of the Department’s Industry Advisory Board, transitioned to a 12-month program, and now has over 300 graduates, many of whom occupy upper to senior level positions in government agencies and private industry.

The program cost is competitive with other advanced degree programs, especially since the \$36,500 comprehensive tuition for the 2011-12 program year includes meals, lodging, books, software, and other fees, eliminating the need for students to purchase books and other materials needed for the courses. Faculty compensation for teaching courses on an overload basis and all program management related expenses are included in the instructional program cost. The breakeven point for the program is approximately 30 students and revenue in excess of cost is divided between the University, the School of Engineering and Applied Science, the Systems and Information Engineering Department, and the School of Continuing and Professional Studies which provides administrative support to the program. These excess revenues provide a base of discretionary funds that can be used to support new faculty, provide fellowships for graduate students, and meet other needs not available through state funds for higher education.

Approximately 2/3 of the comprehensive program cost is for the instructional program and the other 1/3 is for books, meals, and lodging. The residential component, provided through excellent facilities at the Darden Graduate School of Business, is an integral part of the educational experience since it allows students to remove themselves from other professional and personal distractions and affords them time to study together, work on group projects and team-based cases, and exchange ideas and experiences from their professional lives. More experienced students share wisdom and insight with younger students; younger students help older students recall material once learned and now forgotten. In short, students focus on learning and do so in a highly interactive environment where they can learn from each other as well as from well-qualified instructors.

Program Structure

The Accelerated Master's Program offers the following features:

- A one-year Master of Engineering in Systems Engineering degree program (May – April).
- Enables working professionals to earn the degree without career interruption.
- Taught by full time faculty of the Systems Engineering Department and the University's Graduate School of Business Administration.
- Weekend format – Classes meet on Fridays and Saturdays every other week with two full weeks in residence.
- Cohort learning model – provides support during the program and a strong professional network afterward.
- Comprehensive tuition covers instruction, books, software, and lodging and meals.
- Integrated curriculum concept developed by the faculties of the Systems Engineering Department and the School of Business with input from the Department's Executive Advisory Board.
- Curriculum concept is at the intersection of several disciplines: Systems Thinking, Information Systems, and Decision Analytics.

The curriculum is divided into three major components: 1) required “core” courses, 2) common elective courses, and 3) tailored elective courses and topics. In addition, all students attend a one-hour seminar course each weekend that classes are in session where they hear from experienced practitioners and academics, some of whom are alumni of the program. While the common elective courses vary from time to time, they are relatively consistent, reflecting what program leaders see as the most important courses to include in the systems engineering curriculum. The tailored electives are developed using input from each cohort to determine which topics are of greatest interest to the current cohort. While these topics are often similar from year to year, they vary with changes in technology, the global context, and current economic conditions.

The Program includes 33 credit hours: ten three-credit courses and a three-credit seminar series. The four core courses that are required to earn the Master of Engineering degree are:

- SYS6001: Introduction to Systems Engineering (the first course in the curriculum)
- SYS6043: Applied Optimization
- SYS6045: Applied Probabilistic Modeling
- SYS6002: Systems Integration (the Capstone Project)

The common elective courses include the following:

- APMA6430: Statistics for Engineers and Scientists
- SYS6050: Risk Assessment
- SYS6034: Discrete Event Stochastic Simulation
- SYS5044: Economics of Engineering

The tailored elective courses typically include topics selected from the following but may vary depending on the expressed interest of the current cohort:

- SYS6082: Selected Topics in Systems Engineering – Engineering Management Track taught by Darden Graduate School of Business faculty and include topics such as corporate finance, bargaining and negotiation, decision analysis, marketing, global economics, and entrepreneurship.
- SYS7002: Case Studies in Systems Engineering - typically more advanced material in areas such as data mining, financial engineering, human systems design, agent-based modeling, sustainability, and enterprise architecture.

The Friday evening seminars provide interaction with leading practitioners and academic specialists.

