

Name of Institution

University of South Carolina

Name of Program (include concentrations, options, and tracks)

MS in Technology Innovation and Entrepreneurial Engineering

Program Designation

- Associate's Degree
- Master's Degree
- Bachelor's Degree: 4 Year
- Specialist
- Bachelor's Degree: 5 Year
- Doctoral Degree: Research/Scholarship (e.g., Ph.D. and DMA)
- Doctoral Degree: Professional Practice (e.g., Ed.D., D.N.P., J.D., Pharm.D., and M.D.)

Does the program qualify for supplemental Palmetto Fellows and LIFE Scholarship awards?

- Yes
- No

Proposed Date of Implementation

Fall 2017

CIP Code

52.0701

Delivery Site(s)

University of South Carolina - Columbia

Delivery Mode

- Traditional/face-to-face*
*select if less than 50% online
- Distance Education
 - 100% online
 - Blended (more than 50% online)
 - Other distance education

Program Contact Information (name, title, telephone number, and email address)

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Institutional Approvals and Dates of Approval

- | | |
|---|------------------|
| A. College of Engineering and Computing | April 19, 2016 |
| Chemical Engineering | April 8, 2016 |
| Civil and Environmental Engineering | April 8, 2016 |
| Computer Science and Engineering | April 8, 2016 |
| Electrical Engineering | April 8, 2016 |
| Mechanical Engineering | April 8, 2016 |
| B. Graduate Council | October 21, 2016 |
| C. University Provost | |
| D. USC President | |
| E. USC Board of Trustees | |

Background Information

State the nature and purpose of the proposed program, including target audience and centrality to institutional mission. (1500 characters)

There is a growing recognition of the need for technology innovation to sustain national economic revival. To address this need, the three major stakeholders, government, industry, and academia, have begun implementing major initiatives to nurture entrepreneurial mindset. Funding agencies have started to emphasize translational research. Private industry has developed partnership strategies to effectively access scientific discoveries. The academic institutions have taken steps to create entrepreneurial ecology, equip students with business skills, and promote research interactions between faculty and the private sector.

The University of South Carolina spearheads a number of initiatives to unleash the innovation potential of university research. Examples of successful efforts include, but are not limited to, establishing programs (e.g. Faber Center for Entrepreneurship), fostering ties with industry in strategic areas, and launching USC/Columbia incubator. Embedding an entrepreneurial mindset into the university culture, however, requires well trained students who can use emerging science as a basis for the creation of economic value.

We propose that the ongoing efforts at the University of South Carolina can be complemented by the creation of a graduate program in Entrepreneurial Engineering. The goal of the program is to inspire and nurture the culture of innovation in students and faculty in the College of Engineering and Computing. The program will include an integrated curriculum, new venture creation projects and an innovation immersion module. The Moore School of Business will participate in the proposed program by providing overall design support and instruction via several courses. Several entrepreneurship/innovation courses are currently being offered at the master's level and undergraduate level.

List the program objectives. (2000 characters)

In order to prepare engineering students with the skills needed to succeed in today's turbulent economy, engineering programs are increasingly offering some form of entrepreneurship training to their students. There is broad agreement on the need for reform within the engineering community to develop graduates who meet the new standards for the next century. The reform movement encourages more entrepreneurial practices that move instruction from a traditional lecture environment to experiential learning. This transition necessitates that higher education institutions educate people in the fundamentals of entrepreneurship, and encourage a more entrepreneurial mindset.

According to a 2004 report published by the National Academy of Engineering (NAE), "The Engineer of 2020: Vision of Engineering in the New Century," "If the U.S. is to maintain its economic leadership position and be able to sustain its share of high-technology jobs, it must prepare for a new wave of change...it is agreed that innovation is the key and engineering is essential to this task."

The objectives of the program are to:

1. Train students with the tools, knowledge, and skills necessary to meet the challenges of working in today's corporate environment, which may include a startup or large corporation. This will be accomplished by giving students an overall insight into entrepreneurship and the practices necessary to assess technological and marketplace feasibility.
2. Contribute to the economic development of South Carolina by supporting the development of scalable and commercially viable businesses generated by researchers and innovators.
3. Meet the educational goals of the University of South Carolina in its emphasis on innovation and technology.

