2006-2437: TOWARD AN INTERDISCIPLINARY GRADUATE DEGREE IN TECHNOLOGY

Heidar Malki, University of Houston

Heidar A. Malki received his B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Wisconsin-Milwaukee. He is a senior member of IEEE and associate editor for the IEEE Transactions on Fuzzy Systems. Dr. Malki was the general chair for the 1997 ASEE/GSW Conference and one of co-chairs of 1997 ICNN-IEEE International Conference on Neural Networks. Currently, he is Associate Dean for Research in the College of Technology and a professor in the Department of Engineering Technology at the University of Houston. His research interests are applications of neural networks, fuzzy logic, design of fuzzy logic controllers and their applications.

Michael Gibson, University of Houston

Michael Lucas Gibson received a DBA and MBA the University of Kentucky. He has over thirty years of experience in information systems as a practitioner and an academician in information technology. Dr. Gibson has over fifty publications in academic and professional journals, such as IEEE Transactions on Software Engineering, Journal of Management Information Systems, Information & Management, Information Resource Management Journal, Journal of Database Management, International Journal of Software Engineering & Knowledge Engineering, and Computers & Operations Research. He also has over 60 published proceedings for conferences of professional and academic organizations, as well as a textbook, Analysis and Design of Computer Systems: A Comprehensive Methodology with CASE.

Enrique Barbieri, University of Houston

Enrique Barbieri received the Ph.D. from the Electrical Engineering Department at The Ohio State University. He was Associate Professor and Chair of the Electrical Engineering & Computer Science Department at Tulane University (96-98). He is currently a Professor at the University of Houston, Chairs the Department of Engineering Technology, and co-directs the Texas Manufacturing Assistance Center (TMAC) – Gulf Coast. His teaching interests are in Microprocessors, Signals, Systems, and Control, and has published over 60 articles in control theory and applications. He has been the PI/Co-PI of projects from NASA, NSF, the Louisiana Board of Regents, the Gulf South Research Foundation, the University of Houston, the Professional Surveyors Educational Foundation, AT&T, and others.

William Fitzgibbon, University of Houston

William E. Fitzgibbon, III earned both his BA and PhD degrees from Vanderbilt University y. He is currently serving as Dean of the College of Technology of University of Houston and holds professorial rank in both the Department of Mathematics and the Department of Engineering Technology of the University of Houston. Previously he served as Chair of the Department of the Mathematics, co-Head of the Department of Computer Science and President of the University of Houston Faculty Senate. His academic discipline is applied mathematics with specialization in mathematical biology and ecology, reactive flow, nonlinear partial differential equations and integro-differential equations. He has well over 120 research plus numerous articles, reviews, and reports and has lectured extensively in North America and Europe. He is leading an alliance composed of life science/biotechnology employers, the Texas Medical Center and its constituent institutions, area universities and community colleges, the Greater Houston, Partnership, the Texas Workforce Commission and BioHouston. The overarching goal of the alliance is to identify, coordinate, and grow educational and training programs requisite for developing and sustaining a workforce in life sciences and biotechnology.

Toward an Interdisciplinary Graduate Degree in Technology

Abstract

This paper presents a new interdisciplinary graduate program in Technology. This is a result of several years of study in revamping graduate programs in the College of Technology. This unique program consists of 1) core courses, 2) specialized tracks, 3) Practicum/Internship, and 4) thesis/project as shown in Figure 1. The proposed curriculum involves multidisciplinary programs such as Computer Engineering Technology, Electrical Power Engineering Technology, Mechanical Engineering Technology, Construction Management, Information Systems, Logistics Technology, and Technology Leadership and Supervision. Thus, it allows each program to have its own specialty while being flexible enough to grow other disciplines.

Introduction

The College of Technology (CoT) at the University of Houston offers Master's degrees in Technology since 1992. These programs are very focused and technical in nature. In recent years, growing interest has emerged with regard to offering interdisciplinary graduate degrees in Technology. Thus, new innovative, interdisciplinary, and online degrees are being sought.

This paper presents a new interdisciplinary graduate program in Technology. The proposed program consists of 1) core courses, 2) specialized tracks, 3) Practicum/Internship, and 4) thesis/project as shown in Figure 1. The proposed curriculum involves multidisciplinary programs such as Computer Engineering Technology, Electrical Power Engineering Technology, Mechanical Engineering Technology, Construction Management, Information Systems, Logistics Technology, and Technology Leadership and Supervision. Thus, it allows each program to have its own specialty while being flexible enough to grow other disciplines.

