Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 11, November-2020

Artificial Intelligent Manufacturing Professionals for Modern Smart Industries from Technical and Vocational Education and Training (TVET) Sector

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Abstract:- **Intelligent manufacturing technology economy in-demand sector has been essential and mentioned in some country for priority area and concerns for country economic development. like, in China "Made in China 2025",in Germany "Industry 4.0",and in U.S.A "Design Innovation and Digital Manufacturing",...etc. This sector has been identified as the key to country industrialization by having strong modern smart industry that can provide and support the skilled manpower needs. Though, much intervention has been initiated by the government, still the industry suffers from key shortages of skilled workforce for industrial operations. Some countries goal depends much on the smart manufacturing technology as this sector encompasses all other technology sectors. By establishing well designed and equipped artificial intelligent Manufacturing training center (both Workshop and laboratory) in Technical and Vocational Education and Training sector, all countries would benefit in training and producing well educated and skilled workforce that will strengthen the modern smart industry and manufacturing sector.**

Key word:- Establishing well designed and equipped artificial intelligent Manufacturing training center (both Workshop and laboratory) in Technical and Vocational Education and Training sector

INTRODUCTION

One important point that the Technical and Vocational Education and Training (TVET) doing as part of its industry extension service. i.e. Technology Accumulation and Transfer (TeCAT) for priority smart and modern manufacturing industry sector. The Technical and Vocational Education and Training (TVET) is upgrading its capabilities with technical competent on artificial intelligent manufacturing students/ trainers and fabricators (Manufacturers) to be able to produce well designed and produced smart product for priority sector and benefit of society.

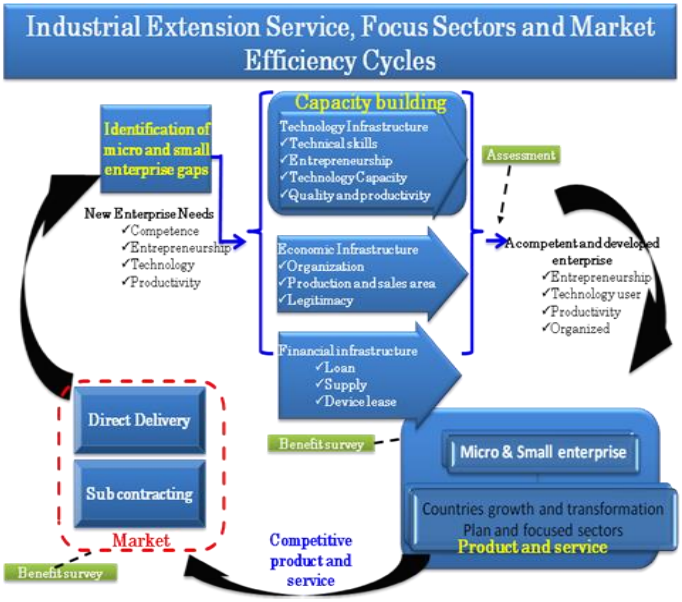

Fig 1:- Industrial Extension Service, Focus Sectors and Market Efficiency Cycles

Having said this development, the approach for qualified and skilled workers in the modern smart manufacturing sector is by intensifying the trainers development which in returns will train, others with the same quality of training the trainers received in intelligent manufacturing technology. Also there is great demand for intelligent manufacturing and manufacturers in smart and modern industry, products that demand manufactured materials are increasing and qualified. Skilled workforce from Technical and Vocational Education and Training (TVET) for smart manufacturing sector are necessary to sustain the momentum of growth of country economic development. Considering the aspirations of each member countries in the world, the availability of quality training of trainers and trainees from Technical and Vocational Education and Training (TVET) in the department of artificial intelligent manufacturing training are essentials to achieve growth and development as all infrastructure initiatives relies more on smart manufacturing sector.