Since the inception of the program, students who live in relative proximity form study groups that meet between classes to work together and master difficult material. In recent years, the classroom delivery model has been augmented by a web-based technology (“Elluminate Live”) that enables “virtual study groups” and virtual study sessions with teaching assistants so that students are able to attend study sessions and collaborate on projects between formal class meetings. While this enhancement has served the program well, it has not replaced the need for face-to-face instruction and study group meetings.

The trade-off between schedule and choice in course offerings reflects the practical need to maintain a sufficiently large number of students in any course to justify offering the course and the need to deliver the courses on an aggressive schedule. Expanding course offerings through this program would result in a program that is economically unsustainable due to small class sizes or would extend the program since all of the courses the department offers could not be offered within the compressed time frame of the accelerated program. The instructional faculty believes the program offers a reasonable balance between relevant coursework and an intense and accelerated delivery schedule. This belief is supported by responses from program alumni who report high levels of satisfaction with the program.

Responses from Program Alumni

A January 2011 survey of AMP alumni who completed the program between 2001 (the first graduating class) and 2010 provides insight into the success of the program in meeting the academic and experiential needs of those who chose to pursue a degree through this program. Obviously, asking those who chose the program their opinions of the program is a bit like asking bus riders why they like public transportation – it may reveal little about the general population’s opinion of the program but it does provide valuable feedback that can affirm what is good and improve what needs improving.

Of the 300 plus AMP graduates, the survey was sent to about 240 for whom a reliable email address was available (a small number email addresses were rejected so it is unclear exactly how many alumni actually received the email survey invitation). Seventy-three alumni responded, a

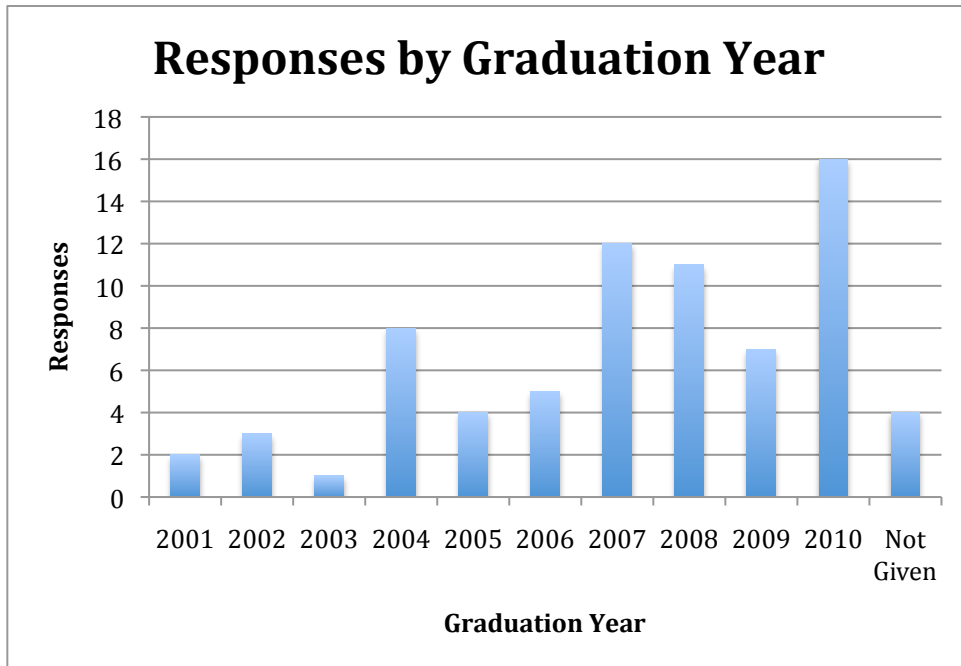


Figure 1. Response rate by graduation year.

reasonable response rate of about 30%. One or more response came from each class, as shown in Figure 1. Class sizes have varied from around 20 students per cohort during the early years to 35-40 students per class in more recent years. Responses are higher for more recent classes because more were reached through current email addresses and class sizes were larger. In any case, the responses are adequate to detect major program advantages and defects.