The primary motivation for proposing an interdisciplinary graduate programs in technology is to capitalize on CoT resources to provide graduate degrees that integrate the different disciplines within the college. A secondary motivation is to elevate the research emphasis within the CoT. Establishing a CoT-wide graduate degree will provide a method of moving towards a doctoral degree in Technology, consistent with the objectives of a Research 1 university. A fundamental graduate degree program proposal would include core courses Technology/leadership/ Management, specialized tracks for various CoT disciplines (Concentrations), Practicum/ /internship, and thesis/project.

Literature Review

There have been increasing efforts to establish new innovative and interdisciplinary graduate programs both in engineering and technology disciplines in recent years. The U.S. "must rebuild its capacity for leadership of systematic technology development and innovation as a core corporate competence in American industry"[1]. An integrated, interdisciplinary graduate degree program can provide the foundation for future innovation leaders.

The paradigm shift is attributed to 1) sharing resources, 2) online offerings, and 3) providing multi-disciplinary education for students. There has been number of new initiatives reported in the literature. A totally hands-on online graduate program in information technology was introduced at East Carolina University[2]. Some of the issues of web-based graduate programs were also discussed[3,4]. Parmentier et al. proposed a multidisciplinary, innovative graduate curriculum

in technology at Arizona State University. This program offers students options that deal with social scientific approaches to study "technology's role in global economics, political, and social development and change"[5]. It also provides the impact of technology on society. North Carolina Agriculture and Technical State University also initiated an interdisciplinary master's program in computational sciences where it consist of various areas such as engineering, physical sciences, life sciences, agriculture, environmental sciences, technology and business[6]. Western Carolina University has initiated and effort by providing partnership with industry to better prepare their graduate students to face challenges of growing technical fields[7]. Keating et al. in a series of four papers formulated a framework for professional studies that promotes "the continuous development of the U.S. engineering workforce in industry concurrently with engineering practice for technological innovation"[1,8,9]. In addition, several institutions offer students individualized interdisciplinary graduate program that allows students to tailor their courses from more than one department to meet their needs.

Existing Programs in the CoT

The CoT has the following Masters degrees: Master of Technology in Network Communications, Master of Technology in Construction Management, Master of Science in Project Management, and Master of Science in Human Development and Consumer Science.

1. **The Master of Technology in Network Communications**

This program builds upon TAC-ABET-accredited baccalaureate degree programs in the fields of computer, electronic or electrical engineering technology, and related fields. The program provides an advanced knowledge of communication between and within computer networks, including data processing in the network environment, network operations software and operating systems, and communication systems.

2. **The Master of Technology in Construction Management**

The program provides an advanced knowledge of construction project planning and management, cost analysis and estimating, and quality control and productivity improvement methods. Graduates are prepared to work in industries that require an advanced knowledge of construction, or to teach in baccalaureate and associate degree programs.

3. **The Master of Science in Project Management**

The Master of Science in Technology Project Management degree includes Logistics as an area of emphasis. It is designed for the professional who seeks advanced preparation in logistics, inventory management, transportation, sales, and procurement. Core courses focus on the development of project management skills that are designed to prepare graduates for responsible leadership roles in technology- and information-based workplaces.

4. **The Master of Science in Human Development and Consumer Science**

This program is designed for the professional who seeks advanced preparation utilizing powerful tools to facilitate sustainable change in diverse organizations. Students examine e-learning tools, build an understanding of adult learning theory and organizational dynamics, combined with research and productivity measurement techniques, to create individual and organizational transformations. Students focus on critical thinking, theoretical foundations of the field,

application of state of the art instructional design strategies, and use of appropriate assessment techniques to measure program effectiveness, impact, and continuous quality improvement in organizational environments.

Proposed Interdisciplinary Graduate Program

A tentative curricula for the Masters in Technology (M.T.) degree includes the following courses:

1. 12 hours in College core and leadership/management classes, including research methods.
2. 12 hours of courses comprising a concentration in one of the CoT disciplines.
3. 0-6 hours of practicum/internship courses.
4. 6 hours of Thesis or Project.

Figure 1 depicts the proposed multidisciplinary graduate program for the CoT.

