

## **AC 2009-1432: EDUCATING FEDERAL ENGINEERS TO BE ENTREPRENEURIAL THINKERS AND LEADERS – WHO WOULD OF THOUGHT?**

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# **Educating Federal Engineers to be Entrepreneurial Thinkers and Leaders Who Would Have Thought?**

## **Abstract**

The Headquarters of the U.S. Army Corps of Engineers (USACE) contracted with the Department of Civil, Environmental, and Infrastructure Engineering (CEIE) of George Mason University (GMU) to assist in the development of a Learning Plan for USACE. In order to determine the learning needs of the USACE Headquarters staff with respect to Leadership, Communication, and Professionalism, CEIE developed and facilitated three workshops. The workshops resulted in GMU offering a Graduate Certificate Program in Technical Entrepreneurship tailored to meet the needs of USACE. Technological change and the increase in privatization and enterprise development trends within the public sector require a wide variety of multidisciplinary skills for the successful management of government technical programs and projects. The graduate level technical entrepreneurship certificate responds to the need for broad training in entrepreneurial skills, performance measurement, engineering information management, systems analysis and leadership.

This paper assesses the impact of the GMU certificate program on USACE Headquarters and its employees. It attempts to answer the question: Are USACE engineers better leaders, better communicators, and more professional as a result of the completion of the certificate program? Do the students feel that they have improved in these areas? Does the USACE leadership see an improvement? The paper compares the assessment methodology and goals of a traditional academic setting with those of an engineering and construction focused Federal organization. The results of student surveys are mapped to the intended goals of the certificate program. Interviews with selected leaders within the USACE Headquarters provide their perspective on the certificate program and help to clarify tangible and intangible organizational benefits.

## **Introduction**

In the fall of the year 2000 the U.S. Army Corps of Engineers (USACE) began a series of reorganizations that changed the Headquarters (Hqs) and eventually the entire Corps from a hierarchal and technically disciplined stove piped organization to one that is matrixed and more systems focused. Reorganizations are always disruptive, but the leadership of the engineering and construction (E&C) division at Hqs recognized a need for various types of training to help the staff cope with the transition and to better prepare them for their roles within the new matrix organization. They drafted an E&C Learning Plan focused on two goals; first, provide some general training avenues for E&C personal to promote the development of skills that would

apply to everyone such as communication, leadership, and professionalism; and secondly, to promote an environment which encourages the individual to identify opportunities to learn as it relates to projects and/or tasks. This includes taking responsibility for participation in some form of a learning activity such as a course or workshop. The Learning Plan included various types of in-house workshops addressing everything from improving PowerPoint presentations to details of the Military Construction and Civil Works Programs project cycle. The Learning Plan called for a workshop to be held to solicit input from among the Hqs E&C staff on the General Learning Areas so that members had a chance to provide input on the skills they believed were needed in the new organizational structure. The Learning Plan stated that the information gathered from the workshop was to be summarized and used to develop some specific general learning activities.

In the fall of 2001, Headquarters U.S. Army Corps of Engineers (HQUSACE) contracted with the Department of Civil, Environmental, and Infrastructure Engineering (CEIE) of George Mason University (GMU) to assist in the development of its Learning Plan by facilitating three workshops. The workshops consisted of half day programs. Three workshops were held over a week and over 100 Corps engineers and technical employees participated. The goal of the workshops was to determine the learning needs of the HQUSACE with respect to Leadership, Communication, and Professionalism; CEIE developed and facilitated three workshops. The workshops were intended to elicit feedback from the technical staff as to which topic areas were desirable for training.

The workshops started with a Leader Brainstorming Exercise which was followed by CEIE presenting various experts' views on leadership – this demonstrated the similarity of the results of the exercise to the experts' opinions. Afterward a Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis was performed. Participants identified strengths and weaknesses of the USACE and after discussion, CEIE employed the Nominal Group Technique to prioritize the weaknesses and find opportunities for improvement. Participants were given three votes each, choosing the weakness or weaknesses that were most important on a personal level. Based on these rankings, the participants brainstormed as to what types of training could address the areas they identified for improvement.

In February 2002, the CEIE team issued a report, U.S. Army Corps of Engineers Headquarters Strategic Learning Workshop, Summary of Workshops which identified and recommended a number of actions that would benefit the E&C Learning Plan. For example, they suggested having HQUSACE employees serve on Industry Association Technical Committees. Each recommendation included the potential benefits to HQUSACE. Additionally, the workshop identified strong support by one or two groups for an on-site Graduate Study Program. One group did not think highly of the Graduate Study Program, which resulted in CEIE's report lacking to address the potential benefits for such a program.

The E&C leadership considered the recommendations of the Summary of Workshops and implemented or encouraged a number of them. The most significant implementation came from the leadership deciding to implement an on-site Graduate Study Program. CEIE already offered a Certificate Program in Entrepreneurship and they presented it to the E&C leadership as a potential solution to their needs. The E&C leadership decided that the flexibility of the

Entrepreneurship Certificate could provide a good match for the organization and so CEIE developed a plan of courses leading to the Certificate in Technical Entrepreneurship within the Federal Government. The graduate certificate in Technical Entrepreneurship is a professional program tailored to meet the needs of the USACE and targeted at USACE employees who are making the transition into management or project/program management positions; it also encompasses other employees who are interested in increasing their understanding of how Federal projects and programs may be identified, planned, funded, and managed.

Technological change and the increase in privatization and enterprise development trends within the public sector require a wide variety of multidisciplinary skills for the successful management of government technical programs and projects. The Technical Entrepreneurship certificate is intended to respond to the need for broad training in entrepreneurial skills, performance measurement, engineering information management, systems analysis and leadership.

Potential candidates are expected to possess a bachelor's degree in Engineering, Architecture, Mathematics, Science, Business, Social Science or other related fields. One course is offered each semester, meeting once weekly for two hours forty minutes at the HQUSACE building in Washington, DC.

The certificate program consists of a core course, Technical Entrepreneurship in the Federal Government (3 credits), and 12 elective credits (four courses) selected from the certificate program course listing or other approved Master of Science (MS) Degree course offerings. These courses are aimed at building the foundations of entrepreneurship and engineering management. The elective certificate program courses consist of the following:

- CEIE 690 - Technical Entrepreneurship in the Federal Government
- SYST 530 - Systems Management and Evaluation
- CEIE 671 - Best Engineering Management Practices
- CEIE 685 - Civil Engineering Information Management
- CEIE 690 - Leading Innovation

Other courses may be substituted based on student interest:

- CEIE 601 Infrastructure Modeling (3 credits)
- CEIE 605 Infrastructure Systems Analysis (3 credits)

These courses are accepted for credit towards the GMU M.S. in Civil and Infrastructure Engineering. Some courses may have prerequisites for which the student must qualify or seek a waiver from the appropriate instructor.

