Proposal for a Joint Degree:

Master of Business Administration and Master of Science in Bioengineering

Institution Submitting Proposal:	The University of Utah
College, School of Division affected:	The David Eccles School of Business The College of Engineering
Department(s) or Areas(s) affected:	The David Eccles School of Business, the Department of Bioengineering in the College of Engineering
Change Description:	Proposal of a joint degree Master of Business Administration (MBA) and a Master of Science (M.S.) in Bioengineering Degree
Proposed Beginning Date:	Fall Semester 2009

Institutional Signatures

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Jack Brittain, Dean, David Eccles School of Business

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Richard Brown, Dean, College of Engineering

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Richard Rabbitt, Chair, Bioengineering Department

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David Chapman, Dean, Graduate School

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David Pershing, Senior Vice President, Chief Academic Officer

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Michael Young, President

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Date

SECTION I: The Request

The University of Utah's College of Engineering, the Department Bioengineering and the David Eccles School of Business request permission to establish a joint degree program that enables students to simultaneously pursue the Master of Business Administration (MBA) and the Master of Science (MS) in Bioengineering with a focus on medical product innovation. If approved, students could enroll as early as the Fall Semester, 2009. This request is part of the bioDesign initiative that teams Business, Bioengineering and the Health Sciences to deliver world-class graduate education in medical product design, product innovation, and entrepreneurial enterprise.

This is not a request to establish a new degree. Instead, we seek approval to coordinate the MBA and MS curricula to synergize content, thereby enabling students to earn both degrees in less time than would be required for separate sequential degrees. Students in the joint program would take 21 credit hours in the College of Engineering, 47 hours in the College of Business and a 6 hour capstone course taught across the Colleges. Up to 9 credit hours of courses would appear on the program of study for both degrees and listed as "courses common to the dual degree programs". The joint program is designed to be an immersion in the experience of innovation and therefore completed as a full-time program requiring simultaneous and continuous enrollment in two Colleges. The program should be completed in no more than six semesters of full-time study. One possible sequence of coursework is given in Appendix A.

Applicants must meet admission standards and be accepted to both the MBA and Bioengineering MS programs. The joint program includes a Comprehensive Final Exam that is required for graduation. Upon completion of all degree requirements, the MS in Bioengineering and the MBA Degrees will be conferred simultaneously. In the event a student exits the joint program or does not complete the full requirements, they will have the opportunity to apply qualified course credits toward the traditional Bioengineering MS or MBA degree(s).

SECTION II: Need

The University of Utah is poised to become a world leader in training future biomedical product entrepreneurs and innovators. We already have in place outstanding MBA, Bioengineering and entrepreneurial training programs. In addition to these training programs, the University has an excellent health science system that is critical to the success of Utah bioDesign programs. Health, health care, and biomedical research components of the University provide key links to biomedical product markets, clinical expertise, and a vast source of early stage intellectual property and product concepts. We propose to establish a graduate program that will engage graduate students and professionals in the identification, advancement, and translation of University of Utah health science ideas. The effort will: 1) train students and professionals in medical product innovation, 2) provide graduates with the MBA and the MS in Bioengineering, 3) add value to UU health science ideas, 4) generate UU intellectual property, 5) lead to viable products and new ventures in Utah, and builds upon the program synergies that already exist in the two Colleges' collaborations in The Pierre and Claudette MacKay New Venture Development Center. Specifically, we will recruit teams of post-baccalaureate science, engineering and business students and teach them how to innovate by immersion in an intense hands-on environment. The ideas and market needs will be derived from UU health science clinicians and research teams (just as done with our current undergraduate bioDesign program). Our vision is that all of these students will be enriched with the knowledge of innovation, and that many of the students will apply their skills to launch

companies or products. The present proposal is focused on graduate training primarily targeting professionals and mature students that will exit the university with an MS and MBA focused on medical product innovation. We also expect students in the joint program to interact with PhD and MD students involved in generation of University intellectual property, thereby transforming the behavior of more traditional graduate students and faculty mentors by introducing the process of innovation into the research laboratories.