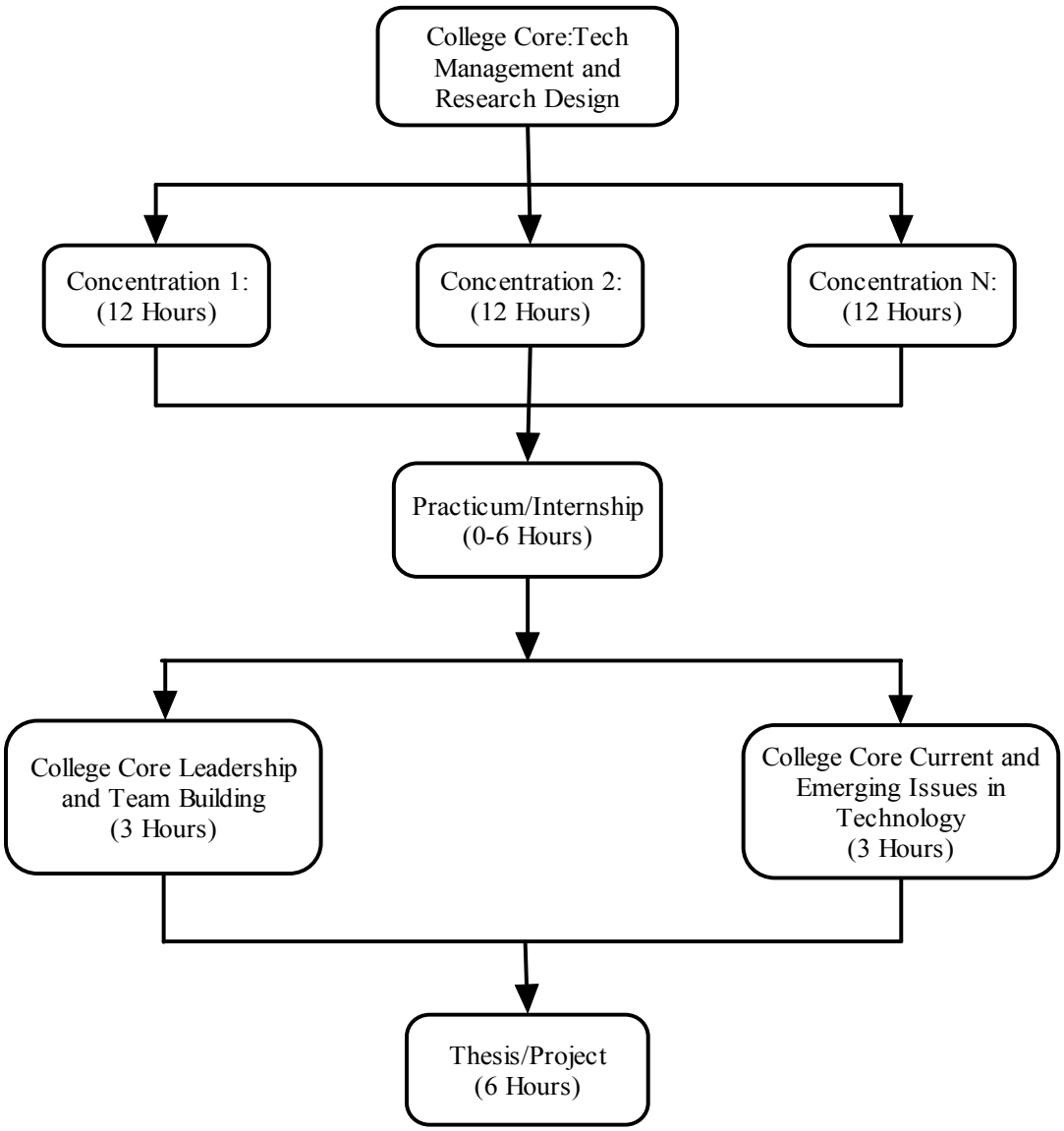

Figure 1: Proposed Multidisciplinary Graduate Program.

Similar to[6], the M.T. degree "focuses upon analytical thinking, problem solving, and decision making coupled with the integration of skills and knowledge necessary for the effective management of technology-intensive systems." A new concentration in Global Technology & Development (GTD) is introduced for an existing M.S. in Technology degree Masters at The College of Technology and Applied Sciences at Arizona State University[5]. Whereas the Arizona State program provided a limited concentration in Global Technology and Development, the M.T. degree provides a more depth concentration component in addition to the core foundation courses in business, analysis methods, and practices. Additionally, the M.T. degree does not necessarily build on existing degree programs, although courses that satisfy requirements in existing degree programs could be included in either the core foundation or concentration courses. With the exception of the Construction Management and Technology Project Management, little integration exists between current Masters degree programs in the CoT. The development of the M.T. degree seeks to remedy that by deriving an integrated, interdisciplinary program that provides concentrations in existing areas of expertise found within existing Masters of Science degree programs. The curricula developers expect that the M.T. program will strengthen the other graduate and undergraduate programs in the CoT; this is a similar expectation to that of[6]. Similar to[6], the developers expect the M.T. program to "help recruit additional well-qualified faculty and students and stimulate or enhance access to federal research funds."

