Development of Technological Manpower Training System in Taiwan

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Abstract: - Development of technological manpower has always been the key factors that impacting the economic growth of a country. This is particularly true when marching into the new era of 21st century; the whole economic society is developing toward knowledge-based economy, high technology and globalization. So, it is becoming increasingly important and even desperate. The education and training system in Taiwan is mainly based on science and technology policy to draw the training policy for technological manpower. The major strategies are: (1) domestic training, (2) imported, and (3) retention and application. In the domestic training policies, it is the responsibility mainly of educational institute and vocational training institute, and the educational institutes mainly includes higher education system and technological and vocational education system, and vocational training institutes include public vocational training and enterprise training. In view of this, this paper, aiming at studying the training system and its development direction of technological manpower in Taiwan, starts the formation of science and technology policy to analyze the training strategy of technological manpower, then it goes to educational institute and vocational training institute separately for analyzing the development and challenges of the technological training institutes in Taiwan. Finally, the author points out some challenges of the training system to meet and directions to endeavor in the future, makes the conclusion, and gives some directions for future research.

Key-Words: - Technological Manpower, Higher Education, Vocational Education, Vocational Training

1 Introduction
Natural resources, capital, techniques and human resources are normally regarded as the 4 major elements the economic growth of a country is relying on. Among them, full and adequate utilization of human resources is even more the key factor in developing economy and promoting competitiveness of a country [3]. So, the advanced countries in the world have all realized the importance of developing human resources and have placed it into a part of overall economic planning of a country. 21st Century is a century of digitalization, globalization, and within it, combining knowledge and human resources together is the critical factor that affecting the economic growth of a country in the future [4]. New mode of economic growth will trigger the wave of global knowledge-based economy revolution, which will attest the importance of quality manpower with creative, professional technical ability and familiar in applying new knowledge techniques in the economic development of a country. Taiwan is an island country, limited area, dense population added with lack of natural resources, in additional to promote Knowledge-Based Economy Development Program, for dealing the global information and knowledge-based economy era, should even more emphasizing on the education and training of technological manpower.

The main target of technological manpower development policy needs be matched with the target of administration and economic development. It is believed that control the needs of human resources, step up human resources education, training and development are the way to create the competitive advantage of a country. Presently, there is a complete technological education and training mechanism in place ready to meet the needs in the training of technological manpower from industries. Whether the mechanism is sufficient to exert its effectiveness in the horizontal and vertical development and whether the national technological manpower policy is sufficient undertaken are the main purposes of this research. It is hoped that the results of this research would become important reference in the education and training of technological manpower and / or a base for comparison.
2 Training System
The Technological Manpower Education and Training (TMET) System (Fig. 1) is based on the TMET Policy of Science and Technology (S&T) Policy. The decision-making units base on it to draw up TMET Programs and establishing systems and carrying out the education and training (E&T) of technological manpower. Presently, the source of technological manpower which is needed for promoting national competitiveness and developing national economy are: (1) domestic training, (2) imported, and (3) Retention and application.

Firstly, the major E&T units of domestic training undertook by two sectors, education institutes and vocational training (VT) institutes. The educational institutes include technical and vocational education (TVE) and higher education. They are of the main high technological manpower training institutes.

The next, VT institutes include public VT and enterprise training. The public VT is for middle and low level technical manpower, while enterprise training is held for their own employees to gear to their currents and future development needs.

Lastly, in retention and application, it is focused in the application of post-graduate manpower in industries, official agencies and academic institutes.

Among the above types of educations, the manpower trained from TVE system concentrates in technological education, technical education and skill education. Higher education system incubates and trains engineering education level manpower. While different E&T unit has its own unique E&T job, there are still overlapping and inter support rooms. We can see that technological manpower of different levels have respective E&T unit, but to maximize the effect of manpower E&T system will take the integration among the E&T units so that they are diversified yet coordinated.

3 Development of TMET Policy
The formation of TMET policy is based on S&T policy and the main strategy of TMET are domestic training, imported and retention and application. The author would like to explain as the following, item by item:

3.1 Science and Technology Policy
The definition of S&T Policy is “The organization, system and execution direction established for strengthening the technological potential of a country to attain the target of general development and the position of the country in the world”. In short, it is important system and administration guidelines adopted by a government for achieving overall construction target of a country through promotion of effective development. The government in Taiwan calls for national S&T conference every 4 years to direct or to modify S&T policy to meet with economical and social needs of Taiwan [8].

