

Construction of CNC Technical Talents Team in Manufacturing Enterprises based on “Eagle Project”

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Abstract

Intelligent manufacturing is a kind of human-machine integrated intelligent system composed of intelligent machines and human experts, which can be applied to many industries. However, aviation manufacturing enterprises are typical ones that produce multi-variety, small-batch, and complex parts. Therefore, the intelligent manufacturing upgrading is faced with more difficulties in technology and construction of technical talents team. To realize the intelligentization of aviation manufacturing enterprises, higher requirements are put forward not only for individual technical talents, but also for the construction of the entire technical talents team. Taking a large state-owned SK enterprise as an example, this paper studied the construction of CNC technical talents team of SK enterprises from four aspects of “selecting, educating, employing and retaining”, and proposed a construction scheme of technical talents team based on “Eagle Project”.

Keywords

Intelligent manufacturing; aviation manufacturing; technical talents team construction; SK enterprise; eagle project.

1. Introduction

At present, all countries regard intelligent manufacturing as the strategic layout of manufacturing upgrading, and promote the development of traditional manufacturing to digital intelligent manufacturing [1]. Since the beginning of this century, China's aviation industry has developed rapidly, with rapid replacement and diversification of models. However, the problem of manufacturing has gradually become prominent in this new development situation. To complete the production tasks with high efficiency and quality, advanced equipment, technology and management are required.

“Everything is people-oriented”, so human resources is an important force to promote the development of enterprises [2]. Manufacturing enterprises are multi-technology compound enterprises, so the inheritance and innovation of technical knowledge is the key to maintain vitality and competitiveness [3]. Therefore, strengthening the training of technical talents, making them grow up rapidly, inheriting enterprises knowledge well, and innovating again is an important way for enterprises to develop rapidly. However, with the advent of the intelligent manufacturing strategy, the problem of the construction of technical talents team in manufacturing enterprises has become increasingly prominent: 1) The structure of technical talents team is unreasonable and lack of successors; 2) The personality of young employees are outstanding in the new era; 3) State-owned enterprises still use traditional training methods for the training of technical talents; 4) Enterprises are unwilling to invest a lot of money in the training of new employees in order to maximize their interests.

In the research of talents team construction, He and Zhao established a set of evaluation system based on the human resources management theory and realized the fuzzy comprehensive evaluation of human resources [4]. Wang et al. proposed an evaluation method for the

development level of technological talents in enterprises using the grey-system theory [5]. Taking different perspectives of talent division as the starting point, Wang explored the problem of building the talents team that matches the organization [6]. Liu et al. discussed the advantages and disadvantages of talent management in Chinese enterprises by using the methods of investigation and research, and put forward the strategies to deal with the problems faced by talents management [7].

Taking a large state-owned SK enterprise as an example, this paper studied the construction of CNC technical talents team of SK enterprise from four aspects of “selecting, educating, employing and retaining”, and proposed a construction scheme of technical talents team based on “Eagle Project”.

2. The Challenge of Intelligent Manufacturing to Sk Enterprises

(1) The production efficiency of aviation structural parts is extremely low in SK enterprises and cannot meet production requirements. For example, in the airbus A320 project of an SK enterprise, a panel part D531-13784-XXX of the wheel well, using the same production equipment as foreign countries, we will spend more than 4 times as much time as foreign countries to prepare processing procedures. The production efficiency is far lower than the international advanced manufacturing level.

(2) The technical skill level of technicians in SK enterprises cannot meet the requirements of the new situation. In the same time, we can complete a set of programs, while foreign technicians can complete multiple programs.

(3) The on-site production mode of SK enterprises has a high degree of manual intervention, which is contrary to the development of intelligent manufacturing. When the equipment is running, technicians need to continuously monitor, adjust and improve the equipment.

(4) The current equipment (manufacturing tools) is not intelligent enough. A set of system often contains multiple equipment from different enterprises. The cooperation between the equipment is not perfect, and they still operate independently. So the degree of automation is not high enough.

(5) The quality of products cannot reach the advanced level. Due to the lack of relevant databases, there is no alarm or suspension of the machine tool when the tool is damaged, resulting in parts damage. Products often fail to meet customer’s requirements because of low quality.

3. The New Requirements of Sk Rnterprise for the Construction of Technical Talents Team

Intelligent manufacturing brings new challenges and opportunities to the manufacturing industry. Under the new situation, SK enterprises also have new requirements for the construction of technical talents team.

3.1. Selecting.

Under the situation of intelligent manufacturing, SK enterprises have higher requirements in the selection of technical talents, and need to introduce high-quality talents with higher degree and stronger research ability. On this basis, analyze the situation of the existing technical talents, to clarify the needs and direction of the selection and recruitment. The selection needs to be carried out from two aspects, the manufacturing model and the business model. External selection should be in line with the development direction of intelligent manufacturing. Internal selection should shift to the mode of “less humanization” on the production site, and adjust the structure of employees.

