Master of Science in Engineering Management
University of Tennessee Chattanooga

External Reviewer Report

by

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April 2024

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PART 1 – Learning Outcomes

How would you rank this program with similar ones in the state, region, and nation?

I would rank Master of Science in Engineering management at UTC in the top 10 – 15% of graduate Engineering Management Programs in terms of its curriculum.

Are the intended program and learning outcomes clearly identified?
- *Has the department specified program mission, vision, and goal statements? Do these statements clearly identify intended program and student learning outcomes? Are they appropriate for the program level (graduate) and for UTC?*

The department has a specified mission, vision and goal statements aligned directly with UTC. These are stated in the self-study report in detail. They are appropriate for a graduate program in Engineering Management.

- *What goals should the department establish regarding its curriculum? In particular, what advice should be offered to the department developing goals regarding the following aspects.*

  - *Student opportunities for research/involvement in faculty research*

The department offers a Research Methodology course to inform graduate students of the research expectations for this degree and to teach the fundamental skills needed to conduct a research project. Graduate students' involvement in faculty research is through the capstone projects. A thesis option and later introduction of a doctoral program may increase student involvement in research.

  - *Student opportunities for practical/field experiences*

The capstone projects, certificate programs offered, and new industry partnership initiatives create opportunities for practical/field experiences. The MSEM program engages students in professional practices and training experiences by offering a variety of seminars, local internship opportunities, and job fairs throughout the year.

  - *Student placement in the workforce related to the field of study*

The Center for Career and Leadership Development provides free resources to assist students in finding employment opportunities in line with their qualifications. The College of Engineering and Computer Science also organizes College-level job fairs multiple times a year.

What criteria does the department use to evaluate sufficient achievement of intended program outcomes? Are the criteria appropriate for such evaluation and/or for the program? How?

The desired learning outcomes of the MS Engineering Management program graduates are stated as follows: Application of Engineering Management Principles and Effective and Professional Communication. The criteria are appropriate.

Does the department make use of evaluation information and/or information obtained from student, alumni, and employer surveys and/or data from institutional research to strengthen and improve the program?

The outcomes of the MS Engineering Management program are regularly evaluated using rubrics developed by the department to measure students' mastery of engineering management principles along with communication and technical writing skills. The department has a Graduate Curriculum Committee which reviews and makes necessary changes in the graduate curriculum every year based on student evaluations and assessment results. Workshops focused on writing and presenting projects are provided each semester to enhance students' preparation for these assessments.

Does the program fit/align within the institutional mission?

The MS Engineering Management program is designed to align directly with the UTC and College of Engineering and Computer Science's missions, visions, and values. These are stated in the self-study report in detail. The MSEM program aligns with UTC mission.

PART 2 – Curriculum

Is the current curriculum appropriate to the level and purpose of a graduate program? Is the program more advanced in academic content when compared to related undergraduate programs?

The curriculum of the MSEM currently has three concentrations: engineering management, an expanding construction management and a recent power systems management. The requirement of 18 hours core courses and 15 hours elective course is the same for all concentrations. All graduate core courses are offered at least once a year. The current curriculum is similar and appropriate to the level and purpose of a graduate program in engineering management.

How has the program designed a process by which students can be assured of making timely progress in the degree program? How is it determined that courses are offered? Is there a set schedule for course offerings upon which the student can rely? Does the department clearly outline program requirements and offer courses regularly to ensure timely completion of the program?

All elective courses are offered at least once every other year regardless of enrollment levels. All elective courses are offered at least once every other year. The curriculum has been designed so students can finish

their master's program in two years. This course offering schedule is popular within students, employers, and industry collaborators in the Chattanooga area.

Does the curriculum align with the program learning outcomes? How is mastery assured through the curriculum? How is the content reviewed on a regular basis with results used to determine actions to take to improve the curriculum? Does the department regularly review and revise curriculum content and organization to ensure that it is appropriate and that it prepares students to meet the specified learning outcomes?

The curriculum content is reviewed on a regular basis. Curriculum review and proposals take place each year. Curriculum proposals have the purpose of continuously improving the graduate program. The curriculum modification suggestions are initiated by students, faculty, and an Industry Advisory Board. The departmental graduate committee collects all the suggestions and forms them into curriculum proposals. The proposals are then discussed in this committee and action to table or proceed with the proposals is taken. Based on the initiatives taken to increase enrollments and improve industry contacts, curriculum updates and development of new initiatives may be necessary as student and industry needs evolve.

Will the department need to update the curriculum and/or develop new or alternative offerings in the near future?

