DEVELOPMENT ORIENTATION FOR HIGHER EDUCATION TRAINING
PROGRAMME OF MECHANICAL ENGINEERING IN INDUSTRIAL REVOLUTION 4.0:
A PERSPECTIVE IN VIETNAM

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1. IMPACTS OF INDUSTRIAL REVOLUTION 4.0 ON HIGHER EDUCATION

The Industrial Revolution 4.0 is assessed to have a strong impact on all aspects of life, economy and society, not just at the scale of factories and enterprises. For higher education (HE), Industrial Revolution 4.0 has the following predictable impacts:

The demand of the labor market has changed, many economists even have pointed out that this revolution could pose a risk of breaking the labor market. When automation replaces people in the entire economy, workers, especially low and medium skilled workers, will be redundant if they do not adapt quickly to production changes. This creates a differentiation of the labor market, dividing it into two groups: one flow-skilled labor with low-paid wages and the other of high-skilled labor with high-paid wages [1]. Higher education must meet an increasing demand for highly knowledgeable labour to create a large surplus value. It is impossible to predict the knowledge and skills that the labor market will need in the near future because technology changes so quickly. Training and scientific research activities at higher education institutions face new reform and competition requirements. Many technology corporations with great technological, human and financial potential will have great advantages in turning knowledge into commercial products that higher education institutions do not have [2]. This has significantly reduced the boundaries and distance of knowledge and creative ability between higher education and industry. Notably, the rapid change of technology in the Industrial Revolution 4.0 requires higher education to equip learners with basic skills and knowledge, creative thinking, the ability to adapt to challenges and constantly changing work demands to avoid the risk of being sacked [3].

The boundary among traditional training disciplines is increasingly fuzzy, the trend of cross- and inter-disciplinary training associated with information technology has become popular. The Industrial Revolution 4.0 differs from previous industrial revolutions in that there is a combination of technologies, blurring the lines between the physical, digital, and biological spheres [4]. This requires higher education to provide learners with popular knowledge and skills and creative thinking, system thinking so that learners can learn by themselves and be able to adapt to challenges and interdisciplinary and changing job requirements. The new learning space on the internet is formed and the combination of traditional education and MOOC (Massive Open Online Course) becomes an inevitable trend. Mobile connectivity and cloud computing applications will help learners acquire both knowledge and skills through online courses. In particular, new knowledge is being created at the exponential level and popularized quickly and extensively. This makes online classes, online conferences and so on become increasingly popular. However, face-to-face teaching still plays a very important role because of its great advantage in forming skills, especially soft skills (employment skills) for learners. Therefore, a harmonious combination of education in the traditional way and MOOC will be the inevitable trend to meet the needs of the global labor market. Education for individuals has become popular, and higher education institutions must better understand learners and provide them with personalized education services to meet different requirements on individual study journeys, locations, times, etc.

2. THE IMPACT OF INDUSTRIAL REVOLUTION 4.0 ON MECHANICAL ENGINEERING

In recent years, Vietnam’s mechanical industry has gained many achievements. However, in the context of the Industrial Revolution 4.0, Vietnam’s mechanical industry still shows a number of limitations. It is necessary to renovate mechanisms, policies and technologies to gain a foothold in the global value chain, especially in the high value-added stages. Although the mechanical engineering has made great strides, however, many experts assess that the industry has not developed in proportion to its current capacity, especially in the context of the Industrial Revolution 4.0. Vietnamese mechanical industries have to face many challenges. The nature of the Industrial Revolution 4.0 is that mechanical production is based on digital technology and it integrates all smart technologies to optimize processes and production methods. It is forecasted that there will be a big breakthrough in technology affecting the...
mechanical production: 3D printing technology, new material technology, automation technology, robotics – Industrial Revolution 4.0 for mechanical production will create "smart mechanical factories". In these factories, the virtual space physical system will monitor physical processes, creating a virtual copy of the physical world. However, domestic mechanical engineering in Vietnam belonging to many economic sectors (except for FDI) is still organizing production at the level of Industrial 2.0 and has not yet reached the Industrial 3.0. Specifically, 39.3% of Vietnam mechanical engineering is low technology, 48% is medium technology, 12% is relatively high technology which mainly belongs to FDI enterprises. Our machinery and equipment are often backward, from 2 to 3 generations compared to the world current average level. Industrial Revolution 4.0 brings many opportunities to Vietnam's mechanical industry such as allowing us to access information, knowledge and advanced technology, creating a highly qualified workforce. Therefore, it helps to increase productivity, shorten the time to bring products into market, produce products with higher quality and more competitive prices. In addition, Vietnamese mechanical industry has not highly developed, with small scale leading to small inertia, therefore it may not cause too great loss in the context of changes in the Industry 4.0. The future orientation of Vietnam should focus on the energy and sustainable development, and material science [5-12].