3.2 Development of S&T Policy
The development history of Taiwan S&T Policy may be divided into the following 3 stages [8]:

3.2.1 National Long Term Development Science Plan Guidelines (1959 to 1968)
The goal is to concrete the base for science development and the main points of implementation include: (1) establishing special funds for national science development and setting up long term plan, (2) drawing up the uses of science development funds, (3) the application scope of science funds shall be at natural science, basic medicine, engineering basic science and humanity / social science, (4) stepping up the science instruction in middle school and first 2 years of college, and increase instrument and equipment appropriately, which shall be budgeted by Ministry of Education sufficiently, (5) extending the deadline for graduated students in natural science, basic medicine and engineering fundamental science.

3.2.2 12-Year Science Development Plan (1968 to 1980)
The main points are improving science education of various level of education, developing research in basic and applied science and promoting the coordination between scientific techniques and national construction.

3.2.3 Convening National S&T Conference
For the overall planning of national technological development the government calls National Technology Conference on regular basis for hearing and drawing suggestions on, challenge and visions of the current technology development of the
country. Up to 2005, there were 7 National S&T Conferences held. The summaries of each conference are stated below [8, 9]. (1) The first conference was called in 1978 and Technology Development Program was established and promulgated the next year. (2) The second conference was called in 1982 for reviewing and modifying execution of Technology Development Program and established Program for Incubation and Recruiting High Technology Manpower. (3) The 3rd Conference was called in 1986, where National 10-Year Technology Development Long Term Plan (1986-1995) was established. (4) The 4th Conference was called in 1991 where Nation 6-year Mid-Term Technology Development Plan (1991-1996) and 12-Year Long Term National Technology Development was passed. (5) The 5th conference was called in 1996, where White Paper for Technology of the Republic of China was compiled and Action Program for Technological country was established, and later in 1999, Technology Basic Law as promulgated. (6) The 6th Conference was called in 2001 to draft National Technology Promoting Program (2001-2004). (7) The 7th Conference was called in 2005 to review the results of previous policy, and draw National Technology Development Plan (2005-2008) as the national technology development directions of present and the future.

3.3 Education, training, recruitment and incentive for technological manpower

For the implementation of TMET strategies, the government has been aggressive in sponsoring education, training, recruitment and incentive (ETRI) for technological manpower for the country. The content of the mission is as the following (Fig. 2) [5, 8]:

![Fig. 2 ETRI system](image)

3.3.1 The TMET

This part is divided into that Ministry of Education (ME) is responsible for high level technological manpower training and sponsoring public funded overseas study and cooperative education between industries and academy, National Science Council (NSC) is responsible for domestic and overseas advance study of persons involved in academic and research institutes and Council of Labor Affairs (CLA) is responsible for VT and fundamental and practical training. E&T of general technological manpower are divided into three, with colleges and university training students, government agency select talented person to take advanced training overseas and TVE units train technical manpower. In addition, the TMET Deployment Program of the Executive Yuan (EY) is for the development of main technological research and train of technological manpower.

3.3.2 Recruitment of Technological Manpower

This part is mainly with Academia Sinica (AS) responsible for recruitment of scholars, experts and students studying abroad, NSC responsible for funding in recruiting domestic and overseas technology research human resources and covering also the short term manpower needs. AS and NSC have each separate measure for recruiting overseas manpower for returning home to make their contribution.

3.3.3 Incentive for technological manpower

Regarding the incentives offered to talented manpower, the EY has Outstanding Technological Honor Award, ME has academic award and National Cathedral and NSC has incentive reward for research. In addition, in order to encourage technological manpower engaging in academic research, technical development and create inventions, the government has established various incentive measures.

4 Development of Educational Institutes

4.1 Development of Higher Education System

The higher education in Taiwan developed from one university and 3 independent colleges in early 1949 to 145 universities, college and junior colleges of 2005 [6, 7]. During this process, there are a few important milestones. On of it is private school helped the development of higher education. Since the inauguration of first private college in 1953, the private run college / university is accounted for half of their total number. The 2nd is that since the first technical / vocational system college / university was established in 1974, the dual-track university and TVE development was established. The 3rd is the University Law of 1994 set up the University Autonomous and Academic Independent Principles [6].