The curriculum has been significantly updated recently and there is a process in place for future updates. There does not seem to be a pressing need for a short-term update.

Is the curriculum adequate to enable students to develop the skills and attain the outcomes? Does the curriculum include knowledge of the disciplinary literature?

The core courses provide the students a strong foundation in the following areas of engineering management: human resources, engineering economics, project management, leadership and entrepreneurship, and strategic management of technology. Knowledge in disciplinary literature is covered through elective courses the students choose based on their background and interest. As such, the curriculum is adequate.

Are opportunities available to students that allow them to engage in research, professional practice or training experiences? How are those opportunities communicated to students?

The MSEM program engages students in professional practices and training experiences by offering a variety of seminars, local internship opportunities, and job fairs throughout the year. Students are informed of these via email, bulletin boards, and e-boards. In addition, capstone projects also act as professional practice resources.

Is the program offered through distance education or online? If so, how are those offerings assessed compared to on ground programming?

The program is offered both online and in live formats. MSEM program is a pioneer program at the University of Tennessee (UT) System to offer a fully online program by using shared resources among UT campuses that offer similar courses and/or programs. For online offering assessments, Walker Center for Teaching and Learning and UTC Learn are utilized. The Walker Center administers course and support

service evaluations each semester to allow for the continuous improvement of UTC's online courses, funded by Online Distance Fees. UTC Learn provides online assessments.

Are appropriate pedagogical and/or technological innovations included that enhance student learning? Are the department's instructional practices consistent with the standards of the discipline?

Each course uses Canvas software to display class materials, create discussion boards, and post assignments. Online offerings are supported by Mediasite to record lectures both synchronously and asynchronously. The College of Engineering and Computer Science has internal technical support personnel and one staff member who is fully responsible for maintaining Mediasite. In addition, Graduate Assistants are trained to assist faculty in administrating online graduate-level courses. These are appropriate and are tools generally used for online course offerings in multiple institutions.

- *Do the instructional practices provide adequate opportunities for student interactions with one another, faculty, and professionals?*

Discussion boards created using the Canvas software provide adequate opportunities for student interactions with each another and with faculty.

- *Does the department make adequate efforts to include students in the life of the program (e.g., seeking student advice in reviewing the curriculum/course schedules/teaching methods, etc.)?*

The Engineering Management has a Graduate Curriculum Committee which reviews and makes necessary changes in the graduate curriculum every year based on student evaluations and assessment results. The curriculum modification suggestions are initiated by students, faculty, and the Industry Advisory Board. The departmental graduate committee collects all the suggestions and forms them into curriculum proposals. The proposals are then discussed in this committee and action to table or proceed with the proposals is taken. The department makes adequate efforts to include students in reviewing the curriculum.

PART 3 – Student Experience

Does the program have enough students to allow an appropriate group of peers as they participate in the program?

The program has enough students to sustain a graduate program in engineering management. Enrollments have experienced a decline from Fall 2020 to Fall 2021. After about a 10% increase in Fall of 2022, enrollments have stayed steady. However, there is indication that this trend may be reversing as the department is taking measures to address the issue and introduction of new industry supported concentrations. The department has a task force made of members of the industry representatives to find ways to promote the program. Faculty members visit companies to inform them about the Engineering Management master's program at UTC. Alumni of the MS Engineering Management program also attend these recruitment meetings to answer questions asked by prospective students. The College of Engineering and Computer Science also hired an Graduate Recruitment Coordinator. Her role is to support the online MS programs in engineering, computer science, and engineering management. The introduction of the JUMP program (Joint Undergraduate to master's program) is expected to help increase enrollments.

Are students offered the opportunity to evaluate both the curriculum and the faculty? How? Are these methods effective in getting feedback about the program and teaching effectiveness?

Students provide feedback on the program and evaluate faculty's teaching effectiveness through surveys conducted online prior to final exams each semester. Students are routinely notified through e-mail and by the instructors in class to login and complete the survey. This method is commonly used and appears effective especially when supplemented by in-class visits and class portfolio reviews.

Are there appropriate curricular and co-curricular offerings to enhance student experiences?

As indicated in the self-study report, the MS Engineering Management program provides professional development opportunities through membership in professional associations such as Tau Beta Pi, Associated General Contractors (AGC), Graduate Student Association (GSA), National Society for Black Engineers (NSBE), the Society of Woman Engineers (SWE). These organizations encourage students to attend conferences and workshops, help them network, and provide job opportunities.

To provide adequate enrichment opportunities, the MS Engineering Management program hosts a variety of seminars conducted by local professional speakers from the Tennessee Valley Authority (TVA), Volkswagen, Mesa Associates and Alteryx in power analytics. These seminars are offered at no cost to students. They are also made available to online students.