Purpose of the Masters in Technology Program

The M.T. degree program should exhibit many of the same characteristics of quality Masters degree programs as outlined in[9]. The program should:

- "provide a very practical component to lifelong learning; a recognized professional degree; and an integrated approach that combines advanced studies with self-directed learning, progressive experience" in technology-based fields of study, with "actual engagement in creative technology development & innovation."
- "emphasize project-based (problem-centered) ─ innovation-based learning" enhanced work-related professional skill acquisition.
- "support the skill-sets/outcomes required for responsible leadership of significant work" in technology-based leadership positions.
- provide M.T. degree program students with an understanding that they are continuing the process of "continuous professional development of intrinsic human potential, for further development of creativity, innovation, and leadership wherein self-directed learning, progressive experience, tangible project-based learning, and further advanced studies all serve as integral components of a working professional's lifelong growth process to reach his or her potential for leadership in engineering practice."
- "support the working professional's on-going creative work and stage of growth" towards "responsible leadership of creative, systematic technology development & innovation."
- focus on many of the same integrative ingredients as[9]; i.e. self-directed experiential-based learning necessary to gain technological expertise in project-based learning experiences in substantive technology development projects.
- "foster the continuous professional development of leaders who contribute to the creation, improvement, development, and innovation of new technology-based systems, operations, products, and processes on which regional industrial growth and economic development depends for creation of new wealth/employment/national security purposes."

College Core Courses

The College Core consists of the following courses: Technology Management, Research Design, Leadership and Team Building, and Current and Emerging Issues in Technology. The Technology Management course is a fundamental management course with a focus on management knowledge content, skills, practices, and experiences within a technology orientation. The Research Design course is similar to the research design course posed by[5] with a focus on "construction of research questions and problem statements, literature reviews and methodology selection, with an introduction to quantitative (statistical) and qualitative methods" for analyzing aspects of the problem situation. The Leadership and Team Building course focuses on defining leadership, its characteristics, how to develop leadership skills, and experiences that help students understand and develop leadership qualities and skills. That course also includes knowledge content, skills, and experiences in developing and directing technology teams charged with using or developing technology that impacts organizations and institutions. The Current and Emerging Issues in Technology course provides varying topics course that changes over time as aspects of the business and governmental communities change.

The core courses provide a multidisciplinary mix of knowledge content, skills, and experiences to equip technology skilled students to better integrate with other professionals involved in multidisciplinary initiative prevalent in today's environment. The concentration courses will provide an opportunity for students to enhance their existing knowledge, skills, and experiences in their own or a related profession. The modern business climate seeks multi-talented individuals with broader knowledge, skills, and experiences. The M.T. degree program seeks to fill that void. A syllabus for an existing course in Leadership and Team Building appears in the Appendix.

Concentration

Concentrations remain open-ended with the capacity to add concentrations as new concentration areas emerge. Current concentrations exist for Project Management, Information Systems Security, Logistics, Human Resource Development, Network Communications, and Construction Management. By having concentrations in existing Master degree disciplines in the College, the College can capitalize on existing CoT resources, logistics, and infrastructure.

Practicum/Internship

The Practicum/Internship course provides an opportunity for students to obtain practical experience in organizations of applying the knowledge, skills, and practices learned during the course of completing the M.T. degree. The examination committee will determine the number of hours required for each student based on an evaluation of their existing experiences in business and public organizations. An example of a graduate practicum course appears in the Appendix

Capstone Thesis/Projects

Similar to the curricula for the M.S. degree in Technology at Arizona State University[5], students can select either a "research-focused thesis or applied project" as the capstone experience for the M.T. degree. In either case, students fulfill a capstone experience comprised of a proposal development, proposal defense before their graduate committee, thesis or project completion, and defense of the completed thesis or project before their graduate committee. The thesis/project deliveries are expected to be similar to the deliverables identified in[9]; e.g. "comparative analyses, pilot/prototype systems, software development, physical plant layouts, automatic data capture

enterprise solutions, educational and training media, human resource studies, design of experiments studies, multimedia development, …" Similar to[5], the thesis or project would be selected from issues or problems that, "pertain to their area of specialization, while utilizing the multidisciplinary foundations of the program." The examination committee for the students will evaluate the deliverables of the project using similar criteria to[9]; e.g. "acceptability of the work, based upon the significance of the project, the quality and completeness of the written report, the suitability of the oral presentation, and the engineer's ability to explain and defend the approach, technical details and analysis in the question and answer session following the oral presentation."