Came into 21st century, the new century with knowledge-based economy development at the
center of the stage, universities have become the arena for knowledge innovation and human resources of countries in the world, and the competitiveness of university is the major indicator of national competitiveness. Following the education development tracks, it has transformed from elite education to be popular education, from piloting economic construction to covering also educational features. Further, it has transformed from employment oriented to be covering also consumptive needs, from government dominated to be covering also independency of education, from monotonous specification to covering diversified needs and from the one stop education to be lifelong education planning. University education changed following the time, satisfying part of social needs but also is facing challenge and changes never met before. It is necessary to think in new mode, accepting new management mechanism, establishing new cultural value, so as to form new university culture to actually reach the functions and the social value of a university.

4.2 Development of TVE system

In 1950s, the industrial structure was still in the labor-intensive production stage, and the TVE was mainly junior middle vocational school for recruiting students graduated from elementary schools. At the later stage of 1950s, the vocational senior high schools started to appear to meet the needs of employment from the industries, and there were 5-year junior colleges and 2-year junior colleges for graduates from vocational highs to train practical management and technical manpower. In early 1960s, the first technical college was established to supply the employment market with high-level leadership and managerial manpower. In later half of 1980s junior colleges with good performance were allowed to reorganize into technical colleges and well performed technical colleges upgraded to be technological universities. The TVE system was pushed to higher education stages and offered further education for students graduated from TVE, and it built a technical / vocational through put system [10]. Pursuing for excellent development of TVE is an important education policy presently, it can not only promoting TVE quality, but also incubate and train the manpower needed for the national economic development, to meet with challenge of new era and enhancing the overall development of nation and the society. Presently the important policy of Taiwan TVE includes: Increase the flexibility of exchange between the two tracks of General University and Technical specialized college and university, simplify and provide flexibility of TVE, practical design of programs, promote students ability in foreign language, strengthen the cooperation between industry and academy and actively establishing vocational license system [11].

In the past, TVE had trained rich manpower resources and had made major contribution to the development in national construction. Presently, under knowledge-based economy and lifelong learning society, TVE system schools must adjust themselves to continue growth and development. The changes and derivative question in the future will need TVE system to adjust swiftly with reformation and strategies on the present basis to be competitive and to be able to incubate and train professional manpower for the country.

5 Development of VT System

The purpose of VT is to train and increase citizens with working skills and related knowledge so that the youth yet to join employment will have skill to be able to get a job meeting their expertise / interests. In the meantime, those who are employed may acquire new skills and new knowledge to meet with their need on the jobs [2]. The planning and implementing of VT is to prepare specialized technical manpower to be able to make substantial contribution and influence in the infrastructure and economic development of a country. Also, for the business, specialized technical manpower is also the guarantee for their corporate value and sustained development. Therefore, in one hand, VT is the other way for young persons in making a living and gets employed other than pursuing further education and to the country and society, it is the development strategies for supplying the manpower for economic development and industries upgrading.

Vocational Training and Employment Services in Taiwan was established in 1981. It has been endeavoring in establishing systems on one hand to make long term planning for solid development base, and actively develop service on the other hand to meet with the needs in national industry upgrading and development of economy and society. The main jobs of Vocational Training & Employment Services are establishing system, prevailing VT, strengthen skill testing and certification, reform employment services, step up aid in VT and handling foreign labor services. On the existing basis, the future services of Vocational Training and Employment Services and its development directions are: Transforming into regional Vocational Training Logistics Center, Upgrading the training equipment and instructor levels for VT, strengthen the guidance
both in career and in life, joining with business in providing training and combining employment services system to build complete employment security mechanism [1].

It is clear that VT plays a role of training technical manpower required in national construction and the role of enhancing full employment of the country. In future, in coping with changes in economy, society and education, following the technological manpower policy and joining international organization of the government, the Services will enlarge VT infrastructure, generating new mode of VT, implementing strategic VT, promoting business entity training, certification and licensing and employment services.

