

Routing for On-Campus Approval of Degree Program Actions

Type of Action: Enter "X" for Action Type(s) and list Title and Prefix(s) as indicated

<input checked="" type="checkbox"/> New Degree Program	Proposed Program Title <u>Biomedical Engineering (PSM)</u>
<input type="checkbox"/> New Certificate Program	Proposed Certificate Program Title _____
<input type="checkbox"/> New Minor Program	Proposed Minor Program Title _____
<input type="checkbox"/> Change in Degree Program Title	Current Degree Program Title _____
<input type="checkbox"/> Change in Certificate Program Title	Current Certificate Program Title _____
	Proposed Certificate Program Title _____
<input type="checkbox"/> Change in Minor Program Title	Current Minor Program Title _____
	Proposed Minor Program Title _____
<input type="checkbox"/> Change in Course Prefix	Current Course Prefix _____ Proposed Course Prefix _____
Proposed Effective Date <u>Summer 2018</u> Program Contact: <u>Bob Barnes bdbarnes16@mindspring.com</u>	
Proposed CIP Code (see https://nces.ed.gov/ipeds/cipcode/default.aspx?y=55): _____	

Routing of Action: Indicate date when the following occurs

Completed Request to Plan and 1-page Concept Paper

8/22/2010 Council of Dean's- Approval to Plan

Completed Proposal

10/28/2010 Department Head endorses*

10/31/2010 College Curriculum Committee (undergraduate or graduate) recommends*

2/2/2010 College Dean endorses*

Proposal moves to Undergraduate or Graduate office for routing

N/A Recommended by Vice Provost, DELTA, if applies*

_____ Substantive Change Review Team (SCRT) informed

_____ If SACS notification is required, SCRT prepares letter for Chancellor to send to SACS

_____ University Courses & Curriculum Committee **or** Administrative Board of the Graduate School recommends

_____ Associate Deans Council **or** Graduate Operations Council informed

_____ Dean (Graduate School or DASA) approves*

Proposal move to the Executive Vice Chancellor Provost's office for routing

_____ Vice-Provosts informed

_____ Deans' Council recommends*

_____ Executive Vice Chancellor and Provost approves*

_____ Chancellor's Executive Officer's (EOM) recommend

_____ University Council informed

_____ Board of Trustees subcommittees recommend

_____ Chancellor approves*

_____ Accreditation Liaison notifies SACS, if applicable

_____ Submitted to UNC-General Administration by Provost's Office

* Signature is required on the signature page for the action

Request to Plan
Joint UNC CH NC STATE UNIVERSITY Biomedical Engineering Department
Professional Science Master's Degree
North Carolina State University

This request has been reviewed and approved by the appropriate campus committees and authorities.


Endorsed By:

Nancy L. Allbritton MD PhD  10/28/16
Head, Department/Director of Graduate Program (Printed Name and Signature) Date

Recommended By:

Douglas S. Reeves PhD  10/31/2016
Chair, College Graduate Studies Committee (Printed Name and Signature) Date

Endorsed By:

Louis A. Martin-Vega  _____
College Dean (Printed Name and Signature) Date

Recommended By:

Vice Provost, DELTA (if DE degree) (Printed Name and Signature) Date

Approved By:

Dean of the Graduate School (Printed Name and Signature) Date

Recommended By:

Dean's Council (Printed Name and Signature) Date

Approved By:

Executive Vice Chancellor and Provost (Printed Name and Signature) Date

Approved By:

Chancellor (Printed Name and Signature) Date

(revised August 2015)

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UNIVERSITY OF NORTH CAROLINA
REQUEST TO PLAN
A NEW DEGREE PROGRAM – ANY DELIVERY METHOD

THE PURPOSE OF ACADEMIC PROGRAM PLANNING: Planning a new academic degree program provides an opportunity for an institution to make the case for need and demand and for its ability to offer a quality program. The notification and planning activity described below do not guarantee that authorization to establish will be granted.

Date: January 21, 2017

Constituent Institution: North Carolina State University

Is the proposed program a joint degree program? Yes No

Joint Partner campus University of North Carolina at Chapel Hill

Title of Authorized Program:

Biomedical Engineering

Abbreviation: PSM - [M. P. S. (at UNC-CH) / MR (at NC State University)]

CIP Code (6-digit): 14.0501 Level: B M I D

CIP Code Title: Biomedical Engineering

Does the program require one or more UNC Teacher Licensure Specialty Area Code? Yes No

If yes, list suggested UNC Specialty Area Code(s) here _____

If master's, is it a terminal master's (i.e. not solely awarded en route to Ph.D.)? Yes No

Proposed term to enroll first students in degree program: Term Summer Year 2018

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Provide a brief statement from the university **SACSCOC** liaison regarding whether the new program is or is not a substantive change.

<http://www.sacscoc.org/pdf/081705/SubstantiveChange.pdf>

Definition: Substantive change is a significant modification or expansion of the nature and scope of an accredited institution. Under federal regulations, substantive change includes

SUBSTANTIVE CHANGES IDENTIFIED BELOW

No.	Question/Change	Yes/No
1	Any change in the established mission or objectives of the institution	No
2	Any change in legal status, form of control, or ownership of the institution	No
3	The addition of courses or programs that represent a significant departure, either in content or method of delivery, from those that were offered when the institution was last evaluated	No
4	The addition of courses or programs of study at a degree or credential level different from that which is included in the institution's current accreditation or reaffirmation.	Yes
5	A change from clock hours to credit hours	No
6	A substantial increase in the number of clock or credit hours awarded for successful completion of a program	No
7	The establishment of an additional location geographically apart from the main campus at which the institution offers at least 50% of an educational program.	No
8	The establishment of a branch campus	No
9	Closing a program, off-campus site, branch campus or institution	No
10	Entering into a collaborative academic arrangement that includes only the initiation of a dual or joint academic program with another institution	Yes
11	Acquiring another institution or a program or location of another institution	No
12	Adding a permanent location at a site where the institution is conducting a teach-out program for a closed institution	No
13	Entering into a contract by which an entity not eligible for Title IV funding offers 25% or more of one or more of the accredited institution's programs	No

Identify the objective of this request (select one or more of the following)

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- Launch new program on campus**
- Launch new program online; Maximum percent offered online _____
 - Program will be listed in UNC Online
 - One or more online courses in the program will be listed in UNC Online
- Launch new site-based program (list new sites below; add lines as needed)
 - Instructor present (off-campus delivery)
 - Instructor remote (site-based distance education)

Supply basic program information for UNC Academic Program Inventory (API) and UNC Online

Minimum credit hours required

37

Expected number of full-time terms to completion

12 contiguous months: 2 summer sessions followed by subsequent Fall and

Spring sessions

1. Review Status.

- a. List the campus bodies that reviewed and commented on this request to Plan proposal before submission to UNC General Administration. What were their determinations? Include any votes, if applicable.

Organization	University
Graduate School	NC State
Office of the Senior Vice Provost for Academic Strategy & Resource	NC State
College of Engineering	NC State
Dean's Council	NC State
School of Medicine	UNC-CH
UNC Hospitals – UNC Healthcare	UNC-CH
Professional Science Masters' Program	UNC-CH
Graduate School	UNC-CH

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- b. Summarize any issues, concerns or opposition raised throughout the campus process and comment periods. Describe revisions made to address areas of concern. **No substantive issues raised but commonly asked questions and their answers are detailed below.**

1. "Is there any idea of whether a new program could negatively impact the applicant pool for the existing program?"

The existing program and the PSM target radically different student populations. The PSM program targets students wanting to work as engineers in industry. The existing MS program targets students wanting to get PhD's, perform engineering research and move into academia. There is little to no overlap between these two pools of students. Currently we have nothing to offer students wanting a master's degree preparing them for industry i.e. a PSM. In fact, we advise them that to find these types of opportunities, they will need to leave North Carolina and enter programs at Georgia Tech, Virginia Tech, Johns Hopkins, University of Michigan, and other Universities. There are no opportunities for these students in the state of North Carolina. We would like to fill this void rather than referring what is often our best students to other Universities.

2. "Any comment on anticipated enrollment between students coming straight from undergrad vs people already in the field who wish to gain a Masters? Clearly the program would benefit from having both, but would there be any differences in their needs?"

We expect that our population will be split between these 2 groups. This will benefit both groups of students. The students with industry experience will convey relevant experience and advice on industry expectations and behavior to the straight-from-UG students. While the straight-from-UG students will play a role in enriching the industry students as they will likely be more up to date on engineering, math, physics etc theory and classroom skills.

3. Regarding the ability to accommodate 30 to 50 extra PSM students and whether this could call for additional resources for faculty presumably to deliver additional sections of courses. This primarily relates to elective courses as it appears there will be dedicated sections of the program-specific courses. The proposed budget has a buffer to address this, but some discussion of what might be involved could be helpful here. [How many courses are likely to be impacted, for instance? Could this have negative implications for students in existing programs?]

We expect that a maximum of 3 of the electives taken by the PSM students to be impacted. The reason is that the students will be encouraged to take these as their electives but the currently offered versions of the classes typically have only 3-5 open seats (not

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30-50 seats). The extra sections supported through PSM funds would offer an advantage to other PSMs increasing the numbers of class sections available and times at which the elective is taught. This is win-win for everyone.

4. A large number of courses will be taught by adjunct faculty. Is there any concern over this? Is this typical for graduate programs, and how would this be viewed by students paying premium tuition? Would any adjuncts teach more than one course? I appreciate that some of these adjuncts, as explained in the proposal, might be industry specialists, which I would see as a very positive thing. From where would other adjuncts be drawn?

Most adjuncts would be drawn from industry. We expect each to teach one course in their specialty area only. The BME faculty (and possibly most University faculty) have little to no industry experience. Thus, it is not appropriate for BME faculty (and other faculty) to teach these industry-related courses. As stated above, we will work with the Departments teaching some of the PSM electives (already offered by other departments) to carefully select, highly qualified, practicing professionals serving as adjuncts as needed. It is our experience that the BME students highly value interacting with industry professionals and actually prefer industry professionals over typical faculty for industry related courses. The students are sufficiently savvy to know that faculty generally have little industry work experience.

5. Premium tuition: Given the stated necessity of premium tuition for the existence of this program, has market research been carried out to assess whether this level is feasible and/or what impact it might have on applications? Comparisons are given to benchmark programs: one issue I wondered is whether the stated figures are the totals of tuition and fees, or simply tuition—the former gives a fairer cross-institution comparison.

As per the directions of the RTP Item 9a, tuition only has been addressed. If one is to compare institutions, we believe that the costs of books and supplies, housing, living and transportation expenses as well as tuition and fees need to be considered. Rather than attempt to consider all these variables, we have chosen to provide the information specifically required by the Request to Plan. For the Request to Establish, we plan to attempt a more detailed market research. We are in the preliminary stages of working with a market research organization currently serving two similar programs to assess market size and potential conversion rates. We are hoping to raise funds to pay for the extensive market analysis being requested. We believe that if we have a Request to Plan granted, we will be able to raise external funds to pay for a detailed market analysis. At the current time, the Joint Department has already expended substantial funds to support the PSM planning.

2. Description and Purpose

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- a. Provide a 250-word or less description of the proposed program, including target audience, delivery method, hours required, program core and concentrations (if applicable), post-graduate outcomes for which graduates will be prepared, and other special features. For programs with an online component, describe whether the delivery is synchronous with an on-campus course, partially synchronous, asynchronous, or other.

(Note: Detail provided in Appendix 1: Background and Appendix 2: Proposed Curricula)

Health and healthcare costs in the US have grown from \$355/person (6.93% of GDP) in 1970 to \$9,532/person in 2014 (17.47% of GDP). During this period, both amounts of care delivered and basic medical research have grown. Unfortunately, a gap exists between the identification of healthcare and related industry needs and the translation of basic research findings.