Are diverse perspectives and experiences provided for the students both through the curriculum and through extracurricular activities?

The self-study report and interviews with faculty and students reveal that MSEM program makes efforts to expose students to various perspectives and experiences throughout the program. Field trips to TVA, VW, Electric Power Board (EPB), Amazon, Miller Industries, McKee Foods Corp. and others are held regularly to introduce students to various work environments. Guest speakers from these companies and others are brought into classrooms as guest speakers by professors to provide opportunities for diverse perspectives, experiences and approaches to problem solutions.

Are students provided with appropriate academic support services? What services are offered? Do students use the services? How well do they meet the needs of the students?

The availability of instructional resources has improved with the opening of the new library building in 2015. The program's instructional equipment and facilities within the College of Engineering seem to be adequate. Graduate students are offered a quite study room. Technical support is provided by technical personnel staffed by the College of Engineering and Computer Science, along with graduate assistants.

PART 4 – Graduate Faculty Quality

Are the faculty competencies/qualifications those needed by the program and by UTC? Do all graduate faculty meet the standards set by the program and expected SACSCOC faculty credentials?

- *Do faculty hold terminal degrees in the appropriate discipline?*

The full-time faculty members in the program all hold terminal degrees in appropriate disciplines. The Engineering Management Department has six tenured and tenure-track faculty and one lecturer. All faculty members are qualified to teach graduate level courses and advise graduate students.

- *Do faculty specialties correspond to program needs and to the concentrations in which they teach?*

All full-time faculty members have different specialties both in education and experience that complement each other in the concentrations and certificates offered.

- *If faculty need additional/different competencies/qualifications, how might these needs be addressed?*

Some additional/different competencies/qualifications are covered by hiring adjunct faculty with the needed education and/or experience. This is appropriate and common practice for professional master's degree programs in engineering management.

Are faculty teaching loads sufficiently reasonable and equitable to accommodate the highly individualized nature of a graduate program, especially the direction of theses or dissertations?

Based on the information provided in the self-study report, MSEM program faculty teaching loads appear to be aligned with the highly individualized nature of graduate instruction. In the case of capstone projects, professors with certain specialties are assigned to guide the students on an individual basis. More details provided on this in summary recommendations section.

With respect to ethnicity, gender, and academic background, is faculty diversity appropriate for the program? Does the program student and faculty diversity mirror the demographics of the discipline?

Students enrolled in the MSEM Program appear to be diverse, with students from multiple groups of minorities and genders. The faculty have a diverse mix that include Asian, Hispanic, African American and white faculty. The program student and faculty diversity does mirror the demographics of the discipline. Currently the faculty is all male. There has been an addition of a new female faculty in leadership area.

Do the faculty have regular opportunities for professional development such as travel and participation in professional organizations, workshops, and other learning experiences? Do faculty take advantage of the opportunities provided?

Conversations with the department Chair, Dean and Dean of Graduate School indicate that the faculty have regular opportunities for professional development such as travel and participation in professional organizations, workshops, and other learning experiences. Funds for these are available to every faculty who wants to participate. Most faculty seem to take advantage of these opportunities. In cases of unused funds, the department chair reallocates to those faculty who request them.

Are faculty engaged in the planning, assessment, and improvement processes that measure and advance student success?

The faculty actively engages in regular planning, evaluation, and improvement activities that measure and advance student success. To enrich and improve the curriculum, which is maintained at the department level, faculty members may propose changes including curriculum, program goals, and an overall assessment process based on feedback from students and inputs during departmental meetings. The department reviews the proposal and, if approved, submits it to the graduate committee. Once approved, the university implements the changes in the following academic year.

Does the program use assessment data, etc. to improve teaching, scholarship and creative activity and service? How does this work? Are the processes effective?

The program uses an appropriate process and data to incorporate UTC's faculty evaluation system. Generally, supervisors score their faculty based on overall performance. The annual Evaluation and Development by Objectives (EDO) process is the main tool used to assess faculty at UTC. The process measures quality of teaching, research, and service. The annual EDO evaluation consists of objectives, reports and evaluation.

PART 5 – Learning Resources

Does the program regularly evaluate its equipment and facilities and pursue necessary improvements?