The core course of Technical Entrepreneurship in the Federal Government addresses the development of enterprise goals and a business strategy as well as execution of that strategy. Students learn how to develop a new idea, identify the opportunities associated with the idea, estimate the market audience and impact of the concept, estimate the costs of development and implementation, promote a technical program, and how to compete for government financing of technical projects/programs.

The Certificate Program also addresses one of the concerns raised in the February 2002 Workshop: deterioration of technical expertise within HQ. The program offers employees a specific education plan that is flexible and accommodates work and personal responsibilities, as well as, opportunities to meet and work with fellow students from other USACE functions and departments. It exposes students to current best-in-class ideas, developments, and practitioners - making extensive use of both case studies and speakers from both public (e.g., National Aeronautics and Space Administration, National Science Foundation, National Institutes of Health, Virginia Department of Transportation, Fairfax Water) and private sectors (e.g., Dewberry, Landsdowne Development).

In the spring 2003 semester, CEIE offered the first course for the Certificate Program - Technical Entrepreneurship in the Federal Government. Of the initial 14 students, six continued with the program until completion, earning their certificate at the conclusion of the spring 2005 semester. During each of the following four semesters, a number of new students began taking courses. Some took the full number of courses required for the Certificate, while some only took one or two courses that piqued their interest. After presenting the first five courses towards the certificate program, the plan was to begin repeating the courses. However, in the sixth semester when the Technical Entrepreneurship class was repeated, it became evident that generating enough interest in the courses to meet the minimum course size of eight students would become problematic.

Despite the difficulty filling that course, many of the students who had earned their certificate as well as other program participants indicated a desire to continue taking courses towards a Master's degree. So rather than repeat courses on a repeating five-semester cycle, it was decided to offer courses based upon the potential for the greatest participation from employees. That has led to recent course offerings on Infrastructure Modeling and Infrastructure Systems Analysis.

Despite the new course schedule, there is still difficulty in attracting students; during the seventh and ninth semesters, no course was offered. However, in contrast to the difficulty in attracting new students and obtaining candidates interested in satisfying the Certificate requirements, by the fall 2007 semester an additional three students had completed the Certificate program, two had completed their MS degree (taking additional classes outside the USACE office environment), and another five are on schedule to earn their MS degree in the spring 2009 semester.

### **Goals and Objectives of the Project**

This paper assesses the impact of the GMU certificate program on HQUSACE and its employees. It attempts to answer the following questions:

1. Are USACE engineers better leaders, better communicators, and more professional as a result of the completion of the Certificate Program?
2. Do the students feel that they have improved in these areas?
3. Does the USACE leadership see an improvement?

The paper compares the assessment methodology and goals of a traditional academic setting with those of an engineering and construction focused Federal organization. The results of student surveys are mapped to the intended goals of the certificate program. Interviews with selected leaders within the HQUSACE provide their perspective on the certificate program and help to clarify tangible and intangible organizational benefits.

### **Collection of Data**

To begin the assessment of the Certificate Program, a survey form was developed. The intent of the survey was to gather the student's opinions on the value of the course(s) to them and the organization, both short and long-term; whether they believed the course(s) helped improve their communication and leadership skills and professionalism; whether their problem solving skills improved; and whether the course improved their ability to generate creative ideas and solutions. The survey was sent to a sampling of former students – those that completed the Certificate Program and those that did not – as well as some HQUSACE employees that did not take any of the offered courses. Non-students were included in the survey to better understand their reluctance to take any of the offered courses.

The survey was emailed to twenty individuals of whom fifteen responded. Of the responders, eight of the students had taken one or two courses, six had completed the Certificate Program (five or more courses), and one had not taken any courses. One of the students taking one or two classes only completed the question on the survey pertaining to the number of classes they took and so no other data from that form was usable. The data analysis presented hereinafter is based upon seven students having taken one or two classes, six having completed five or more courses, and one non-student response.

In order to get a sense and context for the development of the USACE Learning Plan and the Workshop that lead to the Certificate Program, individuals involved with those efforts were interviewed. Interviewed were the former HQUSACE Program Manager for the E&C Learning Plan who went on to be the Program Manager for the GMU Certificate Program at HQUSACE during the first five courses, and the former Deputy Director for Engineering & Construction at HQUSACE during the development of the E&C Learning Plan.

In addition to interviewing those directly involved with the HQUSACE Learning Plan, also former students of the Entrepreneurship course in the GMU academic environment; and two GMU instructors from the HQUSACE courses were interviewed; one of whom was also instructing the Technical Entrepreneurship course at Dewberry - a planning, design, and program management firm. Dewberry partnered with GMU in a similar manner to HQUSACE with GMU offering its first course in Technical Entrepreneurship at Dewberry in the fall 2008 semester. The Dewberry course provides the opportunity to see how another technically focused organization plans to assess the Certificate program and so it was decided to interview the Corporate Director for Training and Development Dewberry to see how its program might differ from the HQUSACE program.

A literature search led to a number of useful journal papers, magazine articles, and books that helped define entrepreneurship in the context of a large technical organization, entrepreneurial government, organizational culture and its effect on individuals. These and numerous sources also discussed the benefits of experiential learning techniques when conveying entrepreneurship.

Additionally, the development of a concept map – a graphical tool that can be used for organizing and representing knowledge – was deemed a potentially useful tool in helping to visualize and organize the concepts and relationships supporting entrepreneurial thought. To facilitate the development of the concept map the Cmap software tool developed at the Florida Institute for Human and Machine Cognition (IHMC) was used. The concept map was used to identify skills taught in the various courses in the Entrepreneurial Certificate Program and relate them to the traits and skills associated with entrepreneurship.