The proposed “Translational Innovation (TraIn)” Professional Science Master’s (PSM) Program, taking advantage of the momentum of the Joint Department of Biomedical Engineering, is designed specifically to provide the technology, design, business, and management skills essential for closing this gap. With an emphasis on translation of innovations, this PSM will be accomplished, as depicted in Figure 2-1 below, through an intense curriculum combining 37 semester hours of coursework (9 hours each of Design and Technology, 10 hours of Management, and six hours of Business courses) in combination with an intensive 520-hour experiential practicum/internship (three semester hours) in partnership with the UNC Healthcare, and leading health and healthcare related companies and organizations. The 12 contiguous month program provides students a unique environment to focus on either Track 1, product development or on Track 2, process design. The goal is for students to receive high quality, interactive, cross-functional instruction and substantial practice-oriented mentoring in a real-world environment. The program is intended for a targeted audience with previous engineering and/or STEM degrees with career goals of leading in the technical and managerial aspects of health and healthcare.

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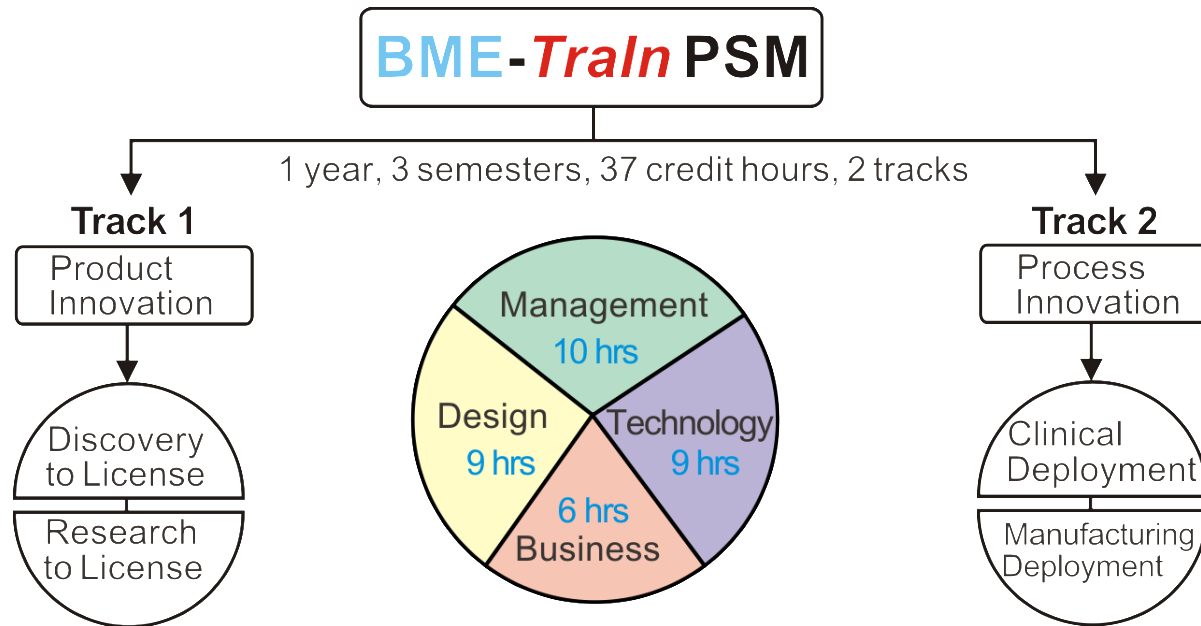


Figure 2-1: Schematic of two track models of BME-Train PSM

b. How does the proposed program align with system, institutional, and unit missions and strategic plans?

1. The Joint Department is in full alignment with the unit, system, and institutional missions and strategic plans. This has been validated by a recent three-year review and strategic planning initiative engaging key players inside and outside the university.
2. The proposed Professional Science Master's (PSM) program has been designed to support three key strategic elements of the Joint Department Plan: (a) education; (b) entrepreneurship; and (c) research.

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Unit Level

The Joint Department of Biomedical Engineering (founded in 2003) occupies a unique and valuable position within the greater University of North Carolina. It is the first and, to date, the only degree granting department officially spanning two flagship campuses of the UNC System. From its Charter it is tasked to continually seek both to leverage and to enhance the strengths and unique abilities of its stakeholders. In this vein, the Joint Department, as part of the above mentioned review, has its Mission Statement: **“to unite engineering and medicine to improve lives.”**

Supporting this mission are three strategic elements:

- **Education** - Train a workforce that can make important contributions to the health and well-being of the citizens of the state, nation, and world;
- **Entrepreneurship** - Create new businesses in the state that can compete globally; and
- **Research** – Provide translation of cutting edge researches to licensing and deployment.

Linked directly to the Joint Department mission and these three strategic elements, the proposed PSM Program will provide the training, experiences, and competencies identified below in Table 2-1.

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Table 2-1: PSM Target Competencies for Both Joint Department BME PSM Tracks

A. received formal classroom and experiential training resulting in the following competencies:	
1	engineering design of products and/or processes
2	key technologies including one or more: pharmacoengineering, biomedical imaging; rehabilitation engineering; biomedical micro and nano-devices; selected others depending upon candidate needs
3	management, leadership and communications
4	business: managerial accounting; finance; organization development and design
B. received formal classroom and tacit “on the job” training resulting in the following competencies:	
1	acceptable culture, ethics, and behavior in a healthcare, medical, and/or US FDA compliant manufacturing environment
2	managing cross-functional professionals in a deliverable driven, business team environment
3	design and delivery of effectively functioning real healthcare devices and/or processes
4	business assessment and planning for new products and processes or improvement thereof
5	new technical skills
C. practical, “in the field,” behavioral and performance level experience resulting in competencies in one or more of the following:	
1	starting up an innovative entrepreneurial med-tech company
2	prioritizing and taking technically proven research ideas to license
3	designing and delivering clinical processes enhancing both health and financial benefits for Accountable Care Organizations and others
4	designing and delivering manufacturing processes of high value
D. demonstrated competencies in presenting, pitching, and documenting individual and team observations, analyses, engineering designs, and business plans in a competitive environment, to competent, practical professionals seeking to benefit from the work products of the candidates, including:	
1	selected angel investors
2	key venture capitalists
3	key UNC-CH and NC State officers at the vice chancellor level, responsible for innovation, entrepreneurship, and economic development
4	executives of leading biomedical manufacturing organizations
5	recognized expert leaders inside and outside of the UNC-CH and NC State organizations
6	leading legal and regulatory experts

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System and Institutional Level

The proposed Joint PSM Program aligns with the UNC System, UNC-CH, and NC State strategic plans as well as the Departmental and School/College plans.

UNC System: Our Time Our Future – UNC COMPACT: The Commitment to North Carolina – 2013

Value for students and for North Carolina

Biotechnology is a target for economic retention and development by the State of North Carolina. A key deficiency for this growth is the shortage of potential employees with integrated training, skills, and experience across four key disciplines: management and leadership; business; biotechnology; and engineering product and process design. These four areas form the core of the proposed Joint Department Professional Science Master's Program. Data surfaced in designing the program indicate increases in median salaries from BS, \$70,500 to MS, \$87,500 or 24.1%. Findings also indicate that for every professional level position created in biotechnology in North Carolina, approximately 3.4 support jobs may be created

UNC-CH: Innovations – 2010

Translate important new ideas more expediently and at an increased volume into innovations that improve society

North Carolina ranks 5th in the US with over \$1.5 billion spent on academic bioscience research and development. However, the state ranked only 14th among all states in terms of bioscience patents issued during the 2004 – 2009 period; or about 2% of all biotech patents during this period.

The proposed Joint Department PSM, Product Track, takes clear focus in this area. Teams of 2 to 3 individuals, as part of their immersion/practicum requirement, working with the offices of technology transfer and supportive faculty will identify and vet high potential research results. Thus, bringing “on the cusp” inventions to Invention Disclosure/Provisional Patent Application, i.e. to the status at which they may be licensed by UNC CH or NC State and delivered to societal benefit.

UNC-CH – School of Medicine and UNC Health Care: Mission, Focus, and Strategy – 2012

Set translational and multidisciplinary team science as a vision for UNC research, and provide the tools needed to foster successful teams

Fifteen to twenty-five, two-to-three-person Joint Department PSM teams may be shadowing and observing within the School of Medicine each summer. These teams will seek to identify heretofore undiscovered healthcare and medical needs transitioning these to a licensable state. Reports from programs similar to the proposed PSM,

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indicate substantial team building initiatives across medical research, engineering analysis and design, and business specialties.

NC State – The Pathway to the Future – Strategic Plan 2011 – 2020

Enhance the success of our students through educational innovation

From its beginning the Joint BME Department has pursued educational innovation - evidenced by the challenges and opportunities presented by combining the capabilities of two flagship universities and two leading disciplines: medicine and engineering. Two innovative concepts drive the proposed Joint Department PSM: immersion and innovation and entrepreneurship. This approach enhances the potential of graduates. They finish the program with an in-depth understanding of the opportunities and challenge presented in health and healthcare and a clear understanding of and potential for starting up their own business.

Joint Department BME – Strategies and Supporting Initiatives

Grow industrial partnerships

Both tracks of the proposed Joint BME Professional Science Master's program require extensive interaction with industry. On the Product track, the department must continue to maintain close relationships to understand the market potential for any new product or process in order ensure the viability of any items presented for licensing. On the Process track, regular interaction is required to provide access for opportunities for teams to shadow and observe in industrial situations during an immersive experience ... leading to the identification of process needs and/or improvements. The Joint Department has already demonstrated this propensity through its Advisory Committee over the past three years; the employment of an Industrial Advisory Board for assistance in implementing the Joint Department Strategy; and in the empanelment of a Professional Science Master's Advisory Committee once the Request to Plan is approved.

c. What student-level educational objectives will be met by the proposed program?

To address the vast gap identified earlier between research and needs in the health and healthcare industry, the program objectives are to educate candidates in:

- (a) discovering health and healthcare needs;
- (b) identifying and prioritizing inventions from research initiatives;
- (c) recognizing opportunities for design and/or improvement;

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- (d) translating these through design, proof of concept prototyping, licensing, business start-ups, and/or other means to practical applications; and
- (e) realizing benefits.

The proposed program provides explicit and tacit training, immersion, and practical experience in 12 specific areas as presented in Table 2-2 below.

Table 2-2: Health and Healthcare PSM Training Focus Areas*

1	STEM disciplines ¹	7	Innovation and entrepreneurship
2	Intellectual property	8	Team work
3	Regulatory affairs	9	Management and leadership
4	Product design and development	10	Project management
5	Process design and improvement	11	Managerial accounting and finance
6	Business communications	12	Business planning: strategic and operational

¹3 course/9 semester hour elective concentration in one of the following or related areas: physiology, synthetic biology, tissue engineering, healthcare systems, biostatistics, clinical trials, and biomedical/biotechnology manufacturing

3. Student Demand

Provide documentation of student demand. Discuss the extent to which students will be drawn from a pool of students not previously served by the institution.

Background:

One-year-long; non-thesis programs similar in focus to that proposed herein; offered at R-1 Universities; in US Biomedical Engineering Departments listed below in Table 3-1; typically, annually receive from 100 to 200 applications of which 30 to 100 enroll. Each of the

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institutions interviewed indicated increasing interest and demand for these intense, practice oriented, non-thesis degrees. There are no reports of difficulty in securing employment post-graduation.

Table 3-1: Institutions Participating in Telephone Interviews

No.	University
1	University of California: San Francisco and Berkley
2	City College University of New York
3	Georgia Institute of Technology
4	Johns Hopkins
5	University of Michigan
6	Purdue University
7	University of Washington - Seattle

In North Carolina, no private or public college or university offers a Biomedical Engineering Professional Science Master's program or its equivalent. Consequently, those students seeking professional applications training must pursue a traditional research driven master's program with thesis, a terminal masters of engineering degree concentrating on in-depth technology without thesis, or out-of-state options.

Ten years of Joint Department data, from 2005 through 2014, reveals that in excess of 80% of those candidates applying specifically for the MS (*not the PhD*) and successfully matriculating, pursue non-academic professional employment as opposed to continuing on to pursue the PhD.

Other colleges and universities seem to be experiencing similar phenomena. Of the approximately 118 biomedical engineering programs in the US, recent correspondence indicates that 43 already have programs reflective of the proposed PSM or are, based upon expressed student demand, actively investigating the establishment of non-thesis, professional BME master's degrees. According to the Council of Graduate Studies, nationally, student applications and enrollment in medical-related PSM programs have risen consistently above 12% per academic year.

