Employee Training System of Manufacturing Enterprises for Implementing Industry 4.0

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Abstract. Enterprises will be more flexible to organize production, more agile to meet individual customer custom in the age of Industry 4.0, which requires the manufacturing enterprise training must comply with the trend and reform soon. Through investigating different types of manufacturing enterprises, and analyzing typical case, manufacturing enterprises should analyze the main problems existing in the training system based on Industry 4.0. The research shows that the orientation of staff training will focus on Intellectualization, the professional ability of employees will be transferred from a single structure to a compound structure structural transformation, staff training will be promoted from single ability to compound ability, the improvement of employees' innovation ability will be the core of training the heart demands, lifelong education will be the core of the enterprise staff training system. The paper puts forward countermeasures and suggestions on employee training from training needs analysis, training plan, training courses, training teachers, training organization and implementation, training effect evaluation, training support, training achievement transformation.

Keywords: Industry 4.0, Information and industrialization, Enterprise staff training system

1 Introduction
Under the historical trend of the deep integration of global information technology and manufacturing industry, the networking and the servitization of manufacturing industry ushered in the fourth industrial revolution led by intelligent manufacturing, which is a revolutionary production and manufacturing. The model is called Industry 4.0. Industry 4.0 is to make people and people, people and machines, machines and machines as well as between service and service be connected through information communication technology and information physical systems (CPS), which can interlink equipment, production lines, factories, suppliers, products, customers closely together. The means of telecommunications technology and the cyber-physical system (CPS) promote manufacturing to intelligent transformation [1]. This is also the core content that China has been promoting the fusion of the information and industrialization for a long time.
Since the 1930s, the western developed countries began to experience the "Re-Industrialization" process, economic development mainly depends on the service industry, labor transfer from the primary and secondary industry to the tertiary industry, and at the same time the global financial crisis hit, the market dropping, as a result the developed countries had to readjust the economic development strategy, and switched to high value-added industrial structure, the knowledge capital intensive and strategic emerging industries and the high technology industry, and launched a series of revitalization of manufacturing and measures of industrialization, industrial 4.0 is one of the important representative action strategy.

Germany's Industry 4.0 is a strategy jointly formulated by German industries, universities and research institutes to improve the competitiveness of German industry. The concept of Industry 4.0 in Germany was officially put forward at the Hanover industry expo held in Germany in April 2011. The essence of Industry 4.0 is the "Re-Industrialization" strategy of developed countries of Germany, which is an upgraded version of the German high-tech strategy proposed by Germany in 2006 and the German high-tech innovation strategy 2020 in 2010. In April 2013, the official scholars from the German industry, government and academics first published the proposal for implementing the Industry 4.0 strategy. Germany's Industry 4.0 strategy is the national strategy toward 2020 set by the German government, which reflects the goal of exploring a new type of industrialization with its advantages in innovative manufacturing technology. Industry 4.0 strategy with information and communication technologies (ICT) and network physical systems, with an emphasis on intelligent and smart plant production of a new generation of key technology for industrial technology R & D and innovation, which dramatically reduces the cost of production and improves the production efficiency, and promotes product functional diversity, and personalization. As the new industrial production mode, Industry 4.0 strategy realizes the integration of physical world and virtual network world through technology, reflects the profound revolution of man-machine relationship, and reflects the application of networked and socialized organization mode. Industry 4.0 strategy is the new partnership of government, colleges and universities, and business, which promoting cross-border cooperation of different industry communities, and facilitating the traditional industry intergration of industrialization and information, and encouraging transformation and upgrading traditional manufacturing, and accelerating the development of high technology industry.