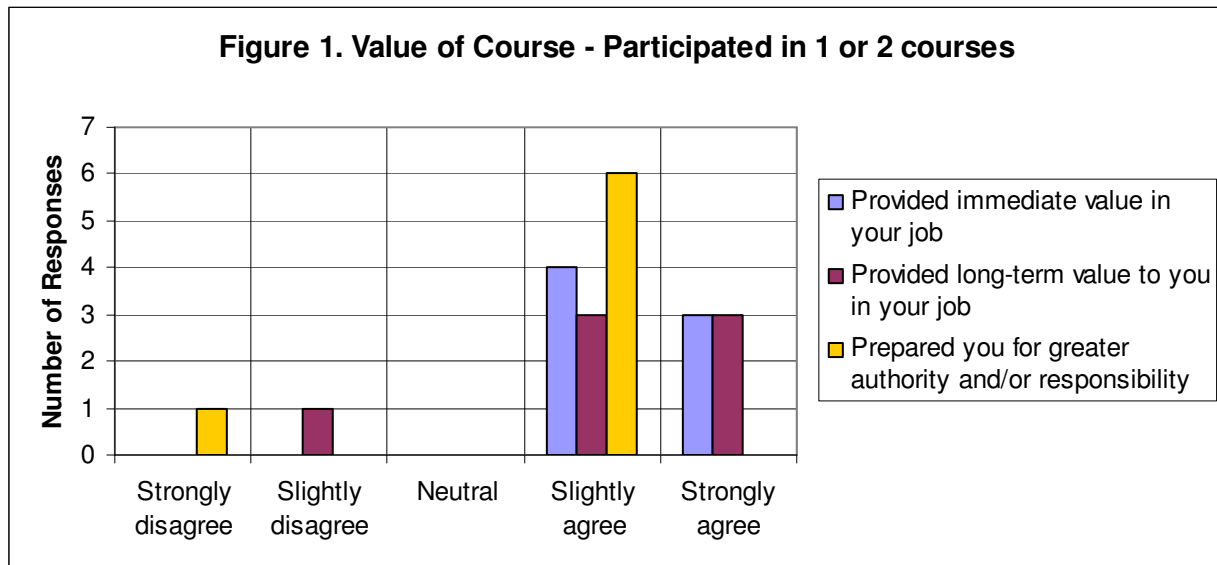
Concept maps are hierarchical, with the most general concept at the top of the map. The focus question is the starting point of a concept map and one of the hardest steps in developing the map is deciding on what the focus question should be. As Novak (2008) points out, "...it is best to construct concept maps with reference to some particular question we seek to answer, which we have called a focus question. The concept map may pertain to some situation or event that we are trying to understand through the organization of knowledge in the form of a concept map, thus providing the context for the concept map." Novak goes on to say "The type of focus question makes a difference in the type of concept maps that the student builds. A question like "What are plants?" will lead to a declarative, more classificatory concept map than the question "Why do we need plants?" Experiments show that not only the focus question, but also the root concept of a concept map have a strong influence on the quality of the resulting concept map (Derbentseva et al., 2004, 2006)." A number of possible focus questions were considered: Do the courses in the Technical Entrepreneurial Certificate Program support or reinforce entrepreneurial traits and skills?; Can entrepreneurial traits and skills be learned?; Is HQUSACE more entrepreneurial as a result of the Technical Entrepreneurial Certificate Program?. After further research, the best focus question was determined to be "Has the GMU Certificate Program made the students more Entrepreneurial?"

The details of the development of the concept map will be discussed later in the paper, but various concepts seemingly related to the focus question get listed in what is called a parking lot of the Cmap tool. As these concepts (such as "learned" versus "natural" entrepreneurial traits and/or skills) became evident, it became clear what the foundation of entrepreneurship is and how the certificate program supports the learning of entrepreneurial skills. The role of the organization, its management and culture, and how they affect entrepreneurship all needed to be addressed by the focus question.

### **Analysis of Data**

The survey data is presented in figures 1-7. Figure 1 displays the responses of USACE students that took one or two courses to a series of questions related to the value they believe they received from the courses offered as part of the Certificate program. Seven students participated in the survey. This represents 23% of the students who participated in the certificate program. It

should be noted that the results of this analysis are not statistically significant due to the small sample size.

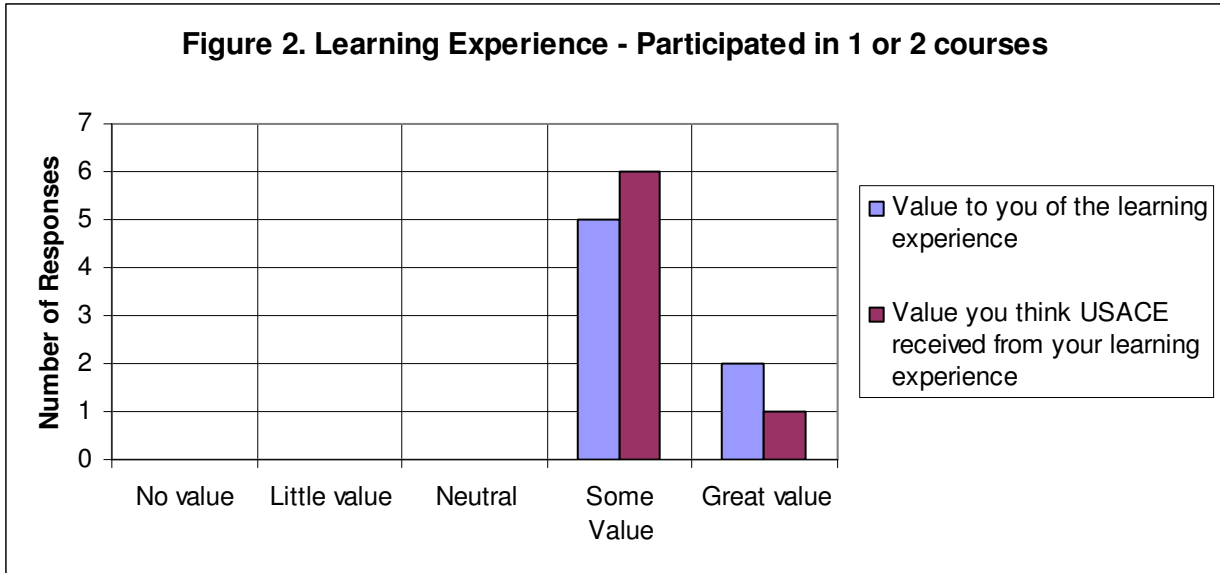


All seven students agreed that the course(s) provided an immediate value to the student in their current job. Six of seven believed the course(s) provided a long-term value to them in their current job. Six of seven believed the course(s) prepared them for greater authority or responsibility. One student disagree slightly that the course(s) provided any long-term value to him/her in their job. Possibly significant, that same student strongly disagreed that the course(s) prepared him/her for greater authority or responsibility. Since the negative ratings came from the same student, in hindsight it would have been useful to ask the students exactly which course(s) they attended. Since students were told the survey would be anonymous, it was not possible to follow-up with them to discover why this one respondent rated these items negatively.

While Figure 1 displays some key questions from the survey, two questions are not reflected about whether the individual had been promoted since taking one of the courses and if she/he believed the course had an effect on their being promoted. One of the seven students had been promoted and while that student responded to questions reflected in Figure 1 as strongly or slightly agreeing, s/he indicated that it was believed that the course(s) was neutral in having a positive impact on their getting the promotion. Had the survey not been anonymous, follow-up questions to this student may have been more revealing.

Figure 2 displays the responses of USACE students taking one or two courses to a series of questions related to the value of the learning experience they believe they received from the courses offered as part of the Certificate program.