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While the existing, Joint BME Department research oriented MS with thesis and planned programs certainly differ along a number of dimensions, there is consistent evidence indicating student interest moving away from the traditional research concentrated MS with thesis toward professional programs emphasizing cross-functional training integrating management, business acumen, engineering design, and/or translation of technology to practice.

Estimates and Interest Specific to North Carolina:

Analysis of Joint Department application and matriculation data from 2005 through 2014 indicates the potential to enroll 30 candidates per year into the proposed PSM program. With modest enhanced effort in three areas, over the next four years, this number is projected to rise to 50 to 60 candidates. These efforts include: (a) enhancing STEM recruitment relationships with ECU, NC A&T, NCCU, Elon, Furman, Campbell, and Meredith; (b) advertising the unique professional and financial benefit of the 1 year, Joint BME Department PSM; and (c) enhancing the international diversity of the candidate population.

Based upon the above and indications from 10 years of experience with an assortment of PSM Programs within the UNC System as reported in the 2014 NC State PSM Results and Resource Guide, there appears to be a sizeable pool of students interested in biomedical engineering related professional careers not previously served by the University.

4. Societal Demand

Provide evidence of societal demand and employability of graduates from each of the following source types.

Anecdotal information from members of the Joint Department Advisory Committee (Table 1) and from the recently impaneled Joint Department of BME Industrial Advisory Board (IAB) composed of seasoned, active, NC resident and non-resident venture capitalists, successful serial entrepreneurs, and representatives with broad industry experience indicate a ready market demand for professionals with the explicit and tacit training proposed. Indeed the IAB over the past 18 months has regularly encouraged the expeditious initiation of the proposed PSM. In their words, "***NOW is the Time!***"

The NC BioTech Center as documented in their report to the NC General Assembly, entitled, "Bridging the Gaps, a Strategic Plan to Accelerate the Commercialization of Life Science Technologies in North Carolina," has documented in detail the serious need for

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professionals possessing capabilities to integrate work across management, business, technology, and design as critical to the growth of the State.

To fully appreciate the commercial and societal demand for BMEs requires an overview of health and healthcare economics. From 1970 to 2014 total associated costs in the US has grown from approximately \$74.6 billion to \$3,031.3 billion, an increase of 3,963%; the per capita cost rose from \$355 to \$9,532, an increase of 2,583%; dwarfing the US population growth from 210 million to 318 million, an increase of only 51%. All the while healthcare productivity has decreased at a compound rate of a -0.6%.

To address these large increases in cost while providing for appropriate health and healthcare will require professionals with the unique capabilities emphasized in the proposed PSM program: management, business, design, and technology. Data from the US Bureau of Labor and NC Works indicates a demand over the period 2012 – 2022 for 17,000 new positions in the state. The median salary projection for BMEs with the capabilities (i.e. PSMs) outlined above is estimated to be on the order of \$87,500 per year.

In conclusion, there is currently and will be in the future ample demand for Joint Department BME PSMs accompanied by good salaries.

5. Unnecessary Duplication

- a. List all other public and private four-year institutions of higher education in North Carolina currently operating programs similar to the proposed new degree program, including their mode of delivery.

There are NO similar, nor duplicative programs of the proposed Joint Department BME PSM either private or public in North Carolina. Other BME master's degrees in North Carolina (while excellent in nature) have a fundamentally different focus than that of the proposed PSM. These other master's programs are offered at: East Carolina University, North Carolina Central Agricultural and Technical State University, Duke University, and Wake Forest University.

- b. Identify opportunities for collaboration with institutions offering related degrees and discuss what steps have been or will be taken to actively pursue those opportunities where appropriate and advantageous.
 - i. Meetings were held with Barbara Muller-Borer, PhD – BME area leader in the Department of Engineering at East Carolina University and with Stephen Knisley, BME Department Head at NC A & T University on 8 August and 9 August to discuss the Joint Department BME PSM Program in detail.

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- ii. Both Dr. Muller-Borer and Dr. Knisley responded favorably to the in-progress planning. Both have discussed the program with their Department Head and Dean respectively.
 - iii. Based upon feedback from Dr. Muller-Borer and Dr. Knisley, the Joint Department will continue to actively communicate and share plans. At this time there is no intention of designing the Joint Department PSM Program to extend formally to other campuses. Rather the Joint Department seeks to ensure a collaborative, cooperative exchange of information, ideas, and intentions in support of the mission of each campus and the UNC System.
 - iv. A number of other colleges and universities currently work formally and informally with NC State and UNCCH, such as Elon and Meredith College. These programs have the potential to provide a steady stream of PSM candidates. Outreach to these programs and others have been initiated.
 - v. Extensive joint planning between the Executive Director of the Joint BME PSM Program and Dr. Heidi Harkins, Director of Professional Science Masters' Programs in the UNC CH Graduate School has been aggressively pursued by both parties since mid-June 2016.
 - The intent is to utilize "as is" or modestly modified UNC-CH PSM courses together with current faculty to support the management and leadership components of the proposed Joint BME PSM Program.
 - Working together, the two leaders seek to ensure compliance of the Program with key requirements of the National Professional Science Masters' Association.
- c. Present documentation that the establishment of this program would not create unnecessary program duplication. In cases where other UNC institutions provide similar online, site-based distance education, or off-campus programs, directly address how the proposed program meets unmet need.

There are NO similar, Nor duplicative programs of the proposed Joint Department BME Professional Science Master's either private or public in North Carolina.

- 6. Enrollment.** Estimate the total number of students that would be enrolled in the program during the first year of operation and in each delivery mode (campus, online, site – add lines as needed).

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Delivery Mode campus Full-Time 30 Part-Time N/A

Estimate the total number of students that would be enrolled in the program during the fourth year of operation and in each delivery mode (campus, online, site – add lines as needed):

Delivery Mode campus Full-Time 50 Part-Time N/A

7. Resources. Will any of the resources listed below be required to deliver this program? (If yes, please briefly explain in the space below each item, state the estimated new dollars required at steady state after four years, and state the source of the new funding and resources required.)

- a. New Faculty: Yes _____ No **X**
- b. Faculty Program Coordination: Yes **X** No _____

Executive Director – Joint Department (UNC CH N C STATE) PSM Program = Salary + Fringe = \$193,056
Salary to be phased in from Joint Department funds over the first four years of the PSM program: year 1, \$0; year 2, 25%; year 3, 50%; year 4, 100%. More detail is provided below in Table 9-2: Budget Summary and Appendix 3: Detailed Year by Year Cost Estimates.

- c. Additional Library Resources: Yes _____ No **X**
- d. Additional Facilities and Equipment: Yes _____ No **X**
- e. Additional Other Program Support: Yes **X** No _____
(for example, additional administrative staff, new Master's program graduate student assistantships, etc.)

- Administrative staff support (contract, part-time)
- Funds for:

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- compensation of consultants to review need specifications, product and process designs, inventions, Invention Disclosure Documents (IDFs), and Provisional Patents;
- development and construction of proof of concept prototype devices;
- advertising, travel and conferences;
- coordination of activities among Joint UNC-CH and NC State personnel and ECU and NC A & T professionals to promote/coordinate mutually supportive programs;
- adjunct faculty for delivering and mentoring existing courses to best meet the tight time constraints of PSM Masters' Program;
- salary supplements as required for faculty at UNC-CH and NC State; and
- tailoring existing courseware to the professional practice focus of the PSM Program.

8. Curriculum leverage. Will the proposed program require development of any new courses? If yes, briefly explain. **YES**

One new course, Biomedical Innovation and Entrepreneurship, not currently delivered at UNC-CH – NC State will be required.

Three other courses may require modification:

- i. BME 551, Medical Device Design I - to accommodate discoveries from the summer practicum/internship;
- ii. BME 552, Medical Device Design II - to accommodate interaction with commercial proof concept model builders and proof of concept testing; and
- iii. MIE 412, Finance and Accounting for Entrepreneurs - to upgrade for needed professional practice content and graduate school requirements.

A new course, Grad 701 (1.5 semester hours; PSM Program UNC CH) – Working in the Clinical Environment, will need to be adapted from current courseware in the first year UNC School of Medicine curriculum.

All other courses are currently approved and actively delivered.

With respect to electives taken by the PSM candidates, it is unlikely that existing sections for all electives will accommodate an additional 30 to 50 PSM candidates. For this reason, the PSM will seek to compensate existing faculty through salary supplements to teach additional sections. If necessary, we will work with the Departments teaching the electives to carefully select, highly qualified, practicing professionals serving as adjuncts. This would be advantageous to other PSM programs and Departments as empty seats in these extra sections could be filled by other students.

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For the 3 courses or 9 hours of electives required in the proposed Joint Department PSM program, discussions with a wide range of departments indicate that Joint Department PSM students may avail themselves of these on a space available basis ... much as non-BME students do now of Joint Department classes. Note that there is a “buffer” in the proposed budget (Appendix 3) to address this should it become an issue.

9. **Funding Sources.**

Does the program require enrollment growth funding in order to be implemented and sustained?

- **NO**, however the Premium Tuition is required *to support the on-going program* as explained in 9a, below.
- Start-up funding will be recruited from non-university funds. Once the Request to Plan is approved, the Joint Department believes that these funds may be obtained by gifts, endowments, and funding from health and healthcare industrial partners/support.

If so, can the campus implement and sustain the program should enrollment growth funding be unavailable? Letters of commitment should be provided.

The PSM Program is envisioned to require 4 years to become fully operational. Without additional funding, the program is projected to result in a total 4-year, shortfall of approximately \$3.3 million. The proposed delivery of the PSM Program will be in two phases: Track 1, Biomedical Product, beginning with the summer session of 2018 with Track 2 and Biomedical Process, beginning with the summer session of 2020. These were illustrated in Figure 2-1 (and for convenience, replicated below in Figure 9-1) with additional detail provided in Appendix 3: Detailed Year by Year Cost Estimates Including Proposed Courses.

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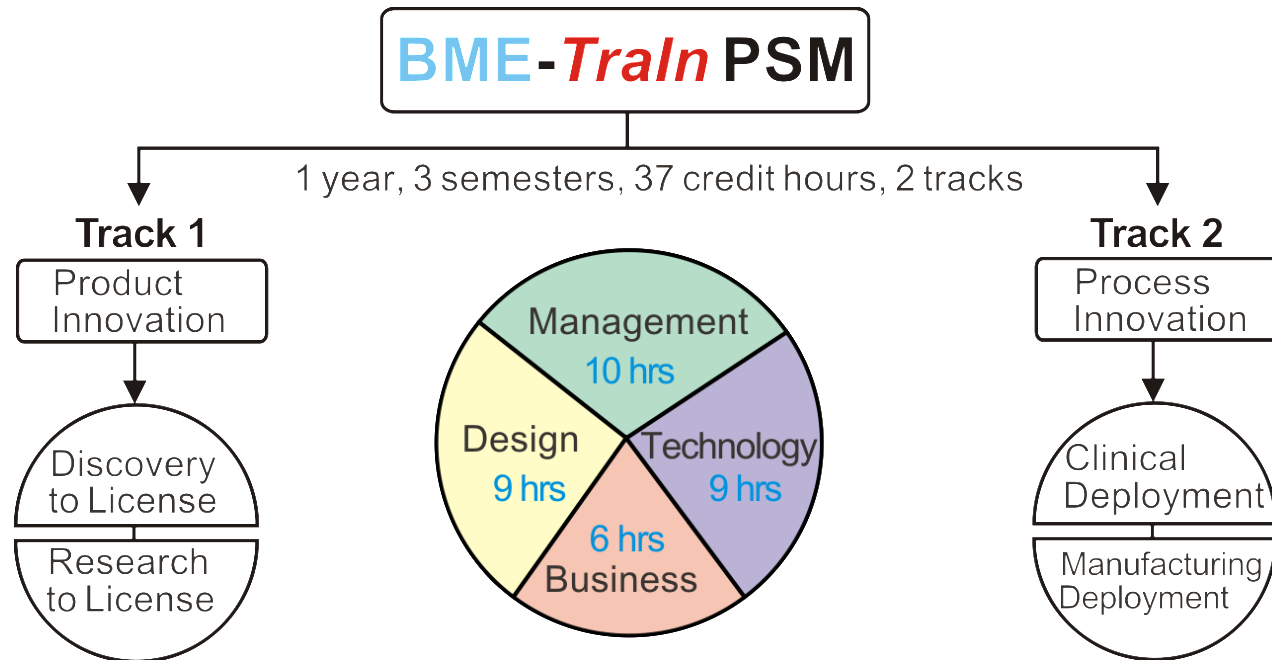


Figure 9-1: Schematic of PSM Track 1 – Product Innovation and Track 2 – Process Innovation.