There are remarkably few programs around the nation focused on teaching design and innovation of commercially viable medical products. One of the most established is Stanford University bioDesign (http://biodesign.stanford.edu/bdn/index.jsp), which offers a variety of courses and resources. One Stanford program recruits diverse teams of young professionals (engineers, medical, business) and immerses them in a process of medical product innovation for roughly a year, with the aim of launching medial product new ventures. A related example is the Ewing Marion Kauffman Foundation financed Institute for Advancing Medical Innovation, (http://foundationcenter.org/pnd/news/story.jhtml?id=238200026) at the University of Kansas, established in 2008. The Stanford program in particular has found some success in generating new ventures and advancing intellectual property, but it is not focused on delivering the technical design and business skill set reflected in the MBA and MS proposed here. The closest model to our proposal is the 3-year joint MBA and Biotechnology MS offered by the MIT Sloan College of Business and the Harvard/MIT Health Science and Technology group (http://bep.mit.edu/program.php). The MIT/Harvard program requires 63 total credit hours., slightly less than the 74 credit hours proposed here. We believe our approach builds on best practices of both the Stanford and the Harvard/MIT programs. Specifically, the Utah program includes immersion in early stage medical product innovation and design (e.g. Stanford) followed by serious entrepreneurial and business training (e.g. MIT/Harvard).

Currently, there is one joint MBA/MS Engineering program in the Intermountain West. The University of Arizona offers an MBA jointly with MS degrees in Electrical and Computer Engineering, Aerospace and Mechanical, Systems and Industrial Administration and Computer Science. Comparable programs at University of Texas, University of Illinois and University of Arizona are described in Appendix B to demonstrate that the proposed program is generally similar to other programs in terms of hours and the distribution of those hours across colleges.

Letters of support in Appendix C

University resources -

The University of Utah is well, if not uniquely, endowed with programs/resources required to establish an MBA/MS program of national or international repute. First, the University has well regarded, research oriented Colleges of Engineering and of Business. The colleges are led by Deans who value a joint program as a facilitator of economic growth in Utah. Dean Brittain serves the University as Vice President of Technology Venture Development (Tech Ventures). Tech Ventures' purpose is to turn good ideas developed at the University of Utah, a Tier 1 research university, into good business. In the most recent year, TCO helped to found twenty-three new companies based on research from the University, second only to MIT in new company formation.

The University also has extensive relations with the Utah Science Technology and Research

(USTAR) economic development initiative – a $180M investment by the Utah Legislature to bolster the state's research strengths and significantly increase technology commercialization. In the last academic year, eight MBA students, primarily with engineering/technical backgrounds, had internships in USTAR and worked on projects ranging from carbon sequestration to the new nanotechnology center. The University's USTAR priorities include two clusters in bioengineering with a specific focus on commercialization of technologies to build a strong bioengineering-focused industrial presence in Utah.

Additional opportunities for development of a notable joint degree program exist with the Pierre Lassonde Entrepreneur Center. The Center hosts two student run business plan competitions, Opportunity Quest and the nationally recognized Utah Entrepreneurship Challenge. Business plan competitions specifically address the boardroom and market dimensions of new knowledge. Closer to the laboratory, The Pierre and Claudette MacKay Lassonde New Venture Development Center "assists researchers with breakthrough technologies and determines the commercialization potential of those ideas while providing students a unique educational experience in new business development". Each year the Center works with the Technology Commercialization Office to evaluate more than 50 top technologies from the University of Utah. Of these technologies, 8-10 close to commercialization are chosen for a year long due diligence conducted by teams of business and engineering students.

Newly founded, the James LeVoy Sorensen Center for Discovery and Innovation Studies conducts research on the earliest stages of the innovation lifecycle. The Center now hosts the Product and Service Innovation Winter Conference. In this its sixth year, the conference will draw approximately 40 internationally prominent researchers who submit research for review and collegial feedback. The Center also sponsors Tech Titans, a statewide student competition of early stage ideas and designs that draws on professional through the Wasatch Front for judging and mentoring. Last year, Tech Titans drew 107 entries from 166 students and involved 23 judges.