The survey asked questions in three areas: 1) curriculum content and instruction, 2) program delivery format and related support, and 3) program value to their professional interests and careers. Each question offered statements and choices (e.g., an “agreement” scale or an “importance” scale) as well as an opportunity for an open-ended response.

The first set of questions asked alumni the extent to which they “agreed” with the following statements, where “strongly agree” scored 5 and “strongly disagree” scored 1 on a five point scale. The questions are:

1. The academic curriculum was what I expected in a systems engineering masters degree program.
2. The curriculum is appropriate for a high quality systems engineering graduate degree.
3. The instructors were competent and capable for the courses they taught.
4. The course content and instruction were geared toward professional practice.
5. Program prerequisites adequately prepared me for the academic demands of the program.
6. The program sequence made sense academically.
7. The capstone project experience was an important component of the curriculum.
8. Overall, the curriculum was well designed and delivered effectively.

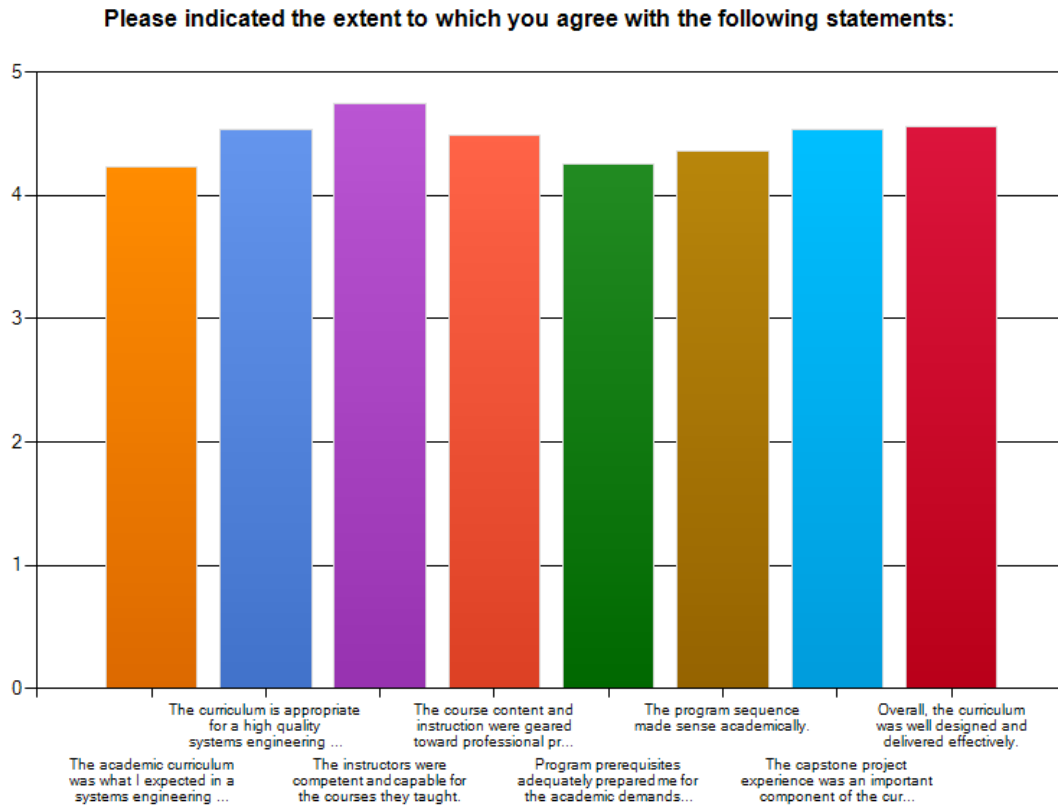


Figure 2. Response to questions relating to course content and curriculum.