- *Has the program requested/encouraged necessary improvements of its equipment and facilities through appropriate internal mechanisms? Through appropriate external mechanisms?*

The MSEM program has been improving its facilities and equipment both through internal mechanisms and external mechanisms. There is a room designated as a 'study' room for engineering management students. Students can plan group studies, work on their capstone projects, or use the computer facilities which have engineering management related software loaded on them. The department has also recently resourced the remodeling a laboratory so that it can be used for projects related to logistics and order processing. A Flexible Manufacturing System (FMS) demonstrator is available to help studies in process optimization, scheduling, order processing and time studies.

- *Does it appear that the program's resources are appropriate within the context of overall college resources?*

The program does appear to have appropriate resources, more so than may be found in similar programs throughout the country. Resource request made by the department chair to improve learning resources in MSEM seem to have been supported by the College. Students and faculty have access to information resources to support teaching and learning primarily through the UTC Library. Additionally, The impressive Walker Center for Teaching and Learning supports faculty by offering development sessions and other teaching resources.

- *How should needs of the program be prioritized? Could savings be realized from current program operations to fund any new budgetary needs?*

The program needs and requests for learning resources would normally be prioritized by the department chair and the Dean based on improving learning, increasing enrollments, research opportunities created and overall contribution to the department, College and University mission within the available resource constraints.

Are library holdings and other learning and information resources current and adequate to support the teaching and learning needs of the discipline? Are there resources adequate to support the research and publication needs of the faculty and staff?

The mission of the UTC Library is to support the teaching and research of faculty and students. The UTC Library seems well staffed with an adequate budget. Librarians have faculty status. The library makes available 124,100 serial titles, including open access titles, through subscriptions to full-text resources, databases, journal packages, and individual journals. 5,765 of these titles are related to engineering management. A conversation with the Dean of the Library indicated that departments are allocated a budget for requested resources that are reviewed frequently. There is support for open-source publishing for faculty. Affordable course material initiative provides $500 per faculty. The library resources seem adequate to support the research and publication needs of the faculty and staff. There have been no issues, other than praise, raised by faculty and the chair related to library resources.

PART 6 – Support

Is the program's operating budget consistent with the needs of the program?

The MS Engineering Management program's internal and external support are consistent with the budget needs of the program. Expenditures stayed roughly the same during the last four years per SCH. Actual expenditures over the years. Internal/external grants received by the department increased significantly from about $600K in 2022 to about $1.6M in 2023. This significant growth if sustained can provide additional resources and recognition for the department.

- *Considering current budget constraints, what are the most pressing resource needs of the program? How should the needs of the program be prioritized? Could savings be realized from current program operations in order to fund any new budgetary needs?*

It seems that resource needs for the department may be addressed by the addition of new faculty in areas dictated by the local industry and student needs. This is happening by the recent focus on the power and data analytics concentrations. Hiring of the new faculty in the leadership and project management areas have the promise of increased enrollments and funded research opportunities. Investments are being made to increase enrollments by new program offerings and technology. Mechatronics program/lab is a good base for MEM manufacturing specialization.

- *Could these needs be met in ways without requiring additional budgetary resources, such as savings from current program operations?*

There is indication that available budget resources are being utilized by the department chair and the Dean effectively. However, the needs above would require some additional resources. Given the

department efforts to increase enrollments and offer new programs, additional resources for MEM would be a good investment.

Does the program have a history of enrollment and graduation rates sufficient to sustain high quality and cost effectiveness?

Even though enrollments and graduation rates have declined slightly in the past few years, the number of students in the program is still sufficient to sustain a high quality and cost-effective graduate program. In addition, there is indication that this trend may be reversing as the department takes measures increase enrollments.

Is the program responsive to local, state, regional and national needs of the discipline?

The MS Engineering Management program is responsive to changing local, state, regional and national needs. The curriculum contents are reviewed regularly, partly to respond to changing regional needs. Since the last program review, a strategic plan for the College of Engineering and Computer Science has been under development to further propel the responsiveness of programs it contains, including the MS Engineering Management Program. The addition of a power concentration, data analytics addressing AI, and leadership courses are an indication of responsiveness to industry needs.

Does the program regularly and systematically collect data related to the success of its graduates, including placement? Do they also incorporate the results of that data to inform program improvements?

The program regularly and systematically collect data related to the success of its graduates. Graduate students are connected to the College's LinkedIn page upon graduation. The LinkedIn page helps the College stay connected with alumni and where they currently work. The College conducts an Annual Review, which is distributed to all alumni in addition to the local and regional businesses.

Are the program policies reviewed on a regular basis to ensure alignment with institutional policies and mission?

The MS Engineering Management program's policies and procedures are regularly reviewed to ensure alignment to institutional policies and mission. This is done every year to comply with and maintain the standards contained in the guidelines of the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), the recognized regional accrediting body in the eleven U.S. Southern States.