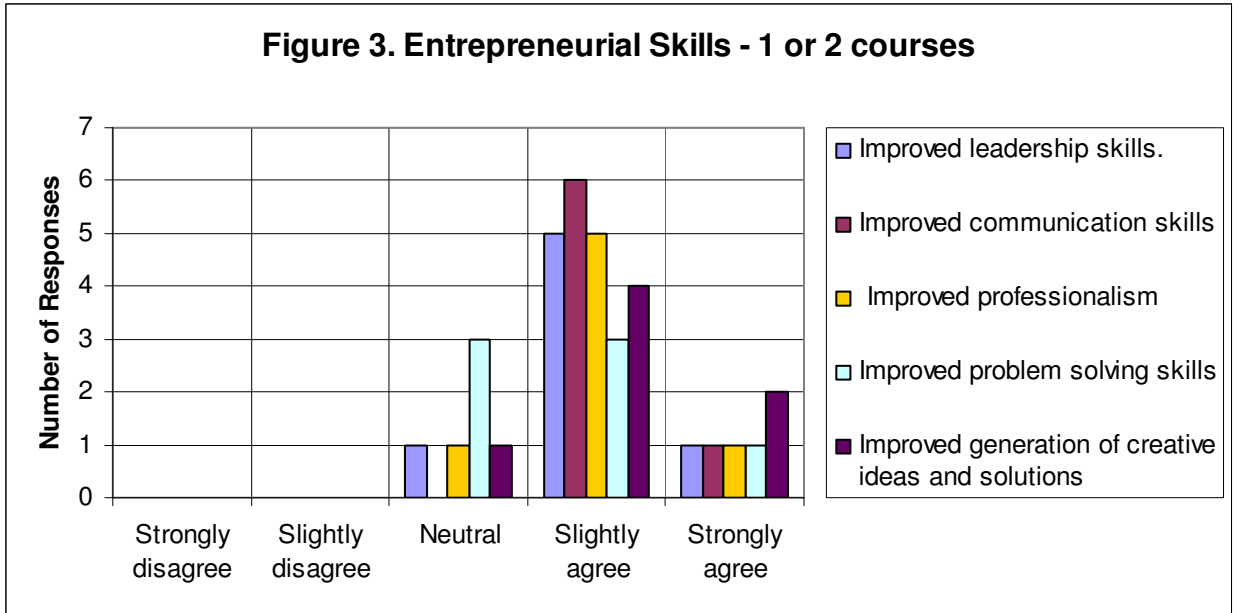




All seven students believed some or great value was received from the learning experience by themselves and the organization. Even the student who rated the questions in Figure 1 to a lower degree, agreed that the learning experience provided some value to him/her.

At this point, it might be useful to clarify what is meant by the learning experience. Much research has been done into what constitutes learning, learning experiences, and knowledge. Since the focus of this paper is the Technical Entrepreneurship program, using this focus helps to narrow the applicable references to a slightly smaller source of selections. Sherman (2008) states “The process of learning, by individuals or organizations, is complex and has no one definition. Brookfield (1984) described learning as the process of acquiring skills and knowledge.” While this seems to help define learning experience it still seems incomplete. Much has been written about experiential learning as well, more specifically, its impact on entrepreneurial thought, so this, too, must be included in our meaning of the learning experience. Sherman continues “Kolb (1984) described learning as “the process whereby knowledge is created through the transformation of experience.” Experiential learning is any knowledge gained through experience. Experiential learning actually occurs when students engage in some activity, reflect upon the activity, derive insight from the analysis, and incorporate the result through a change in understanding (Kolb, 1984).” Since the CEIE Entrepreneurship class uses experiential learning, this report will use Sherman’s definition as encompassing the learning experience – acquiring skills and knowledge through engagement of students in activities.

Figure 3 displays the responses of USACE students that took one or two courses to a series of questions on the improvement of entrepreneurial related skills they believe they received from the courses offered as part of the Certificate program.



The majority of responses fell into the “slightly agree” category for the questions dealing with leadership skills, communication skills, professionalism, and improved generation of creative ideas and solutions. However the problem solving skills were equally divided between the neutral and the slightly agree rating. It is interesting to note that the goal of the E&C Learning Plan was to improve the employees’ communication & leadership skills and their level of professionalism. In almost all cases, these very skills were rated as improved by the students. While the E&C Learning Plan did not address entrepreneurial skills like problem solving skills or creative ideas, these too were generally improved in the opinion of the students.

Figure 4 displays the responses of USACE students that took five or more courses to a series of questions related to the value they believe they received from the courses offered as part of the Certificate program. Like Figure 1 but for students that attended more classes and completed the Certificate program. The students’ responses confirm the hypothesis that students valued the courses and believed they and the organization benefited from the courses more than the students that took fewer courses.

The students were unanimous that the courses provided immediate and long-term value to them in their jobs. All but one believed strongly that the courses prepared them for greater authority and/or responsibility. While Figure 4 displays some key questions from the survey, not reflected are two questions about whether the individual had been promoted since taking one of the courses and if they believed the course had an effect on them being promoted. One of the six students had been promoted and while that student responded to questions reflected in Figure 4 as strongly agreeing, s/he slightly agreed that the course(s) had a positive impact on their getting the promotion. Again, had the survey not been anonymous follow-up questions to this student may have been more revealing.

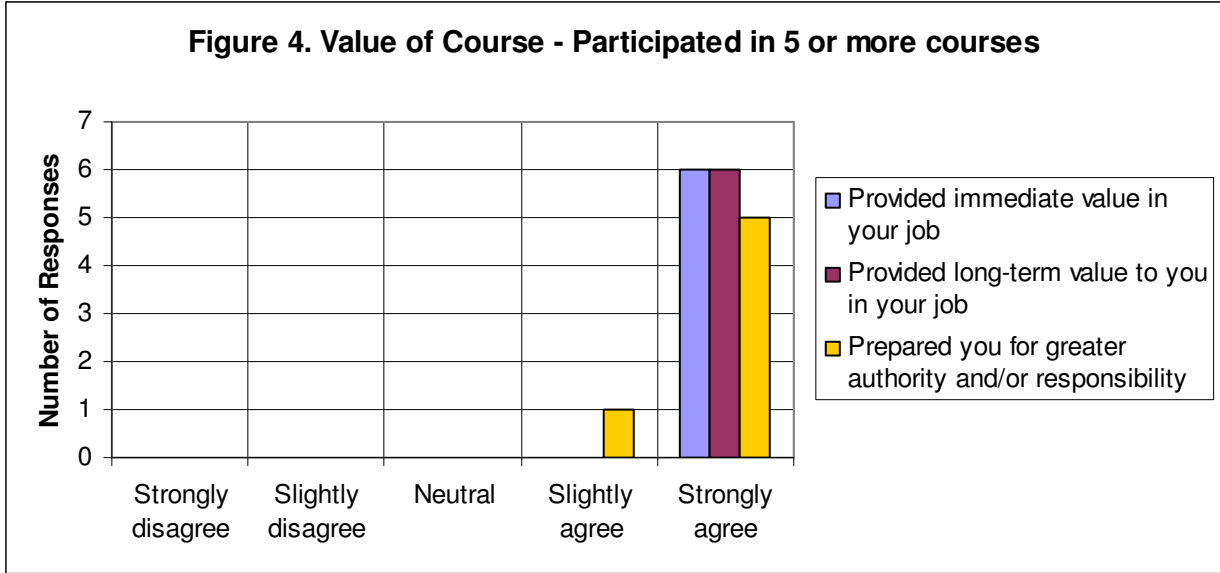


Figure 5 displays the responses of USACE students taking five or more courses to a series of questions related to the value of the learning experience they believe they received from the courses offered as part of the Certificate program.

