

## Distance Learning Trends for Graduate Engineering

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### Introduction

Constant technological changes require employees to seek educational opportunities to stay competitive. It is estimated that 50% of all employees' skills become outdated within 3 to 5 years.<sup>1</sup> In today's society it is quite clear that investment in intellectual capital is important and valuable in this new economy.

Intellectual capital is now a major engine of economic growth. Research translated to working ideas leads to innovation. Innovation leads to new products and services that lead to economic growth. Given this type of environment, where there is pressure to produce, it is important for decision makers to value and support educational opportunities in order to stay competitive.

Many engineers decide to update their skills either through short courses, workshops, or enrolling in graduate degree programs. Educational opportunities are available via distance learning through a variety of delivery formats. Furthermore, an increasing number of four-year universities are offering graduate degrees, certificates, and short courses via distance learning. The challenge for employees working in high demand fields, such as engineering and information technology, is finding the right course, compatible learning environment, and convenient time to pursue their life long learning goals. Additionally, the responsibility of the worker is stretched thin given the multiple roles and responsibilities required of him or her at work and at home. How do educators accommodate the learner working in the "Age of Information" and under increasing demands from home and work? To answer this question Virginia Tech conducted a statewide market research study in order to identify the distance education and professional continuing education opportunities for the Commonwealth Graduate Engineering Program CGEP. The outcomes of the study provided researchers with insight to key perspectives related to distance learning trends as well as the educational needs of professional engineers for the future.

### Overview of the Commonwealth Graduate Engineering Program

The Commonwealth Graduate Engineering Program is the premier distance learning education program of graduate engineering courses and degree programs in Virginia. This consortium, which consist of five universities: Virginia Tech, University of Virginia, Old Dominion, Virginia Commonwealth and George Mason, has provided graduate engineering courses to working engineers and other qualified individuals with strong backgrounds in the sciences since the early eighties. This collaborative effort has served thousands of engineers in a variety of disciplines throughout the years. We believe that professional continuing education and distance learning is a must for continued innovation and economic

development in the Commonwealth.

Currently students take classes via two-way video conferencing. There are over 20 receive sites for CGEP which are located within organizations such as the federal government, community colleges and higher education centers. To receive courses arrangements can be made to accommodate corporations that have the appropriate equipment. Students not able to attend class have the ability to watch the class session via videotape or by streaming media. As the consortium members look towards the future and innovative ways to scale the delivery of courses, our solutions lie with the growth of internet-based delivery tools. These tools, which allow faculty to create online learning communities, are becoming more acceptable as the Internet increases in acceptance and quality of service becomes more stable.

The Commonwealth Graduate Engineering Program has grown and changed to meet the needs of our learners. This organization has a solid infrastructure with world-class faculty and quality programs to support learners across the Commonwealth. This study marks a journey of learning that will impact the scope and type of professional continuing education provided for engineers to meet the challenges of the new millennium.