The Joint Department PSM is a new program. It does not supplant any currently existing MS or other programs. Consequently, all costs are in addition to existing programs and/or initiatives. The Projected Costs are presented below in Table 9-1: Four Year Summary of Estimated Costs.

Table 9-1: Four Year Summary of Estimated Costs – Joint Department Professional Science Master’s Program*

SUMMARY OF ESTIMATED COSTS FOR PROPOSED PROGRAM*

Exec Director Annual Salary and Benefits	\$193,056
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E/D Base Salary \$152,500
Average Rate of Fringe Ben 22.883%
Fixed Insurance Component \$ 5,659.00

Reference: Bian Bertlshorfer, Director, Cost Analysis and Compliance, Office of
Sponsored Research, UNC CH, 8/1/16

No.	Description	4 year Total	Year 1	Year 2	Year 3	Year 4
			Track 1	Track 1	Track 1 & 2	Track 1 & 2
1	Adjunct Faculty	\$ 1,166,667	\$ 211,667	\$ 211,667	\$ 371,667	\$ 371,667
2	Admin Support - Contract	\$ 288,000	\$ 72,000	\$ 72,000	\$ 72,000	\$ 72,000
3	Advertising	\$ 96,000	\$ 24,000	\$ 24,000	\$ 24,000	\$ 24,000
4	Communications	\$ 96,000	\$ 24,000	\$ 24,000	\$ 24,000	\$ 24,000
5	Travel	\$ 108,000	\$ 27,000	\$ 27,000	\$ 27,000	\$ 27,000
6	Vetting	\$ 128,000	\$ 32,000	\$ 32,000	\$ 32,000	\$ 32,000
7	Prototype Construction	\$ 600,000	\$ 150,000	\$ 150,000	\$ 150,000	\$ 150,000
8	Other	\$ -	\$ -	\$ -	\$ -	\$ -
9	Sub-Totals	\$ 2,482,667	\$ 540,667	\$ 540,667	\$ 700,667	\$ 700,667
10	Exec Director: Salary & Fringes	\$ 772,222	\$ 193,056	\$ 193,056	\$ 193,056	\$ 193,056
11	Grand Totals	\$ 3,254,889	\$ 733,722	\$ 733,722	\$ 893,722	\$ 893,722

*Appendix 3: Detailed Year By Year Cost Estimates, provides detailed information including planned course delivery

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9a. For graduate programs only:

Does the program require a tuition differential or program specific fee in order to be implemented and sustained? **YES**

i. If yes, state the amount of tuition differential or fee being considered, and give a brief justification.

As proposed, see Table 9-2: Budget Summary, the Joint BME Department PSM Program will require Premium Tuition of \$7,000 per candidate per semester for a total of \$21,000 per student for the complete 12 contiguous month program.

Premium Tuition may be reduced to approximately \$5,000 per candidate per semester for a total of \$15,000 per student, pending three conditions:

- (a) Innovation Certificates - funds resulting from subject matter related short course, "certificate" programs, are offered to industry and individuals with substantive profitability;
- (b) External Gifts - funds that may result from gifts, endowments, and the like are successfully recruited; and/or
- (c) Enrollment Increase – on the order of twice the currently projected numbers.

Once this proposed Request to Plan is approved, active investigation of the above will be pursued with the findings incorporated into the Request to Establish and Request for Premium Tuition.

Detailed supporting documentation is available in forthcoming separate submittals to the Provosts at UNC-CH and NC State: Request for Premium Tuition including Form A, Justification.

Justification

- (a) As currently envisioned, without Premium Tuition, the program will incur a shortfall over a 4-year period of approximately \$3.3 million.
- (b) Comparing the PSM Program to similar programs at benchmark universities (e.g. Georgia Tech, UVA, University of Michigan, etc.), an increase in semester charges as Premium Tuition in the amount of \$7000 is comparable. The PSM non-Resident Tuition at NC State would increase from approximately \$13,000 to

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\$20,000 and at UNC-CH from about \$14,000 to \$21,000; The Resident Tuition will also need to rise by \$7000 per semester to approximately \$13,000 per semester.

- (c) Current tuition, on a semester basis, for the benchmark programs identified above varies from \$19,000 at Georgia Tech to \$24,500 at UVA.
- (d) Note that the summer period is treated as a full semester in this proposal.
- (e) With Premium Tuition alone, in the early years, inadequate funds will be available to cover the salary of the Executive Director of the PSM Program. This position is essential to the planning, delivery, and sustainable operation and growth of the program. The estimated salary and fringes for the position is approximately \$193,056.
- (f) The Joint Department is not requesting new funds to cover this position. The Department plans to use its existing funds to launch the program. BME perceives the PSM program as a critical component of building a top ranked department. The Joint Department anticipates that as the program grows and prospers, the program (with premium tuition) will recover these costs within the first four years of offering.
- (g) For planning purposes, the Department intends to phase-in the Executive Director salary over the start-up four-year period as follows: year 1, \$0; year 2, 25%; year 3, 50%; year 4, 100%.
- (h) Premium Tuition will eliminate any cumulative shortfall over the first four years of the PSM Program.

As shown Table 9-2 below, proceeding in the manner recommended above for the first four years of the program, results in full recovery of the Exec Directors' salary and an annual on-going risk reserve of approximately \$150,000.

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Table 9-2: Budget Summary*

	A	B	C	D	E	F	G	H	
Year	Directly Incurred Costs	Innovation Certificates ¹	External Gifts and Financial Support ²	Ex Dir. Salary Paid from Dept Resources	Total Reduction E = (B+C+D)	Cost after Reductions F = (A - E)	Premium Tuition Contribution (\$7000/semester /candidate)	Funds Remaining to Cover Risk ³ (G - F))	No. of Candidates
1	\$ 733,722	\$ -	\$ -	\$ 193,056	\$ 193,056	\$ 540,666	\$ 630,000	\$ 89,334	30
2	\$ 733,723	\$ -	\$ -	\$ 144,792	\$ 144,792	\$ 588,931	\$ 735,000	\$ 146,069	35
3	\$ 893,722	\$ -	\$ -	\$ 96,528	\$ 96,528	\$ 797,194	\$ 945,000	\$ 147,806	45
4	\$ 893,722	\$ -	\$ -	\$ -	\$ -	\$ 893,722	\$ 1,050,000	\$ 156,278	50
Totals	\$ 3,254,890			\$ 434,376			\$ 3,360,000	\$ 539,486	160

*Appendix 3: Detailed Year by Year Cost Estimates provides detailed information including planned course delivery

¹Innovation Certificates – Funds that may result from subject matter related short course “certificate” programs offered to industry and individuals

²External Gifts – Funds that may result from gifts, endowments, and the like

³Funds Remaining to Cover Risk – New programs often encounter unforeseen situations related to estimates of costs, enrollment and administration.

- ii. Can the campus implement and sustain the program if the tuition differential or program fee is not approved? **No.** Letters of commitment from the Chancellor and/or Chief Academic Officer should be provided.
TO BE PURSUED pursuant to cross-functional review of this draft Request to Plan

10. **For doctoral programs only: Not Applicable**

- a. Describe the research and scholarly infrastructure in place (including faculty) to support the proposed program.
- b. Describe the method of financing the proposed new program (including extramural research funding and other sources) and indicate the extent to which additional state funding may be required.
- c. State the number, amount, and source of proposed graduate student stipends and related tuition benefits that will be required to initiate the program.

- 11. **Contact.** List the names, titles, e-mail addresses and telephone numbers of the person(s) responsible for planning the proposed program.

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Carolina State University
Eshelman School of Pharmacy | Molecular Pharmaceutics
Division
Department of Medicine | Endocrinology and Metabolism
Division
University of North Carolina at Chapel Hill
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Fax: (919) 513-3814

This request for authorization to plan a new program has been reviewed and approved by the appropriate campus committees and authorities.

Chancellor: _____ Date: _____

Chancellor (Joint Partner Campus): _____ Date: _____

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Appendix 1: Background and Details for Planning Purposes

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Description - Joint Department Professional Science Masters' Program

Preamble:

Health and healthcare costs in the US have grown from \$355/person in 1970 to \$9,532/person in 2014, an arguably unsustainable 18% of GDP. During this period both the amount of care delivered and the amount of basic medical research have grown. Unfortunately, a gap exists between the identification of healthcare and related industry needs and the application of basic research findings.

To address this gap, the proposed program focuses on the *translation* of need from those observing and experiencing needs to those conducting research and in turn on the *translation* of basic research to those with needs. Hence the proposed Professional Science Master's Program may be appropriately referenced as PSM-Train or shortened for convenience to simply **Train** for **Translation of Innovation**.

As depicted below, the Joint Department Professional Science Master's Program – **Train** consists of two tracks.

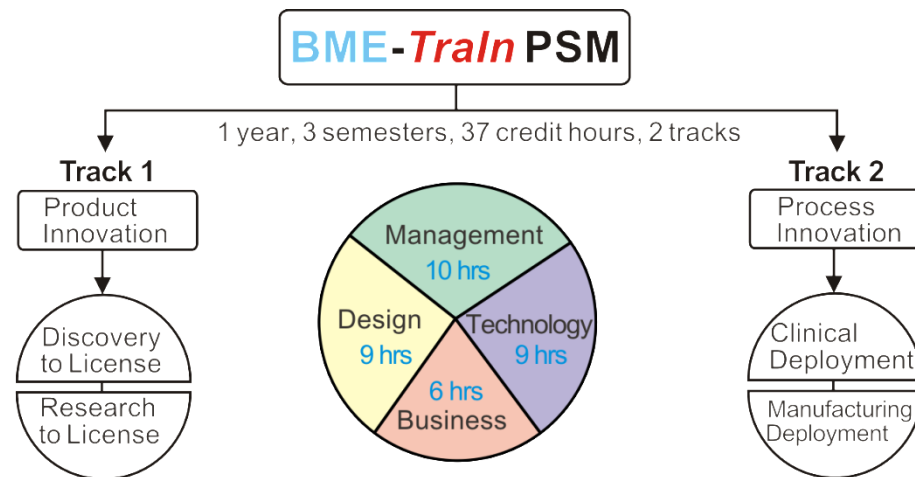


Figure 1: Schematic of two track models of BME-Train PSM

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Track 1: to Transfer Innovation from needs identified during immersion in a hospital setting and from research on the cusp of practical application to licensing and/or

Track 2: to Transfer knowledge by the creation of highly efficient processes or to the improvement of existing processes and/or procedures with cooperating manufacturing and clinical entities.

Translation in each case is to be accomplished in a manner to protect intellectual property and/or confidentiality.

Throughout the Request to Plan, to simplify communications, the proposed program is referred to as Professional Science Master's or PSM.

Discussion:

Members of the Joint Department, working in consultation (i.e. sharing information, insight, ideas, concerns, and best practices) with:

- a. the Biomedical Engineering Program in the Department of Engineering at East Carolina University;
- b. the Department of Chemical, Biological, and Bioengineering in the College of Engineering at The North Carolina Agricultural and Technical State University; and
- c. the UNC Professional Science Masters' Program;

are in the process of developing a BME Professional Science Masters' Program (PSM), identified as "TraIn" for Translation of Innovations.

- At this stage of planning, the program, having a strong innovation and entrepreneurship bias, has two tracks: one focusing on biomedical products; the other on biomedical processes.
- The detailed product and process work is to be conducted in such a manner to protect the intellectual property of the University and confidentiality of those organizations partnering in the work.
- Both practical, application oriented tracks are designed to be completed in a single 12-month period beginning with a summer immersion, a Fall Semester emphasizing engineering design, with a final Spring Semester focusing on licensing and/or deployment.
- The curriculum is tentatively composed of 37 semester hours of course work combined with 240 person hours of healthcare domain immersion and 280 person hours of practical experience addressing management, design, business, and focused STEM electives (practicum/internship hours captured as three 1-semester-hour courses BME 650, 651, and 652).

