Feasibility Study of Quality Workforce Development using STEM Education: Case Study in TVET for BDI Group.

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Abstract- The object of this research is to develop the quality of personnel in companies producing automotive parts by using STEM Education model, which is educational model that integrates groups of subjects (Interdisciplinary Integration). These include Science, S; Technology, T; Engineering, E; and Mathematics, M. The organization for the case study is BDI Group in Thailand, which is used for designing curriculum for managing education of students enrolled in automotive parts production study programme in Thai-Taiwan Technological College. The research method includes organizing Focus Group Discussion with experts in education and automotive parts production from 3 groups of institutes: 5 universities in Taiwan, 1 university in Thailand, and 7 companies that conduct business in automotive parts. The results from the Focus Group Discussion show that developing personnel in automotive parts production must include development of basic capabilities of the personnel (Competency-based), which consist of 30% Knowledge, 30% Skills (Professional Skills and Soft Skills) and 40% Attributes. Also, the personnel must have knowledge of automotive parts production industry, including materials, process, after finishing process quality control, and quality assurance.

Keywords: STEM education, competency-based, knowledge, skills, attributes

I. INTRODUCTION

BDI Group of business [1], having the company philosophy—“Building new company culture for better life quality” consists of Bangkok Die-casting and Injection Co., Ltd, who produces plastic parts and BDI Alloy Enterprise Co., Ltd, who produces aluminum parts for automotive.

Established in 1978 and has been 38 years that the BDI Group has grown up constantly in consistent with 85% Thai government local content rate policy. During the boom period, when customer orders were increasing, the company made loans from the banks to invest more in the plant building, machines, materials, recruiting workers, etc., to meet the increasing demand. During the boom period, the company started to face the shortage of the workforce-skilled labor, technicians, engineers, supervisors, and even managers. Unfortunately in 1997, Thailand faced a financial crisis which had a great impact on the business also. With the 1997-1998 crisis; the exchange rate collapsed, following the government decision to float the currency in July 1997 which impacted the company’s order by more than 60% and we were forced to lay off employees.

This was a big lesson for the company for both the booming and crisis period. The key factor is the quality of the human resources. The company needed quality people with good knowledge to improve the most cost-efficient production process and also new knowledge and skills to develop the new technology in order to change to new products and markets.

In 2011, the group of companies established Thai-Taiwan (BDI) Technological College with the philosophy—“Knowledge, Morals and Ethics leading the technology” to produce skilled labors and technicians with the vocational certificate and diploma degree education in accordance to the needs from labor market in the industrial sector. Meanwhile, Thai-Taiwan (BDI) Technological College also acts as the training center to develop and elevate the skilled labor and as the preparation of the technicians to achieve the international professional qualification standards. The college utilizes the Dual Vocational Training and Cooperative Education with Bangkok Die-casting and Injection Co., Ltd and BDI Alloy Enterprise Co., Ltd.

In the new era of AEC formation (21st Century,) [2] there will be a big change for the free mobility of the production factors such as capital, professional, product and information in the industrial sector. The auto-parts industry which is closely related to science, technology and innovation, are necessary to prepare sufficient workforce capable to deal with change and encounter with both internal and external competitions from industries, services and innovation. The increasing needs for the future lower cost, changing technology, consumption habits, energy-saving motorcycles and vehicles are changing rapidly.

Time consuming in nurturing a technician or engineer by the company itself takes a long period of time and not meeting the demand of the industrial growth. To solve the shortage of the quality work force, good cooperation between the education and companies in accordance to the management and production to build a mutual knowledge
management is urgently necessary. The students from the college will need to be sent out to have short term training in the real work place in the first to third years and at least one-semester internship in the fourth and fifth year. Thus, the graduate students can be readily employed by the company immediately and effectively.

The needs to utilize the resources together, especially with the assistance from the Office of National Science and Technology Development, Office of Policy of the National Science, Technology and Innovation, and other education institutes to help the employees acquire new knowledge and skills, especially STEM education [3,4], contributes both the students and employees to have new skills to solve the problem systematically with research of the causes of the problem, critical analysis of the pros and cons of the tentative solutions, simulating the ideas applied to hardware and software, making prototypes (sample parts) or trial test run, gathering data for comparison by means of statistic as well as find out the best solution for the company with future suggestions, etc.

II. RESEARCH OBJECTIVES

Research in developing personnel in automotive parts production by using STEM Education model [5,6] is for advancing knowledge on basic capabilities and knowledge of automotive parts industry that the personnel must have and to use it for designing curriculum for managing education for students who are enrolled in automotive parts production study programme in Thai-Taiwan Technological College.

III. METHODOLOGY

A. Conducting the research. The researcher studied data on the state of the question on knowledge, capabilities and skills of personnel in automotive parts production in BDI Group and BAE Group. The research found out that the knowledge, capabilities and skills of the personnel, absent Attributes were not adequate in matters of performing work.

