The Application of Biomechanics for Sporting Goods Innovation in Taiwan

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"**New Economy of Idea**"has created a huge profit for many companies. This is not because they are brand owners or manufacturers, but they are the knowledge holder. Over the past few years, Apple relies on excellent creativity and numerous patents as the cornerstones of its astonishing success. These creative ideas are appealing to consumer tastes and create a new way of living. Apple creates its own exclusive position in the IT industry as well as a successful model of new economy of ideas. Crossing the whole 20 century, the society of mankind has entered a new phase of knowledge economy from the phase of industrial economy. Without any doubt, the 21st century is a new time of knowledge economy. Viewing Taiwan, a small island with higher level of education compared to most of countries in the world which is the best support to create knowledge economy. At present Taiwan sporting goods manufacturing industry has become one of the most important value-added supply countries in the global market. In the meantime, Taiwan is also able to create brands in the international markets and plays a significant role in the World Federation of the Sporting Goods Industry (WFSGI). In order to elevate the level of the domestic sporting goods industries to the knowledge economy phase, the industries need to break through the shortage of innovation and strengthen the capacity of product research and development. Thus Taiwan sporting goods industries could have better international competitiveness.

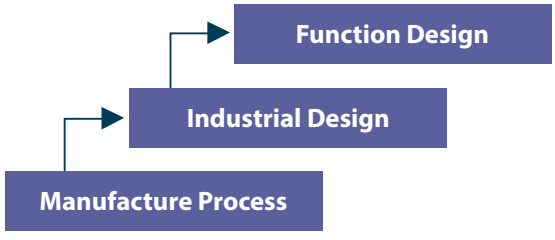


Figure 1: Core competitiveness of Taiwan sporting goods industry

Excellent manufacturing process had been the core competitiveness of Taiwan's traditional industries. In recent years, companies spent more time on product design; however, most of manufacturer is still lack of function design. Taiwan sporting goods industry is also a traditional industry and keeps the traditional approach to run the company. Only a few manufacturers with larger scale are equipped with scheduled research and development team. Right now the R&D direction still remains consumer-oriented, low-pricing, appealing-design. The new trend of sporting goods design should focus on function, new functional concept will bring a brand new direction of sporting goods. In order to develop new functional sporting goods, we have to thoroughly understand the basic principles of sport science and apply biomechanics to develop new training mode and new functional sport equipment. Only new functional equipment can make a new wave of sport activity to help sporting goods industry developing in the future.

Biomechanics, the application of mechanical principles to biological systems, is an essential academic field of sport science. In the early development, sport games and physical education were the major applications. The research then focused on movement analysis. Movement analysis focused on animal behavior and gait analysis in earlier stage. Later it developed into the analysis of human gait, simple movement, complex movements of human body, and at last into the complete sport technique analysis. The purposes are to enhance sport performances and to reduce sport injuries. Besides, movement analysis provides a solid base for physical education. In order to search for more detail of the parameter affecting the quality of human movements, biomechanics is with a further step to study the human muscular-skeletal system and how they work. Plus physical therapy, orthopedics and sport-related medicine studies, biomechanics is ongoing search for the biomechanics principles inside human body as well as the impacts on human performance. When technology continuously advanced, the technical devices were applied into sport training and competitions. This development influences the movement performances and the results significantly. Thus the researches of sport biomechanics shift from movement analysis and muscular-skeletal system into sport equipment study. Due to broader study of applied biomechanics and there are more new and diverse research scopes. At the moment, the complete sport biomechanics covers the biomechanics of human muscular-skeletal system, human movements and performances analysis, and sports related equipment for human body (please see Figure 2).

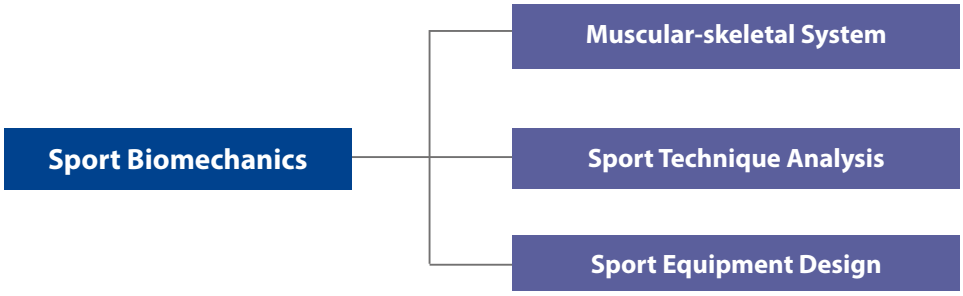
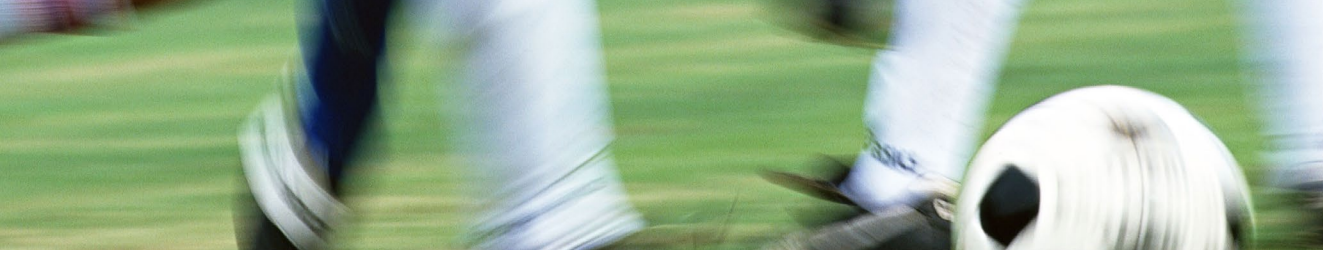


Figure 2: Sport Biomechanics – Research Scopes

There are all kinds of fitness equipment in current market. The new equipment which enhance muscle strength and explosive power come out one after another. In the recent years, more and more biomechanics theories are applied in the sporting goods industry. Vibration training equipment is a typical model which applied biomechanics for sporting good innovation. The aerospace institutes at the Soviet Union period used to combine vibration stimulation and muscle trainings to solve the problem of osteoporosis when astronauts live in the non-gravity environment. In 1980s, the European countries brought vibration trainings into the sport field and they received significantly positive effects which caught many coaches attention. Vibration training, in the early time, was applied in the physical therapy to mainly treat patients with muscle anxiety and spasticity and help relax muscles. Recently vibration training has been widely discussed which includes partial body vibration training and whole body vibration training (WBV). Many documentaries point out that vibration training activate the neuromuscular system, and is often applied to muscles or tendons passive contraction, also called tonic vibration reflex (TVR). This training enables muscles to perform maximum contraction.

The latest researches also supported that vibration stimulation helps the flexibility of human body which involve nervous system, circulatory system, and thermoregulatory system. Stretching exercise usually stretched the joint to the maximum range of motion which causes pains or uncomfortable feelings because the nervous system will react. However, vibration stimulation will release the muscle pain, additionally it stimulates Golgi tendon to control muscle contractions, then makes muscle to relax. Most of researches support that the application of whole body vibration can increase lower extremity range of motion. So the vibration training does provide positive effects on flexibility enhancement.



Tonic Fitness Technology, Inc. has been recently involved in the research projects of National Science Council in Taiwan and also cooperated with sport science research institutes. Tonic Fitness Technology, Inc. applied its innovative technology and biomechanics into its product design and has successfully developed different vibration training machines for different training purposes. Their products have won the prize of innovative sport products at Taipei International Sporting Goods Show. The research is to find out the impacts of vibration training on the flexibility, muscle strength and explosive power of professional athletes. The research proves that 3 times of vibration training in a week, compared with normal trainings, will boost the muscle power and flexibility. It helps not only muscle strength, the joints range of motion, but also the sport performances. Furthermore, as to sport injuries which concerns athletes the most, vibration training also creates preventive effect. Compared with the traditional training, vibration training simultaneously increase muscle power and flexibility performances. For coaches and athletes in the sport training, vibration training is worth trying.

Vibration training machine is a very popular training device in recent years, mainly provides external vibration to stimulate the human muscles, then to enhance sport performance. And most of related researches are focus on the impacts of vibration training on muscle strength, explosive power, and flexibility. Based on many research conclusions, it does enhance the flexibility, muscle powers and explosive performances. Many scholars also go deeper into the subject to find out its impacts on other body systems. And more results indicate that vibration training can accelerate the blood flow and hormone density. In the meantime, vibration training gives instant effects on hormone and neuromuscular system. And neuromuscular performances can be much better. Different prescriptions of vibration training bring out different effects. Sporting goods should be designed based on different sport categories to provide the optimum training effect. According to this successful model of vibration training, applying biomechanics for sporting goods innovation is a promising approach to increase international competitiveness and create its own exclusive position in sporting goods industry.

Figure 3: Whole Body Vibration Equipment (Tonic Fitness Technology, Inc.)

Figure 4: Vibration Stretching Training Equipment (Tonic Fitness Technology, Inc.)