### **Continuous Process Improvement – CGEP Market Research**

#### *Description of the Study*

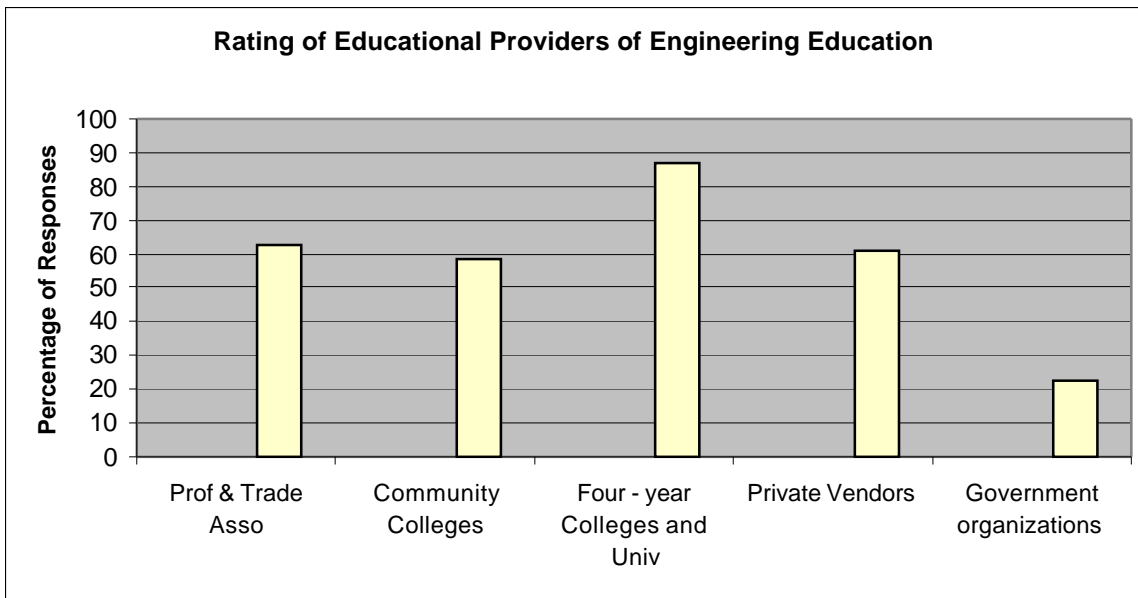
From October 2000 through May 2001, Virginia Tech conducted a market research study to update our understanding of the educational needs of engineers. This comprehensive study collected information from employers, potential market employees, current students, other national consortium organizations, faculty, and competitors. A variety of research methodologies were used and included personal phone interviews, written questionnaires, and a literature review. Virginia Tech teams from the College of Engineering, University Outreach, Institutional Research and Planning Analysis, and the Center for Survey Research conducted the study. A total of 1,411 participated.

#### *Outcomes of the Study*

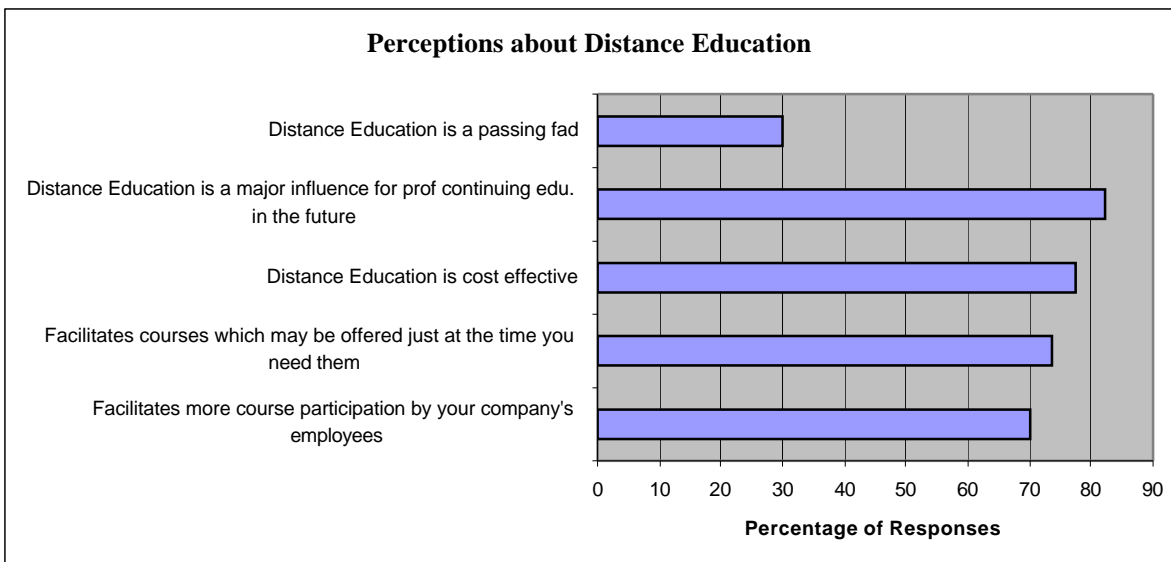
Over 50 perspectives about the program, how it functions today, and the needs of professional engineers for the future were identified. The major findings were outlined from the perspective of the employer, potential market employee, current student and faculty teaching in the Commonwealth Graduate Engineering Program. This paper will highlight the trends obtained from the study related to distance education programs designed for the working engineer from the employer and the potential market employee perspective.

