An Analysis of Competency for Hydrogen Energy and Full Cell in Taiwan

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***Abstract*—Hydrogen energy and fuel cell industry just developed a few years ago in Taiwan, experience and professional high-tech worker are not enough to satisfy these fast expand request. It seems a big gap between human resource demand and supply. To develop and train these high-tech workers, this research is trying to find out the work competence in Hydrogen Energy and Fuel Cell worker. Appling quantitative approach to explore the depth and broadness of the knowledge of core competence, two frameworks are proposed: building the context system of core competence concept, and constructing the learning model for the core competence. The paper describes the specific and general skills and how higher-education curricula align with workforce needs. In conclusion, appropriate suggestions of training system are proposed to push ahead the future development of Taiwan's Hydrogen Energy and Fuel Cell industry.**

***Index Terms*—Hydrogen energy and full cell, new energy, competency.**

I. Introduction

The gaseous waste discharged by petrochemical energy is the main reason for the Greenhouse effects that cause climate changes around the world. The present average temperature of the earth is higher than that of 20 years ago. Global climate change and energy crisis urge all countries to think about the next new energy [1]. Hydrogen energy and fuel cell is cleaner, more efficient, and versatile renewable energy [2], [3]. Many countries take hydrogen energy and fuel cell as the next new energy. Solar power, LED illumination, wind power generation, bio-fuels, hydrogen energy and fuel cells, energy ICT and electric vehicles were choose to Green Energy Development Plane in Taiwan. However, hydrogen energy and fuel cell industry just develop a few years ago in Taiwan, compared with solar power and LED illumination, hydrogen energy and fuel cell is infant industry in Taiwan [4]. Experience and professional high-tech workers are not enough to satisfy the fast expand request in hydrogen energy and fuel cell industry. It's time to have renewable energy's workforce development and education activities support the further development and enhancement of these critical workforce skills.

This research is trying to find out the work competency in hydrogen energy and fuel cell industry. Competency model is considered and efficiently in particle and in academic analysis [5]. Confirming key competence items for hydrogen energy and fuel cell worker will be helpful to their development and training programs. Finally, we will propose core competency for hydrogen energy and fell cell.

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II. Research Objects

While the world's economy is slowly recovering and improving, green collar economy is booming [6]. It's critical period of business transformation in Taiwan. Green energy may be the next emerging industry [7]. Having the advantage of high efficiency, low pollution, and widely using, hydrogen and full cells have become one of the main green energy in Taiwan [8]. There are both threats and opportunities in labor market responses to climate change policies. Some people will switch careers to green industry, and they will be active to learn more about the renewable energy. The highly nature of the energy generation industry poses particular challenges for planning how existing workers can be re-trained or re-distributed effectively into newer jobs and industries. Therefore, green-job training programs or certificate program are needed. The changes to the energy labor market will largely be dependent on the kinds of alternate energy solutions that Taiwan adopts. The aim was to gain better insight into how the greening economy is affecting the job market. The new prominence of environmental considerations is already having an impact on the job market. Workers from all walks of life need to expand their skill set so that they can help safeguard the environment. Here are some questions addressed by this paper:

1) Which specific and general skills are new and emerging in hydrogen energy and fuel cell industry?
2) Which occupations are needed in hydrogen energy and fuel cell industry?
3) How can education and training systems be developed to respond quickly to the industrial needs?
4) How can educational and training standards be brought closer to occupational standards and employer priorities in green jobs?
5) How higher-education curricula align with workforce needs?

III. Methodology

The subsequent surge in the number of hydrogen and fuel cell companies, have created a big imbalance between supply and demand for green workers. Experience and professional workers are not enough to satisfy these fast expand. The purpose of this research is exploring the competency for hydrogen energy and full cell, and proposal some training

program for new energy worker. Using multiple-case study [9], document analysis, and depth interviews [10], the competency framework and training program will be proposed. Study procedures as Fig. 1:

TABLE I: COMPETENCE FOR HYDROGEN AND FUEL CELL INDUSTRY CHAIN

	Upstream: Fuel Supply, Material Components	Midstream: Fuel Cell Manufacturing and Testing	Downstream: System Application and Design
Subjects	materials, chemistry, chemical, electrochemistry, machinery, high polymer, thermal conduction	materials, chemistry, electrochemistry, machinery, high polymer, heat recovery, thermal conduction	electricity, software, electrical, machinery, system control, marketing, business
Core competence	good teamwork spirit, communication capability, independent thinking, sharing, frustration tolerance, positive attitude, responsibility, and absorption, enthusiasm, creativity	good teamwork spirit, communication capability, independent thinking, sharing, frustration tolerance, positive attitude, responsibility, and absorption, enthusiasm, personality	good teamwork spirit, communication capability, independent thinking, sharing, frustration tolerance, positive attitude, responsibility, and absorption, enthusiasm, creativity
Professional competence	knowledge of the basis of polytechnic, material cost control, development of new materials, chemistry, chemical, electrochemical, product market-oriented, battery design, heat conduction experience	knowledge of the basis of polytechnic, chemical, electrochemical, machinery, product market-oriented, settings the heat flow catheter	knowledge of the basis of polytechnic, electrical, mechanical structure, electric power administration, software design, system control

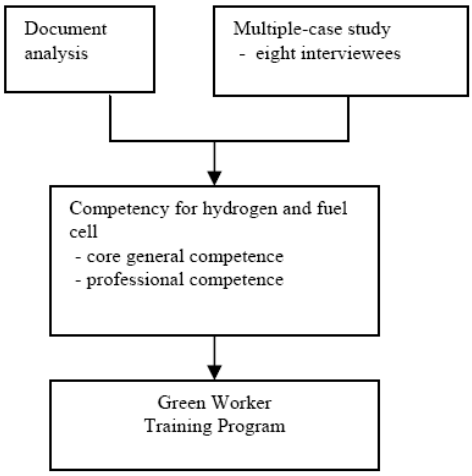

Fig. 1. Study procedures

Via reviewing relevant literatures, we will clarify and define the contents and conceptual benchmarks of hydrogen and full cells. To validate the instrument development framework by interviewing chief managers various from hydrogen and full cells industry chain. Eight companies on behalf upstream, midstream, and downstream companies, nine chief managers were interviewed to gather information about specific and general skills are new and emerging in hydrogen and fuel cell industry. Valid conceptual competence in hydrogen and fuel cell industry will proposed that comprehensively define hydrogen and fuel cell related content knowledge, attitudes, and personality.