B. The researcher conducted Focus Group Discussion [7] with experts in education and production of automotive parts from 3 groups of institutes: 5 universities from Taiwan, which are Ming-Chuan University, Chung Yuan Christian University, Yuan Ze University, Southern Taiwan University and Feng Chia University; one university from Thailand, Rajamangala University of Technology Lanna (RMUTL); and 7 companies conducting business in automotive parts, which are AIC, BTS, BDIG, BAE, TCS and TKC. From the exchanging knowledge, experiences and opinions in Focus Group Discussion, the researcher formed conclusion, as shown in Illustration I.

Illustration I: Focus Group Discussion with experts in education and production of automotive parts

C. The researcher analyzed the results of the Focus Group Discussion by dividing them into basic capabilities (Competency-Based), which consist of Knowledge, Skills and Attributes and knowledge of automotive parts production industry.

D. From these results, the researcher could use basic capabilities (Competency-Based), which consist of Knowledge, Skills and Attributes and knowledge of automotive parts production industry to construct a model for designing educational curriculum for students enrolled in automotive parts production study programme.

IV. RESULTS

From Focus Group Discussion with experts in education and automotive parts production from 3 groups of institutions, i.e. 5 universities from Taiwan, which are Ming-Chuan University, Chung Yuan Christian University, Yuan Ze University, Southern Taiwan University and Feng Chia University; one university form Thailand, Rajamangala University of Technology Lanna (RMUTL); and 7 companies conducting business in automotive parts, which are AIC, BTS, BDIG, BAE, TCS and TKC, it was found that personnel in automotive parts production must have basic capabilities according to Table I as follows:

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Competency-based courses are designed according to the following proportion: K(Knowledge) 30%: S(Skills) 30%: A(Attribute) 40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>30%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>5</td>
</tr>
<tr>
<td>Science</td>
<td>5</td>
</tr>
<tr>
<td>Technology</td>
<td>5</td>
</tr>
<tr>
<td>Metrology</td>
<td>4.5</td>
</tr>
<tr>
<td>Machinery and Equipment Repair and Maintenance</td>
<td>4</td>
</tr>
<tr>
<td>Safety</td>
<td>4</td>
</tr>
<tr>
<td>Environment Protection</td>
<td>4</td>
</tr>
<tr>
<td>5S</td>
<td>4</td>
</tr>
<tr>
<td>Kaizen Process (improvement)</td>
<td>1.5</td>
</tr>
</tbody>
</table>
I. Knowledge means the knowledge that is related to the BDI business mindset. Basic knowledge such as mathematics, science, technology, metrology, machinery and equipment repair and maintenance, safety, environment protection, 5S, process kaizen(improvement), QCC (Quality Control Circle), PDCA(Deming Cycle), ISO(International Organization for Standardization), sufficient economy, English for technical terms, and Chinese or Japanese for communication.

II. Skills

- Soft Skills refers to Communication skills, Teamwork and collaboration, Adaptability, Problem solving, Happy Reading, Critical thinking and literacy skills, Systematic thinking, presentation skill and ICT literacy.

- Professional Skills refers to fundamental engineering work such as lathing, drilling, cutting, polishing, welding, CAD/CAM/CAE, CNC, automation, material (plastic, aluminum), 3D drawing, mold design, electronics and electricity, machine set up, robotics, Manufacturing Process Management (MPM), plastic injection and alloy high pressure diecasting.

III. Attribute refers to the working attitude, gratitude, integrity, responsibility, accountability, discipline, human relation, time management, professional ethics, moralistic courage, volunteer spirit, endurance, fast-learning, self-development, creative thinking and leadership.

Based on the aforementioned factors, the researcher could use basic capabilities (Competency-based), which consist of knowledge, skills and attributes, and knowledge of automotive parts production industry for constructing a model for designing a curriculum for education of students enrolled in automotive parts production study programme, as shown in Illustration II.

The illustration of the Model is composed of Bangkok Die-casting and Injection Co., Ltd (BDI), Bangkok Alloy Enterprise Co., Ltd (BAE), Thai-Taiwan (BDI) Technological College (T-Tech), and Rajamangala University of Technology Lanna (RMUTL) that cooperate in managing education according to Project-based
Learning (PjBL) and Work-Integrated Learning styles (WIL) [8]. It includes the main points of Competency-based model together with knowledge of materials, processes, after finishing process, quality control, and quality assurance.

V. CONCLUSION

From the research conducted to find a model for designing an educational curriculum for the students enrolled in automotive parts production study programme in Thai-Taiwan(BDI) Technological College and for managing development of quality in personnel and in automotive parts production by using STEM Education Model, it was found that personnel in automotive parts production must have basic capabilities (Competency-based), consisting of 30% Knowledge, 30% Skills (Professional Skills and Soft Skills) and 40% Attributes. This also includes knowledge of automotive parts production industry which includes knowledge of materials, process, after finishing process, quality control, and quality assurance. The results from conducting the research identifies that it is possible to design an educational curriculum for students who enrolled in the automotive parts production study programme.

REFERENCES