The proposed program is intended to deliver essential value:
to candidates and prospective employers by

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- reducing the total duration required to complete a master's level program from 21 (4 semesters + 1 summer) months to 12; (estimated result of \$18,000 in cost of living savings)
- allowing the candidates to become employed 9 months earlier than a the traditional research focused MS with thesis (estimated added opportunity income at a minimum of \$6,000 per month or \$54,000)
- improving median salaries from 20% to 40%
- preparing candidates to immediately contribute in the practical/applied biotech/biomedical environment, i.e. manufacturing, development, management, leadership, design, process enhancement, intellectual property protection, and business assessment and planning;

to UNC-CH and N C State University by

- delivering newly “discovered” products and processes to the licensing stage;
- translating “on the cusp” research into licensable products; and

to the economic development of North Carolina by

- providing a pipeline of experienced early stage biomedical start-ups and
- providing an increased number of dynamic engineers with demonstrated team-based managerial potential attractive to organizations interested in potentially locating in North Carolina

Target Audience

- graduates with 0 to 5 years' experience
- individuals with BS degrees in STEM curricula
- minimum undergraduate GPAs of 3.2
- non-PhD candidates focusing on practice and industry
- individuals with biases to innovation and entrepreneurship
- high performing individuals who can finance themselves or may be financed by their employer
- professionals recognizing the financial benefits of a one year intense immersion, design, development, deployment, engineering, business, and team leadership experience

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Delivery Method

- immersion, shadowing, coaching, mentoring – summer sessions
- conventional classroom together with on-going mentoring – Fall and Spring Semester
- asynchronous lectures (as available) with real-time remote and on-site advising, mentoring, and coaching
- year-long product and/or process design or enhancement practicum

Hours Required –37 semester hours including 3 practicum/internship experiences, each yielding 1 semester hour of credit requiring a minimum 520 person-hours of immersion/shadowing/observing/discovery

- **Summer Sessions** - 9 semester hours – **plus 1 semester hour for practicum/internship** - 240 person-hours of immersion, shadowing, observing, discovery
- **Fall Semester** - 13 semester hours– **plus 1 semester hour for practicum/internship** - 140 person-hours product/process design and pitching
- **Spring Semester** - 12 semester hours – **plus 1 semester hour for practicum/internship**- 140 person-hours proof of concept prototype and pursuit of licensing/deployment

Program Core and Concentrations – four key areas identified by industry/economic development demands

- **Management & leadership** – 6 courses/10 semester hours
- **Discovery and design** – 3 course/9 semester hours
- **Business** – 2 course/6 semester hours
- **Technology electives** - 3 courses/9 semester hours
- **Practicum/Internship** – 3 courses /3 semester hours - discovery, design, and development

Post-Graduate Outcomes for Which Graduates Will Be Prepared

- 9-month opportunity income/cost saved for each candidate
- 24%, \$17,000 increase in annual income potential (BME undergraduate salary compared to graduate degree)
- potential to start own company
- start with or return to employer with targeted, ready to deploy skills
- enhanced technical, business, management, and leadership skills essential to success in the complex and technically challenging biomedical innovation and entrepreneurship business environment
- improved potential for promotion

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Special Features

1. active collaboration (i.e. sharing information, insight, ideas, concerns, and best practices) among the N C Biotech Center, North Carolina State University, the University of North Carolina at Chapel Hill, The North Carolina Agricultural and Technical State University, and East Carolina University
2. employment multiplier of 3 to 3.4; i.e. adding support jobs to the economy for each graduate
3. attraction, expansion, and retention of biomedical companies in North Carolina
4. increased number of viable start-up companies
5. addresses “management gap” in North Carolina biotech industry staffing needs: individuals with management/leadership, business, engineering, and BME specific technology skills
6. partner across multiple organizations at UNC CH and N C STATE together with NC A&T and ECU
7. deliver viable Invention Disclosures (IDFs) to UNC CH and/or N C State Technology Transfer Offices
8. supports key strategic education and economic development plans
 - a. UNC System – Our Time Our Future
 - b. UNC CH - Innovate at Carolina
 - c. UNC CH School of Medicine – Strategic Plan for the UNC
 - d. School of Medicine
 - e. N C State University - Pathway to the Future
 - f. N C Biotech Center – Bridging the Gaps
9. leverages existing co-operative STEM programs with other colleges and universities, e.g. Elon University and Meredith College,
10. brings “on-the-cusp” research from the lab to IDF (Invention Disclosure Form), Provisional Patent Application, and licensing
 - a. Regenerative medicine
 - b. Unltrasoud imaging
 - c. Pharmaco-engineering
 - d. Rehabilitation engineering
 - e. Biomedical Micro- and Nanodevices
 - f. Other heath and health care STEM disciplines
11. provide demonstrated new and/or improved key process to clinical and biomedical manufacturing partnering organizations

**Appendix 2:
Joint Department BME Professional Science Master's
Proposed Curricula***

Table IA – Discovery to License

Table IB – Research Products to License

Table IIA – Manufacturing Process Design/Improvement

Table IIB – Clinical Process Design/Improvement

* Note – each pathway/curriculum incorporates three deliverable and vetting milestones. Participants are required to register for the following 1-semester hour courses.

BME 650 – Internship in Biomedical Engineering: Discovery - Summer

BME 651 – Internship in Biomedical Engineering: Design - Fall

BME 652 – Internship in Biomedical Engineering: Development - Spring

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Table IA – Discovery to License

UNC CH NC STATE Joint BME PSM: Product Innovation - IA Discovery to License or Start-Up																	
No.	Required	Focus	Courses	Location	Short Title	IMMERESION Summer 1 - Healthcare Immersion	IMMERESION Summer 2 - Healthcare Immersion	Deliverable & Vetting	Fall	Deliverable & Vetting	Spring	Deliverable & Vetting	Totals	%			
Mgmt													10	29%			
1	Core	Mgmt	GRAD 701A TBD	UNC - CH	Working in the Clinical Environment	1.5		Each student will deliver Two Complete Comprehensive "Need Specifications" including Conceptual Design, Provisional Patent Application, and IDs. These will have been selected from at least 50 identified "Need Statements" from each participant		Students will aggressively participate in the NC STATE and UNC CH Entrepreneurship Initiatives. They will form teams from across the campuses potentially including the Poole and Keenan Flagler Business Schools, interested undergrad and grad students, UNC SOM/N residents and nurses, etc. At the end of the semester each team will have a developed a detailed, ready for prototyping design.		Each student will be an active leader and/or participant competing for venture funds in events sponsored by UNC CH, NC STATE, and other in the Research Triangle area. Each student will have actively engaged in the production of a working prototype of a clinical device that has met the criteria for verification and validation, leading to the next steps: in product development and product deployment.	1.5				
2	Core	Mgmt	GRAD 710	UNC - CH	Professional Communications: Writing		1.5								1.5		
3	Core	Mgmt	GRAD 711	UNC - CH	Professional Communications: Presenting				1.5						1.5		
4	Core	Mgmt	GRAD 712	UNC - CH	Leadership in the Work Place				1						1		
5	Core	Mgmt	GRAD 713	UNC - CH	Applied Project Management: Frameworks; Principles; and Techniques				1.5						1.5		
6	Core	Mgmt	MIE 412	NC STATE	Finance and Accounting for Entrepreneurs								3		3		
Dsn																9	26%
7	Core	Dsn	BME 7xx	UNC - CH	Biomedical Innovation and Entrepreneurship	3									3		
8	Core	Dsn	BME 551	NC STATE	Design in Biotechnology				3						3		
9	Core	Dsn	BME 55X	NC STATE	Proof of Concept Prototyping, Verification, and Validation								3		3		
Bus																6	18%
10	Core	Bus	MBA 586	NC STATE	<u>Legal and Marketing Dynamics in Pharmaceutical and Biotechnology</u> (Unique Constraints Biomedical Device I & E: Intellectual Property, Business Law, Reimbursement, and the Regulatory Environment)		3									3	
11	Core	Bus	BUSI 504	UNC - CH	<u>Launching the Venture</u> (Commercializing Technology Innovations: Business Law, Term Sheets and Negotiations for the Entrepreneur)									3		3	
Tech Elec																	9
12	Elect	Tech	Statistics	TBD	See List - I & E Advisor						3		3				
13	Elect	Tech	BME Elect	TBD	See List - I & E Advisor				3				3				
14	Elect	Tech	BME Elect	TBD	See List - I & E Advisor				3				3				
					Practicum Emphasis	Discover & Define Needs	Develop Strategy		Build Team, Finalize Design & Pitch		Build and Demonstrate Proof of Concept Prototype						
	Course Counts				Totals	4.5	4.5		13		12		34	100%			
	Core	11				13.2%	13.2%		38.2%		35.3%						
	Elect	3															
	Mgmt	6															
	Dsn	3															
	Bus	2															
	Tech	3															

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Table IB – Research Products to License

UNC CH NC STATE Joint BME PSM: Product Innovation - Research Translation to License/Start-Up																	
No.	Required	Focus	Courses	Location	Short Title	IMMERESION Summer 1 - Healthcare Immersion	IMMERESION Summer 2 - Healthcare Immersion	Deliverable & Vetting	Fall	Deliverable & Vetting	Spring	Deliverable & Vetting	Totals	%			
Mgmt													10	29%			
1	Core	Mgmt	GRAD 701D	UNC - CH	Working in the Biomedical Research Environment	1.5		Each student will deliver Two Complete Comprehensive "Need Specifications" including Conceptual Design, Provisional Patent Application, and IDs. These will have been selected from at least 25 identified "Need Statements" from each participant		Students will aggressively participate in the NC STATE and UNC CH Entrepreneurship Initiatives. They will form teams from across the campuses potentially including the Poole and Keenan Flagler Business Schools, interested undergrad and grad students, UNC SOM/N residents and nurses, etc. At the end of the semester each team will have a developed a detailed, ready for prototyping design.		Each student will be an active leader and/or participant competing for venture funds in events sponsored by UNC CH, NC STATE, and other in the Research Triangle area. Each student will have actively engaged in the production of a working prototype of a clinical device that has met the criteria for verification and validation, leading to the next steps: in product development and product deployment.	1.5				
2	Core	Mgmt	GRAD 710	UNC - CH	Professional Communications: Writing		1.5								1.5		
3	Core	Mgmt	GRAD 711	UNC - CH	Professional Communications: Presenting				1.5						1.5		
4	Core	Mgmt	GRAD 712	UNC - CH	Leadership in the Work Place				1						1		
5	Core	Mgmt	GRAD 713	UNC - CH	Applied Project Management: Frameworks; Principles; and Techniquet				1.5						1.5		
6	Core	Mgmt	MIE 412	NC STATE	Finance and Accounting for Entrepreneurs									3		3	
Dsn																9	26%
7	Core	Dsn	BME 7xx	UNC - CH	Biomedical Innovation and Entrepreneurship	3										3	
8	Core	Dsn	BME 551	NC STATE	Design in Biotechnology				3							3	
9	Core	Dsn	BME 55X	NC STATE	Proof of Concept Prototyping, Verification, and Validation									3		3	
Bus																6	18%
10	Core	Bus	MBA 586	NC STATE	<u>Legal and Marketing Dynamics in Pharmaceutical and Biotechnology</u> (Unique Constraints Biomedical, Medical, and Pharmacology I & E: Intellectual Property, Business Law, Reimbursement, and the Regulatory Environment)		3									3	
11	Core	Bus	BUSI 504	UNC - CH	<u>Launching the Venture</u> (Commercializing Technology Innovations: Business Law, Term Sheets and Negotiations for the Entrepreneur)									3		3	
Tech Elec																9	26%
12	Elect	Tech	Pharm Elect	TBD	See List - I & E Advisor						3		3				
13	Elect	Tech	BME Elect	TBD	See List - I & E Advisor				3				3				
14	Elect	Tech	BME Elect	TBD	See List - I & E Advisor				3				3				
					Practicum Emphasis	Discover & Define Needs	Develop Strategy		Build Team, Finalize Design & Pitch		Build and Demonstrate Proof of Concept Prototype						
	Course Counts		Totals			4.5	4.5		13		12		34	100%			
	Core	11				13.2%	13.2%		38.2%		35.3%						
	Elect	3															
	Mgmt	6															
	Dsn	3															
	Bus	2															
	Tech	3															