3.2. Training.

Cultivation of talents needs to be carried out from many aspects, not only the training of professional skills, but also the cultivation of personality, values, world views, outlook on life and other aspects. Only in this way can it meet the development of the new situation and the personality of new employees in this new era.

3.3. Employing.

Known to make good use of people is the key to the stable operation and sustainable development of an enterprise. Employers cannot be selected from one aspect, and the choosing and using must be coordinated. This will balance the pros and cons in all aspects. At the same time, it is necessary to avoid the relationship theory and the academic theory when selecting, only in this way can talents suitable for the enterprise be selected.

3.4. Retaining.

Selecting, training, and employing are all laying the foundation for retaining people. "Retaining" refers to retaining employees who meet the development of the enterprise and share the same values with the enterprise. Since the realization of intelligent manufacturing in SK enterprises still have a long time, it requires the inheritance and innovation of technology. In the future era of intelligent manufacturing, technology may be the most important. Therefore, the technical level determines the survival and development of an enterprise. So retaining high-tech talents is the key to the sustainable and healthy development of an enterprise.

4. Construction of Talent Training System Based on "Eagle Project"

4.1. Formulation of "Eagle Project"

The traditional training mode of new employees is "apprenticeship" model, which lacks scheduling, systematicness and standardization. Through improvements in recent years, SK enterprise have made some progress in training, but there are still some problems.

The training cycle of new employees takes about three years. Theoretical training and practical post training are the main means. The overall training is divided into three stages, and the framework is shown in Figure 1.

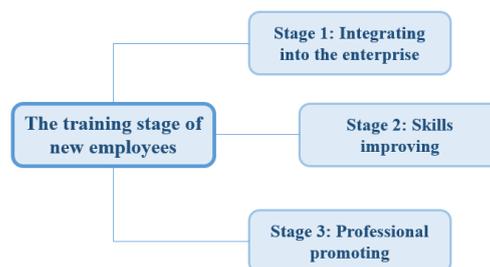


Figure 1. The training stage of new employees

Stage 1: Basic training to integrate into the enterprise (6-8 months).

Objective: To lay a solid foundation for new employees, so that they can master basic processing programming skills, be basically competent for the post requirements, and engage in simple processing work. Making efforts to let new employees establish the awareness of standardized work, know what rules, quality control documents, processing specifications, etc. need to be observed and implemented in the work, and how to develop a good work habit.

Tasks: Enabling new employees to change their roles and master the basic system of the enterprise, to understand the on-site operation process and basic knowledge of machine tool operation, to clearly understand the specific content and process of technological work, to master the basic functions of programming and simulation software, be familiar with basic

system documents and work specifications, be able to carry out daily processing work according to standards, and be competent for the whole processing programming of simple parts.

Stage 2: Skills improving to integrate into the post (1.5 years).

Objective: Carrying out training application ability of various software and hardware for new employees to strengthen their working ability in all aspects, emphasizing mastering more skills, enriching and improving their own experience, and comprehensively understanding and mastering the fields they come into contact with and the knowledge they will use in the daily work. New employees must complete all training at this stage, pass the assessment, and process the ability to undertake the technical work of moderate difficulty.

Tasks: Making new employees have a further understanding of the processing work, and independently formulate CNC machining flow and process plan, rather than imitating. Mastering and be proficient in application of professional software, rather than mastering basic functions. Integrating into a professional team, be able to work proficiently in accordance with standardization, and be able to basically complete the whole process preparation of typical parts with moderate difficulty.

Stage 3: Professional promoting to integrate into the career (one year).

Objective: Carrying out various typical and specialized trainings, so that new employees can understand specialized work and integrate into specialized teams. Enriching the knowledge of new employees to strengthen the ability in various aspects. By carrying out training to expand the vision of new employees and improve their ability of innovation and application, improve their skills and cognitive level.

Tasks: Equipping new employees with the ability to solve general site problems. Possessing the ability to participate in the research of professional technical fields such as the innovation of CNC machining plan, the application of cutting parameters, new equipment, tool, tooling and so on. Be able to complete the process preparation of moderately difficult parts independently.

At the same time, the corresponding training effect evaluation should be carried out at each stage, and corresponding reward and punishment measures should be implemented to stimulate the enthusiasm of employees. The results of the assessment also directly reflect the student's mastery of the relevant skills, so that the curriculum can be adjusted at any time to suit the students. What's more, the three-year total credits of new employees will be considered as one of the factors to consider for promotion, which can greatly improve the enthusiasm of employees.

In the meantime, a similar evaluation is also carried out for the teachers, which can not only improve the teaching quality, but also improve the teaching efficiency. It enables new employees to master more comprehensive knowledge and skills in the shortest time, avoiding the drawbacks of the traditional apprenticeship mode.