#### *Perspective of Employers*

One hundred and seven employers of large, medium, and small Virginia companies participated in the study by responding to a telephone interview. For this respondent group as a whole, almost 70% have fewer than 500 employees in Virginia. Most of the companies reported they were consulting engineers. Over half of the companies were located in Northern Virginia, a more urban part of the Commonwealth. When asked to rate an educational provider's potential to provide educational and training programs, four-year colleges and universities were the overwhelming favorite of the employers, receiving excellent or good ratings from 87% of the respondents.



The major finding is employers view four year colleges and universities very favorably in their ability to deliver distance education programs. Furthermore, when asked about perceptions regarding distance education, respondents provided positive responses and viewed distance education as a major influence for professional continuing education in the future. Very few respondents view distance learning as a passing fad.

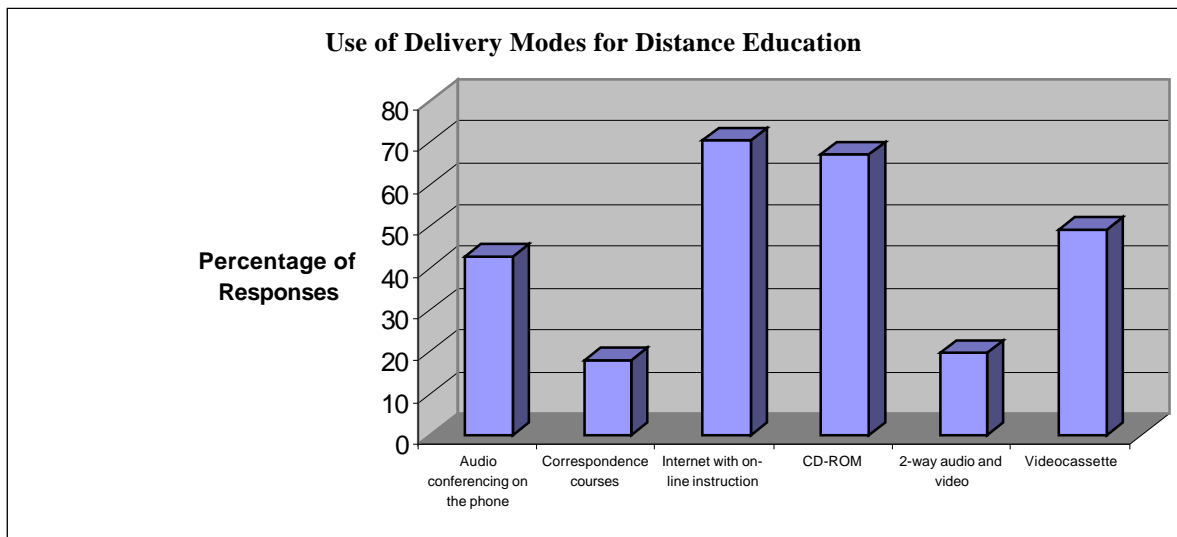


More than half of the respondents strongly agreed that distance education is cost effective however, over 50% of the companies have no formal contract with a vendor or educational service to provide distance education, and over 60% reported having no staff to facilitate distance education for employee training and professional development. This provides an opportunity for partnerships, although the lack of internal corporate infrastructure to support distance education does present a challenge. It was interesting to note that companies continue to use more traditional methods of continuing education and training. It is recognized, however, that different delivery methods of education and training are

technologically on the horizon. A higher percentage of larger companies use vendors or service providers for distance education or have an in-house staff to facilitate the learning.

The use of course management systems, a variety of delivery formats, and content designed for different learning styles are just a few types of requirements for competing in the distance education market. The cost to develop learning experiences using a distance education model may be one reason smaller companies are still using traditional methods.

The use of instructional delivery modes included over 70% of the organizations using the Internet with online instruction as the most often or sometimes used delivery method. The CD-ROM delivery mode was used by 67% with close to half using video cassettes delivered by mail.