4. Provide an alternate mechanism for engineering and science students to increase competitiveness in attaining technical, business development, consulting and leadership roles in early stage emerging ventures, and in established organizations that emphasize innovation.

Assessment of Need

Provide an assessment of the need for the program for the institution, the state, the region, and beyond, if applicable. (1500 characters)

Innovation has been recognized as an engine for economic growth. This has encouraged academic institutions to develop collegiate degree and certificate programs at the crossroads of engineering technologies and business, and to invest in efforts that encourage innovation in all disciplines. For example, a recent study in 2010 by Shartland et al. highlighted that over half of the ASEE accredited universities offered a form of entrepreneurship content to engineers, with over 25% reporting more structured offerings like minors and certificates. The recent support by the NSF to launch a national STEP center to foster entrepreneurship, and the changes in ABET accreditation requirements for “professional skills” (Kuratko, 2005) further highlight the need for structured programs to instill an entrepreneurial mindset in engineering students. The effort permeates the curriculum, research and industry endeavors, and state economic engagement. The proposed program in Technology Innovation and Entrepreneurial Engineering is planned so that engineering and science students who wish to augment their technical skills with entrepreneurial skills can readily do so.

The University of South Carolina has been implementing a bold strategic plan to inspire creativity. The proposed program is directly related to the core USC mission, particularly the focus on education and the granting of terminal degrees, and is thus in-line with the overarching goals delineated in the mission statement.

At the state level, South Carolina is home to a number of industrial clusters in the transportation, recycling, biotechnology, medical/healthcare technology, manufacturing, automotive and aerospace sectors. The continued growth of these industries depends on the presence of a robust entrepreneurial ecosystem that meets the technological and workforce needs of companies. Achieving this goal requires a comprehensive strategy that employs a “bottom up” approach to entrepreneurial education, as well as a “top-down” approach to stimulate high-tech venture creation. The proposed program is a stepping-stone towards this goal and will solidify the University of South Carolina’s position as the leading partner in advancing the State’s innovation economy.

Employment Opportunities

Is specific employment/workforce data available to support the proposed program?

Yes

No

Provide supporting evidence of anticipated employment opportunities for graduates, including a statement that clearly articulates what the program prepares graduates to do, any documented citations that suggests a correlation between this program and future employment, and other relevant information. Please cite specific resources, as appropriate. (3000 characters)

Note: Only complete this if the Employment Opportunities table and the section that follows the table on page 4 have not previously been completed.

The need for creativity and innovation corresponds to the changing economy and the imperative to create sustainable 21st Century employment. The rapidly evolving nature of R&D and product development has created a significant demand for engineers with entrepreneurial and business mindset (National Science Board, Science and Engineering Indicators: 2010). It is no longer sufficient to graduate with a purely technical education; engineers need to understand how to bring research and technical skills to fruition by building commercially viable and scalable organizations and deliver new products and services tailored to the market demands. A recent Kauffman-funded Census report cites that “new firms and young businesses account for about 70 percent of gross job creation and disproportionately contribute to net job creation.” According to the Small Business Administration, Office of Advocacy, Small Business Profile: South Carolina, in 2009 there were 76,142 small businesses with less than 500 employees throughout the state. These small businesses accounted for 97.3% of the state’s total employers and 50.0% of private-sector employment (U.S. Dept. of Commerce: Bureau of the Census). These statistics highlight the great demand for students with entrepreneurial training who can join established or new businesses and become effective team leaders supporting employers as innovators.

The purpose of the program is to train entrepreneurial-minded engineers who will take leadership roles in product design and innovation in large organizations. Entrepreneurial engineers who seek leadership roles will have ample employment opportunities for in the private sector, consulting engineering firms and industry as well as in local, state and federal government agencies. This includes in-state organizations as well as outside the state and in foreign countries. We anticipate that approximately 50% of the graduates obtain jobs in technology startups, 25% of the graduates will secure positions in traditional engineering companies, and the rest of graduates will either start their own companies or move into non-traditional positions such as management consulting.