All six students indicated they received great value from the learning experience to themselves, but were evenly split – between great value and some value - on the value the organization received from their learning experience. While it is impossible to say why the students believed the organization didn’t benefit as much as they did, one possible reason could be the organizational culture. Students may believe that it the learning experiences can be directly applied to their jobs, but are less likely to be applied towards work beyond their immediate control and hence lesser benefits accrue at the organizational level.

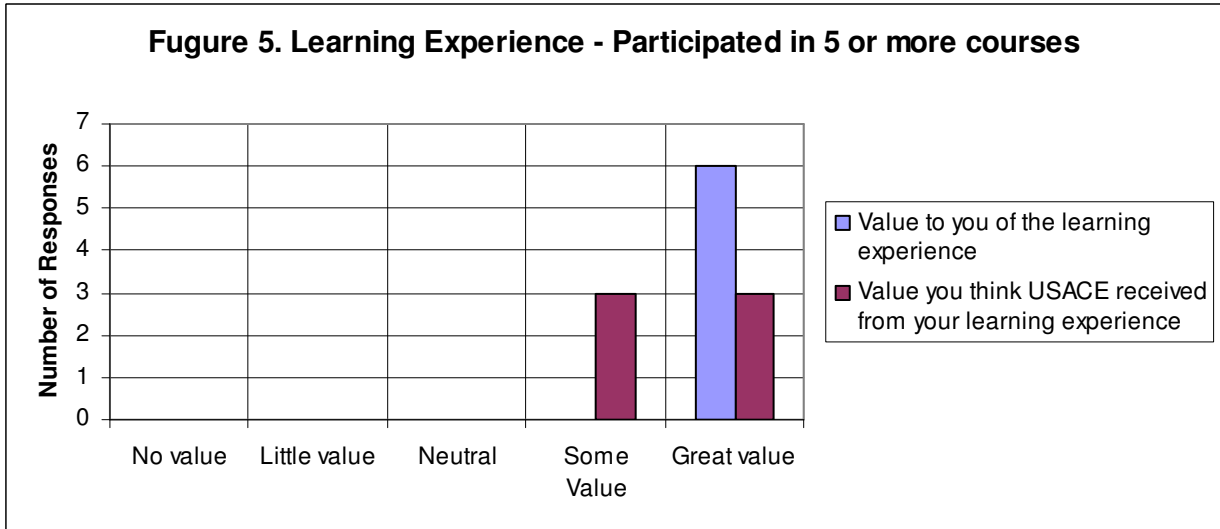
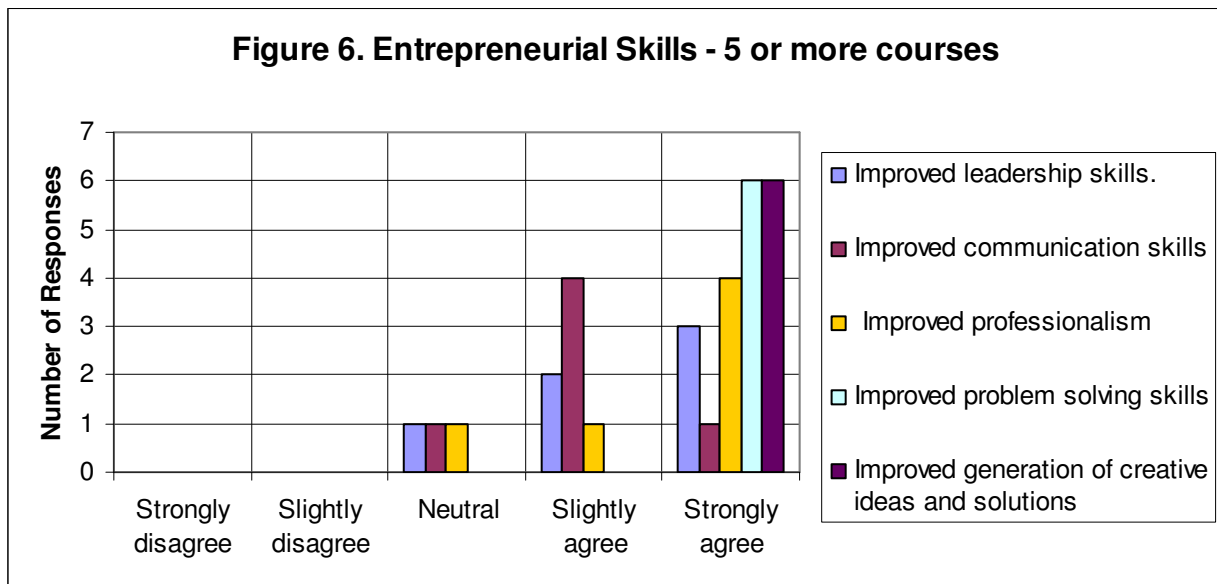
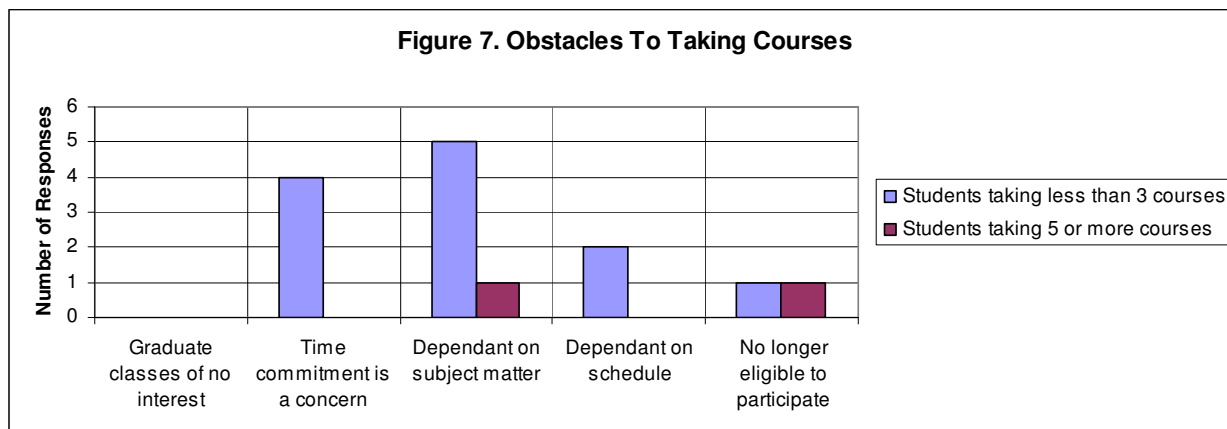


Figure 6 displays the responses of USACE students taking five or more courses to a series of questions on the improvement of entrepreneurial related skills they believe they received from the courses offered as part of the Certificate Program.