Admission Requirements and Student Body Profile

Applicants should complete the Graduate Record Examination with a minimum of 1000 including a minimum of 400 on the Verbal portion of the exam. They should have a 3.0 minimum G.P.A. with either an undergraduate or graduate degree in a technology related area. International students are required to complete the TOEFL exam with a minimum score of 213.

The target population for applicants to the M.T. degree program includes mature students with work experience in a technology related field who seek advancement through completing advanced academic degrees. Mature students refers to persons with a bachelors degree currently working in industry or governmental positions who need additional credentials to move into more advanced management or professional positions. These students could be graduates with fewer than 3 years industry experience or professionals with extensive experience who have reached the ceiling for advancement with their existing credentials. These prospective students would be seeking an integrative, multidisciplinary graduate degree that would qualify them for advancement in existing or future vocations. However, the Practicum/Internship experience can remedy a deficiency in actual organizational experience. The M.T. degree program seeks applicants similar to those sought by[9]; i.e. persons who seek to emerge as leaders and are pursuing career paths centered upon the "creation, development & innovation of new/improved technology in the form of new/improved/breakthrough products, processes, systems, or technical operations."

Program implementation, Growth, and Assessment

The initiation of the M.T. program should begin in 2007-2008 with an expected enrollment of 10-15 students. It is expected that the program will experience 20-25% growth in its first 3 years with a leveling out of 50-75 headcount in the program over time.

Initial growth will be the result of local and national marketing efforts to businesses, industries, governmental agencies, and other universities. These marketing efforts will emphasize the multidisciplinary nature of the program, multi-talented student objectives, integration of multidisciplinary professionals, and technology based focus.

The ultimate success of the program will be measured by the growth in enrollment, demand for graduates, and success of graduates in technology-based positions in industry and government. Statistics will be compiled regarding enrollment, positions obtained by graduates in industry and government, surveys of industry and government contacts familiar with graduates of the program, and surveys distributed to recent graduates of the M.T. program.

Finally, it is expected that the M.T. program will provide foundation courses for a multidisciplinary Ph.D. program within the College of Technology. The M.T. core and concentration courses provide functional knowledge, skills, experiences that should serve

graduates of the program well in working in a world with multi-disciplinary professionals serving different but related functions on important initiatives in business and government. These same multi-talent oriented courses should provide a functional foundation towards seeking a technology-based Ph.D. The Ph.D. program will like emerge through raising the consciousness of the individual concentration towards conceptual and research focused discovery objectives, expanding research methods content, and enhancing multidisciplinary content from a more conceptual basis.

Summary

This paper presented a multidisciplinary, technology-based Master of Technology degree program. The program includes a multidisciplinary core, a technology-based concentration, and thesis/project practicum. The intent of introducing the program is to integrate different disciplines within the College of Technology and provide a degree program to integrate the knowledge content, skills, and experiences of today's professionals.

Bibliography

1. Keating, D. A., Stanford, T. G. Dunlap, D. D., McHenry, A. L., DeLoatch, E. M., Lee, P. Y., Depew, D. R., Bertoline, G. R., Dyrenfurth, M. J., Tricamo. S. J., Palmer, H. J., Davis, I. T., Morrison, E. R., Tidwell, J. P., Gonzalez-Landis, S. J., O'Brien, J. O., Snellenberger, J. M., Quick, D. H., Olson, R. N., Coulson, L. M. Framework for integrating project-based learning experience and practice in professional graduate for engineering leaders in industry leading to the professional engineering doctorate and fellow levels. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

2. Mohammed, T. and B. Yang. (2005). Issues in hands-on online graduate programs in information technology. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

3. Smith, D. M. and Pennington, C. H. (2004). Experience in distance for a graduate engineering program. Proceedings of the South Eastern Section of the American Society for Engineering Annual Conference & Exposition.

4. Carroll, B. D. Osborne, W. P., Behrooz, S. S. Cantrell, C. D. Tjuatja, S. (2202(CS/EE Online-Lessons Learned in planning, developing, and operation a joint Web-based master's program. Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition.