Figure 2 shows responses to these statements, with the vertical axis showing the average level of agreement (with “5” being strong agreement). Note that the statement with the highest level of agreement was “The instructors were competent and capable for the courses they taught” but, importantly all of the statements were answered with relatively strong agreement, indicating that the alumni were generally pleased with what they received academically. Interestingly, alumni were in stronger agreement with “The curriculum is appropriate for a high quality systems engineering graduate degree” than with “The academic curriculum was what I expected in a systems engineering masters degree program” suggesting that they may have gained new insight into what it means to be a systems engineer.

Comments about the curriculum and courses ranged from very positive to comments with suggestions for improvement. Typical comments include

- I loved the course work and the professors in this program. I have an undergrad in Industrial Engineering so the coursework wasn't exactly what I was expecting. It ended up being a much better fit for my career goals and I am grateful for the classes as they were chosen for this program.
- The vast majority of instructors were excellent and very cognizant of the need to provide high quality instruction in an efficient manner due to the compressed nature of the program... the majority, but not all.

- Regarding the curriculum, I was not sure what to expect; however, in hindsight it dovetailed into my next two positions.
- The curriculum did an excellent job of emphasizing that Systems Engineer's are challenged with understanding large-scale complex systems involving technology, people, institutions, policy, economics, and social and cultural elements. Both the academic approach coupled with the real world Friday night seminars were key to our understanding of the practical application of the material.
- The capstone project was by the far the best learning experience of my entire academic career. Having a hands-on, real application/customer problem to tackle with a highly motivated, high-skilled team provided great closure to the program. That week was invaluable in my understanding of systems engineering.
- Every one of the professors was of superior quality. Curriculum was outstanding. Food was great. Don't know what else to ask for.
- This was the most quantitative curriculum I could find that did NOT focus on so heavily on Project or Acquisition Management. The analysis and design focus made it perfect for my needs.

The next set of questions asks alumni about their level of agreement with statements related to the program delivery format. These statements were designed to gain insight into alumni opinions regarding the importance of selected program features in their decision to pursue a degree through this program, again using the "agreement" scale. The questions are

1. The AMP delivery format (classroom-based) was an important factor in selecting a systems engineering graduate degree program.
2. The alternate weekend Friday/Saturday all day classes were generally compatible with my work schedule and created little conflict.
3. The "weeks-in-residence" were integral to the overall program delivery concept.
4. I could have achieved the same academic value through a purely on-line or distance learning format.
5. The "cohort model" was an important factor in selecting the AMP.
6. The accelerated program schedule was an important factor in selecting the AMP.
7. The cohort size was about right for an effective learning experience.

Figure 3 shows responses to these statements. Note that the statement with strongest agreement was "The accelerated program schedule was an important factor in selecting the AMP" indicating that, although intensive, individuals who choose this program are attracted to the shortened timeframe for earning the degree. Again, with one exception, alumni agreed with all of the statements, the exception being "I could have achieved the same academic value through a purely on-line or distance learning format." Of course, given that these alumni chose the classroom-based program, this response is not surprising. However, it does provide a strong indication that there are those who place great value on programs that offer "hands-on" and "face-to-face" programs.

Typical comments in response to these statements are:

Please indicate the extent to which you agree or disagree with the following statements.