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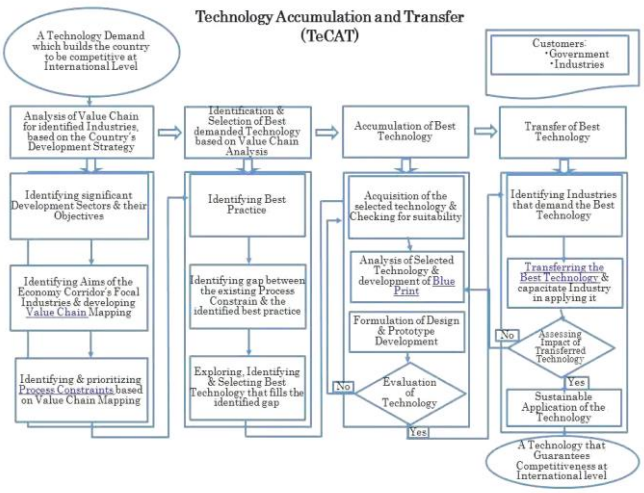

Fig 2:- Technology Accumulation and Transfer (TeCAT) in TVET system

1. The impact of intelligent manufacturing on professional manufacturing activity in Technical and Vocational Education and Training Sector

In smart and Modern manufacturing industries and micro and small enterprises (MSEs),the role of artificial intelligent manufacturing not only has an impact on the production format of the smart product and production system, but also has a huge impact on the professional manufacturing activity in Technical and Vocational Education and Training (TVET) sector. The following basic areas are huge impact on the professional manufacturing activity:-

I. Transition from manufacturing positions to production service positions

Production equipment under the traditional manufacturing mode, such as CNC machine tools, wire cutting, etc., is a single equipment plus Manufacturing positions require many operators/manufacturers technicians. In the artificial intelligent manufacturing mode, smart Manufacturing industries and micro and small enterprises (MSEs) interconnect production equipment to form an automatic/automation processing production line. Simple and repetitive production operations are completed by industrial robots. Technicians/Manufacturers are only responsible for monitoring multiple equipment on the production line. Very few staffs are required.

Therefore, Artificial intelligent manufacturing industries have reduced the number of technicians/employees in the manufacturing positions that Technical and Vocational Education and Training (TVET) students or trainees can work in. Few of the Technical and Vocational Education and Training (TVET) students or trainees who have been cut can engage in Artificial Intelligent design work, and most of them migrate to production service positions.

In the traditional manufacturing mode, production and service are independent of each other, and after-sales service is carried out on-site maintenance or repair according to customer requirements. Artificial Intelligent manufacturing uses a new generation of information technology and network technology to form a cyber-physical system (CPS) for Artificial intelligent management(AIM),Artificial intelligent production(AIP), Artificial intelligent logistics (AIL) and Artificial intelligent services(AIS). The products of Artificial intelligent smart manufacturing are developing in the direction of "product and value-added services", and the productive service industry. It is a supporting service directly related to the smart manufacturing industry. It is a service industry to maintain the continuity of the smart manufacturing production process, promote industrial upgrading (IU), improve production efficiency(PE), and provide guarantee services(GS). The integration of production and service is a new feature of production under the background of Artificial intelligent manufacturing. Manufacturing industries provide users with online product support, real-time maintenance and health based on the operating status of the product.

Health monitoring and other remote artificial intelligent services[1]. The remote monitoring and maintenance of smart products sold by smart manufacturing industries will become a normal state in the near future. Preventive inspection and maintenance of smart products can effectively reduce the maintenance cost of smart products.

Based on the above analysis, there will be a large shortage of well educated Technical and Vocational Education and Training(TVET) professionals demand for specialized services such as remote operation and maintenance, online diagnosis, industrial applications, artificial intelligent control and service platforms in the future.

Therefore, a new kind of activities will be created, that is, smart and modern production service activity. Technical and Vocational Education and Training (TVET) students' or Trainees professions on the production line will shift from machine tool operation to product smart monitoring, online diagnosis, and after-sales maintenance services.

II. Transition from a single type of profession to a composite active profession

The traditional manufacturing mode of Smart Industries focuses on a single process, such as business management, Artificial Intelligent design, and Smart technology formulation, Artificial Intelligent manufacturing, Artificial Intelligent assembly and debugging,...etc. The content of this production mode is permanent, so the positions of technicians are also permanent.