The program administrators will build a strategic alliance with local industry through class projects, an invited lecture series and the recruitment of students as interns. In addition, the program will actively participate in national organizations (e.g. Keen Foundation, Tech Connect World, National Council of Entrepreneurs, VentureWell), and regional society meetings (e.g. SCBIO, Young Entrepreneurs of America). These interactions will contribute to enriching the opportunities that will be available to students in the program.

Will the proposed program impact any existing degree programs and services at the institution (e.g., course offerings or enrollment)?

Yes

No

If yes, explain. (500 characters)

List of Similar Programs in South Carolina

Program Name	Institution	Similarities	Differences
Technology Entrepreneurship	Clemson University	The program serve those graduate students in engineering and science disciplines who envision gaining an overall insight to entrepreneurship and commercialization feasibility.	This is a certificate and not a graduate masters' degree. Clemson University's program focuses on classic entrepreneurship and new venture creation. The program a USC aims at instilling an entrepreneurial mindset in students and bringing a new dimension to education in science and engineering. The focus of our program is the cross-disciplinary skills that connects traditional with entrepreneurial engineering. The program includes concepts such as innovation, creativity, business plan development, and technology and commercialization feasibility analysis.

Description of the Program

Projected Enrollment						
Year	Fall		Spring		Summer	
	Headcount	Credit Hours	Headcount	Credit Hours	Headcount	Credit Hours
2017-2018	25	325	25	325	25	100
2018-2019	25	325	25	325	25	100
2019-2020	25	325	25	325	25	100
2020-2021	25	325	25	325	25	100
2021-2022	25	325	25	325	25	100

Besides the general institutional admission requirements, are there any separate or additional admission requirements for the proposed program?

Yes

No

If yes, explain. (1000 characters)

The admission criteria will generally conform to those currently required by the USC Graduate School. Individuals with the following qualifications will be admitted into the program:

- Must hold a B.S. degree from an accredited program (or equivalent if from an international university) in engineering, technology disciplines, or science, and must provide transcripts from the institution where the degree was obtained.
- A minimum undergraduate grade point average (GPA) of 3.0 is required for admission.
- International students are required to submit qualifying TOEFL or equivalent test score.
- Individuals may request a waiver of some of the above requirements (e.g., undergraduate GPA less than 3.0, or undergraduate degree not in engineering) and admission to the program if they provide sufficient evidence to the graduate program director that they have had compensatory industrial experience to warrant an exception.

Are there any special articulation agreements for the proposed program?

Yes

No

If yes, identify. (1000 characters)

Curriculum

Select one of the following charts to complete: Curriculum by Year **or** Curriculum by Category

Curriculum by Year					
Course Name	Credit Hours	Course Name	Credit Hours	Course Name	Credit Hours
Year 1					
Fall		Spring		Summer	
ENCP 730 - Cases in Technology Feasibility Analysis	3	ECIV 707 - Management of Engineering Projects	3	ENCP 737 - Entrepreneurial Laboratory	6
ENCP 735 - Developing and Launching New Ventures	3	MGMT 777 - Innovation and New Venture Analysis	3		
EMCH 522 - Design for Manufacturing and Assembly	3	COSM 701 - Business and legal issues for Science Managers	3		
Business Elective	3	Business Elective	3		
Total Semester Hours	12	Total Semester Hours	12	Total Semester Hours	6

Business Electives (6 hours): Choose two approved business courses (500-level or above). Students should consult with the program director prior to enrolling in elective courses. Recommended Business Electives:

- (1) BADM 790 - Strategic Management of Technology and Innovation (3 Credit Hours)
- (2) BADM 790 - Entrepreneurial Finance and the Dynamics of Emerging Ventures (3 Credit Hours)

Upon the completion of 24 credit hours of coursework, students are required to successfully complete a comprehensive exam. The exam will include a case study report that synthesizes and integrates knowledge gained from the core courses of the program. The result of comprehensive examination will be signed by the advisor and members of the committee. The comprehensive exam will be at the end of second semester.