The Technology Venture Development (Tech Ventures) program includes an educational outreach component that currently involves over 800 students per year. In addition to various competitions and structured programs offered by the Pierre Lassonde Entrepreneurship Center and the James LeVoy Sorenson Center for Discovery and Innovation Studies, Tech Ventures provides nearly two dozen internships focused on commercialization that range from the Intellectual Property Clinic in the law school to positions working directly with PhD qualified licensing managers. Biosciences innovations account for about a third of the University's commercialization portfolio and there are opportunities for students to be involved in the commercialization process at every step.

David Eccles School of Business resources –

The David Eccles School of Business is a recognized leader in the areas of innovation and entrepreneurship business education. As noted, the school has well established relationships with other centers of innovation and commercialization on campus. Faculty conducting research in innovation, commercialization or entrepreneurship specifically include Abbie Griffin (Presidential Professor), Bill Schultz, Ming Piao, Weiyu Tsai, Glen Schmidt, Lyda Bigelow, and Bill Moore. In addition, the school has recently had searches for an Entrepreneurship Professor and the Sorensen Chair in Innovation. More generally, the opportunity for inter-college dialogue is facilitated by business faculty with engineering backgrounds including Abbie Griffin (BS Chemical,

Purdue), Gerardo Okhuysen, Don Wardell (BS and MS Metallurgy, the University of Utah), Mike Lemmon (BS and MS Electrical, the University of Utah), Karl Lins (BS Petroleum, Texas A&M), Glen Schmidt (MS Engineering, Kansas State), Jeff Stratman (BS Mechanical and Aerospace, Princeton), Mike Cooper (BS Industrial and Systems Engineering, Georgia Tech), Michael Halling (MS and PhD Computer Science), Paul Hu (BS Chemical), Olivia Sheng (MS and PhD, Computer and Information Systems, Rochester) Sriram Thirumalai (BS Metallurgy, IIT Madras).

College of Engineering/Bioengineering resources -

The Department of Bioengineering at the University of Utah is among the oldest in the nation and consistently ranks among the top bioengineering departments in the nation (e.g. as reported by the National Research Council, Faculty Scholarly Productivity Ranking, U.S. News and World Report). Dr. H. Warner established programs in Bioengineering, Biophysics and Medical Informatics in the 1950s, that later led to establishment of Bioengineering as a stand-alone academic unit in 1972. The current Department of Bioengineering has benefited enormously from a deep commitment of the faculty and from the mutually supportive interactions between engineering, medicine, and pharmacy at the University of Utah. Significant FTE and student enrollment growth has been facilitated by Development Awards from the Whitaker Foundation in the 1990s and, more recently, the "Engineering Initiative" and the "Utah Science Technology and Research (USTAR) Initiative". The Department of Bioengineering main administrative office is located in the Warnock Engineering Building, while a majority of the research laboratories are located on the health sciences campus in the Biopolymers Research Building.

Bioengineering has a strong history of engagement in intellectual property generation and advancement. A majority of the faculty have been directly involved in new ventures and virtually all have patent portfolios. Almost all faculty hold secondary or primary appointments in the health sciences and derive many of their innovative ides from this interdepartmental mix. Upon completion of our last alumni survey, we found that over 15% of Bioengineering Ph.D. alumni are entrepreneurs engaged in new ventures. This is not surprising given the intellectual property portfolio of the University of Utah with a majority of the current activity in the medical product arena.

The multi-disciplinary nature of the field of bioengineering is reflected in the makeup of the faculty - a faculty strongly committed to the advancement of knowledge, health, and the human condition through bioengineering. The size of the tenure-track faculty currently numbers 20 (18 male, 2 female) sharing ~14 full-time-equivalent salaries (9-month FTEs). The faculty team also includes 5 full-time research faculty with primary appointments in bioengineering, and 64 affiliate faculty that hold primary appointments in other academic units or industry. These faculty are supportive of the MS-MBA program and well positioned to offer the Engineering content. The faculty has the required laboratories and faculty expertise.