To assess the need for new courses to offer to practicing engineers, company representatives were asked to name their three preferred course topics for enhancing the engineers' effectiveness. Respondents identified leadership/soft skills, project management software courses and information technology as preferred course topics for enhancing engineers' effectiveness. According to Bowman and Farr, "Employers are calling for [engineering] graduates who are not merely expert in design and analysis, but who possess the leadership skills to apply their technical expertise and to capitalize on emerging construction and information technologies, management models, and organizational structure."<sup>2</sup> This finding provides directions to investigate expanding the CGEP course offering to include non-technical course topics.

Training seems to be a win-win for all. The information received from the organizations describes a very positive climate for professional continuing education as well as for providing distance education learning experiences for their employees. The respondents did not see training as a potential for losing that employee and the employee sees opportunities for education and training as a major employee benefit. Furthermore, top performing employees rated the opportunities to learn new skills as one of the top three non-monetary rewards for employees.<sup>3</sup>

Employers were also asked to provide three major trends they perceived would have the most influence on the preparation of their engineers during the next five years. The pairs of topics mentioned most by respondents are listed below.

- Emerging technology and web-based trends
- Management and communication
- Management and flexibility
- Management and workforce concerns
- Organizational change and globalization/location concerns
- Organizational change and technical knowledge
- Software development and web-based trends

The information received from the organizations describes a very positive climate for professional continuing education and distance learning. The employers' request for product quality, a solid track record for delivery, value for the dollar, and the potential for distance learning as an option for their employees is no different than criteria being sought nationally. Furthermore the ability to deliver quality continuing education courses will be essential to the perceived effectiveness and success of four-year colleges and universities.

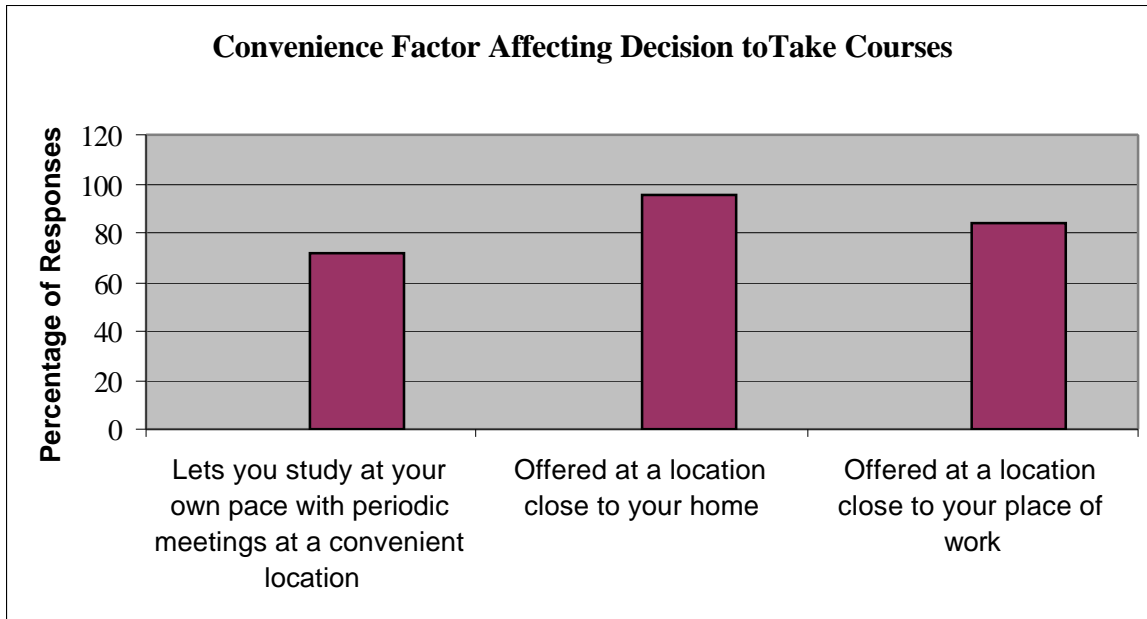
#### *Perspective of Working Engineers*

The potential market consisted of 860 employees in Virginia. Participants were randomly drawn from the Dunn and Bradstreet's database of 13,809 engineers from a variety of industries, health organizations and governmental agencies in the Commonwealth. Only individuals with a bachelor's degree or higher were included in the sample. Members of the potential market provide unique insights for the future. These are the working engineers, information technology specialists and leaders to whom we look to for expansion of the program to insure it is state-of-the-art.