Any student failing the comprehensive exam may petition to attempt it a second time. There is no guarantee that the petition will be accepted.

Course Descriptions for New Courses

Course Name	Description
ENCP 735 Developing and Launching New Ventures	The objective of this course is to immerse students in (1) the frameworks that describe the process of new venture emergence and (2) the strategies and tools used to analyze and facilitate the emergence of new ventures, especially science and technology oriented ventures. The course will examine critical issues associated with key activities undertaken for the growth of a new initiative, whether in the form of a startup entity or within an established organization. The course will investigate how entrepreneurs address the challenges of creating viable business models and durable organizations. And, the course will engage with the entrepreneurial community and with founders of emerging ventures in projects that will provide value to their organizations.
ENCP 730 Cases in Technology Feasibility Analysis	The courses focuses on determining whether to exploit a technological innovation idea. Students will acquire skills to evaluate the technical merits, operational logistics, consumer demands, team skills, and the financial viability of a technological innovation. In addition, students will apply entrepreneurial techniques to create a value proposition, conduct competitive analysis, and perform competitive analysis to assess whether an innovative technology is ready for commercialization.
ENCP 737 Entrepreneurship Laboratory	The course will structure an intensive project experience for students to learn about challenges and opportunities facing entrepreneurs in startups. The course includes an experiential learning field visit. Student teams will work with technology-based startup companies incubated in government/university based innovation centers and conduct project-based research and analysis.

Faculty

Faculty and Administrative Personnel				
Rank	Full- or Part-time	Courses Taught or To be Taught, Including Term, Course Number & Title, Credit Hours	Academic Degrees and Coursework Relevant to Courses Taught, Including Institution and Major	Other Qualifications and Comments (i.e., explain role and/or changes in assignment)
Program Director	Full-time	Cases in Technology Feasibility Analysis (3 credits); Entrepreneurship Laboratory (6 credits)	PhD/MBA	Faculty in the School of Engineering & Computing
Full Professor	Full-time	Strategic Management of Technology Innovation (3 credits)	PhD	Faculty in the Moore School of Business
Clinical Professor	Full-time	Innovation and New Venture Analysis (3 credits)	PhD/MBA	Clinical Faculty in the Moore School of Business
Clinical Professor	Full-time	Developing and Launching New Ventures (3 credits); Entrepreneurial Finance and the Dynamics of Emerging Ventures (3 credits)	PhD/MBA	Clinical Faculty in the Moore School of Business
Assistant Professor	Full-Time	Design for Manufacturing and Assembly (3 credits)	PhD	Faculty in the School of Engineering & Computing
Adjunct Professor	Part time	Management of Engineering Projects (3 credits)	PhD	Practicing – Experienced engineer/entrepreneur Adjunct Faculty in the School of Engineering & Computing
Adjunct Professor	Part-time	Business and legal issues for Science Managers (3 credits)	JD/MBA	Practicing – Experienced in intellectual property and technology development with a background in engineering – School of Engineering & Computing

Note: Individuals should be listed with program supervisor positions listed first. Identify any new faculty with an asterisk next to their rank.

Total FTE needed to support the proposed program (i.e., the total FTE devoted just to the new program for all faculty, staff, and program administrators):

Faculty	1	Staff	1	Administration	1
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Faculty /Administrative Personnel Changes

Provide a brief explanation of any additional institutional changes in faculty and/or administrative assignment that may result from implementing the proposed program. (1000 characters)

All full-time faculty members in the program are presently in the College of Engineering and Computing and Moore School of Business. The program will be staffed with two adjunct faculty from the private sector. The budget to cover the costs for the adjunct faculty is included in Financial Support Section.

An attribute of a strong entrepreneurial engineering program is that students engage in academic theories as well as real-world examples. To accomplish this goal, the proposed program will be taught by a blend of academic faculty at USC and experienced entrepreneurs and investors from the private sector.