Bioengineering research has historical strengths in artificial organs, biomaterials and drug delivery; and today has recognized strengths in neural engineering, cardiovascular engineering, molecular/cellular therapeutics and engineering, and medical imaging/visualization (among other areas). Extramural research expenditures in biomedical engineering exceed $800,000 /yr/FTE (2006). A vast majority of the research funding continues to come from the National Institutes of Health (NIH), with secondary funding from NSF, DARPA, PATH and other sources.

Bioengineering currently enrolls ~40 new undergraduates and ~35 new graduate students (primarily Ph.D.) each year. Undergraduates are admitted to major status on a competitive basis after two years of study. Graduate students are selected from an applicant pool of approximately 300 each year. Approximately 20 entering Ph.D. students are promised 5 years of support at the NIH predoctoral rate plus tuition benefit and health insurance. Approximately 4 entering Ph.D. students are supported by intramural Fellowships (Brown, Campbell) and several are supported by training grants (varies by year). Other graduate students are primarily supported at the discretion of individual faculty. A vast majority of the financial support is derived from extramural research assistantships with teaching assistantships provided as secondary support. Students that graduate with the B.S. in biomedical engineering are exemplary at the University of Utah and are placed in nearly equal proportion among top medical schools, graduate programs and industries across the nation.

Section III: Institutional Impact

It is expected that the MBA/MS and associated programs will bring in an additional 5 students in the first year, 15 students in the second year and reach a steady sustainable yearly intake of 30 students within 5 years. The colleges will continue to largely operate as they do now.

There are already numerous business courses suitable to students in the joint program. Examples include: FIN 6300 Venture Capital, FIN 6881 Managing the Venture process, MKT 6860 Marketing Research, MGT 6810 Entrepreneurship, MGT 6830 Entrepreneurial Consulting, MGT 6860 Lassonde, MGT 6910 Management of Technological Innovation, FIN 6310 Advanced Venture Capital, MGT 6710 Strategy and Technology, MGT 6820 Building the Entrepreneurial Venture, MKT 6715 Entrepreneurial Marketing, MKT 6910 Entrepreneurial Internet Marketing, and Independent Study Courses. There are also a host of Bioengineering graduate courses that cover the engineering aspects of medical products that will be available to the students.

Students will experience the interplay of engineering and business in early stage product/process development through a year-long, 6 credit hour, interdisciplinary capstone course. The course will require students, individually or in small groups, to identify and understand some “new knowledge” originating in engineering or allied disciplines as precursor to a thorough and disciplined evaluation of its economic viability as instantiated in a new product or process. This interdisciplinary course will be jointly developed and delivered by engineering and business faculty. Involvement of University centers in such a course is yet to be determined but expected to be high. A description of the capstone course is in Appendix D.

In addition to the 6 hour capstone course described above, the program will require the development and delivery of a 6 hour Biomedical Design course sequence. This will be a graduate-level medical product design course organized to advance UU ideas identified in clinical medicine and life science research into viable medical products (following approach of BIOEN 3801/4801). The BIOEN design course will educate students in topics specific to medical product design (e.g. Food and Drug Administration, Good Manufacturing Practice, Quality System regulations, prototyping, testing, Intellectual Property,…) and immerse them in the process of advancing ideas from University of Utah clinical enterprise and research laboratories into viable medical products.

The full-time MBA program currently admits 50-60 students each Fall. It is anticipated that the MBA/MS Bioengineering program will add 5 students initially and near-term growth can be easily accommodated. There will be some need for the coordination of admissions and academic advising between the two programs. The Business School Masters Programs Office (MPO) will take the lead in this coordination. The College of Engineering/Mechanical Engineering Department will inform the MPO as soon as a current or prospective student indicates intent to apply for or matriculate in the joint program. The MPO will inform the COE and Bioengineering Department Director of Graduate Studies whenever a current or prospective MBA student files an application to the joint program.