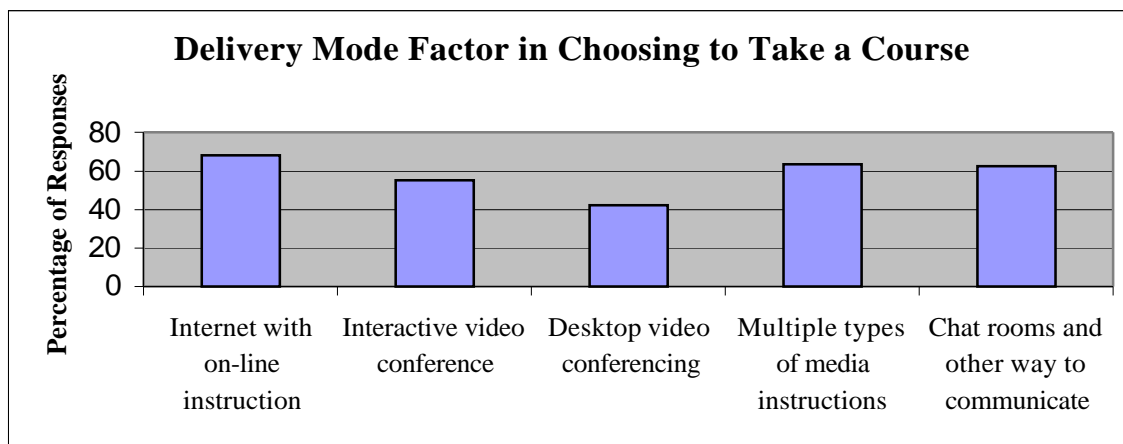
The participants were asked to name their top three choices of course topics in these major categories, engineering, information technology, and leadership/management. Their choices in the engineering category were electrical, mechanical, and environmental; in the information technology category computer networking, database management, and programming; and in the leadership/management category project management, people management, and executive leadership.

Some participants did not identify earning a degree as their primary goal. This finding provides opportunities to expand the course formats to include certificates or "Bits of Knowledge" learning modules. For example, the certificate format is three to four courses organized around a specific area of competency, and a "Bits of Knowledge" format allows an individual to learn one specific skill or obtain a piece of information to apply immediately at work. In fact, of the engineers surveyed, there were three major factors that influenced choices in deciding to take courses. These factors included convenience, course delivery mode, and course content. This reinforces the concept of the new consumer pressed for time who is more interested in the convenience of locating and using a product. The potential market respondents rated each of the factors on a scale from very important to not at all important. Of the convenience factor, considered somewhat to very important, courses that let you study at your own pace with only periodic meetings at a convenient location received a 72% response rate from participants whereas, classes offered at a location close to work

received 84% and courses taken at a location close to home received 96%.