In recent years, China's economic development has entered a new mode of operation: low-end manufacturing constantly is not only under the pressure from low-cost manufacturing of southeast Asian nations, but also for a long time under the intensive mode of production pressure waste of resources, environmental protection, environmental factors at home and abroad, these challenges require us to speed up the adjustment of industrial structure, intelligent manufacturing, otherwise it will affect the orderly operation of national economy and the historical process of national revival[2]. From the view the world, the concept of Industry 4.0 has led the development direction of the world's manufacturing industry, Its emphasis on the integration of industrialization and intelligent development road, has been adopted by some China's major manufacturing industry. China must follow up and lead the historic industrial revolution, and China's government has upgraded the Chinese version Industry 4.0-"Made in China 2025"to national strategic height, this is enterprise's future development path, and also is the national key support in global competitiveness. In the era of Industry 4.0, enterprises will be more flexible and agile in organizing production and more nimble in satisfying customers' individual customization. The production mode will shift from mass customization production to small variety and large batch production, reduce the manpower in the production process, increase the flexibility of terminal product design, all of these jobs in manufacturing enterprises such as management, finance, research and development, production, quality inspection, logistics and sales positions will have more flexible and comprehensive professional awareness, professional knowledge and skills. Therefore, employees need to improve themselves with more detailed and systematic professional knowledge and professional skills. It is the final choice for enterprises to accelerate the training and development of human resources, and optimizing the design of employee training system based on Industry 4.0 is the key guarantee to improve the training performance.
2 Investigation and Analysis
The Questionnaire Design, Sample Selection and Data Collection. The questionnaire about personal basic situation survey, which mainly include gender, age, record of formal schooling and the responsibilities of the department, class type, working years, technical title and so on; Enterprise training system status quo survey: survey the enterprise training system of systematic, integrity and the status of the enterprise training implementation, which is divided into training concept, training needs analysis, training plan, training courses, training teachers, training groups and implementation, training effect evaluation, training, support, training achievement transformation and so on.

Method in this research mainly include questionnaire and interview. The respondent is general manager (deputy general manager), department manager (deputy department manager), supervisor, and employee. The formal investigation questionnaires out of 800, the actual recycling questionnaire is 675, the invalid is 23, so the real effective entry questionnaire is 652, accounting for 96.5% of the recycling questionnaire.

2.1 The training concept needs to be improved.
Survey analysis shows that 75.3% Manufacturing enterprise staff training system design lack of the guidance with clear ideas and principles guidance, and that leads to a focus on post adaptability training content. First of all, they are lack of strategic principle as the instruction, which has failed to effectively serve the overall development of the enterprise strategic goals, and this makes the lack of systematic design and arrangement. Second, the lack of integrated thinking. This mainly reflected in the key training to improve the key management personnel and technical people to respect, training depth often cannot meet the needs of the staff growth and enterprise development. Third, the lack of information and personalized concept support. Industry 4.0 need for big data acquisition, integration, and application, this is a key step towards intelligent manufacturing, at the same time, the post will become more flexible, it also put forward the dynamic and personal need for training requirements. Finally, the general lack of the concept of life-long education as guidance, enterprise training is anxious to get ahead quickly, intellectual investment and human resource development of long-term, sustainable design needs to be strengthened.

2.2 The survey method of training needs to be diversified
Currently, the suvey of manufacturing enterprise training needs was mainly carried out in the form of questionnaire without group discussion, in-depth interviews, and other forms of investigation. Such investigation and analysis often can't reflect the real appeal behind the data, and there are lack guidance on the staff training program and curriculum design. the training investigation and analysis needs the support of human, financial, and material resouces, but most companies did not set up independent training departments and training management personnel, this has led to inadequate training needs analysis. because of partial difference appears on the source of training activities without considering the practical need of employees and the future development of enterprises, and thus the employees participaing training often lack enthusiasm and initiative.

2.3 The training plan needs to be improved.
In terms of training objects, almost all enterprises have carried out suvey on employee training needs, but there are 75.2% of companies are not reasonable classification on the training objects, thus the training for the employee's actual performance is shortage. In terms of training goal setting, manufacturing enterprises more emphasis on the training target for standardization system and the training of workflow process. At the same time, due to the lack of forward-looking training goal setting, this made the design of the training system can't keep pace with technology and management, and seriously hampered the transformation and upgrading of enterprises. In the mode of training, classroom teaching is the main way of training, as a result of the training resources about beam, exercise training, open training, rotational training and research training are used less, training effect is not ideal.
2.4. The training courses need to be enriched
In terms of curriculum system design, 85.2% of enterprises did not undevelop, curriculums that covering the top, middle, grassroots and new enterprises employee training curriculum system at all levels. At the same time, there are 80.9% of companies which didn’t develop the intercouses of production and management. In the course of informatization, only 5.1% of the enterprise can provide online real-time mobile learning course channels with the IOS and Android system, and can achieve the APP built-in check-in, practice and research for class activities and test line. In the course the personalized design, there are still 86.8% of the enterprise is unable to meet the needs of the employees of individuation and diversification of development, and can’t provide meet the demand of different rank employees for the same position.