Graduate classes in the College of Engineering can accommodate increased marginal enrollment with little logistic accommodation. Since it is anticipated that students will not be directly involved in or sponsored by faculty research, the increased load on faculty will be minimal. There will be additional teaching required for the Design sequence and some additional administrative load as the program(s) increase in size and number.

Section IV: Finances:

Increased administrative load (recruiting, admissions, orientation, advising, career management) for the departments will be offset by the increase in SCHs. Potential involvement of Tech Ventures or other University entities and hence their associated costs and contributions cannot be predicted at this time, but Tech Ventures will continue to provide internships and would like to engage students from this program.

We anticipate that the students will be primarily professionals and will pay full tuition for the course, including any differentials and/or program fees. The departments and Colleges will actively pursue external funding for scholarships/assistantships. Since these graduate students will not be directly engaged in the research mission any funding for scholarships or assistantships will generally at a lower level than that of students working on sponsored research. Our intent for this and similar joint MBA/Engineering programs is to increase enrollment by 60 graduate students enrolled within 5 years. Under the current formula, the differential tuition plus productivity funding tied to increased enrollments and returned the respective units would be adequate to cover the additional administrative costs (1.5 FTE/Yr staff noted above) that will come with a program this size. 0.5 FTE/AY additional medical design faculty will be required. Since this topic is aligned with the mission of the USTAR faculty, we anticipate that the faculty resources will become available as additional USTAR positions are filled.

Appendix A – Program Structure

Business	Capstone	*Bioengineering	
1.5		0	Summer Yr 1
13		3	Fall Yr 1
10		6	Spr Yr 1
9		*3*	*Sum Yr 2*
6	*3*	*6*	*Fall Yr 2*
7.5	*3*	*3*	*Spr Yr 2*
47	6	21	

Bioengineering MS Requirements

Candidates must satisfy the normal requirements for the Master of Science in Bioengineering. The program of study for each student must be approved by the Bioengineering Director of Graduate Studies (DGS) and, for the MS-MBA, allows 2 credit hours of the Capstone course to replace the standard "Scientific Presentations" MS requirement, and 7 credit hours of Capstone/Business course to count as MS graduate electives. The DGS can approve a standard bioengineering track as part of the program of study to replace of the design sequence listed below. As part of the MS requirements, students must pass the Bioengineering MS comprehensive examination in any area of specialization offered by the Department. Additional details regarding MS requirements can be found on the Bioengineering web site.

Required Courses by semester

Summer Yr 1 – Teams (1.5)
Fall Yr 1 – Financial Accounting (3), Marketing Management (3), Managerial Economics (3), Data Analysis I (1.5), Production and Operations I (1.5), Communications (1), BIOEN MS Core (3)
Spring Yr 1 – Financial Management (3), Managerial Accounting (1.5), Information Systems (1.5), Data Analysis II (1.5), Production and Operations II (1.5), Communications (1), BIOEN MS Core (3), BIOEN Biomedical Design 1 (3)
Summer Yr 2 – Marketing Research (3)
Fall Yr 2 – Strategic Management (3), Managing and Leading (3), BIOEN Biomedical Design (3), Capstone I (3)
Spring Yr 2 –Capstone II (3)

By taking simultaneously taking business and engineering courses, the students will be continually exposed to business and engineering faculties, research and their peers. Pedagogically, it accentuates the integration/interaction of the two areas.

Appendix B – Comparable Dual MBA/Engineering Degree Programs[1]

The MBA/Master of Manufacturing and Decision Systems Engineering – University of Texas

Students spend their first year in the Dual Degree Program taking Engineering courses. The second year is dedicated to MBA core courses and approved business electives. The final year is a combination of courses from both departments. (The MBA Program begins in the fall semester only and all students are expected to enroll in fifteen credit hours per long semester during the academic year that is devoted to business courses.)