All six students strongly agreed that the courses improved their problem solving skills and their generation and use of creative ideas. The responses for questions dealing with improved leadership and communication skills and professionalism, while mostly positive, do have some neutral ratings. Each of these neutral ratings came from a different student, so no student taking five or more courses had more than one neutral rating in entrepreneurial skills. The student who rated improved professionalism as neutral provided comments outside the survey. S/he stated that an employee with over ten years of federal service and a Professional Engineering license was already professional before taking the courses. S/he suggested that had “professionalism” been defined in the survey, s/he may have rated the response otherwise. S/he felt that all the students were already very professional in their manner and work ethic and that the courses did not improve that skill further. This is an interesting point and one that will warrant further discussion later when the USACE program is compared to the same class being offered in an academic setting and in a non-Federal technically oriented planning and engineering organization.

Figure 7 displays the responses of all the USACE people surveyed to help determine what some of the obstacles might be to getting improved participation in the Certificate Program. While students taking five or more courses basically said the subject matter was the biggest determining factor, those taking less courses indicated that additional impediments might be the time and day the course is offered, the subject matter of the course, and their work/family time balance. Two students replying are no longer eligible to take the courses offered at USACE because one had retired and the other has changed Federal agencies.





The interviews of key people included those involved with the HQUSACE program, those with the GMU Entrepreneurship course presented on-campus, and one person from a non-Federal technical organization. These interviews helped to highlight some differences between the students, their level of proficiency, and the culture of the classes.

In the on-campus or academic setting, the former students-turned GMU instructors noted that there was a wide span between those with the best and worst presentation skills and a wide span in ages between the youngest and oldest students. From the presentation perspective, this turned out to be less of a problem than initially thought, since the presentations in the Technical Entrepreneurship class were done as team efforts, providing some compensation for the poor presenters. The wide age difference was also more significant early in the class as some students did not present a professional look during initial presentations. However, by the final presentation all the students looked and dressed professionally as they presented their business plans to a team of judges. Students in the academic environment had a very strong focus on developing products versus services for their entrepreneurship projects, and they had a strong drive for the potential commercialization of their project. Students and instructors did not notice a particular “culture” or organization within the classroom environment and the final class presentations had a tremendous wow factor. Student teams dressed the part, used props, and distributed brochures and pamphlets as they would at the presentation of a major business plan.

The Entrepreneurship course presented at the non-Federal E&C consulting firm exhibited some differences between the course taught in the academic environment and that taught at HQUSACE. At the consulting firm, since the students regularly make presentations to clients, their writing and presentation skills were superior to those in the academic and HQUSACE setting. The age difference among students was a bit less than the students in the academic course setting but more than at HQUSACE. The student project ideas were more eclectic than the academic setting, the majority being product-focused but with some focused on improving services. However, all of the projects had a strong commercial focus. The presentations had less wow-factor than the presentations from the academic setting, but were more polished than those of the HQUSACE students. It may be worth noting some other differences between the consulting-firm students and the students at HQUSACE. The government employees had tuition and fees paid by the government whereas the consultant required students to pay tuition and fees and after successful completion of the course they would be reimbursed. This may have

provided additional motivation for the consultant-firm students to excel in the class. While classroom time is the same for all the settings, it may also be significant that the consultant students began class at 4 p.m. which cuts into a part of their workday. The courses taught at HQUSACE all occurred during normal workday hours.

The projects of the students at HQUSACE were generally less focused on commercialization and more focused on improved cost savings. The instructors believed the classroom environment seemed more structured than at the other venues and that may be a part of the office or organizational culture. Likewise, the HQUSACE student team presentations, while very good, had the lowest wow-factor between the different settings. The student presentations throughout the course were good, but generally exhibited less overall improvement than those in academic setting. This is somewhat expected since the students in the academic setting generally were not as accustomed as those in an office environment with making presentations and so they had more room for improvement.

The differences in the students presentation skills and the focus of there projects may be the result of numerous factors. However it is this paper's supposition that one such factor is the organizational culture, or lack thereof, which helped to make each presentation of the Technical Entrepreneurship course unique to its setting. Given the differences between the student project presentations and their focus (product versus service) it might be good to devote some discussion to the basic concepts of entrepreneurial thought and how they may differ between the three course environments: the office setting at HQUSACE, the office setting at a non-Federal technical firm, and the normal campus based academic setting.

Looking into the characteristics of entrepreneurship and the organizational culture that supports entrepreneurial individuals Marvel (2007) refers to prior research that identified five conditions that support corporate entrepreneurship "...five distinct internal organizational factors were necessary to support corporate entrepreneurship: (1) rewards/recognition; (2) management support; (3) resources, including time availability; (4) organizational structure; and (5) acceptance of risk." But they question the sufficiency of these conditions for motivating individual scientists or engineers and so they interviewed technical corporate entrepreneurs and human resource managers. Their "...research suggests that the technical corporate entrepreneurs investigated are complex, both in terms of how to manage them and how to sustain their intrinsic motivation. While the conditions for corporate entrepreneurship do apply in motivating these individuals, they are not sufficient. Therefore, we propose adding the dimensions of intrinsic motivation and work design to the theoretical framework."

Examining the role of entrepreneurship in government (state, local, federal), Coffee (1996) points out "...entrepreneurial strategy is not new to government but it obtained new interest as a result of successes at the local level following the 1992 publication of *Reinventing Government: How the Entrepreneurial Spirit is Transforming the Public Sector* by David Osborne and Ted Gaebler." But that doesn't mean entrepreneurship means the same thing to those in government as those in business. Bernier (2007) lays out "...a new model for public entrepreneurship, arguing that today's public entrepreneurs are teams and their actions are systemic. Public entrepreneurs do not create new artifacts, nor do they design grandiose projects, but they slowly reinvent their organizations and, in so doing, transform the systems that control government

effectiveness and efficiency.” This is especially interesting as the HQUSACE student projects in the Entrepreneurship course were all focused on changing their organization to improve its processes or efficiency.