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Table IIA – Manufacturing Process Design/Improvement

UNC CH NC STATE Joint BME PSM: Process Innovation - Biomedical Manufacturing																	
No.	Required	Focus	Courses	Location	Short Title	IMMERESION Summer 1 - Healthcare Immersion	IMMERESION Summer 2 - Healthcare Immersion	Deliverable & Vetting	Fall	Deliverable & Vetting	Spring	Deliverable & Vetting	Totals	%			
Mgmt													10	29%			
1	Core	Mgmt	GRAD 701C	UNC - CH	Working in the Pharmaceutical and/or Device Manufacturing Environment	1.5		Each student will deliver Two Complete Comprehensive "Need Specifications." Each will include a process or product Conceptual Design. Depending upon the improvement objective, Provisional Patent Application, and IDs may be appropriate or high level process improvement networks including detailed description for VA, NVA, and VE nodes described in detail. These will have been selected from at least 25 identified "Need Statements" from each participant. The exact nature of the deliverable will depend upon the specific sponsor or client organization guidelines.		Students will form teams from across the campuses potentially including the Poole and Keenan Flagler Business Schools' Industrial Engineering. Interested undergrad and grad students; UNC SOM/N residents and nurses; members from the observed organization/entity; etc. At the end of the semester each team will have developed a detailed, ready for piloting improved process and/or products.		Each student will have actively engaged in the delivery and implementation of a working fully piloted manufacturing process that has met pre-established criteria for verification and validation, leading to the next steps in an organization wide implementation of the piloted process or product improvement.	1.5				
2	Core	Mgmt	GRAD 710	UNC - CH	Professional Communications: Writing		1.5									1.5	
3	Core	Mgmt	GRAD 711	UNC - CH	Professional Communications: Presenting				1.5							1.5	
4	Core	Mgmt	GRAD 712	UNC - CH	Leadership in the Work Place				1							1	
5	Core	Mgmt	GRAD 713	UNC - CH	Applied Project Management: Frameworks; Principles; and Techniquet				1.5							1.5	
6	Core	Mgmt	MBA 503	NC STATE	Survey of Accounting.									3		3	
Dsn													9	26%			
7	Core	Dsn	ISE 515	NC STATE	Manufacturing Process Engineering	3										3	
8	Core	Dsn	BEC 577	NC STATE	Advanced Biomanufacturing and Biocatalysis						3					3	
9	Core	Dsn	ISE 714	NC STATE	Product Manufacturing Engineering for the Medical Device Industry									3		3	
Bus													6	18%			
10	Core	Bus	Busi 533	UNC - CH	Supply Chain Management				3							3	
11	Core	Bus	BEC 575	NC STATE	Global Regulatory Affairs for Medical Products									3		3	
Tech Elec													9	26%			
12	Elect	Tech	ISE Elect	TBD	See List - BME Mfg Advisor						3		3				
13	Elect	Tech	BME Elect	TBD	See List - BME Mfg Advisor				3				3				
14	Elect	Tech	BME Elect	TBD	See List - BME Mfg Advisor				3				3				
					Practicum Emphasis	Discover & Define Needs	Develop Strategy		Build Team, Finalize Design & Pitch		Pilot Process & Deliver Deployment Plan		34	100%			
	Course Counts				Totals	4.5	4.5		13		12						
	Core	11				13.2%	13.2%		38.2%		35.3%						
	Elect	3															
	Mgmt	6															
	Dsn	3															
	Bus	2															
	Tech	3															

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Table IIB – Clinical Process Design/Improvement

UNC CH NC STATE Joint BME PSM: Process Innovation - Clinical Care																	
No.	Required	Focus	Courses	Location	Short Title	IMMERESION Summer 1 - Healthcare Immersion	IMMERSION Summer 2 - Healthcare Immersion	Deliverable & Vetting	Fall	Deliverable & Vetting	Spring	Deliverable & Vetting	Totals	%			
Mgmt													10	29%			
1	Core	Mgmt	GRAD 701B TBD	UNC - CH	Working in the Clinical Care Environment	1.5		Each student will deliver Two Complete Comprehensive "Need Specifications" including High Level Current Process Map; Identification of VA, NVA, and Value Enhancing options; and Improvement Claims. These will have been selected from at least 20 identified "Need Statements" from each participant		Students will form Teams from across the campuses potentially including the Poole and Keenan Hagler Business Schools; Industrial Engineering; interested undergrad and grad students; UNC SOM/N residents and nurses; members from the observed organization/entity, etc. At the end of the semester each team will have developed a detailed, ready for piloting improved process.		Each student will have actively engaged in the delivery and implementation of a working fully piloted clinical process that has met pre-established criteria for verification and validation, leading to the next steps in an organization wide implementation of the piloted improvement.	1.5				
2	Core	Mgmt	GRAD 710	UNC - CH	Professional Communications: Writing		1.5				1.5				1.5		
3	Core	Mgmt	GRAD 711	UNC - CH	Professional Communications: Presenting						1.5					1.5	
4	Core	Mgmt	GRAD 712	UNC - CH	Leadership in the Work Place						1					1	
5	Core	Mgmt	GRAD 713	UNC - CH	Applied Project Management: Frameworks; Principles; and Techniquet						1.5					1.5	
6	Core	Mgmt	MIE 412	NC STATE	Finance and Accounting for Entrepreneurs									3		3	
Dsn													9	26%			
7	Core	Dsn	BME 7xx	UNC - CH	Biomedical Innovation and Entrepreneurship	3										3	
8	Core	Dsn	IE520	NC STATE	Healthcare Systems Performance Improvement I 3.						3					3	
9	Core	Dsn	IE 521	NC STATE	Healthcare Systems Performance Improvement II 3. (Demonstration Pilot)									3		3	
Bus													6	18%			
10	Core	Bus	MBA 586	NC STATE	<u>Legal and Marketing Dynamics in Pharmaceutical and Biotechnology</u> (Unique Constraints Clinical Procedures, PPACA, Medicare & Medicaid; Business Law; Reimbursement; and the Regulatory Environment)		3									3	
11	Core	Bus	BUSI 854	UNC - CH	Organizational Design and Development									3		3	
Tech Elec													9	26%			
12	Elect	Tech	Clinical Electives	TBD	See List - I & E Advisor (Epidemiology, Nursing, Phys & Pathology)						3		3				
13	Elect	Tech	BME Elect	TBD	See List - I & E Advisor				3				3				
14	Elect	Tech	BME Elect	TBD	See List - I & E Advisor				3				3				
Tech																	
Practicum Emphasis						Discover & Define Needs	Develop Strategy		Build Team, Finalize Design & Pitch		Build and Demonstrate Proof of Concept Prototype						
Totals						4.5	4.5		13		12		34	100%			
						13.2%	13.2%		38.2%		35.3%						
Course Counts																	
Core						11											
Elect						3											
Mgmt						6											
Dsn						3											
Bus						2											
Tech						3											

Appendix 3: Detailed Year by Year Cost Estimates Including Proposed Courses

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SUMMARY OF ESTIMATED COSTS FOR PROPOSED PROGRAM											
Exec Director Annual Salary and Benefits	\$193,056										
E/D Base Salary	\$152,500										
Average Rate of Fringe Ben	22.883%										
Fixed Insurance Component	\$ 5,659.00		Reference: Bian Bertlshorfer, Director, Cost Analysis and Compliance, Office of Sponsored Research, UNC CH, 8/1/16								
					Year 1 - Track I only						
				Resource Description	Summer A	Summer B	Fall	Spring	Total		
Adjunct Faculty	Designation	Credit Hours	Title - Description						\$ 211,667		
11	Grad 701	1.5	Working in the clinical environment	Grad PSM UNC Adjunct	\$ 10,000	\$ -			\$ 10,000		
12	Grad 710	1.5	Professional Communications: Writing	Grad PSM UNC Adjunct	\$ -	\$ 10,000			\$ 10,000		
13	BME TBD	3	Biomedical Innovation and Entrepreneurship: Needs Finding and Specification	Adjunct Faculty	\$ 20,000	\$ -			\$ 20,000		
14	MBA 586	3	Legal and Marketing Dynamics in Pharmaceuticals and Biotechnology	Adjunct Faculty	\$ -	\$ 20,000			\$ 20,000		
15	ISE 515	3	Mfg Process Engineering		\$ -	\$ -			\$ -		
16	BUS 533	3	Supply Chain Management		\$ -	\$ -			\$ -		
18			Need Spec Prep Support: Inward Facing - coaching and mentoring of candidate teams	Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000		
19			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000		
D1	Grad 711	1.5	Professional Communications: Presenting	Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000		
D2	Grad 712	1	Leadership in the work place	Grad PSM UNC Adjunct			\$ 6,667		\$ 6,667		
D3	Grad 713	1.5	Applied Project Management: Frameworks; Principles; and Techniques	Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000		
D4	BME 551	3	Design in Biotechnology	Adjunct Faculty			\$ 20,000		\$ 20,000		
D5	ISE 714	3	Prod Mfg Engr for the Med Device Industry				\$ -		\$ -		
D6	BEC 577	3	Advanced BioMfg & Biocatalysis				\$ -		\$ -		
D7	IE 520	3	Healthcare Systems Performance Improvement				\$ -		\$ -		
D11			Design Support - assists in formation of cross-functional teams and development of their work product for vetting	Adjunct Faculty for BME 551 - Additional Responsibility			\$ 5,000		\$ 5,000		
IDF1	MIE 412	3	Finance and Accounting for Entrepreneurs (to be tailored course to fit both tracks)	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF2	BME 55X TBD	3	Proof of Concept Prototyping, Verification, and Validation	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF3	BUSI 504	3	Launching the Venture	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF4	BEC 575	3	Global Regulatory Affairs					\$ -	\$ -		
IDF5	IE 521	3	Healthcare Systems Performance Improvement					\$ -	\$ -		
IDF6	Bus 854	3	Organization Design & Development					\$ -	\$ -		
IDF9			Prototype Support - Technical consulting, sourcing of equipment, model making, advising on proof of concept testing	Technical consultant/model maker				\$ 20,000	\$ 20,000		

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Admin Support - contract									\$ 72,000
I11			Staff Support			\$ 12,000	\$ 12,000		\$ 24,000
D14			Staff Support					\$ 24,000	\$ 24,000
IDF12			Staff Support					\$ 24,000	\$ 24,000
Advertising									\$ 24,000
I10a			Advertising			\$ 4,000	\$ 4,000		\$ 8,000
D13a			Advertising					\$ 8,000	\$ 8,000
IDF11a			Advertising					\$ 8,000	\$ 8,000
Communications									\$ 24,000
I10b			Communications			\$ 4,000	\$ 4,000		\$ 8,000
D13b			Communications					\$ 8,000	\$ 8,000
IDF11b			Communications					\$ 8,000	\$ 8,000
Travel									\$ 27,000
I10c			Travel			\$ 4,500	\$ 4,500		\$ 9,000
D13c			Travel					\$ 9,000	\$ 9,000
IDF11c			Travel					\$ 9,000	\$ 9,000
Vetting									\$ 32,000
I7			Need Specification Vetting	4 angels/VC @ \$2000 per day		\$ 8,000			\$ 8,000
D10			Design Vetting	4 angels/VC @ \$2000 per day			\$ 8,000		\$ 8,000
IDF8			Prototype Vetting	8 angels/VC @ \$2000 per day				\$ 16,000	\$ 16,000
Prototype Construction									\$ 150,000
IDF14			Prototype Construction					\$ 150,000	\$ 150,000
Other Items									\$ -
D8	Elective	3	TBD					0	\$ -
D9	Elective	3	TBD					0	\$ -
IDF7	Elective	3	TBD					0	\$ -
D12			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Exec Director				0	\$ -
IDF10			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Exec Director				0	\$ -
Sub-Totals									\$ 540,667
Exec Director Salary + Fringe									\$ 193,056
Grand Total									\$ 733,722
									Year 1 - Gross