2.5. The teacher training system needs to be improved
In terms of teacher training, 76.5% of enterprises have not established their own teacher training system combining internal and external trainers. In terms of the management mechanism of teachers, 95.2% of enterprises have not established the trainer management grading system, and there is no clear certification system for the instructor rating and class reward standard. In terms of internal trainer training, only 3.5% of enterprises can carry out the training and certification of internal trainers. At the same time, there is a special training team construction plan and corresponding guarantee measures to promote the development and improvement of the training team. Due to internal trainers generally come from the enterprise primary technical and management job with rich work experience and work performance and strong leadership. They can effectively improve the structure of the inter-training and provide excellent teachers to ensure the quality of the training.

2.6. The organization and implementation of training needs to be strengthened
As for the establishment of enterprise training organizations, 92.5% of enterprises do not set up an independent training department, and 83.6% of enterprises' training departments are merged with the human resources department. less than 0.5% had an enterprise college (Corporate University) responsible for employee training and development. Fixed training time and fixed training place are the main training patterns at present. If employees work in shifts and some employees often travel for business trips due to the expansion or change of the enterprise business, such training organization mode will have a negative impact on the work and rest of employees, which making training a constraint and burden to employees.

2.7. The training effect evaluation needs to be improved
In terms of the establishment of training effect evaluation system or mechanism, 67.5% of enterprises lack the evaluation and feedback mechanism of training implement. Due to the lack of timely and comprehensive evaluation and feedback on the training effect of implement, it is impossible to provide guidance on the adjustment and improvement of subsequent training programs. In terms of the evaluation method, 89.6% of enterprises have a single training evaluation method, most of them evaluate the training effect by means of the satisfaction questionnaire filled out by trainees, failing to comprehensively evaluate the project design, lectures and training achievements. In terms of the setting of evaluation indicators, they pay more attention to the satisfaction of the training courses. The lack of whole-process monitoring and evaluation of the overall design of the training project and the improvement of employees' abilities after the training which leads to the gap of training and the waste of training resources.

2.8. Training support needs to be strengthened
In terms of training system guarantee, 65.1% of enterprises have not established a systematic training rulers and regulations from the project design to curriculum development, and from teacher training management to training evaluation. In addition, 50.7% of enterprises training system cannot be effectively connected with the performance assessment and position promotion, namely, the training
system cannot be effectively combined with the human resource management system, which resulting in low attendance, formalized training evaluation, and difficult to guarantee the training implement. In the aspect of training funds support, only 71.5% of enterprises can have special staff training budget, 28.5% have not capital budget for staff training, thus the development of the training program can't find key resources support.

2. 9. The transformation of training achievements needs to be improved
In terms of the transformation mechanism of training achievements, 98.6% of the surveyed enterprises failed to establish the corresponding incentive system and measures for the transformation of training achievements. Due to the lack of effective incentive mechanism which had serious impacts on the enthusiasm and motivation of the achievement transformation. In the term of training achievement transformation applications, 82.6% of enterprises failed to consider training achievement transformation effect with employee performance achievement which contribute to the disjoint of "learning" and "practice".

3 Industry 4.0 Challenges to the Training of Manufacturing Enterprises
Industry 4.0 is a high-tech strategic planning proposed by the German government. This concept contains from the centralized to the enhanced control. It aims to establish a highly personalized and digitized production model [3]. This revolution will make manufacturing enterprise training to be currently faced with unprecedented challenges. The enterprise training system should meet the needs of enterprise strategic transformation of intelligent manufacturing, optimize the existing training system, use more reasonable and scientific training methods, and promote and improve training management, process, flow process, evaluation, and achievements.