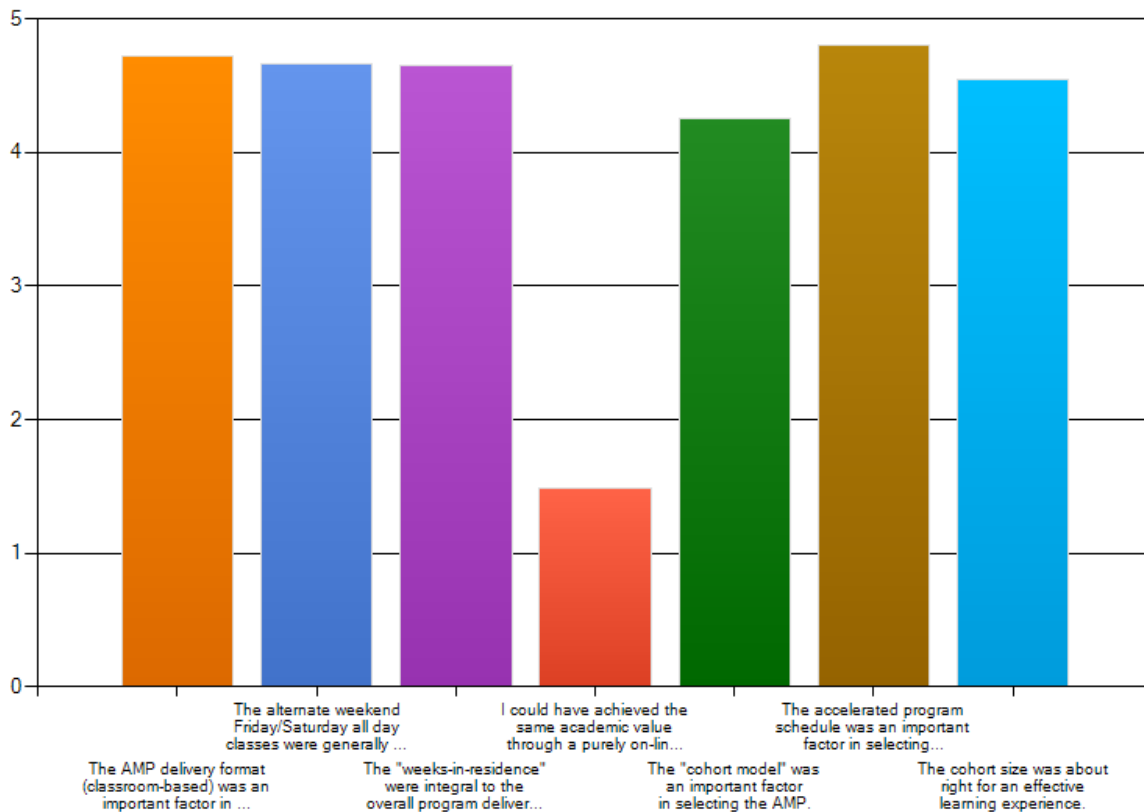


Figure 3. Responses regarding program delivery format.

- I absolutely would not have done the program on-line or distance learning. I tried that with one class in my undergrad and it took me 2 years to complete with a C. Spanish. Needless to say I know no Spanish....
- Our cohort is still close and we still work together. I will be friends and coworkers with this group of people for probably the rest of my life. Ten years later, they are still some of the best systems engineers I know in the community.
- The cohort model works.
- I could have achieved much of the academic value through other formats, but none of the other value - professional development, growing my network, making close friendships, and thoroughly enjoying the experience.
- Best was the Cohort model - especially using random number generators to assign folks into groups and teams throughout the program...whoever came with that idea - needs to be awarded.
- I am not sure many people can argue that they get more out of an online program than a classroom program.
- Even though the AMP and [xx] program is similar, the added semi-residential approach let the students bond after class instead of racing home to beat rush hour traffic.
- Compared to other programs, the AMP is the best program available that lets you continue to work, earn an engineering Master's degree from a highly reputable university, and develop

friendships with other students.