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SUMMARY OF ESTIMATED COSTS FOR PROPOSED PROGRAM										
Exec Director Annual Salary and Benefits	\$193,056									
E/D Base Salary	\$152,500									
Average Rate of Fringe Ben	22.883%									
Fixed Insurance Component	\$ 5,659.00			Reference: Bian Bertlshorfer, Director, Cost Analysis and Compliance, Office of Sponsored Research, UNC CH, 8/1/16						
					Year 2 - Track I only					
					Resource Description	Summer A	Summer B	Fall	Spring	Total
Adjunct Faculty	Designation	Creidt Hours	Title - Description							\$ 211,667
11	Grad 701	1.5	Working in the clinical environment		Grad PSM UNC Adjunct	\$ 10,000	\$ -			\$ 10,000
12	Grad 710	1.5	Professional Communications: Writing		Grad PSM UNC Adjunct	\$ -	\$ 10,000			\$ 10,000
13	BME TBD	3	Biomedical Innovation and Entrepreneurship: Needs Finding and Specification		Adjunct Faculty	\$ 20,000	\$ -			\$ 20,000
14	MBA 586	3	Legal and Marketing Dynamics in Pharmaceuticals and Biotechnology		Adjunct Faculty	\$ -	\$ 20,000			\$ 20,000
15	ISE 515	3	Mfg Process Engineering			\$ -	\$ -			\$ -
16	BUS 533	3	Supply Chain Management			\$ -	\$ -			\$ -
18			Need Spec Prep Support: Inward Facing - coaching and mentoring of candidate teams		Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000
19			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community		Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000
D1	Grad 711	1.5	Professional Communications: Presenting		Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000
D2	Grad 712	1	Leadership in the work place		Grad PSM UNC Adjunct			\$ 6,667		\$ 6,667
D3	Grad 713	1.5	Applied Project Management: Frameworks; Principles; and Techniques		Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000
D4	BME 551	3	Design in Biotechnology		Adjunct Faculty			\$ 20,000		\$ 20,000
D5	ISE 714	3	Prod Mfg Engr for the Med Device Industry					\$ -		\$ -
D6	BEC 577	3	Advanced BioMfg & Biocatalysis					\$ -		\$ -
D7	IE 520	3	Healthcare Systems Performance Improvement					\$ -		\$ -
D11			Design Support - assists in formation of cross-functional teams and development of their work product for vetting		Adjunct Faculty for BME 551 - Additional Responsibility			\$ 5,000		\$ 5,000
IDF1	MIE 412	3	Finance and Accounting for Entrepreneurs (to be tailored course to fit both tracks)		Adjunct Faculty				\$ 20,000	\$ 20,000
IDF2	BME 55X TBD	3	Proof of Concept Prototyping, Verification, and Validation		Adjunct Faculty				\$ 20,000	\$ 20,000
IDF3	BUSI 504	3	Launching the Venture		Adjunct Faculty				\$ 20,000	\$ 20,000
IDF4	BEC 575	3	Global Regulatory Affairs					\$ -	\$ -	\$ -
IDF5	IE 521	3	Healthcare Systems Performance Improvement					\$ -	\$ -	\$ -
IDF6	Bus 854	3	Organization Design & Development					\$ -	\$ -	\$ -
IDF9			Prototype Support - Technical consulting, sourcing of equipment, model making, advising on proof of concept testing		Technical consultant/model maker				\$ 20,000	\$ 20,000

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Admin Support - contract										\$ 72,000
I11			Staff Support			\$ 12,000	\$ 12,000			\$ 24,000
D14			Staff Support					\$ 24,000		\$ 24,000
IDF12			Staff Support						\$ 24,000	\$ 24,000
Advertising										\$ 24,000
I10a			Advertising			\$ 4,000	\$ 4,000			\$ 8,000
D13a			Advertising					\$ 8,000		\$ 8,000
IDF11a			Advertising						\$ 8,000	\$ 8,000
Communications										\$ 24,000
I10b			Communications			\$ 4,000	\$ 4,000			\$ 8,000
D13b			Communications					\$ 8,000		\$ 8,000
IDF11b			Communications						\$ 8,000	\$ 8,000
Travel										\$ 27,000
I10c			Travel			\$ 4,500	\$ 4,500			\$ 9,000
D13c			Travel					\$ 9,000		\$ 9,000
IDF11c			Travel						\$ 9,000	\$ 9,000
Vetting										\$ 32,000
I7			Need Specification Vetting		4 angels/VC @ \$2000 per day		\$ 8,000			\$ 8,000
D10			Design Vetting		4 angels/VC @ \$2000 per day			\$ 8,000		\$ 8,000
IDF8			Prototype Vetting		8 angels/VC @ \$2000 per day				\$ 16,000	\$ 16,000
Prototype Construction										\$ 150,000
IDF14			Prototype Construction						\$ 150,000	\$ 150,000
Other Items										\$ -
D8	Elective	3	TBD					0		\$ -
D9	Elective	3	TBD					0		\$ -
IDF7	Elective	3	TBD						0	\$ -
D12			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community		Exec Director			0		\$ -
IDF10			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community		Exec Director				0	\$ -
Sub-Totals										\$ 540,667
Exec Director Salary + Fringe										\$ 193,056
Grand Total					Year 2 - Gross					\$ 733,722

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SUMMARY OF ESTIMATED COSTS FOR PROPOSED PROGRAM											
Exec Director Annual Salary and Benefits	\$193,056										
E/D Base Salary	\$152,500										
Average Rate of Fringe Ben	22.883%										
Fixed Insurance Component	\$ 5,659.00		Reference: Bian Bertlshorfer, Director, Cost Analysis and Compliance, Office of Sponsored Research, UNC CH, 8/1/16								
				Year 3 - Track I and II							
				Resource Description	Summer A	Summer B	Fall	Spring	Total		
Adjunct Faculty	Designation	Credit Hours	Title - Description						\$ 371,667		
I1	Grad 701	1.5	Working in the clinical environment	Grad PSM UNC Adjunct	\$ 10,000	\$ -			\$ 10,000		
I2	Grad 710	1.5	Professional Communications: Writing	Grad PSM UNC Adjunct	\$ -	\$ 10,000			\$ 10,000		
I3	BME TBD	3	Biomedical Innovation and Entrepreneurship: Needs Finding and Specification	Adjunct Faculty	\$ 20,000	\$ -			\$ 20,000		
I4	MBA 586	3	Legal and Marketing Dynamics in Pharmaceuticals and Biotechnology	Adjunct Faculty	\$ -	\$ 20,000			\$ 20,000		
I5	ISE 515	3	Mfg Process Engineering	Adjunct Faculty	\$ 20,000	\$ -			\$ 20,000		
I6	BUS 533	3	Supply Chain Management	Adjunct Faculty	\$ -	\$ 20,000			\$ 20,000		
I8			Need Spec Prep Support: Inward Facing - coaching and mentoring of candidate teams	Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000		
I9			Professional Support: Outward Facing - Shadowing, Observing, Tech Trans and Interfaces with Research Triangle Incubator Community	Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000		
D1	Grad 711	1.5	Professional Communications: Presenting	Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000		
D2	Grad 712	1	Leadership in the work place	Grad PSM UNC Adjunct			\$ 6,667		\$ 6,667		
D3	Grad 713	1.5	Applied Project Management: Frameworks; Principles; and Techniques	Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000		
D4	BME 551	3	Design in Biotechnology	Adjunct Faculty			\$ 20,000		\$ 20,000		
D5	ISE 714	3	Prod Mfg Engr for the Med Device Industry	Adjunct Faculty			\$ 20,000		\$ 20,000		
D6	BEC 577	3	Advanced BioMfg & Biocatalysis	Adjunct Faculty			\$ 20,000		\$ 20,000		
D7	IE 520	3	Healthcare Systems Performance Improvement	Adjunct Faculty			\$ 20,000		\$ 20,000		
D11			Design Support - assists in formation of cross-functional teams and development of their work product for vetting	Adjunct Faculty for BME 551 - Additional Responsibility			\$ 5,000		\$ 5,000		
IDF1	MIE 412	3	Finance and Accounting for Entrepreneurs (to be tailored course to fit both tracks)	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF2	BME 55X TBD	3	Proof of Concept Prototyping, Verification, and Validation	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF3	BUSI 504	3	Launching the Venture	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF4	BEC 575	3	Global Regulatory Affairs	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF5	IE 521	3	Healthcare Systems Performance Improvement	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF6	Bus 854	3	Organization Design & Development	Adjunct Faculty				\$ 20,000	\$ 20,000		
IDF9			Prototype Support - Technical consulting, sourcing of equipment, model making, advising on proof of concept testing	Technical consultant/model maker				\$ 20,000	\$ 20,000		

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Admin Support - contract									\$ 72,000
I11			Staff Support			\$ 12,000	\$ 12,000		\$ 24,000
D14			Staff Support					\$ 24,000	\$ 24,000
IDF12			Staff Support					\$ 24,000	\$ 24,000
Advertising									\$ 24,000
I10a			Advertising			\$ 4,000	\$ 4,000		\$ 8,000
D13a			Advertising					\$ 8,000	\$ 8,000
IDF11a			Advertising					\$ 8,000	\$ 8,000
Communications									\$ 24,000
I10b			Communications			\$ 4,000	\$ 4,000		\$ 8,000
D13b			Communications					\$ 8,000	\$ 8,000
IDF11b			Communications					\$ 8,000	\$ 8,000
Travel									\$ 27,000
I10c			Travel			\$ 4,500	\$ 4,500		\$ 9,000
D13c			Travel					\$ 9,000	\$ 9,000
IDF11c			Travel					\$ 9,000	\$ 9,000
Vetting									\$ 32,000
I7			Need Specification Vetting	4 angels/VC @ \$2000 per day		\$ 8,000			\$ 8,000
D10			Design Vetting	4 angels/VC @ \$2000 per day			\$ 8,000		\$ 8,000
IDF8			Prototype Vetting	8 angels/VC @ \$2000 per day				\$ 16,000	\$ 16,000
Protype Construction									\$ 150,000
IDF14			Prototype Construction					\$ 150,000	\$ 150,000
Other Items									\$ -
D8	Elective	3	TBD					0	\$ -
D9	Elective	3	TBD					0	\$ -
IDF7	Elective	3	TBD					0	\$ -
D12			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Exec Director				0	\$ -
IDF10			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Exec Director				0	\$ -
Sub-Totals									\$ 700,667
Exec Director Salary + Fringe									\$ 193,056
Grand Total									\$ 893,722