3.1. The Orientation of Staff Training will Focus on Intellectualization
Intellectualization is the cornerstone and platform of Industry 4.0. German academic and industrial circles think that industry 4.0 concept is the fourth industrial revolution and revolutionary production methods. The strategy aims to make full use of information and communication technology and network space virtual System - information Physical System (Cyber Physical System), and makes the manufacturing transfer to intellectualization transformation. Industry 4.0 project consists of three major themes, namely "Smart factory", "Cyber production" and "intelligent logistics" [4]. In Industry 4.0 age, the virtual world and real world will be merge together perfectly. By the synergistic effect of calculation, control and networking, machine and information can join each other as an organic whole. The future manufacturing will achieve higher production and shorter time -to- market [5]. Thus, Industry 4.0 involves a wide range content of machine perception, planning, decision-making and man-machine interaction, and these will be the key topics that manufacturing enterprise employee training focus on.

3.2. The Professional Ability of Employees will be Transferred from a Single Structure to a Compound Structure Structural Transformation
Industry 4.0 will encourage enterprise's post structure change, such as assembly, packaging and other manual jobs which need low technology and high mechanical repetition will gradually disappear. The simple and conventional jobs will gradually decrease. but the relationship between human and machine will be more closely, the man-machine combination will be in favor at the same time, the unconventional study of the jobs will gradually increase. The German federal institute of vocational education considered that at least 11% of the nature of work is changingin Industry 4.0age[6]. For example, in the new added jobs, industrial data analyst is the fastest growing jobs, through big data mining in industrial analysis and research, production, management, marketing, after-sale service. they may improve product added value, build smart factory, and upgrade manufacturing mode. This kind of talents should have good ability of analyzing and solving problem, and have independent ability of product planning and development, project management and business communication.
3.3. **Staff Training will be Promoted from Single Ability to Compound Ability**

Industry 4.0 will bring new industrial revolution and technology revolution, the boundaries among industry will be blurring, the iteration of production technology will be accelerating, the new jobs will be created constantly. Especially enterprises will increase demand for compound talents by a large margin, namely, the compound talent being familiar with information, electronics, machinery, management, marketing and other multi-disciplinary knowledge and skill will become the future backbone of manufacturing enterprises.

3.4. **The Improvement of Employees’ Innovation Ability will be the Core of Training the Heart Demands**

With the development of Industry 4.0, consumer’s demand will become diversified and personalized product design not only to meet the functional demand, but also to focus on the performance and satisfaction. With the coming of the Industry 4.0, automated mass production system will be difficult to deal with more complex products, products are increasingly the reality of differentiation, product life cycles are getting shorter, smart factory and intelligent manufacturing will get full development, customization and personal products will become mainstream, small-batch varieties production will become the future main mode of production. The change of consumer propensity will deeply affect the product design, production and sales. Through good interaction and communication with consumers, the enterprise take innovation and value-added services as the core customized production, and provide different products. Industrial production needs a large number of quality and ability of employees to cope with the consumer's flexible demand in the future. Thus, high end digital equipment and intelligent manufacturing technology will no longer be scarce resources, and talents with the ability of integration and innovation will be scarce resources [7]. In the future the talents need have abilities of artistic expression to product design, flexibility of thinking to the production process, and the innovative planning of market competition.

3.5. **Lifelong Education will be the Core of the Enterprise Staff Training System**

Lifelong vocational education and training is the need of Industry 4.0 development, jobs will reconstruct the working content and working mode, and large data, cloud computing, intelligent production, AR, VR, MR new technology will constantly emerge, the future trend of the mode of production of industry adjustment and change is difficult to predict in the rapid technological progress. The efficiency of the traditional worker training system in the near future and long-term prospective has laged behind changes of the new environment. With the coming industrial revolution, globalization of economy and market, how employees can adapt to technological innovation and progress, and improve the manufacturing capability of science and technology and core skills, this is the imminent key issue of the future staff training. Only those who are good at lifelong learning can choose have choice by themselves and individual development [8]. Thus we should provide systematic training and upgraded konwledge and skills from the employee'sentry to retirement, according to the individual endowments and job characteristics.

4. **Construction of Manufacturing Enterprise Training System based on Industry 4.0**

Combined with the above theoretical and empirical analysis, in view of the challenge of Industry 4.0 and manufacturing enterprise transformation of intelligent manufacturing reality needs educating and training professional staff team, which is the key strategic solution of the development of intelligent manufacturing [9]. Based on the concept of life-long education and full staff education, this study put forward the training system solution of manufacturing enterprise.