The program fee will be sufficient to cover adjuncts or overload compensation for faculty and staff as well as other associated operating expenses.

Library and Learning Resources

Identify current library/learning collections, resources, and services necessary to support the proposed program and any additional library resources needed. (1000 characters)

Moore School of Business maintains its own library (Elliott White Springs Business Library) which currently has 7,507 books and 79 periodicals pertaining to management and other related fields.

The College of Engineering and Computing's allocated amount for periodical subscriptions is \$228,504 and \$10,186 for books. The current library holdings are adequate for research and teaching for the proposed program.

Student Support Services

Identify academic support services needed for the proposed program and any additional estimated costs associated with these services. (500 characters)

Present academic support services will suffice in the first two years. As enrollment increases, the need for academic services will be reassessed.

Physical Resources

Identify any new instructional equipment needed for the proposed program. (500 characters)
No new equipment or resources are needed to support the proposed program.

Will any extraordinary physical facilities be needed to support the proposed program?

Yes

No

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Identify the physical facilities needed to support the program and the institution's plan for meeting the requirements, including new facilities or modifications to existing facilities. (1000 characters)

All resources required to deliver the proposed curriculum are already present at USC, and are available for the realization of this program. No additional physical plant requirements are foreseen specifically for the proposed program. However, some reallocation of existing space may be performed to allow for the development and operation of the class-associated laboratories as needed.

Total Estimated Costs						
Year	1st	2nd	3rd	4th	5th	Total
Program Administration	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$50,000
Faculty and Staff Salaries	\$150,000	\$150,000	\$150,000	\$150,000	\$150,000	\$750,000
Graduate Assistants	-	-	-	-	-	-
Equipment	-	-	-	-	-	-
Facilities	-	-	-	-	-	-
Supplies and Materials	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000
Library Resources	-	-	-	-	-	-
Other*	-	-	-	-	-	-
Total	\$165,000	\$165,000	\$165,000	\$165,000	\$165,000	\$825,000
Sources of Financing						
Year	1st	2nd	3rd	4th	5th	Total
Tuition Funding	\$399,937.50	\$399,938	\$399,938	\$399,938	\$399,938	\$1,999,688
Program Specific Fees	\$165,000	\$165,000	\$165,000	\$165,000	\$165,000	\$825,000
State Funding (i.e., Special State Appropriation)*	-	-	-	-	-	-
Reallocation of Existing Funds*	-	-	-	-	-	-
Federal Funding*	-	-	-	-	-	-
Other Funding*	-	-	-	-	-	-
Total	\$564,938	\$564,938	\$564,938	\$564,938	\$564,938	\$2,824,688
Net Total (Sources of Financing Plus Minus Estimated New Costs)	\$399,938	\$399,938	\$399,938	\$399,938	\$399,938	\$1,999,688
Net Total - College of Engineering (Program Specific Fees Minus Estimated Costs)	\$0	\$0	\$0	\$0	\$0	\$0
ROI (Tuition Funding Plus Fees Minus Costs)	242%	242%	242%	242%	242%	242%

*Provide an explanation for these costs and sources of financing in the budget justification.

Budget Justification

Provide a brief explanation for the other new costs and any special sources of financing (state funding, reallocation of existing funds, federal funding, or other funding) identified in the Financial Support table. (1000 characters)

Note: Institutions need to complete this budget justification *only* if any other new costs, state funding, reallocation of existing funds, federal funding, or other funding are included in the Financial Support table.

The annual costs of implementation for the first 5 years is \$165,000/year. The costs include admin oversight and clerical support, marketing supply costs, and faculty salaries. The program will be partially taught by experienced investors, entrepreneurs and industry leaders as adjunct faculty. The proposed compensation cost for adjunct faculty is \$30,000 per year. The Moore School of Business will cover 4 courses, all of which are currently being offered. The Moore School will receive a total of \$60,000 from the fees generated from the program to cover the overload compensation. The remaining \$60,000 generated from the fees will cover the salary of full time faculty in the College of Engineering and Computing. The remainder of request is to cover the program administration and marketing costs.