Year 3 - Gross

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SUMMARY OF ESTIMATED COSTS FOR PROPOSED PROGRAM										
Exec Director Annual Salary and Benefits	\$193,056									
E/D Base Salary	\$152,500									
Average Rate of Fringe Ben	22.883%									
Fixed Insurance Component	\$ 5,659.00			Reference: Bian Bertlshorfer, Director, Cost Analysis and Compliance, Office of Sponsored Research, UNC CH, 8/1/16						
					Year 4 - Track I and II - Steady State					
				Resource Description	Summer A	Summer B	Fall	Spring	Total	
Adjunct Faculty	Designation	Creidt Hours	Title - Description						\$ 371,667	
I1	Grad 701	1.5	Working in the clinical environment	Grad PSM UNC Adjunct	\$ 10,000	\$ -			\$ 10,000	
I2	Grad 710	1.5	Professional Communications: Writing	Grad PSM UNC Adjunct	\$ -	\$ 10,000			\$ 10,000	
I3	BME TBD	3	Biomedical Innovation and Entrepreneurship: Needs Finding and Specification	Adjunct Faculty	\$ 20,000	\$ -			\$ 20,000	
I4	MBA 586	3	Legal and Marketing Dynamics in Pharmaceuticals and Biotechnology	Adjunct Faculty	\$ -	\$ 20,000			\$ 20,000	
I5	ISE 515	3	Mfg Process Engineering	Adjunct Faculty	\$ 20,000	\$ -			\$ 20,000	
I6	BUS 533	3	Supply Chain Management	Adjunct Faculty	\$ -	\$ 20,000			\$ 20,000	
I8			Need Spec Prep Support: Inward Facing - coaching and mentoring of candidate teams	Adjunct Faculty	\$ 5,000	\$ 5,000			\$ 10,000	
I9			Professional Support: Outward Facing - Shadowing, Observing, Tech Trans and Interfaces with Research Triangle Incubator Community	Adjunct	\$ 5,000	\$ 5,000			\$ 10,000	
D1	Grad 711	1.5	Professional Communications: Presenting	Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000	
D2	Grad 712	1	Leadership in the work place	Grad PSM UNC Adjunct			\$ 6,667		\$ 6,667	
D3	Grad 713	1.5	Applied Project Management: Frameworks; Principles; and Techniques	Grad PSM UNC Adjunct			\$ 10,000		\$ 10,000	
D4	BME 551	3	Design in Biotechnology	Adjunct Faculty			\$ 20,000		\$ 20,000	
D5	ISE 714	3	Prod Mfg Engr for the Med Device Industry	Adjunct Faculty			\$ 20,000		\$ 20,000	
D6	BEC 577	3	Advanced BioMfg & Biocatalysis	Adjunct Faculty			\$ 20,000		\$ 20,000	
D7	IE 520	3	Healthcare Systems Performance Improvement	Adjunct Faculty			\$ 20,000		\$ 20,000	
D11			Design Support - assists in formation of cross-functional teams and development of their work product for vetting	Adjunct Faculty for BME 551 - Additional Responsibility			\$ 5,000		\$ 5,000	
IDF1	MIE 412	3	Finance and Accounting for Entrepreneurs (to be tailored course to fit both tracks)	Adjunct Faculty				\$ 20,000	\$ 20,000	
IDF2	BME 55X TBD	3	Proof of Concept Prototyping, Verification, and Validation	Adjunct Faculty				\$ 20,000	\$ 20,000	
IDF3	BUSI 504	3	Launching the Venture	Adjunct Faculty				\$ 20,000	\$ 20,000	
IDF4	BEC 575	3	Global Regulatory Affairs	Adjunct Faculty				\$ 20,000	\$ 20,000	
IDF5	IE 521	3	Healthcare Systems Performance Improvement	Adjunct Faculty				\$ 20,000	\$ 20,000	
IDF6	Bus 854	3	Organization Design & Development	Adjunct Faculty				\$ 20,000	\$ 20,000	
IDF9			Prototype Support - Technical consulting, sourcing of equipment, model making, advising on proof of concept testing	Technical consultant/model maker				\$ 20,000	\$ 20,000	

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Revision: 21 January 2017

Admin Support - contract									\$ 72,000
I11			Staff Support			\$ 12,000	\$ 12,000		\$ 24,000
D14			Staff Support					\$ 24,000	\$ 24,000
IDF12			Staff Support					\$ 24,000	\$ 24,000
Advertising									\$ 24,000
I10a			Advertising			\$ 4,000	\$ 4,000		\$ 8,000
D13a			Advertising					\$ 8,000	\$ 8,000
IDF11a			Advertising					\$ 8,000	\$ 8,000
Communications									\$ 24,000
I10b			Communications			\$ 4,000	\$ 4,000		\$ 8,000
D13b			Communications					\$ 8,000	\$ 8,000
IDF11b			Communications					\$ 8,000	\$ 8,000
Travel									\$ 27,000
I10c			Travel			\$ 4,500	\$ 4,500		\$ 9,000
D13c			Travel					\$ 9,000	\$ 9,000
IDF11c			Travel					\$ 9,000	\$ 9,000
Vetting									\$ 32,000
I7			Need Specification Vetting	4 angels/VC @ \$2000 per day		\$ 8,000			\$ 8,000
D10			Design Vetting	4 angels/VC @ \$2000 per day			\$ 8,000		\$ 8,000
IDF8			Prototype Vetting	8 angels/VC @ \$2000 per day				\$ 16,000	\$ 16,000
Prototype Construction									\$ 150,000
IDF14			Prototype Construction					\$ 150,000	\$ 150,000
Other Items									\$ -
D8	Elective	3	TBD					0	\$ -
D9	Elective	3	TBD					0	\$ -
IDF7	Elective	3	TBD					0	\$ -
D12			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Exec Director				0	\$ -
IDF10			Professional Support: Outward Facing - Shadowing, Observating, Tech Trans and Interfaces with Research Triangle Incubator Community	Exec Director				0	\$ -
Sub-Totals									\$ 700,667
Exec Director Salary + Fringe									\$ 193,056
Grand Total									\$ 893,722
									Year 4 - Gross



UNC
SCHOOL OF MEDICINE

Julie Story Byerley, MD, MPH
Vice Dean for Education
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University of North Carolina at Chapel Hill
Chapel Hill, NC 27599-7000
919.962.8499
julie_byerley@med.unc.edu

February 3, 2017

To: B. D. Barnes PhD PE PMP
Executive Director
The Joint Department BME
Professional Masters' Program
UNC CH NC STATE

From: Julie S. Byerley, MD, MPH
Vice-Dean for Education
UNC School of Medicine

Subject: **Endorsement:**

Joint Department of Biomedical Engineering
Professional Science Master's Program
UNC CH & NC STATE

Dear Dr. Barnes,

Thank you for this opportunity to endorse the subject Joint Department PSM Program. Let me come quickly and I hope concisely to the point. I am inspired to be the chief advocate for education as our large academic health center accomplishes its multiple missions in its drive to be the nation's leading public school of medicine. I serve on the Senior Executive Team of our UNC School of Medicine and the UNC Health Care System and thereby regularly face the challenges of the competing demands in this rapidly changing landscape. It is clearly a time of transformation in a complex and crucial system.

Over the last several months, I have had the opportunity to follow and to contribute to the development and planning for the Joint Department PSM. As the program is currently designed with a strong, even unique, emphasis on observation, shadowing, team work, and innovation, it provides a unique opportunity to discover new and innovative ways to "do" healthcare and to provide new tools and capabilities to improve access and economic delivery. Perhaps even more important, I am genuinely excited that it provides young professionals with the skills and motivation, to become partners with health care professional in life-long learning, innovation, and entrepreneurship.

Obviously, I strongly endorse the program; will work in partnership with the Joint Department to ensure its success; and urge its prompt approval.

Respectfully,

Julie S. Byerley



February 6, 2017

To: B. D. Barnes PhD PE PMP
Executive Director
The Joint Department BME
Professional Masters' Program
UNC CH NC STATE

From: Andrew Schwab, PhD
President
First Flight Venture Center
Research Triangle Park, NC

Subject: **Endorsement:**

Joint Department of Biomedical Engineering
Professional Science Master's Program
UNC CH & NC STATE

Dr. Barnes,

Thank you for this opportunity to comment on the subject proposed program emphasizing the integration of management, business, engineering design, and technology within the highly competitive, difficult, challenging, international, regulatory driven, world of health and health care.

For better or for worse, I may be in a unique position to provide feedback on your program with respect to the challenges of innovation and entrepreneurship. As a graduate of Duke's engineering program, for well over 30 years I have been building what I would like to think are successful start-up companies in and around the health and health care domain. In addition, I have mentored and advised over 40 companies and been involved on multiple boards and committees designed to vet technology and executive teams. My work has indeed taken me from one end to the other of the business of engineering: student, inventor, designer, founder, salesman, manager, executive, venture capitalist, and former owner --- several times.

With the above in mind, I find the proposed program to be ambitious and practical in context and content. To be successful in this venture, three issues must always be at the top of mind: the right students, the right faculty, and the right environment. Those students pursuing this degree must be intellectually capable and at the same time recognize the absolute necessity of becoming equally

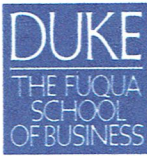
capable at and integration of leadership, business, and creativity. The right faculty will ***not*** be those pursuing a traditional research/academic pathway. They must know the health and health care domain; be able to mentor as opposed to lecture; and demonstrate the curiosity and practical perseverance of an entrepreneur. These two are necessary but not sufficient. Since the intent is to produce practical professionals, the curriculum must live within the world of innovation and entrepreneurship. Just as with surgery, the environment must be one requiring the student to “do” in order to become.

My judgment of the proposed program is that it has all the elements needed to yield outstanding practical professionals and to deliver valuable intellectual property and efficient and effective processes. The only thing missing is the “doing.” Consequently, I strongly endorse the program and encourage its expeditious implementation.

Respectfully,



Andrew Schwab
President



February 21, 2017

Dr. B.D Barnes
Executive Director
The Joint Department Biomedical Engineering
Professional Masters' Program
University of North Carolina, Chapel Hill
North Carolina State University

**Subject: Endorsement of the Joint Department of Biomedical Engineering,
Professional Masters' Program, UNC CH & NC State**

Dear Dr. Barnes,

Your programs in biomedical device development impressed me greatly at Duke and I am pleased to see that you will be amplifying this effort in the PSM initiative at NC State/UNC.

Over the last several years, I participated in your similar programs as Duke as a lecturer and advisor in the Biomedical Engineering Department and in the Department of Neurosurgery. I have often recounted these experiences to my colleagues in the Graduate Business School as a highly effective model for developing core entrepreneurship skills. In particular, these programs resonated with my 35 years of "real world" entrepreneurial experience for ensuring: 1) direct and close interaction with physicians in the clinical environment; 2) comprehensive diligence in market, regulatory, intellectual property, and competitive constraints, and; 3) realistic assumptions for the scope and extent of a such projects in an academic setting.

Over many years, I participated as a judge for your students in the Biomedical Engineering program at Duke and I was simply wowed by their preparation and professionalism. Since I am able to compare these with similar presentations throughout Duke, I can say with confidence that they were truly the best I had seen. This is gratifying for me as an advisor, to be able to dig into the essence of the venture and not be distracted by issues in the compulsory elements of a project.

Matching these strong academic and pragmatic principles within the PSM mission is a strong start, however, further synergies underscore its prospects for success. First, the program aims to establish a broad cadre of entrepreneurial expert advisors – an essential element in guiding new entrepreneurs. Second, your program is juxtaposed with entities that provide capital needed to establish core aspects of value, particularly in the all-important realms of early proof-of-concept and intellectual property. All combined, these elements make for a program that is both unique and potent. As an entrepreneur, I am excited to see the PSM taking form and strongly endorse it as a right-minded approach to stimulate entrepreneurial development in the biomedical field.

Very truly yours,

A handwritten signature in blue ink, appearing to read "Matthew Megaro", written over a light blue background.

Matthew Megaro
Executive-in Residence
Duke University Fuqua School of Business
Matthew.megaro@Duke.edu



February 7, 2017

B. D. Barnes PhD PE PMP
Executive Director
The Joint Department BME
Professional Masters' Program
UNC-Chapel Hill and NC State

Subject: **Endorsement:**

Joint Department of Biomedical Engineering
Professional Science Master's Program
UNC CH & NC STATE

Dear Dr. Barnes:

Thank you for taking on the responsibility of supporting Dr. Allbitton and Dr. Gu in leading the establishment of the Joint Department Professional Science Master's Program focusing on translation, innovation, and entrepreneurship across the School of Medicine at UNC Chapel Hill and our College of Engineering here at NC State.

It is clear from our success both at NC State and at UNC Chapel Hill that technology based programs integrating management, business, engineering, and technology are in demand today and build the skills and mind-set for continued professional growth and contribution that are essential in the rapidly changing world of engineering, health, and health care.

Last semester, I had the opportunity to share the Joint Department's success and plans for the future with the NC State Board of Trustees. The Board of Trustees was enthusiastic about the progress of the Joint Department and strongly supportive of planned initiatives, especially the Joint Department Professional Science Master's Program.

It is clear from my perspective that the program, as planned, is academically sound and exemplary as a professional practice discipline. Students, faculty, industry, economic development, and the people of NC and beyond have the potential to greatly benefit from this PSM.

In closing, please know that I fully endorse the program, strongly urge its approval, and on behalf of the College of Engineering at NC State will vigorously support its establishment, growth, and success.

Respectfully,

Louis Martin-Vega, Ph.D.
Professor and Dean