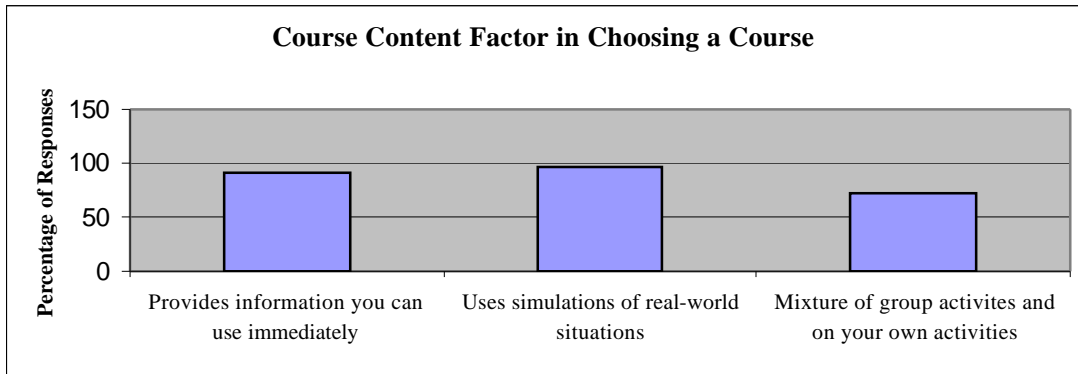


Overall responses indicated that the delivery method was not as crucial as scheduling and convenience for the students; however the way a student “receives” a course is a dimension of both scheduling and convenience. Courses offered over the Internet with on-line instruction were considered at least somewhat important by 76% of the participants, the inclusion of multi-media instruction by 63%, courses that include chat rooms and other ways to communicate with faculty and classmates by 62%, interactive video conferencing by 55% and desktop video conferencing by 43%. Participants identified a demand for asynchronous learning on the Internet. In 2000, corporations spent \$2.2 billion on Internet based training. By 2003, this market is expected to increase to more than \$11 billion<sup>4</sup>. The critical aspect of this development is to ensure that students are learning in an online environment where they can at the same time be part of a community of learners.

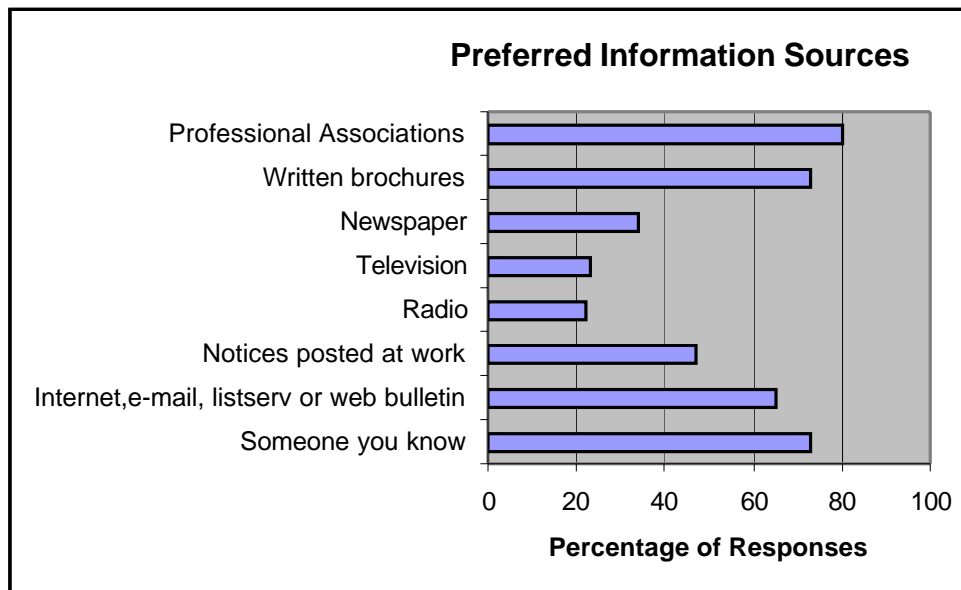


As noted in literature, students want projects or case studies as preferred instructional methods and want to interact with others on completing projects and developing a sense of

community.<sup>5</sup> This theme was also reflected by the participants surveyed. Courses that provide real-world situations are very or somewhat important to 97% of respondents and 91% of respondents view it very or somewhat important to take courses where they can use the information immediately on the job, whereas 72% prefer courses that include a mixture of group and on your own activities.