- Creating a Systems Engineering AMP that has similarities to an executive MBA program close to the [deleted] area was a brilliant idea. I do not know of any other engineering program that is similar.
- Work-balance is always difficult especially with the all day Friday classes, but both my employer and I knew this upfront so it was an expected expectation.
- Personally, I know that I learn most effectively in a face-to-face, interactive setting. On-line would be very difficult for me. I liked that I knew my classmates for the full year, but having new students in various classes would have brought more interaction and experiences and not been a problem (traditional campus class schedules). The weekend schedule did work very nicely with my professional requirements and having the year scheduled from the beginning was great.
- On-site learning is much more effective than on-line/distance learning.
- The format is definitely challenging because it's so compact, but it has two huge advantages over other programs I looked at -- the fact that you can obtain a degree in 14 months, and the fact that there is not much disruption to your work schedule, as you typically only miss one day per pay period. [note: this comment came from an alumnus who complete the program in the 14 month format]

The third set of questions addressed the perceive value of the program. One set of questions asked the extent to which their degree program was an influencing factor in an outcome affecting their professional advancement. The percentage of alumni who indicated that their AMP experience influenced each of the outcomes listed is as follows:

1. New job assignment with current employer involving increased responsibility – 59%
2. New job with different employer – 42%
3. Increased responsibility in current job – 68%
4. Increased compensation as a result of new assignment or new job – 73%

Finally, we asked alumni to indicate what they saw as having greatest long-term value to them from their AMP experience. Alumni were asked to indicate whether each of the following was “very important,” “somewhat important,” or “not important.”

1. AMP alumni network of friends and professional associates
2. Academic credential in Systems Engineering
3. Systems analysis tools and methods
4. "Systems methodology" way of thinking
5. Alumni services (e.g., career services)
6. Group problem solving and teamwork skills

Figure 4 shows responses to these questions. The “systems methodology way of thinking” and the “systems analysis tools and methods” were, by far, viewed as the most valuable. The academic credential and group problem solving and teamwork skills were also viewed as highly valuable.

Several of the comments speak to the long-term value some alumni derive from the program:

1. The whole systems way of thinking has changed my perception of engineering and problem solving. Invaluable skill.
2. The network of friends I had from the AMP helped me to find a job while I was in the program and also a second job later after graduation. With an online program, I would never have met these people and known about the different opportunities available.
3. The tools and methodology of problem solving stays with me even to today, almost 10 years since the program. I may not have all of the application support (Crystal Ball, @Risk, etc), but I know where to get it if I do need it and I have a solid understanding of why and what the tool does versus how it works. Too often people just learn the how it works versus the basis of understanding what and why it is doing what it's doing. The tools, experience, and matriculation gained from the program has been life-changing investment for me.

As you reflect on the Accelerated Master's Program, what do you consider to be of value to you? Indicate how valuable each of the follow is now or has been to you since you received your degree.