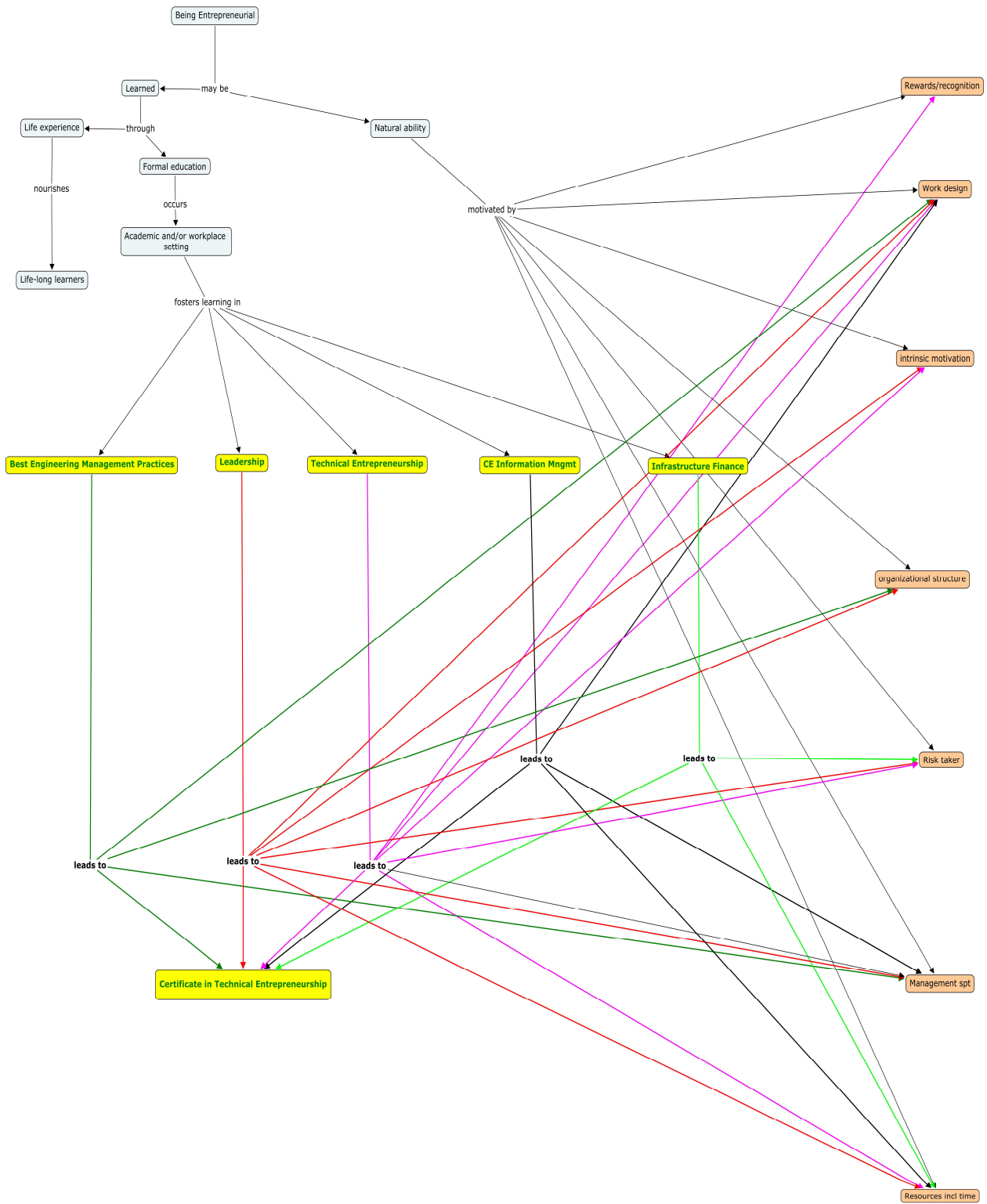
With regard to examining the role of teaching entrepreneurship in classrooms Marvel (2007) states “...Some have compared teaching entrepreneurship without the experiential process to teaching someone to swim without a pool. The fundamentals can be taught, but the individual will not really know what it’s like to swim until the person dives into the pool and begins to swim. If one has only been taught on land, then they will not likely have much confidence in their attempt to swim.” This serves as confirmation of the methods used in the Technical Entrepreneurship courses offered by CEIE. Four of the five courses in the Certificate Program involved team projects providing hands-on learning.

Development of the concept map began with deciding on the focus question, “Has the GMU Certificate Program made the students more Entrepreneurial?”. Then, using the Cmap software tool a series of concepts - defined by Novak (2008) as “*a perceived regularity in events or objects, or records of events or objects, designated by a label*” – that might apply were placed into a list or “parking lot” (concepts such as each of the five courses that led to the Technical Certificate in Entrepreneurship, the seven traits of entrepreneurship proposed by Marvel). Then, using the focus question as a guide, the concepts are placed into the tool and connected or linked by relationships – lines that connect the concepts. Relationships include terms like occurs, fosters learning in, and leads to.

Figure 8 is the Cmap parking lot and placing them into the Cmap tool in a hierarchical fashion and then linking them yields the concept map shown in figure 9.

- Figure 8 - Cmap Parking Lot**
- Technical Entrepreneurship in the Federal Government
  - Systems Management and Evaluation
  - Best Engineering Management Practices
  - Civil Engineering Information Management
  - Leading Innovation
  - Being Entrepreneurial
  - Rewards/recognition
  - Work design
  - Intrinsic motivation
  - Formal education
  - Life experience
  - Natural ability
  - Life-long learning
  - Academic and/or other settings
  - Management support
  - Resources (includes time)
  - Risk taker
  - Organizational structure

Figure 9 - Concept Map of GMU Technical Entrepreneurship Courses Mapped to Theoretical Dimensions of Entrepreneurship (Marvel 2007)





Upon evaluation of the concept map, it is apparent that each of the theoretical dimensions of entrepreneurship as defined by Marvel map into the certificate courses. Similarly, each course maps into at least one dimension of entrepreneurship. This suggests that each of the important entrepreneurial dimensions is covered by one or more courses and that every course contributes to at least one entrepreneurial dimension.

## Summary

The CEIE courses which entail the Technical Entrepreneurship Certificate Program have had little measured impact on the HQUSACE organization as a whole. However, the program has had a significant impact on the individual students, especially those completing the Program. While the organizational inertia is moving towards entrepreneurial thought and a systems engineering focus, it is not a direct result of the students' influence on the organization. While over 30+ students have taken one or more courses in the program, only seven have completed the Master of Science degree and nine have completed the Certificate Program - out of a HQUSACE population of 600+. This slow infusion of employees into the HQUSACE organization that have been exposed to the curricula which fosters systems thinking, entrepreneurial thought, and program management skills, has been overcome by various outside events. These events, like Hurricanes Katrina, Gustav and Ike, one of the largest military construction programs ever faced by the USACE, and a need for improved watershed planning, and dam and levee safety issues, have all forced an increased awareness of risk & reliability analysis and the need for a systems engineering focus on many projects. This has driven creativity and innovation in HQUSACE. But that results more from the necessity of responding to these outside influences than the influence of the Certificate Program students.

On an individual student basis, most of the students have used the knowledge gained during the courses directly for work. All of the students completing the Certificate Program used the knowledge gained directly for work, and as a result of the program some students attribute the knowledge and skills gained to supporting them in getting new jobs or promotions. The great majority of students believe the program improved their leadership skills, their communication skills, and their professionalism. Obstacles against increased participation in the program include difficulty in making a long-term commitment to the Certificate Program, an office operational tempo that makes balancing work/family time difficult when a graduate-level class is added to the mix (increased organizational efforts in responding to terrorist and natural disasters cause office deployments of many people leaving those behind to pick-up additional work), and a cyclic -3 year - change of Commanders/leadership with changing priorities.