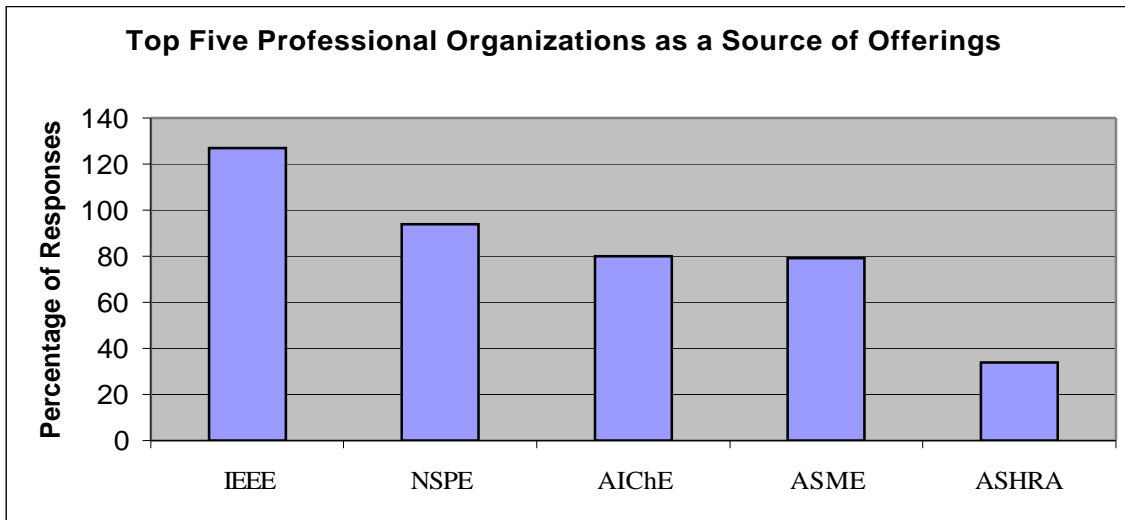


The preferred way working engineers want to receive information about course opportunities is from professional associations or from people they know at work. Eighty percent chose professional associations and societies as their preferred source to receive information. Seventy-three percent like to receive information from people they know at work or in networking situations. Recent graduates are more likely to prefer a referral from someone they know by the Internet, email, and/or listserv. Interestingly, 73% chose to receive written brochures or catalogs, whereas TV and radio were preferred by only 22%.



Engineering employees were asked to name three associations or professional societies that they would most likely use to find out about courses or training programs being offered. There were 56 professional groups mentioned, and the top five were the Institute of Electrical and Electronics Engineers (127) responses, National Society of Professional Engineers (94), American Institute of Chemical Engineers (80), American Society of Mechanical Engineers

(79), and the American Society of Heating, Refrigeration, and Air Conditioning Engineers (34).



Engineering professional societies are collaborating with distance learning service providers to create portals to support lifelong learning activities for working engineers. For example the IEEE has a strong relationship with four-year institutions to offer educational programs for credit in telecommunications, project management, and computer science. This type of collaboration forges increasing opportunities to leverage resources as well as create a shared vision for supporting the educational success for the working engineer.

The respondents perceived several factors that were important to their success were technical knowledge, keeping up to date with state-of-the-art developments in the field through continuing education, information technology knowledge, and leadership and management knowledge. Employees also responded with their perception of the trends that would have the most influence on engineers in the next three years with the Internet, advanced technologies/broadband, computer, and economy. The top ten are listed in the table below:

<b>Top Ten Business Trends in the next three years:</b>	<b>Frequency</b>
Internet	91
Advanced technology - broadband	84
Computer	70
Economy	50
Information Technology	47
Practical Experience	42
Workforce	40
Management/Leadership	37
Design	33
Communication	33

*Implications for the future*

As we look towards building upon the Commonwealth Graduate Engineering foundation for



the future our challenge will be to meet the needs of our 21st century learner. These learning experiences can take the form of certificates, “Bits of Knowledge” learning modules, graduate credit or non-credit course offerings and delivered either by Interactive Video Conferencing or via the Internet with online learning. Our current delivery format, interactive video conferencing as well as our plan to move towards online course offering is similar to the national trend.<sup>6</sup> The key is for CGEP to be agile enough to provide flexible and convenient learning opportunities where learners can work on real-world problems as well as participate in a learning community.

Our employers recognize the importance of learning initiatives that match their strategic goals and they value the quality of Virginia’s four year colleges and universities with being able to provide high quality learning experiences for their employees. The outcomes of this study will be used as a departure point to further develop the Commonwealth Graduate Engineering Program. Additionally, our goal is to meet the educational needs of the knowledge worker as well as impact the scope and type of professional continuing education provided for engineers to meet the challenges of the new millennium.

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#### Biographical Information

LINDA G. LEFFEL, Professor, Director of Marketing Research, University Outreach. Dr. Leffel received her Doctor of Education, 1973, Virginia Tech. The University Continuing Education Association (UCEA), Region III in 2001 presented her with the Outstanding Service to Continuing Education Award. It recognized her contributions to advancing the development and use of distance-education and market-research initiatives.

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