In the context of artificial intelligent manufacturing, intelligent production links are transformed from smart production circulation to the full life cycle of smart and modern products and production system. Modern and smart production links such as product information management (PIM), Artificial Intelligent design (AID), Artificial Intelligent process analysis (AIPA), and virtual manufacturing (VM) are all operated on the unified data platform of the industries and micro and small enterprises (MSEs). With the development of products in the direction of personalized demand under the artificial intelligent manufacturing production system, the content of activity has become uncertain. The internet of things (IoT) has integrated technicians and smart production system. The

International Journal of Engineering Research & Technology (IJERT)
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various links of smart production and modern smart manufacturing are more closely connected, and the activity boundaries of modern and smart industries and micro and small enterprises (MSEs) technicians have become more. It has become more and more ambiguous, no matter which position you are in, different occupations must be familiar with the artificial intelligent manufacturing smart manufacturing production process and activity content.

Under the artificial intelligent manufacturing process, there are fewer and fewer positions on the smart production line with low technical content and simple single mechanical operation skills. The internet of things(IoT) technology integrates high-end numerical control equipment (NCE), industrial robots(IR), sensors, precision testing instruments(PTI),...etc. into artificial intelligent manufacturing smart production line and system, requiring practitioners to quickly solve the problems of these artificial intelligent equipment and smart products. With the intelligentization of modern smart products, the production structure becomes more complex, and the production technology is upgraded to high-end technology.

The professionalization requirements for practitioners are higher, and the professional level is significantly improved. This requires Technical and Vocational Education and Training (TVET) students or trainees to move from the original single activity/job position to possesses complex and active activity/job transitions to handle complex tasks.

To summarize the above, the uncertainty of the work content of artificial intelligent smart manufacturing puts forward higher requirements on employees. For trainees/students majoring in smart manufacturing in Technical and Vocational Education and Training (TVET) Universities, Institutes, Colleges and Training Centers, they must have the ability to operate, monitor, and maintain on the smart production line and system, as well as teamwork and cooperation.

- The ability to correctly handle interpersonal relationships;
- The ability to continuously pursue innovative product functions and the ability to transform design results into real products in Artificial Intelligent Manufacturing design positions;

It can be seen that with the development of smart manufacturing technology, Technical and Vocational Education and Training (TVET) trainees/students must not only have basic smart manufacturing technology professional abilities, but also have the ability to collect, analyze, and process production information and comprehensively use knowledge and experience on the area of intelligent manufacturing technology and production of smart products.

III. Transition from skilled positions to knowledge-skilled positions

The traditional production intelligent smart manufacturing system emphasizes the skill of fixed positions, but the human operation position under the artificial intelligent manufacturing system are getting less and less. With the introduction of artificial intelligent manufacturing in different countries, many existing artificial intelligent manufacturing smart industries will undergo informatization, industrialization, and intelligent and smart transformation. High-end CNC machine tools, Artificial intelligent equipment, 3D printing,...etc. will be popularized and applied.

Smart industries need professionals who can operate these equipment, debug and maintain them. This not only requires technical professional to have corresponding operating skills, but also multi-disciplinary knowledge and capabilities such as machinery, automatic/ automation control, and programming.

Artificial intelligent smart manufacturing is a system of multi-disciplinary integration, breaking traditional discipline boundaries, highlighting the value position of knowledge in artificial intelligent manufacturing, and transforming the demand for talents to knowledge and skills. Artificial intelligent smart manufacturing industries and micro and small enterprises (MSEs) not only emphasize professional basic knowledge, new processes, new materials, new technologies and new equipment technical skills, but also emphasize the ability to apply knowledge to independently solve complex technical problems in production of smart product.

To summarise the above, Technical and Vocational Education and Training (TVET) trainees/students, especially the knowledge reserves of emerging technologies such as

- 3D printing technology,
- Internet of things technology,
- Data analysis technology,
- Precision measurement technology,
- Information technology, and
- The ability to operate and maintain smart devices in both Hardware and Software smart manufacturing technology,

A. Smart manufacturing software's:-

- Computer-Aided Design (CAD),
- Computer-Aided Engineering (CAE),
- Computer-Aided Manufacturing (CAM),
- Computer-Aided Process Planning (CAPP),

B. Smart manufacturing hardware to explore design alternatives in simulation technology:-

- Numerical Control NC
- Computer Numerical Control CNC and
- Robotics fabrication

C. Virtual reality technology to generate virtually smartly manufactured products.

Therefore, the practical implementation and application of Technical and Vocational Education and Training (TVET) trainees/students will change from the original skill type to the knowledge skill type.