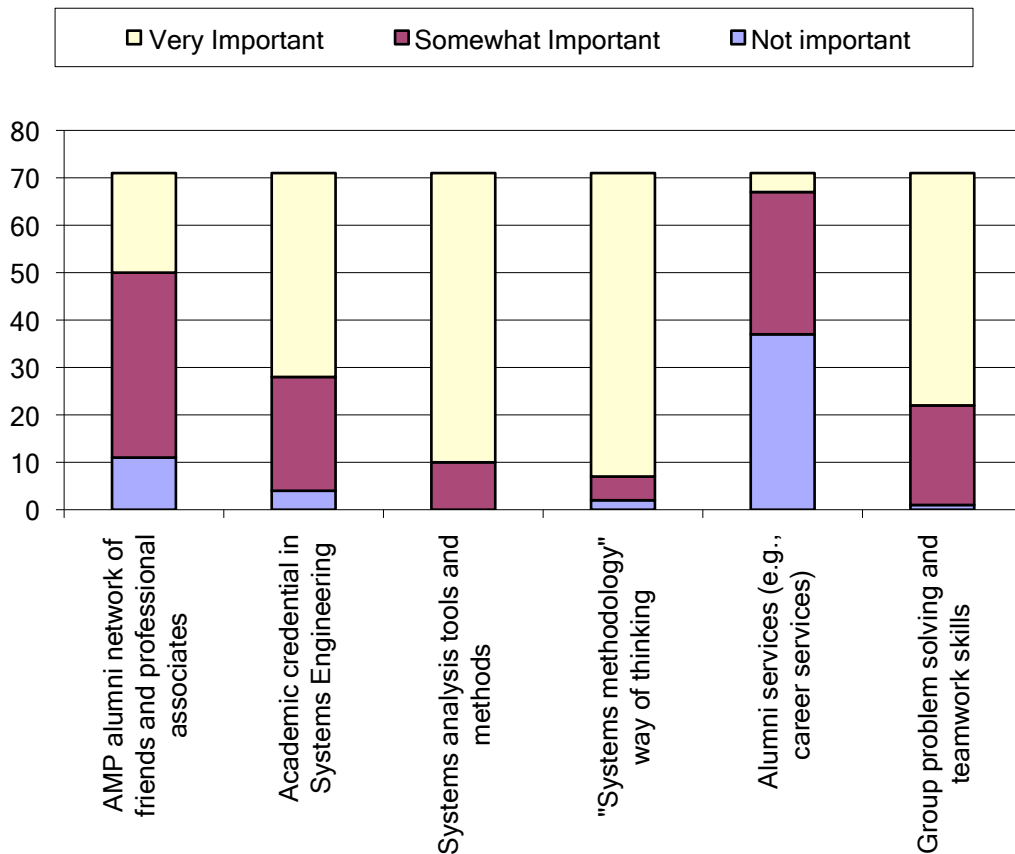


Figure 4. Responses to questions regarding the long-term value AMP program features.

Summary and Conclusions

We began by asking the questions “How can more people get more relevant experience quickly?” and “How can academic institutions meet the needs for systems engineering talent and

help individuals advance in their chosen profession?” Clearly the number and quality of on-line and distance learning systems engineering graduate degree programs designed specifically for working professionals suggest that many are seeking degrees and many highly respected institutions are offering them. This paper is not intended to infer that these programs are inferior or lack substance or fail to produce quality results. Rather, it is intended to caution those of us in the academy to proceed carefully, recognizing that there is still a need for “high touch, high value” programs that meet the needs of those who will benefit immensely from a personalized experience where students learn from each other, interact directly with well-qualified faculty, and are offered amenities that enhance the learning experience.

We do not expect other professionals to obtain quality educations primarily through on-line programs – where and how did your physician receive her professional degree and subsequent certifications? Why should we expect those individuals whom we expect to assume key technical and business leadership positions and address the problems associated with large-scale complex systems to receive any less? Additionally, the benefits of collaborative learning are proving to be substantial, especially when coupled with a program delivery model that encourages long-term personal and professional relationships.

In the end, individuals and their employers will choose systems engineering graduate programs that are convenient, cost-effective, and value producing. Academic institutions will offer programs that serve the needs of their constituencies, meet the demand for quality degree programs, and add to their resource base that can support other research and service activities. “High touch, high value” programs such as the one offered by the University of Virginia’s Department of Systems and Information Engineering should remain among the choices offered. To do otherwise would diminish our ability to equip the next generation of effective leaders.

¹ *Creating a DOD Strategic Acquisition Platform*, Report of the Defense Science Board Task Force on Future Perspectives, April 2009.

² *Best Jobs in America*, CNNMoney.com, <http://money.cnn.com/magazines/moneymag/bestjobs/2009/snapshots/1.html>, accessed January 17, 2011.

³ C. West Churchman, *The Systems Approach*, Dell Publishing Co., Inc., New York, 1968, p. 11.

⁴ Andrew P. Sage, “Systems Engineering Education”, *IEEE Transactions on Systems, Man, and Cybernetics – Part C: Applications and Reviews*, vol. 30, No. 2, May 2000, p. 164.

⁵ Sage, p. 168.

⁶ John E. Gibson, William T. Scherer, and William F. Gibson, *How to do systems analysis*, John Wiley & Sons, Inc., Hoboken, NJ, 2007, p. 4-6.