

A Novel Graduate Program in Healthcare Technologies Management

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Introduction

Employment opportunities for biomedical engineers exist in clinical, industrial, and consulting environments. Many biomedical engineers become involved in research and development or new product development for medical device companies. Others may work for hospitals as clinical engineers. Some find employment with healthcare consulting firms. Each of these career paths involves the management of healthcare technology. Engineers in industry manage the development of technology from the conception to commercialization stages. Engineers in the clinical environment manage the selection, implementation, utilization, and assessment of hospital based technologies.

Typically, new graduates with no work experience possess solid technical skills but lack training in business, management, and regulatory issues. Their background in product development and project management tends to be weak, and they lack an understanding of the economic and regulatory environments of healthcare delivery. Engineers working in industry advance along their career paths until they reach a point where the next job level involves management responsibilities. In companies that offer a dual ladder career path, engineers may choose to advance along the technical ladder. However, to qualify for positions along the technical ladder, engineers may need several years of experience, published papers, and recognition as an industry expert outside the company. Engineers interested in advancing into positions along the management ladder find themselves in need of management skills for career advancement. Thus, new graduate engineers and those preparing for career advancement are in need of formal training in business and management and other areas. Additional technical training would allow new graduates to strengthen and experienced engineers to update their technical skills.

Medical device companies, hospitals, and healthcare consulting firms need engineers with technical and business training, and an understanding of the economic and regulatory aspects of healthcare delivery. In order to develop, promote, and retain their key employees, they need to invest in employee training and education.

Most undergraduate biomedical engineering curricula include courses in math, physics, chemistry, physiology, design, and the engineering sciences. Biomedical engineers working in clinical or industrial environments have some unique additional educational needs that are not addressed by most undergraduate or graduate biomedical engineering programs. The Healthcare

Technologies Management Program was designed to meet the educational needs of these engineers and their employers.

Description of Program

The Healthcare Technologies Management Program (HTM) was designed with the guidance of representatives from medical device companies, hospitals, healthcare consulting firms, and insurance companies. The program is supported by a Special Opportunity Award from the Whitaker Foundation and is jointly offered by Marquette University and the Medical College of Wisconsin, in Milwaukee, Wisconsin. Graduates of the program will earn a Master of Science degree in Healthcare Technologies Management from both institutions.

The objectives of the program are to provide engineers with formal business and management training, update their technical skills, develop and understanding of the healthcare delivery and regulatory environments, and prepare students for placement and advancement into clinical, industrial, and consulting positions. The program is designed to train engineers to manage the design, development, commercialization, and regulatory compliance of medical devices, and the implementation, utilization, and assessment of hospital based healthcare technologies. It meets the unique needs of biomedical engineers by providing training in areas not covered in typical graduate business or technical degree programs, such as:

- Medical terminology and surgical procedures
- FDA and international regulatory requirements
- Medical device package design and testing
- Sterilization processes and testing
- In-vivo testing of medical devices
- Economics of healthcare

The program consists of 15 courses representing 38 credit hours. Courses are offered in the evenings to accommodate working engineers and are taught at both institutions. Students may enroll as full or part-time students. Full-time students can complete the program in three semesters. To be admitted to the program, students must have a degree in engineering, physics, applied science, or other related field, or they must have significant engineering work experience.

Curriculum

The program includes courses in Healthcare Technologies Management (47%), Business and Management (37%), and Engineering electives (16%). The Healthcare Technologies Management core curriculum includes the following courses:

- *Survey of Biomedical Engineering Technology*
Review of technologies employed in medicine for diagnosis, treatment, and prevention of chronic and acute diseases. The goal of this course is to familiarize students with the operating principles, indications for, costs, and economic and marketing aspects of healthcare technologies.

- *Environment of Healthcare Delivery*
Review of current models for healthcare delivery such as fee for service, managed care, capitated care, IPO's, and HMO's, and the existence of various models in different geographic regions and in response to economic incentives.
- *Biomedical Technology Evaluation*
An introduction to quantitative assessment of healthcare technologies encompassing retrospective and prospective approaches. Topics include the history, development, and adoption of technologies and the evaluation of efficacy, safety, financial costs, healthcare quality, effectiveness, and clinical outcomes.
- *Biomedical Technology Standards and Regulations*
An overview of the principles of effective management of technological innovation and the protection and marketing of intellectual property. Topics include entrepreneurship, identification and planning of business opportunities, sustaining and supporting creativity, managing risk and resource availability, national and international standards and regulations, regulatory compliance, needs assessment, contract negotiations, and dispute resolution.
- *Ethics of Technology Utilization*
Ethics applied to the utilization and management of healthcare technologies in a patient care setting. Topics include beneficence, nonmaleficence, quality-cost, resource allocation and personal-public conflicts, technology diffusion models and controls, clinical research and research integrity, and patient rights and confidentiality.
- *Product Development of Medical Devices*
Activities required for the design, development, and commercialization of new medical devices. Design, testing, regulatory, and legal requirements will be presented along with project evaluation and management methods. Marketing, packaging, and sterilization issues will be discussed.
- *Special Topics Seminar*
Features outside speakers who will discuss relevant, important, timely topics involving the management of healthcare technology.
- *Independent Study/Internship*
Project or internship experience designed by the student to meet their career goals. Students will have faculty and industry or hospital advisors whom they will work with to design and complete their projects. Oral presentations to the HTM faculty will be required of each student to obtain initial approval of their projects and present final results.