IV. Individual positions change from independent to teamwork

In order to improve work efficiency, artificial intelligent manufacturing industries and micro and small enterprises (MSEs) generally organize production from the perspective of production division and specialization. As Adam Smith said:- Division of labor not only maximizes the productivity of labor, but also obtains more skilled labor skills[2]. This

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division of labor makes activity/jobs relatively independent, and it is also easy to cause monotonous and boring work, and cause psychological fatigue of employees. Under the artificial intelligent manufacturing system, both smart industries and micro and small enterprises(MSEs) have closer production links, and more cooperation between different positions is needed, individual work content becomes richer, and human-to-human cooperation makes employees no longer feel monotonous and boring at activity, and activity is virtualized Human-to-human cooperation can be realized at any place and at any time, such as

- Global manufacturing,
- Cloud manufacturing,
- Collaborative manufacturing,...etc.

In addition, the artificial intelligent production line will be human-machine cooperation, and humans and machines are like colleagues, communicating with each other during activity/work. Mutual cooperation, such as online perception of surrounding production information through working conditions, automatic acquisition of smart manufacturing process knowledge, and simulation of human brain work to make production decisions, and finally complete product production tasks.

To summarise the above, the activity/work content of artificial intelligent manufacturing is characterized by complexity and uncertainty. After all, the technical skills and knowledge possessed by individuals are limited. If you want to make a difference at production smart product and process, you need to play a team role. Division of labor and collaboration are mutually inclusive. It can be seen that the future production smart product and process of Technical and Vocational Education Training Trainees or students will change from the individual and independent work to teamwork.

V. The job position has changed from a fixed position to a mobile position

The activity/job management form of most smart production industries is to fix people in a position for a long time[3], but with the intelligent system the wide application of manufacturing technology in the smart product production industry has greatly changed the structure of the smart manufacturing industry and also brought about changes in employment.

The "robot substitution" of management informationization and production line has caused the "fewer people" of these positions, but the demand for employment in positions:- such as

- Big data analysis,
- Intelligent design,
- Intelligent service,
- Intelligent equipment debugging and
- Maintenance has increased.

In addition, the application of new technologies, such as:-

- High-speed cutting technology,
- 3D printing,
- Ergonomic simulation,
- Manufacturing production process execution management,
- Production simulation,
- Dynamic analysis and
- Static analysis of product flow,

Is a distributed production model for industries and small and micro enterprises(MSEs). Enterprises and entrepreneurship bring unprecedented development opportunities[4].

Although robots replace humans to improve production efficiency, they can only replace some simple and repetitive mechanical labor. Those tasks that require complex thinking, innovation, and flexibility still need to be handled by well educated and trained Technical and Vocational Training and Education (TVET) Experts and Technicians i.e TVET trainees/students. In the era of modern smart manufacturing, the middle and low ends of the manufacturing smile curve-assembly, production and sales[5], etc. have reduced added value, while the two ends of the smile curve Research and development (R&D) design and after-sales service have increased added value, becoming the front and back of the value chain.