6 Challenges to meet and directions to endeavor in the future

Looking back the institution and development processes of Taiwan S&T policy, we must admit that it is quite complete, but from the institution to execution, there are still some gap exist. The following is our analysis from different levels and angles. (1) In supply and demand in manpower structure: Presently there are apparent shortages in basic and high levels technical manpower, while at the middle level, there is oversupply. Since the basic level technical persons are working under poorer working conditions, general people would rather not to touch, which needs the injection of foreign labor. In the high level, the prosperity in domestic higher education is significant in quantity than quality, what is more is that the manpower quality trained by university is in the trend of moving downward. So there is oversupply of middle level technical manpower and with unemployment rate staying high. (2) In the coordination with education and policy: School education mechanism is lack of flexibility to meet with the requirements for building a technological country, because universities are mostly focused in basic research and there is still lack of mechanism introducing the results of research of universities into the industries and market, so when students are busing to pass admission examination of graduated institutes, the doctors and masters produced by universities are still busing in returning to university. (3) From quality of manpower: The prosperity of higher education in Taiwan, special high level TVE emphasized too much in quantity but lack a objective assessment mechanism, which caused the down sliding of quality of manpower produced. There is lack of balance in quantity and quality of manpower. (4) From technological literacy education: It inclined to emphasize on technical oriented instruction but lack the scientific attitude and methods required, as well as general knowledge training. (5) From professional technological education, it lacks creative thinking and problem solving ability as well as experience in practical R & D. (6) From related learning field: such as humanity training and general knowledge ability, environment protection, cross fields’ manpower incubation, continuous education for technological professions and the implementation of education and policy coordination, there is still large space to work on.

It is apparent that difficulty in carrying out, a policy would lose its focus in the original policy institution. So, it is of vital important to establish a complete TMET policy executing mechanism to enable all the policies to be feasible, so as to perform the job as it is planned originally. This should be the direction for endeavor in carrying out TMET policy.

7 Conclusions

For the study of S&T development in Taiwan, it is better to start from the rooting of science and enhancing basic science education. Since 1960s, the manpower education and training plan started concurrently from upgrading level of higher educations, expanding recruitment of overseas technological manpower and preventing outflow of technological manpower. Later in 1979, the government promulgated “Technology Development Program” to urge technology development aggressively. At that time the quantity and quality of were the core concerns of technology development. The policies and measures of the government adjusted with time so as to cope with the changing environment and to satisfy business needs. From the viewpoint of manpower supply, the government expands the scale and facilities of domestic graduated institutes to produce high level manpower of masters and doctors to meet with the industrial development needs of manpower in research. At the same time, the military services was changed to be defense services that frees the manpower from pure military training but to supplement the needs in research of related industries [5]. Also, the recruitment of overseas high caliber technological manpower has become the main source of middle and high-level managerial manpower.

In recent years, in order to promote the technological training and ability of Taiwanese, the postgraduate training keeps on expanding; it is especially significant in growth of quantity.
Presently, in order to meet with the development of knowledge-based economy, emphasis is placed specially on the training of creative thinking. In future, as private sector is still the consumer of high-tech manpower, so the government should adopt innovative system to open up new high-tech industry and help the private sectors to reduce risk in their research and development and enlarge their core capacity in R&D, so that they may be competitive in the long run. This is the direction government need to concentrate their attention.

Under the impact of technologies and globalization, domestic economic development and industrial environment are undergoing tremendous change and the competition within and between industries are getting keener and keener. This is particularly true when facing international competition, economic down in Taiwan, outward shifting of industries, plus serious short of high tech manpower. These are also responsible to the high employment rate in Taiwan. VT, in the context of personal career development, is another channel for make a living, employment and create own venture, other than normal school education. It plays an important role in the social and economic development as well as training of industrial technological manpower.

While we expect Taiwan become a country of technology in the new 21st century, the education, training and deployment of manpower is still the core issue, and the S&T policy, the education, training, recruiting and deployment are the critical issues in technological development of Taiwan. It is all too important that we join government, academic and industrial resources to educate, to train and to recruit high caliber manpower to meet with the needs of the new century.

8 New directions for future research

Based on Taiwan’s technological manpower training experiences, this paper is to analyze the differences of training system among different regions or countries, and to understand their various ways of solutions under different social backgrounds and culture, so that it can serve as a grounded data of reference for other countries to enact technological policy, promote engineering education and cultivate technological manpower.

References: