

## The Research on the Construction of Applied Biomedical Engineering for Medical Equipment Industry

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### Abstract

Firstly, introduce the background of medical equipment industry and describe the meaning of the construction of applied biomedical engineering for medical equipment industry. Secondly, 4 development directions including precision medical equipment, medical electron instrument, test technology and clinical engineering were proposed. Finally, discuss the existing problems about teaching staff building, laboratory construction and major self-identity development and put forward some suggestions.

### Keywords

Biomedical engineering, Medical equipment, Major construction.

### 1. Introduction

Biomedical engineering refers to a combination of chemistry, physics, mathematics, computer and principles of engineering, engages in research in medicine, biology, health science, behavioral science and related fields. Its coverage is very broad, including biomechanics, biomaterials, bio-cybernetics, medical electronics, medical imaging and so on.

Currently, in China the train objectives of biomedical engineering major mainly including: (1) Training in the management of medical equipment, medical equipment quality control and management, medical technology and other aspects of the service personnel; (2) Training in senior clinical engineering and clinical technical personnel; (3) Training in biomedical engineering and senior talent personnel of technical development[1,2].

The employer of the author is a university of Applied Sciences about medicine and medicine related majors, which is founded in 2015. One of its faculties is former Shanghai Medical Instrumentation College, which is close to the medical device industry and medicine and engineering combination. This paper describes the construction of applied biomedical engineering significance, elaborated professional construction direction biomedical engineering for the medical device industry, and discusses some problems during major construction.

### 2. Industry background and significance of major construction

China's medical equipment industry is currently facing three major opportunities.

First, the primary health care system reconstruction has stimulated the growth of the medical device market. In terms of potential demand, 60 per cent of more than 300,000 medical instruments and equipment in health service institutions are Mid-1980s products. They need upgrading, which will ensure the rapid growth of the medical device market[3].

Second, health care reforming inspired the potential in the middle and low end market of medical device, especially the demand for primary health care services. Primary health care services accounted for nearly 95% of the total national health services[4].2014 global high-end medical equipment market growth rate is 10%, while the growth rate in the low-end medical equipment is 30% [5].And China has become one of the world's production base in the low-end medical

equipments. In recent three years the Chinese exports increased more than 40%, the products are including diagnosis and treatment equipment, health rehabilitation supplies, medical materials, etc[6].

Third, China has entered the aging society and the country's elderly population aged over 60 has reached 180 million. In Shanghai, for example, as of 2014, Shanghai aged 60 and older population 413.98 million, 28.8% of the total population, compared with the previous year, an increase of 6.8%[7]. Elderly people need more medical equipment for medical treatment and health care, because of Long-term health care Smart Portable Medical Devices Universal medical devices play more and more important role.

Biomedical engineering disciplines is an important basis and driving force of the medical device industry, Medical equipment is one of the world's most rapidly developing industry, all the major countries of the world have to include it in the field of high-tech focus on the development, China from "the 10th five-year plan" began to actively promote the development of high-tech industry of medical devices, medical equipment industry in 2014 China market size of 255.6 billion Yuan, becoming the world's second largest after the US medical device market[8]. China's medical equipment industry has become a pillar industry of national economy and leader. Meanwhile, the modernization of the hospital is also a good development, advanced medical equipment, continue to enter the hospital, the role of medical equipment to improve medical technology has become increasingly evident. These medical devices used in today's advanced technology, and constantly enhance the functionality, but the attendant is the increasing use and maintenance complexity, making it possible to complete the operation and maintenance, quality measurement, engineering and technical personnel needs increasing clinical application design .But the status quo is, the proportion of clinical engineering and technical personnel of the hospital less than 3% in China and 300 million Yuan of medical equipment asset management with less than one person[9]. It causes large need engineering and technical personnel. Meanwhile, the more than 15,000 medical device manufacturers also need to be able to complete the design aspects of medical device products, technical services and other electronic and electromechanical have professional medical knowledge class background. Therefore, for the construction of the medical device industry Applied Biomedical Engineering, train qualified medical device applied talents is very much needed.

### **3. Professional orientations for the construction of the medical device industry biomedical engineering**

#### **3.1 Precision Medical Devices orientation**

With the rapid development of China's medical equipment industry, medical equipment industry has now become a relatively complete, multidisciplinary sunrise industry. For example: surgical aid equipment, medical laboratory equipment and medical optical instruments and other medical devices, these high-tech products urgently need skilled personnel with Complex knowledge about application technology in medical basics, optical, mechanical and electrical etc."Precision Medical Devices" orientation focused primarily on mechanical and electrical control, Preparation and Evaluation of Medical Devices. This professional orientation requires students to master electronic circuits, computer hardware and software, mechanical design, electrical and mechanical control and other aspects of the application of technology, with hardware design and debugging, mechanical design and processing, computer software programming, system design skills. The students should find the problem from a practical biological and medical applications, be able to model the application, solve problems using science, engineering methods.

### 3.2 Medical electronic equipment orientation

Medical electronic equipment is an extremely important part of the medical device industry. It is human's health and life related. It is based on modern electronic technology, information technology, sensor technology, based on chip technology, and applies to medical research, clinical diagnosis, clinical care, rehabilitation and other fields. "Medical electronic equipment" orientation focused primarily on the design and implementation of medical electronic systems, the students should understand the method about biomedical signal detection and signal processing, the basic principles of medical imaging technology, the constitute the principle of medical electronic equipment. They should have the ability to use, maintenance, administrative and support design of modern medical equipment.

### 3.3 Medical Device Testing technical orientation

Medical device testing refers to personnel in production, laboratory, research, use, maintenance and other areas, by means of special equipment, the measured, controlled object in real-time or non-real-time qualitative detection and measurement and issued test report. Medical device testing is an essential part in medical device industry and divided into registered testing, acceptance testing, maintenance testing, using test equipment (forcible inspection), and scrap detection. "Medical Device Testing technical orientation" mainly focused on the direction and development of detection methods for medical device testing equipment. It requires students to master the basic principles and design methods of detection equipment, the medical device-related quality inspection techniques, the supervision and regulation of medical devices related knowledge, the products standards for medical devices.

### 3.4 Clinical engineering and technical orientation

Currently in modern hospital, mainly by doctors, nurses and medical technicians directly to provide medical services. Clinical engineers and medical technicians is an important part of the hospital is responsible for the clinical use of important medical equipment, technical services and security management to ensure their safety and effectiveness, to avoid or reduce due to equipment failure, improper use life-threatening medical malpractice. Europe and other developed countries have already established a clinical engineer jobs legislation and vocational qualification system. "Clinical engineering technology" focused primarily on the direction and management of life-support equipment safety testing and patient monitoring devices. Students should master both theory and skills in medicine and engineering, certain amount of business knowledge and management skills, the medical management of economic, medical environment, quality and safety of medical equipment and other areas of assessment, monitoring and management capabilities.

## 4. Problems and Solutions

### 4.1 Building of teaching staff

Biomedical Engineering as science, engineering, medicine combines comprehensive discipline will require diverse teaching team composition. Currently, in addition to science, engineering, medical background of professional teachers, management, law background will be added to the biomedical engineering faculty. Superficially, teaching team cover all disciplines, it is very effective. But in practice there are still many problems to be solved. (1) Due to limiting the number of teacher preparation, more teaching disciplines in the teaching team, less teachers has same Professional background. The so-called interlacing as foster, which often lead teachers into the situation alone in teaching and research, not only limits the teacher's own development, but also limits the improvement of the overall level of teachers. (2) Currently most of university teachers with doctoral degrees, without doubt they are a particular area of expertise, but few generalist covering biomedical

engineering, therefore, in each teacher's knowledge structure system, there are certain drawbacks. Such a situation reflected in the teaching, those teachers with engineering backgrounds are often more concerned about the technology itself, but the technical aspects of the clinical application very difficult. Conversely, those teachers with medical backgrounds for clinical application of new technology is very understanding, but often know the how but not the why, ultimately limits the improvement of teaching quality.

To solve these problems, we can use the following methods to compensate. (1)in the short term, based on the existing teachers, the integration of the professional background of teachers, construction of teaching and research team, the formation of complementary advantages, coordinated development of healthy development trend. (2)In the long term, should combine "internal Training and talent introduction" combined to build a rational structure of high-level professional team gradually. To send a group of outstanding young teachers aboard to participate foreign joint research. While strengthening overseas talent introduction work, bringing together a group of professional elite talent. Improving introduction of talent from oversea, to build a Professional elite talent team.

#### **4.2 Construction of Professional Laboratories**

Construction Applied Biomedical Engineering major is inseparable from the construction professional Laboratory. On the one hand it is conducive to better Training students' practical application ability, on the other hand also help teachers carry out related research work, in order to promote scientific research and further professional development. Biomedical Engineering Laboratory involving various types of medical equipment, computer equipment, testing equipment and software programs, the purchase of these devices require substantial funding, usually requires a number of professional and technical personnel to perform routine maintenance on equipment. In addition, different from other specialized laboratories, biomedical engineering laboratory software and hardware equipment replacement very quickly, often leads into a large output, lack of sustainability.

To solve these problems, we can try the following aspects. (1) Do not the pursuit of brand new and full coverage laboratory equipment. Construction of Professional Laboratories should be "adequate, appropriate advance, to ensure that teaching and research" principle, in accordance with the teaching and researching arrangements, systems planning, step by step, gradually improve, to avoid duplication and equipment idle. (2) Could build laboratories with medical devices related enterprise together, equipments are provided by the company, the school provides teachers, students can carry out experiments. In order to achieve win-win, the companies can use the laboratories as training center and showroom for themselves. (3) Further enhance the level of laboratory operations and management personnel, to ensure that the instrument to play its proper performance, and extend the useful life.

#### **4.3 Construction of professional identification**

On the one hand Biomedical engineering involves a wide range of professional, complex professional knowledge. Students are lack of understanding of the profession itself. On the other hand from the employment point of view, in most Chinese hospitals, Medical Equipment Division as an auxiliary departments not being taken seriously. Demand for qualified personnel is also large, but the enterprise quality varies greatly, career development is expected to uncertainty, lack of confidence in the professional students[10]. Eventually some students lack professional identity, impact on the overall learning atmosphere, to a negative impact on professional development.

To solve these problems, we consider the efforts in the following aspects. (1) Curriculum Arrangement can be "rich" but not "discrete". It should be based on the premise widely, combined with the application direction ,set the corresponding targeted professional courses, link between the past, clear " What to learn?", " Why learn?", enhance students' professional identity. (2) Hospitals and

related employers to increase biomedical engineering propaganda. So that they can fully understand the professional application-oriented positioning and orientation of training, and gradually improve professional social identity.

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