Students must complete at least 76 credit-hours of coursework:

- 28 hours of required MBA core courses (Note: BA 380N, a required MBA core course, is also an Engineering core course)
- 18 hours of business electives
- 6 hours of MDSE core courses
- 15 hours of MDSE "Technical Option" Courses or their pre-approved substitutes
- 6 hours of MDSE electives
- 3 hours of MDSE Master's Report (MFG 398R)

MBA/Master of Mechanical Science and Engineering* – University of Illinois

(*- also programs in Civil and Environmental, Computer Science, Electrical and Computer, Industrial and Enterprise Systems and Materials Engineering)

The Illinois MBA and the Department of Mechanical Science and Engineering (MechSE) have jointly established a program leading to a MBA/MSME degree. Students must apply for admission to both the MBA program and to the Mech E department. Students must complete a total of 92 hours of graduate coursework to obtain both degrees. The requirements for the MSME degree in this joint program are a total of 32 hours of coursework, which include 8 hours of thesis coursework. To complete the MBA degree requirements, students must complete 60 hours of coursework, which includes one concentration.

Students in the joint degree program spend their first year in the MBA curriculum, paying tuition at the MBA rate. In the second year, students take courses in Mechanical Engineering and pay tuition at the MSME rate. In the final (third) year, students take courses in both business and engineering. The degrees are awarded simultaneously upon completion of all requirements in both curricula. Students pay MBA tuition for three semesters.

MBA/MS *Science and Technology - University of Arizona**

(* - includes Computer Science, Electrical and Computer Engineering, MIS, Optics, Aerospace and Mechanical Engineering, and Systems and Industrial Engineering)

[1] Materials in this Appendix are taken from university/program websites.

Year 1
Traditional MBA core courses + 1 or 2 courses that leverage professional expertise and experience.
Summer
Complete an Entrepreneurial Principles and Environments Course for credit as well as work on your Master of Science Thesis or Report.
Year 2
Electives to meet graduation requirements for both colleges + optional completion of entrepreneurship certification courses/activities. Program admission to the McGuire Center for the entrepreneurship certification is automatic.

Appendix C - Letters of Support

Appendix D – Capstone Course Description

Course content and structure developed jointly by Abbie Griffin (Marketing), Glen Schmidt (Operations), Bill Schultz (Management), Bob Hitchcock (Bioengineering), Mikhail Skliar (Chemical Engineering), Kent Udell, Eberhard Bamberg, William Provancher (Mechanical Engineering)

- **6-hour Capstone Class -** Fall and Spring semesters of the second year. Students must take both semesters of the class.
  - Fall Semester Yr 2 – Between the start of school and mid-October, students individually develop initial evaluations for one specific new technology or project idea. This can either be one of the project ideas that the students were exposed to during the summer or one of their own project ideas. Students meet twice weekly. In one session each week, they meet to compare notes and obtain advice on their evaluation process and reactions to the outputs of that process from both faculty and peers. In the second session, classroom instruction will be provided on topics including IP protection, project management, valuation, internationalization, and other topics to be determined. The week before Fall Break, students distribute their project evaluations to the faculty and their student peers, and then "pitch" their projects to move forward into development for the rest of the year. Student peers rate the projects proposals and vote for their membership preferences. Over fall break, a panel of professors and industry personnel choose some number of projects to go forward based on professional and student peer evaluations. After the break, students are assigned to teams to work on those projects.
  - Second half of Fall Semester Yr 2 through Spring Semester Yr 2 – Student teams work with their technologist, industry coaches, clinicians and professors (and TCO if locally generated) to refine the underlying IP, develop proof of concept efficacy (either physically or digitally) and select a commercialization pathway. Teams must complete and present business and marketing plans consistent with commercialization pathway.
    We expect that at least some teams will participate in Tech Titans and the Utah Entrepreneurship Challenge. Additionally, teams may present their plans to the University Venture Fund, Launch Pad or TCO for possible funding.

Minimum deliverables for the final phase of the class are: functioning prototype of the innovation, digital or physical proof of the prototype's technical efficacy, an analysis of possible commercialization paths and an N month development (technical and business/marketing) plan for the innovation.

The course has been reviewed and unanimously approved by the David Eccles School of Business Masters Curriculum Committee.