4.1. **Training Demand Analysis and Training Plan Formulation**

In Industry 4.0 era, the production mode of small-bath varieties will be given priority to product, product customization will be the mainstream of the market[10]. In order to adapt to the rapid flexible customization production, the types of jobs will change significantly. Questionnaire should pay more
attention to open questions, and increase the variety of options to replenish the information demand, especially consider "competency-position fit". The core content of the training needs survey should be urgently needed knowledge and skills in order to enhance performance, combined with curriculum requirements put forward by the employees themselves. The survey means should be questionnaire, interview, observation, discussion, key events, and other research methods. The key should be combined with more training needs change, more focus on training needs satisfaction, and more employee support.

4.2. Training Courses and Methods
With the coming of Industry 4.0, the use of modern information technology made "Internet +" wisdom training, information technology and employee training integration, and become a mainstream enterprise training development pattern. [11]Enterprise training course design should be made a scientific understanding of "Three steps order": in the course for the entry job description need the knowledge and ability; The course of the job promoted in 1 to 2 years which need knowledge and ability; The course of the job promoted in 3 to 5 years which need knowledge and ability. By designing different positions with big data and cloud platform, we should effectively integrate online and offline course according to the knowledge and ability, develop the mobile APP on the line of class and intelligent learning cloud platform, build wisdom training classroom, motivate employees to participate in the training courses for career development. In terms of training methods, we should provide online and offline integration training model, optimize training course and integrate human-computer interaction, and provide employees more flexible learning time, more diverse learning resources, more human nature learning environment.

4.3. Teachers and Guarantee of Training
Manufacturing enterprises should build their own "three combination" training teacher team, namely, the enterprise's internal trainer and external trainer together; Online teaching speaking teacher lecturer and guidance for offline together; internal and overseas together. In training guarantee, first of all, designing support system, including rulers and regulations for training committee work, training management and post evaluation, training department work, training class schedule resources development, training teacher rating and reward systems, from cloud platform construction and management system, training budget and management, training, performance evaluation and rewards and punishment system, build the training document filing and management, manager training, new staff training, promotion training, job-transfer training, and so on. At the same time, we should effectively converge with the employee's assessment, post promotion and the compensation.

4.4. Training Organization and Implementation
In terms of training organization, Iteration of knowledge and skills of iteration speeds up faster, the complexity of the enterprise training will be greater, part-time training department and employees will not be able to fulfill the arduous training task. Therefore, the enterprise should set up the independent training department, prepare a special training budgets, build enterprise’s own training system step by step. Large-scale enterprises should consider to build their own university (college), to meet the demand for the continuous improvement of employees’ knowledge and skill. In the implementation of training, enterprise should pay attention to the future development online and offline training methods, to fully meet the needs of the new generation employees’ mobile learning and fragmented learning.

4.5. Training Performance Evaluation
The training performance evaluation is important control means to guarantee the training quality, according to Kirpatrick’s evaluations model, there are four levels. First the feedback’s evaluation, which mainly evaluating the feedback and feeling of participants. Second, the learning evaluation, which mainly evaluating the improvement of the trainees’ knowledge and skill. Third, the behavior evaluation, which mainly evaluating the changes in attitudes and behaviors among participant. Finally,
the performance evaluation, which mainly evaluating the trainees' performance after training. In specific training performance evaluation, we should collect data and information in the process of training, so as to put forward the suggestions for training course development.

4.6. Transfer of Training Achievements
The ultimate goal of corporate training is to get all the benefits that employees who participate in training will receive new knowledge, new skills and new thinking effectively in practice, and to gain the effective transfer of training achievement. Manufacturing enterprises need combine knowledge and skills in the beginning of training will set goals for training achievement transfer, and record persistently training achievement, with the academic qualifications, skills certificate innovation achievements, post rank promotion, and so on. Training department should record every trainee's growth of electronic archives, summarize and analysis regularly, and encourage outstanding students timely, which can be used for annual assessment of individuals and departments, and scientific decision basis for the next training resources allocation.

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