Does the program have acceptable completion rates? If unacceptable, what are possible contributing factors? How is this information used toward program revision?

Enrollments in MSEM have increased from 46 in 2021 to 52 in 2022. They have been steady for 2022 and 2023. Graduation rates have increased from 2021-22 to 2022-23. As mentioned earlier, the department has been taking measures to increase enrollments. There is a promise of an upward trend through these efforts, The graduation rates will follow later and increase. The completion rates provide important data toward program revisions and taking appropriate measures. Recent addition of new programs, learning resources, the JUMP program and recruitment efforts indicate the use of such data for revisions.

PART 7 – Summary Recommendations

Overall, what are your impressions of the program?

- *What are the major strengths of the program?*

The program in M.S. in Engineering Management fulfills a critical need in higher education and industry by providing skills required by the students and employers in the area. A major strength is the department chair and the College Dean who understand the field of engineering management and seems to work in harmony with the students, faculty and with a supportive higher administration to make it a success. The curriculum is well developed and continuously evaluated and improved using input from the students, faculty and from the industry. The multidisciplinary faculty are well qualified, motivated and in touch with the students and with the local industries. The program has a potential to grow significantly through new initiatives, their online/live programs, new concentrations, and new certificate offerings. UTC support for online program development and faculty support is commendable.

- *What are the major weaknesses of the program?*

The program is currently healthy, doing well and improving its offerings. If there is a weakness, the potential to grow significantly and student/industry needs will be better served by additional resources in two areas. The size of the full-time faculty is barely adequate to offer both the undergraduate and graduate programs online and in live formats. The workload in teaching, advising and online course development is heavy for fulltime faculty, not leaving much time for scholarly publications and research. Scholarly publications and research are necessary for the program and faculty to grow and gain nationwide reputation. A new push for R2 status and a directive to increase enrollments will bring new challenges in terms of competing resources and faculty workload.

What goals would you suggest the program set for the next five years? Please list goals in order of priority (i.e., the most important goal first, followed by the second most important goal, etc.)

Below are some suggestions based on my observations during the visit. Some of these are easy to implement and some will require additional resources. I will leave the priority assessment to the department chair and the Dean.

1.Suggest a new faculty position to expand the MSMEM graduate program and the new concentrations and certificate programs.

2. Suggest developing a plan for the growth of the online/live programs, new concentrations and a justification a plan for additional resources needed from the University. A review of similar programs in engineering management, how they are funded, and their successes may be helpful. Study the potential for online students both within the local and distant areas and come up with incentives for online course development, and a detailed budget for all resources needed. In a longer term, initiatives for an R2 status need to be planned for.

3. Suggest seeking graduate program certification from the American Society for Engineering Management. This is a specialized accreditation process for engineering management. It can bring more visibility for the

UTC programs and serve as a marketing tool. The time and effort for this one is not much. There already seems to be an ongoing effort.

4.Suggest turning the visiting/lecturer position to a fulltime tenure-track position.

5. Recommend introducing a course in systems engineering for MSEM and developing an AI related course covering potential impacts to the academic programs and industry. A course in systems engineering on design, integration and managing complex systems will enable students to better evaluate needs of their organizations and better assess prioritization, lifecycle costs and risk positions.

6.Suggest expanding live and online certificate programs, especially the one on leadership and project management.

7. Suggest developing a plan in offering a Ph.D. program, or a Doctor of Engineering Management program. Such a program would have a significant potential to attract engineers in management positions from the local industries and enable increased scholarly research participation from faculty. A plan for development and resourcing a doctoral program will also help in the path to R2 status and increased research funding.

How can the program work to achieve these goals over the next five years?

- *Considering current budget constraints, what are the most realistic strategies the program can use to achieve the highest priority goals?*

A major strength of the program is its location in a growing industrial region and the Tennessee Valley Authority. Most companies/organizations need expertise in the engineering management area. Issues in project management, manufacturing, data analytics, logistics, product/process design, quality and risk analysis are common. The engineering management faculty at UTC is in a unique position to address such problems. Partnerships with the industry in recruiting students, student/faculty projects, internships and research funding can generate additional resources. This assumes an incentive system and a project funded faculty course release time system is in place.

- *What goals would require additional resources? What level of resources would these goals require? How might the program secure these resources?*

Significant growth of enrollments and a push for R2 status is going to require a commitment and a sizeable investment from the department, faculty, and the university. Faculty financial and workload incentives for developing new courses/programs and certificates will be helpful. I believe, such investments in the program can pay for itself by generating substantial increases in additional student credit hours, tuition revenue and funded research dollars.