The Certificate Program courses seem to map well on the content map to the traits of being entrepreneurial. However, additional research may be warranted to show alignment with the Learning Plan goals. The assessment methodology and goals of a traditional academic setting compare favorably with those of engineering and construction focused Federal organization

The students and some of the former HQUSACE leadership believe that the students are better leaders, better communicators, and more professional as a result of the completion of the certificate program. They have a more system engineering focus, and are more entrepreneurial

in their thought. However, that assessment seems to be from the student's supervisors and does not seem to be recognized beyond the initial level of management.

## **Recommendations**

To ensure long-term commitment to the HQUSACE Technical Entrepreneurship Certificate Program - both from a leadership perspective and through appropriate funding mechanisms – the Program Manager must establish a connection between the Graduate Certificate Program in Technical Entrepreneurship and the organizational goals/vision. Without such a connection to the organizational goals/vision, a long-term leadership commitment to the program is doubtful.

Similarly, if students are to be allowed to continue to take courses beyond the Certificate Program, such an option must be recognized and supported by the leadership with clear ties to the organizational goals so that a value can be attributed to such on-going student development. The HQUSACE Program Manager in consultation with the HQUSACE leadership should develop this too.

Currently, the organizational leadership supports the Graduate Certificate Program but the commitment is without real depth. It is recommended that a senior leader become the Certificate Program Champion, spearheading efforts at the senior levels of the organization to garner funds and support for the program. The results of the survey and of the interviews make it clear that the Certificate program is providing benefits to the organization, albeit not enough to steer change within the organization. Students can and are impacting their local culture (micro-level). But leaders impact the organizational culture at the macro-level fostering entrepreneurial thought/actions throughout the Hqs and the entire organization, and it is these leaders that the program must influence if the ultimate goal of the program is to be achieved.

The Certificate Program currently has a Program Manager, who is almost the only reason the program has continued to function. S/he has been unable to generate enough student interest some semesters forcing the cancellation during two semesters. More active participation from senior leadership in support of the program manager would help to ensure the program takes on a life of its own and is no longer completely dependant on the program manager's dedication to the program.

The Program Manager should market the program more aggressively to all USACE employees within commuting distance of the courses held at the Washington DC Hqs location. This would include Baltimore District employees, especially those working at Fort Belvoir and in Washington DC; and those at the US Army Topographic Engineering Center and the Institute for Water Resources, both also located at Fort Belvoir.

In order to avoid students taking numerous non-matriculated courses and then applying for the Master of Science degree program, all students should apply for the graduate program if they continue taking courses beyond the Certificate Program. The Program Manager should work with the Program Champion to determine if de-emphasizing the Certificate Program in favor of choosing course offerings based upon current areas of focus to the organization should be

implemented. The current areas of interest in question at the HQUSACE include watershed planning, infrastructure security, and sustainable design.

The Program Manager should schedule presentations by the students for the senior leadership at HQUSACE so that student projects from key courses are used to brief the leadership. This will help to publicize the benefits of the Certificate Program on both a tangible and intangible level hopefully getting the leadership to encourage greater student participation. Currently, there are significant course project efforts associated with the following courses: Technical Entrepreneurship in the Federal Government; Best Engineering Management Practices; Leading Innovation; and the Civil Engineering Research Project. This will help to publicize the benefits of the Certificate Program on both a tangible and intangible level hopefully getting the leadership to encourage greater student participation.

The Program Manager should continue the improvement of the content map for the CEIE Certificate program and recommend that the E&C Learning Plan and the USACE Learning Organization Doctrine be mapped to the existing content map and be used to further identify courses that reinforce systems engineering and entrepreneurial traits.

Lastly, the Program Manager should formally document the assessment methodology and goals of the Certificate Program and compare them to those in a traditional academic setting to ensure they match up favorably.

Based upon the results of the survey, the HQUSACE students judge the Certificate Program as successful in improving their communication and leadership skills, their professionalism, and in fostering and developing a systems and entrepreneurial mindset in them. The Cmap software tool was used to generate a concept map. It was used to validate that the Technical Entrepreneurship Certificate Program does reinforce the necessary skills and traits of those with entrepreneurial tendencies in technical organizations. There are differences (age span, skill level of presentations, computer proficiency, etc.) in the students between the three classroom settings (HQUSACE, Dewberry, and GMU academic campus). But most of those differences seem to not effect the final project submissions as part of the Technical Entrepreneurship course. The two key exceptions being that HQUSACE students - like many in government - continue to focus on service oriented improvements versus product improvements, and seem less competitive among their classroom teams.

## **Conclusion**

The Technical Entrepreneurship Certificate Program at HQUSACE has had a minor effect in transforming HQUSACE into becoming more entrepreneurial. A great involvement in the program would be needed to revolutionize the thinking of the organization. Nevertheless, the GMU certificate program has contributed positively to the education of over 30 students throughout the organization. It has successfully encouraged seven of the students to continue their graduate education and complete their MS degree in Civil and Infrastructure Engineering. The Corps management views the program in a positive light and students feel that the program has improved their professional skills necessary for success.

## **Bibliography**

Bernier, Luc and Hafsi, Taïeb, The Changing Nature of Public Entrepreneurship; Public Administration Review; May 2007

Coffee, Joseph N., Creating Entrepreneurial Government: The Franchising Movement, Public Administration Quarterly, Spring 1996

George, Gerard and Zahra, Shaker A. ; Culture and Its Consequences for Entrepreneurship.; Entrepreneurship: Theory & Practice; Summer 2002, Vol. 26 Issue 4

Guo, Kristina L. and Sanchez, Yesenia; Entrepreneurship at the State Level: A Case of Massachusetts' Prescription Drug Program; Source International Journal of Public Administration; 2006, Vol. 29 Issue 7

Novak, J.D. & A.J. Canas, The Theory Underlying Concept Maps and How to Construct and Use Them, Technical Report IHMC CmapTools 2006-01 Rev 01-2008, Florida Institute for Human and Machine Cognition, 2008, available at:  
<http://camp.ihmc.us/Publications/ResearchPapers/TheoryUnderlyingConceptMaps.pdf>

Marvel, Matthew R, Griffin, Abbie, . Hebda, John, Vojak, Bruce, Examining the Technical Corporate Entrepreneurs' Motivation: Voices from the Field, Entrepreneurship: Theory and Practice, September 2007, Vol. 31 Issue 5

Sherman, Peter S., Sebora, Terry, Digman, Lester A., Experiential Entrepreneurship In The Classroom: Effects Of Teaching Methods On Entrepreneurial Career Choice Intentions , Journal of Entrepreneurship Education, Volume 11, 2008

Slater, Stanley F. and Narver, John C.; Market orientation and the learning organization; Journal of Marketing; Jul 1995, Vol. 59 Issue 3

Vesper, Karl H.; Entrepreneurship, A Fast Emerging Area In Management Studies, Journal of Small Business Management; Oct 1974, Vol. 12 Issue 4