Student tuition will cover the implementation costs. The revenue from the program is calculated based on the enrollment projections (page 6). The in-state tuition per graduate student per semester is \$6,399. The summer tuition per credit hour is \$533.25. The College of Engineering and Computing fees for this program is based on the \$220 per credit hour due to the executive nature of the proposed MS program.

Evaluation and Assessment

Programmatic Assessment: Provide an outline of how the proposed program will be evaluated, including any plans to track employment. Identify Assessment tools or software used in the evaluation. Explain how assessment data will be used. (3000 characters)

A committee composed of faculty in the School of Engineering and Computing, the Moore School of Business, and adjunct faculty coming from industry will be formed to oversee the academic curriculum and coordinate the presentation of all curriculum changes to the faculty at-large for approval. The Director of the program will chair the Curriculum Committee. The committee will formalize the assessment plan, tactical metrics, and implementation plan.

The committee will document its assessment processes and program improvements. Program-level information will be linked to the student learning outcomes. The student learning outcomes for the new degree program include:

1. Develop an understanding of fundamentals of technology prototyping, legal protection, market sizing, business plan development, and capital raise.
2. Communicate effectively across the entire enterprise and contribute in multidisciplinary teams.
3. Lead entrepreneurial process including ideation, feasibility analysis, and management of organizational resources.
4. Apply corporate innovation strategies including the assessment of commercial viability and transformation into business plans.
5. Analyze the impact of engineering solutions in global, economic, and entrepreneurial contexts.
6. Identify alternative career possibilities in the context of innovation and entrepreneurship.

There are six tools/instruments to be used to evaluate the Student Outcomes:

1. Student ePortfolios
2. Course Notebooks
3. Employer Survey
4. Internship preceptor evaluation
5. Exit survey

These measurement instruments encompass both direct and indirect measures, but with at least one direct measure per Student Outcome. Table 4 lists descriptions of the assessment instruments with the responsible party and schedule, as well as evaluation criteria.

Student Learning Assessment

Assessment Instrument	Description of Assessment Instrument	Responsibility	Schedule	Evaluation Criteria
ePortfolio	Digital collection of the student's work with artifacts demonstrating competency in engineering design, oral/written communication, industrial practices, and mentoring/ leadership addressing the program learning objectives.	Assessment Committee and program advisory board (consisting of practicing entrepreneurs in technology industry).	Every year	Assessment Committee and advisory board will conclude that the ePortfolio is complete and outcomes have been met.
Course Notebooks	A course notebook contains examples of all graded work collected from students (e.g., exams, homework, lab reports, etc), course syllabus, and textbook(s). Made for each course.	Course Instructors and Assessment Committee	Every third year in December and May	Assessment Committee will conclude that the Student Outcomes examined during a particular review have been achieved.
Employer Survey	Employers are queried for assessment of Student Outcomes of graduates employed at their institutions. Employment of students following attainment of the degree will be monitored through the CEC Career Office staffed with a student services coordinator.	Program Director and Assessment Committee	Every other year in March	Advisory Board member surveys will indicate that graduating students have achieved the outcomes.
Internship evaluation	A performance report following the completion of the internship by the assigned preceptor reviews business, professional, leadership, and communication skills of the intern.	Program Director and Assessment Committee	Every year	At least 80% of preceptors will concur that students have met outcomes.
Exit Survey	Program Director surveys graduating students using Exit Survey Form	Program Director	every three years thereafter	At least 80% of students will agree that the Student Outcomes are achieved.

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Will the proposed program seek program-specific accreditation?

Yes

No

If yes, provide the institution's plans to seek accreditation, including the expected timeline for accreditation. (500 characters)

Will the proposed program lead to licensure or certification?

Yes

No

If yes, explain how the program will prepare students for licensure or certification. (500 characters)

Teacher or School Professional Preparation Programs

Is the proposed program a teacher or school professional preparation program?

Yes

No

If yes, complete the following components.

Area of Certification

Please attach a document addressing the South Carolina Department of Education Requirements and SPA or Other National Specialized and/or Professional Association Standards.