5. Parmentier, M. j C. and R. Sundarajan. (2005). Designing multidisciplinary graduate education in technology and the social sciences. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

6. Kelkar, A. D., Mohan, R. Tang, G., Radhakrishman, N., Murray, K. (2005). Innovative graduate program in computational science and engineering. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

7. Ferguson, C. W. Ball, A. K., Stone, W. and McCrary, P. Engaging industry in graduate engineering/teaching education. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

8. Dunlap, T. G. Keating, D. A., Stanford, D. D., McHenry, A. L., DeLoatch, E. M., Lee, P. Y., Depew, D. R., Bertoline, G. R., Dyrenfurth, M. J., Tricamo. S. J., Palmer, H. J., Davis, I. T., Morrison, E. R., Tidwell, J. P., Gonzalez-Landis, S. J., O'Brien, J. O., Snellenberger, J. M., Quick, D. H., Olson, R. N., Coulson, L. M. Framework for integrating project-based learning experience and practice in professional graduate for engineering leaders in industry leading to the professional master of engineering. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

9. Snellenberger, J. M, Quick, D. H, Tidwell, J. P., O'Brien, J. O., Davis, I. T., McHenry, A. L., Bardo, H. W., Dunlap, D. D., DeLoatch, E. M., Lee, P. Y., Palmer, H. J., Tricamo, S. J., Depew, D. R., Bartoline, G. R. Dyrenfurth, M. J., Keating, D. A., Stanford, T. G. Economic impact for integrating constructivism, project-based learning and practice into high quality professional graduate education for engineers in industry to enhance corporate advantage and U.S. Competitiveness in the global economy. Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

Appendix

SPRING 2006
New Graduate Courses
Department of Engineering Technology
http://www.tech.uh.edu/departments/et/index.htm

ELET 6397 Practicum and CNST 6397 Practicum

Cr. 3. (3-0). **Prerequisite**: Completion of twelve graduate credits, a minimum of 3.25 GPA, and consent of faculty advisor and work supervisor via approval of a **Practicum Proposal**. The course offers an opportunity to attain academic credit for work experience in a pre-approved industrial site or research facility including those found on-campus. During the internship, the student will be able to demonstrate her/his ability to analyze, integrate, improve, organize, and manage a complex system relevant to the student's field of study. Students also develop interpersonal and communication skills to function effectively in the workplace. With faculty advisor consent, course may be repeated twice.

Course Requirements. Weekly interaction with the faculty advisor, written monthly progress reports, a final written report, an oral presentation, and a supervisor completion letter are required to receive a satisfactory grade. A minimum time commitment of 10 hours per week for 15 weeks is expected.

Practicum Proposal. This is a formal document consisting of:

- A description of the work to be performed:
    1. Problem definition and status.
    2. Techniques to be investigated.
    3. Relation to student's field of study.
    4. Expected Deliverables.
    5. Time frame.
    6. Budget (if applicable).
- Approval by a faculty advisor and a work supervisor.

Final Report. This is a formal document written in an **Executive Summary** style that includes the technical details of the work activities, how the Practicum experience contributed to the original objectives, and how it enhanced the classroom instruction and provided practical applications of knowledge learned.

Completion Letter. This is a letter from the work supervisor to the faculty advisor providing comments on the Practicum experience and the student's performance.

TEPM 6302: Leadership and Team Building for Technology

Cr. 3. (3-0). Prerequiste: TEMP 6301 or approval of graduate faculty advisor. Dynamics of project leadership from the individual, tem, and organizational perspective in achieving improved performance in the information-technology-based workplace.

Course Description: This course is focused on the dynamics of project leadership from the individual, team, and organizational perspective in achieving improved performance in the information or technology-based workplace. Students will learn the role assessment and evaluation in developing world class project teams.

Course Objectives: Upon successful completion of this course, students will be able to:

1. Demonstrate knowledge of the different levels within which project teams work.
2. Identify best practices for project teams from an individual level.
3. Identify best practices in project team development from a team level perspective.
4. Assess the role that the organization plays in the effectiveness and success of a project team.
5. Identify what processes and tools to use in positioning, planning, and implementing project teams across organizational boundaries.
6. Use project team assessment and evaluation techniques and tools to improve team performance
7. Use best practices in contracting and engaging team members as well as project team sponsors and stakeholders.
8. Use online project team tools to further understand and build expert project teams.