IV. CONCLUSION

The value of knowledge assets play even more important role as the competition is getting vigorous in nowadays [11]. Therefore, the vehicle of knowledge, human resource, of organization is becoming the major focus [12]. Especially, hydrogen and fuel cell is still infant industry in Taiwan, it is needed to conduct the content of skilled workforce. The present study addresses the gap in literature of competence in hydrogen and fuel cell. How to employ the core competency model to acquire the winning edge in the industry is the utmost unanswered question in the mind of the academician and the field manager. The present study addresses this gap in the literature, and try to conduct the knowledge, skills, and abilities that successful green worker demonstrate on the job.

This research intends to clarify the content and context of the concept of core competence as the starting point. After that, the research tries to develop a technique with comprehensive theory base and applicable tools to help field

people identify the hydrogen and fuel cell core competences. Based on these understandings, this research tries to construct the learning model for each identified core competence in that of industry survey.

The research applies quantitative approach to explore the depth and broadness of the knowledge of core competence. Document analysis and depth interviews are used to support our arguments. The competency framework and the training program may be promoted to and adopted in the future. According to the results, two frameworks are proposed: building the context system of core competence concept, and constructing the learning model for the core competence.

A. The Context of Core Competence in Hydrogen and Fuel Cell

According to the results of this research, some specific and general skills are emerging in hydrogen energy and fuel cell industry. We identity eight core general competence: good teamwork spirit, communication capability, independent thinking, sharing, frustration tolerance, positive attitude, responsibility, and absorption. Workers with some of that core general competence, hat successful green worker demonstrate on the job. But, competence for hydrogen and fuel cell industry chain is diverse. What it need for upstream is different from downstream. Further description for hydrogen and full cell industry chain was shown in Table I.

B. The Learning Model for the Core Competence

The workforce could be divided into two groups: school student and employee. They may have different learning programs. Here, we propose learning programs on the translation between competence standards and curriculum development from the aspect of industrial-driven. The training r programs are mainly divided into internal training, external training, and tertiary education, and we proposed that in Table II. The result can provide the basis of recruiting and training.

TABLE II: CHANNEL OF TRAINING

Curriculum development	Internal training	External training
self-directed learning, case study, team training, monographic study, industry-university collaboration projects	R & D team, on-job-training, apprenticeship, industry-university collaboration projects	advanced studies, public courses, off-job-training, conference, discussion forum

APPENDIX

	Needs	School education	Internal training	External training
Core Competence	Absorptive capacity	Participate in thematic activities, Self-directed learning		Advanced studies, Discussion forum
	Positive attitude	Participate in thematic activities, Simulation training		
	Responsibility, Enthusiasm	Participate in thematic activities, Simulation training, Case studies		
	Frustration tolerance	Participate in thematic activities, Simulation training		
	Independent thinking	Participate in thematic activities, Case studies		
	Teamwork spirit, communication	Participate in thematic activities, Team training	R & D team	
	Creativity	Participate in thematic activities, Self-directed learning	R & D team	
Professional Competence	Knowledge of the basis of Polytechnic	Academic credit learning	on-job-training	Advanced studies, Courses of public sector
	Material cost control	Academic credit learning	apprenticeship training, R & D team	Discussion forum, Courses of public sector
	Development of new materials	Participate in thematic activities	Produces study the cooperation, R & D team	Advanced studies, Courses of public sector
	Electric power administration	Participate in thematic activities, Simulation training	apprenticeship training, Behaviors emulate	Courses of public sector
	Battery design	Simulation training, industry-university collaboration projects	apprenticeship training , R & D team	Courses of public sector
	Heat conduction experience	Simulation training, industry-university collaboration projects	apprenticeship training , R & D team	
	Settings the heat flow catheter	Simulation training, industry-university collaboration projects	apprenticeship training, Team Training	
	Software Design	Simulation training, industry-university collaboration projects	Produces study the cooperation	Advanced studies, Courses of public sector
	System Control	Participate in thematic activities, industry-university collaboration projects	apprenticeship training , Produces study the cooperation	
	Electric power administration	Academic credit learning, Simulation training	apprenticeship training	Courses of public sector
	Product market-oriented	Discussion forum, industry-university collaboration projects	apprenticeship training, R & D team	Discussion forum

As the era of low-carbon economy has come, the energy technology development is not only related with the future of the wellbeing of humanity, but also directly affects the economic development in one's country. Taiwan lacks natural resources and the degree of dependence on energy imports is as high as 99.3%. However, Taiwan has excellent R & D and manufacturing capacity. If we deepen the development of new energy technology, it will become the next engine to lead Taiwan industry. The current issue is the workers need to expand their skill that can help them switch to new industry. This study aims to explore the hydrogen energy and fuel cell industry, and confirm core competence for hydrogen energy and fuel cell industry. Through the core competence assessment, we describe and plan the industrial learning paths and make recommendations for the training system for enterprises, schools and related organizations in

training and selection of personnel.

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