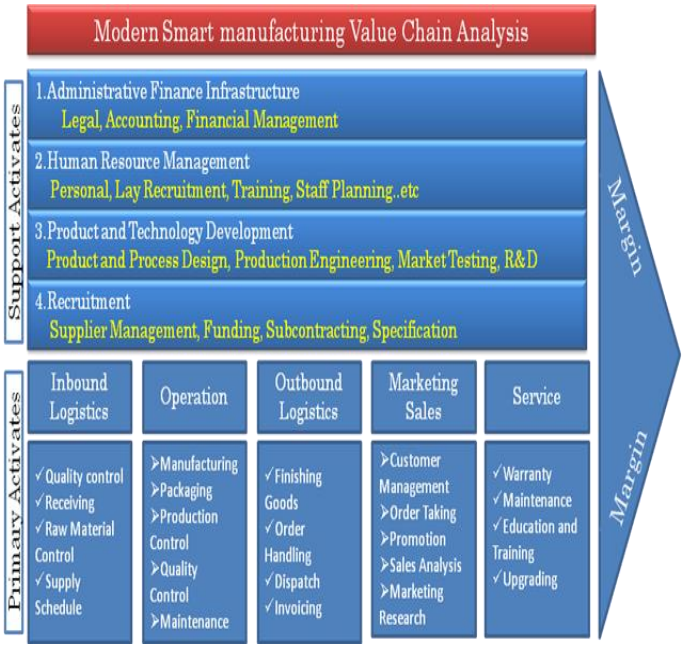

Fig 3:- Modern Smart manufacturing Value Chain Analysis

Therefore, the application of Artificial intelligent manufacturing in modern smart industries will enable smart industries to compress the middle-end activates of the smile curve and increase the support of Technical and Vocational Education and Training well skilled and trained experts and technicians at both ends of the smile curve, thereby creating many new production activates in modern smart manufacturing Industries.

From the above analysis, it can be seen that the modern smart product production activates of Technical and Vocational Education and Training trainees or students are changing from fixed to mobile and new modern and smart production positions, and the future professional ability requirements will

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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be higher and higher for all modern smart manufacturing sector and Industries as well as for Micro and Small Enterprises (MSEs).

SUMMARY

In modern and smart industrial-led education and training system, competent, well skilled, trained and educated technical and vocational education and training (TVET) professionals for smart manufacturing industries and micro and small enterprises(MSEs) indispensable and fundamental, also impacts of artificial intelligent manufacturing on manufacturing professionals for modern and smart industries to produce smart products for market and government priority sector.

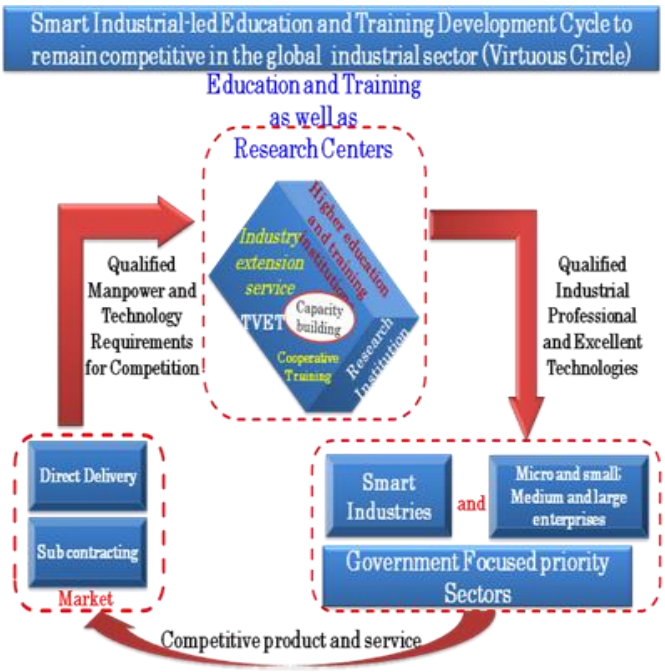

Fig 4:- Smart Industrial-led education and training development cycle (Virtuous Circle)

The impact of Artificial intelligent manufacturing on the smart manufacturing industry and the employment of Technical and Vocational Education and Training (TVET) trainees or students, and the challenges faced by Technical and Vocational Education and Training (TVET) skills and abilities in dealing with artificial intelligent manufacturing.

First, the characteristics of smart manufacturing and smart factories are analyzed, and the technological changes in the smart manufacturing industry are sorted out. The study found that each technological change has simplified the operation capabilities of the first-line production equipment, and the knowledge has become more complicated;

Secondly, the analysis of modern smart manufacturing. The impact of the modern smart manufacturing industry has been fully studied from the changes in smart enterprise functions, enterprise management, production links, production modes, production drives, production methods, and production technologies; once again, they will conduct field investigations and analysis in the enterprise.

Finally, The impact of artificial intelligent manufacturing on the employment of Technical and Vocational Education and Training (TVET) trainees/students, including the transition from manufacturing posts to production service posts, from single-type jobs to multiple active posts, from skilled posts to knowledge-skilled posts, and from individual positions to independent Transformation of teamwork, from fixed positions to mobile positions, etc.

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