3. THE IMPACT OF THE INDUSTRIAL REVOLUTION 4.0 ON HUMAN RESOURCE DEVELOPMENT

Each Industrial Revolution has led to a drastic change in the structure of human resources and employment. Like the previous three Industrial Revolutions, Industry 4.0 has the potential to bring many benefits to employees through increasing labor productivity, resulting in increased income. Many new products and services are launched to help improve quality of life, especially the opening of the labor market helps create more new jobs. Industrial Revolution 4.0 with the emergence of high technology, smart machines and robots with artificial intelligence will bring great changes to the labor market and employment structures at many different levels. Labour supply - demand, labor structure, and the nature of employment will all be seriously affected [13]. The sectors based on manual labor and the industries associated with the automation process will also be significantly affected. Thus, the impact of Industrial Revolution 4.0 on employment will be a shift from labor-intensive to knowledge-intensive and technology-intensive production. In Industrial Revolution 4.0, the opportunity for everyone is the same [14]. Those who possess good competence, qualifications and skills to create many values for society will succeed. For universities, Industrial Revolution 4.0 requires more better training of human resources with new skills than in the previous decades, because the market requires human resources with more skills and better education levels. Currently, higher education generally has not satisfied the requirements of employers. One of the challenges facing developing countries when approaching Industry 4.0 is the skilled human resources. According to WEF's Future Production Readiness Report 2018, Vietnam ranked among the last in the 81/100 high-skilled labor rankings, even behind Thailand and the Philippines in ASEAN countries. Also in this report, the ranking of Vietnam's vocational training quality is only 80/100, compared to the other ASEAN countries, Vietnam just stood before Cambodia (92/100). Industry 4.0 with new technologies has changed the production platform, created more new industries, and set new requirements for human resources. This is a major challenge for Vietnamese higher education. Therefore, universities in Vietnam need to be aware of these challenges and should have a suitable strategy for the development of science and technology, change of training mode and investment of facilities to train high quality human resources in the digital era.

4. ORIENTATION TO IMPROVE THE QUALITY OF HUMAN RESOURCE TRAINING FOR THE MECHANICAL INDUSTRY

Vietnam with a population of over 96 million people and many advantages in human resources. This human resource must become an advantage for socio-economic development. However, the fact shows that the competitiveness of the economy will be very weak because one of the basic causes is the low quality of human resources. Industrial revolution 4.0 sets new requirements for employees, requiring us to have a corresponding education - Education 4.0. Considering the criteria of objectives, programs and teaching methods, it can be seen that our education is still somewhere between Education 2.0 and Education 3.0. On the basis of properly assessing the situation and fully recognizing the impacts of the Industrial Revolution 4.0 to higher education, universities have been implementing solutions to receive opportunities and prepare for challenges from the Industrial Revolution 4.0, namely:

4.1 Regularly reviewing and updating the list of training disciplines and develop new training programs

Regularly researching, surveying and associating with enterprises to grasp labor demand and focus on training the fields with great demand when approaching the Industrial Revolution 4.0, especially the sectors belonging to engineering and technology, such as Precision Engineering, Automation, Robotics, Network Programming, Electricity - Electronics, New Energy, and so on.

Regularly evaluating and improving the training programs to meet the current needs of enterprises and anticipate future changes of the labor market.

Researching new training models associated with innovation and restructuring of training programs in a number of interdisciplinary areas, focusing on fundamental knowledge of basic science and basic techniques plus the foundation of information technology, foreign languages and creative ability. This is an important premise to be able to train high quality human resources, being able to adapt to many different jobs which can fluctuate in practice.

4.2 Applying CDIO approach in developing training programs

Approaching CDIO (Conceive - Design - Implement - Operate) helps form a standard framework in developing training programs. Many universities have been applying CDIO approach in designing and operating higher education training programs to:

i) ensure training meets Output standards;

ii) ensure output standards reflect the capabilities of learners that the market requires;

iii) equip learners with basic broad-based knowledge and skills, creative thinking, self-study ability so that graduates can adapt to interdisciplinary and changeable work requirements in the world of work.

When developing training programs based on CDIO approach, it is necessary to adhere to the processes closely like developing output standards, designing the program framework and how to convey it in practice as well as evaluate learning outcomes and the entire training program [15,16]. The cornerstone of CDIO is CDIO syllabus. This is a statement of the objectives of the training program that the 12 CDIO standards are designed to achieve. CDIO aims to develop higher education with 12 standards such as designing programs from basic to advanced levels, learning space, curriculum evaluation, integrated curriculum and active teaching and learning methods. With the current training methods, universities offer training programs before determining output standards, which produce graduates who do not satisfy the requirements of high-quality human resources from employers. Therefore, in recent years the fact in Vietnam is that labor recruitment units have been forced to retrain or supplement knowledge and skills after their recruitment. CDIO aims at training and providing high quality human resources, because CDIO training program is designed on the basis of carefully surveying the real social requirements set by employers, so it contributes to reducing training costs and resources. Students will be well-trained and provided with knowledge, skills and aptitudes appropriate to the set standards. Applying CDIO, lecturers must apply advanced teaching methods and meet the standards of scientific research, thus contributing to creating a high-quality and international-standard teaching staff. In addition, the CDIO model also helps evaluate teaching and learning methods as well as assess

students and lecturers’ competence more comprehensively. Apart from providing a sample for output standards, the CDIO model also provides very specific instructions on training and management methods such as entrepreneurship, leadership, tertiary internationalization, project-based learning, program framework improvement, informal communication skills, learning experiences and active learning, learning and testing environments, therefore it is very useful if CDIO application is widely implemented. In the CDIO training program, each subject contributes a part to achieving the output standard of the entire training program at different angles. Therefore, each lecturer must comply with the program standards and commit to convey the subject output standards that the lecturer in charge of.

REFERENCES