The Business/Management core curriculum includes the following courses:

- *Accounting Foundations*
- *Managerial Accounting*
- *Marketing Management*
- *Financial Management*

- *Organizational Behavior*

These courses are taught as part of the Executive MBA program at Marquette University. They are not courses specifically designed for engineers.

The HTM faculty consists of members of the Department of Biomedical Engineering, the School of Nursing, and the School of Business Administration at Marquette University, and the Biophysics Research Institute and Departments of Radiology and Medical Physics at the Medical College of Wisconsin. HTM faculty members have experience in industry research and development, quality assurance, academic research, teaching, hospital technology management, patent licensing, clinical studies, FDA regulations, and healthcare delivery.

Advantages of the Program

The Healthcare Technologies Management Program is the first graduate program in the United States to combine business, biomedical engineering, and healthcare technology management. It offers a practical, relevant curriculum designed to meet the unique needs of entry level engineers and healthcare technology managers. It requires less time to complete than a master of business administration (MBA) degree, and is flexible to accommodate the career goals of the students.

For engineers who plan on moving into and/or remaining in technical management, the program better addresses their needs than other educational programs. It provides training not covered in graduate business (MBA) or engineering (MS) programs in areas typically learned on the job. It also allows students to update their technical skills.

The HTM program will qualify engineers for increasing management responsibilities and career advancement. Employers will benefit from the HTM program by developing skills in current employees, which will aid in retention of good employees. By taking courses in business and management, engineers will view their organizations with a more global perspective, which will help them understand the objectives of other departments within the organization. This will result in more effective interactions with marketing, finance, and other departments represented on their project teams. Graduates of the HTM program will be better equipped to help their employers meet their goals.

Distance Education

Working engineers are interested in finding educational opportunities to prepare them for career advancement. Many employers are very supportive of their employees' seeking additional education and will reimburse employees for educational expenses. These employees are interested in enrolling as part-time students who will complete courses while working full-time. They are interested in programs that are flexible enough to fit into their work, travel, and personal schedules. Thus, programs that do not require commuting to a campus and allow students to take classes at any time during the day are desirable.

In order to make the HTM program available to working engineers around the country, courses in the program are being developed for web based, online teaching. Faculty members will work

with a dedicated course developer to develop each course for online teaching. Faculty members will then be trained in online teaching. A mix of synchronous (real-time) and asynchronous teaching methods will be used as needed. Two courses are expected to be available via the Internet by fall 2000. Other courses will follow until all courses in the program are available via distance education.

Summary

The Healthcare Technologies Management Program offered by Marquette University and the Medical College of Wisconsin is a unique, new program designed to meet the unique needs of biomedical engineers and their employers. The program prepares new graduate engineers to work in hospitals, medical device companies, and consulting firms, and provides experienced engineers with the training needed for career advancement. It provides several advantages over graduate business and technical degrees. Plans are underway to make the HTM program available via web based distance education.

JAY R. GOLDBERG

Jay R. Goldberg is currently the Director of the Healthcare Technologies Management Program and an Assistant Professor of Biomedical Engineering at Marquette University and an Assistant Adjunct Professor of Biophysics at the Medical College of Wisconsin. He has fourteen years of product development experience with several medical device companies and is a registered Professional Engineer in Illinois and Wisconsin. Dr Goldberg received a B.S. degree in General Engineering from the University of Illinois, a M.S. degree in Bioengineering from the University of Michigan, a Master of Engineering Management degree from Northwestern University, and a Ph.D. in Biomedical Engineering (Biomaterials) from Northwestern University.

WILLIAM R. HENDEE

William R. Hendee received his Ph.D. degree in Physics from the University of Texas. He then joined the University of Colorado, ultimately serving as Professor and Chair of Radiology for several years. In 1985 he became the Vice President of Science and Technology for the American Medical Association. In 1991 he joined the Medical College of Wisconsin, where he now serves as Senior Associate Dean and Vice President and Dean of the Graduate School of Biomedical Sciences. His faculty appointments are Professor and Vice Chair of Radiology, and Professor of Bioethics, Biophysics, and Radiation Oncology. He is also Professor of Biomedical Engineering at Marquette University. Dr. Hendee has served on many professional and government panels concerned with the assessment of medical technologies.

STEVEN R. KROGULL

Steven R. Krogull is the Manager of Instructional Programs at the Medical College of Wisconsin. His staff provides instructional design, computer systems, and teleconferencing support for the development and delivery of a wide range of multimedia and distance education programming. Mr. Krogull has over 15 years of experience providing instructional technology services ranging from computer-based instruction to compressed video and satellite-based teleconferencing. He also serves as a program coordinator and instructor for the Medical College of Wisconsin – Milwaukee School of Engineering Master of Science degree program in Medical Informatics.