4.2. Establishing the double mentorship system for technical talents development

Double mentorship system is job mentor and ideological mentor system. For the construction of the talents team of the enterprises, in addition to having excellent professional skills, young talents should not only have excellent professional skills, but also should basically identify with and practice the enterprise culture in terms of ideology, and truly integrate into the enterprise. Therefore, a double mentorship system is implemented for young employees, with one mentor responsible for technical guidance and the other for ideological leadership. In this way, on the one hand, it provides a channel for young employees to relieve themselves of any confusion or problems they encounter in their work or life, so that they can communicate with their ideological mentors and thus seek help. On the other hand, it can subconsciously strengthen the

young employees' integration into the enterprise culture. Grasp job skills enhancement with one hand and ideological and civilizational construction with the other. 'Grasp with both hands, both hands must be hard.' The job mentor is an upgrade and optimization of the original teacher-apprentice, and the ideological mentor is a new training vehicle to explore.

Job Mentor

Job mentors are found in general companies, only the function and degree of implementation of the mentor varies from company to company. In most cases, however, the concerns between post mentors and new employees tend to be different, with who being more concerned with: ① They perceive the job mentors to be working with negative emotions. ② The job mentors have a specific job and sometimes is not able to care for the new employees as well as answer their questions at work in a timely manner. ③ The young technicians of the post-90s need to be given a particularly strong sense of attention and recognition. ④ Most of the technical employees in SK enterprises are from non-local region, and the superior-subordinate relationship between leading managers and the competition between colleagues makes new employees feel a strong sense of loneliness.

Ideological Mentor

Ideological mentors are trusted advisors or guides. Mentorship is the establishment of a relationship of mutual trust between mentor and mentee. An ideological mentor is a relationship that focuses on professional development and aims to provide assistance to the mentee's personal development. Clarify the duties, assessment requirements, rewards and punishments of the ideological mentor.

The duties of ideological mentor are: ① To carry out interviews and daily communication with new employees with the enterprise culture, the environments and relevant standard. ② To communicate well with new employees' job mentors, to understand the progress of new employees' job learning, to summarize achievements and shortcomings in a timely manner, as well as to give timely encouragement or guidance. ③ To collect all kinds of information and provide timely feedback to the Engineering Technology Office (ETO) and the Integrated Management Office (IMO) on the 'Mentorship Record Form' and to follow up the progress continuously. ④ To provide information required for the evaluation of new employees at the end of their probationary period.

The assessments of ideological mentor are: ① Whether the enterprise culture, values, rules and regulations as well as the relevant culture of the branch and section are correctly conveyed. ② Whether the new employees are given timely guidance and sufficient care to new employees. ③ Whether to insist on good daily communication, information collection and feedback, and interview work during the probationary period of new employees. ④ Whether to maintain good communication with the job mentor.

The rewards of ideological mentor are: ① An advanced individual each year is planned to be selected by the training workgroup from ETO according to the assessment and evaluation results of ideological mentors. ② Ideological mentors who has poor performance assessment results, which means the score is below 60 on 100), for two consecutive years will be disqualified.

4.3. Establishing three-dimensional learning model

Under the new situation of intelligent manufacturing, new requirements are put forward for the construction of technical talents, and the traditional passive learning model can no longer meet the new requirements. In the new form, more attention is paid to the autonomy of learning, so that trainees gain more of an active learning attribute. In this context, SK enterprises have developed a "three-dimensional learning model" for the construction of technical talents, mainly based on "night school" as the central axis of the new learning direction of intelligent manufacturing, "boutique lecturer group" as the core, the "management forum" as the middle

level, and the “technical lecture hall” as the shell of the three-dimensional model. The main innovative thinking is as follows.

(1) The central axis content of learning and training of intelligent manufacturing is mainly implemented and completed in the form of night school, which is specifically divided into three levels: process technology level (process night school), quality control level (quality and equipment night school) and information construction level (IT software night school).

Specific measures to carry out the night school: although the training system of SK enterprises has been established and relatively perfect, there is a gap in the learning platform for professional extension, available for employees to choose and table to play a voluntary participation of employees. In order for training to be effective, participants must first have a strong personal will and be able to mobilize their personal interests. For this reason, SK enterprises’ technology department has taken the lead in running a technology night school. The night school is open to all and participation is voluntary. The majority of participants are new employees in the technical department and field workers who want to build a solid foundation and improve more quickly. The night school is conducted in the evening spare time for a period of one month, with three classes per week, 24 classes of teaching time and 12 classes of question and answer time. The main content of the training is the knowledge of CNC machining process technology, software tools application and so on. The training is open-ended, with the teacher giving trainees practice assignments to practice in class and then coming to the lectures with questions, with the teacher setting aside time to answer questions. This kind of training is very helpful for those who are interested in solving questions, enriching their knowledge and getting a quick boost.

(2) The boutique lecturer group is the core layer of the entire incubation model. The boutique lecturer group is composed of management, technical elites and visiting scholars from SK enterprises, who dovetail with frontier technological developments, master the industry dynamics. Introduce ideas, disseminate innovative thinking among employees, and open the doors and embrace intelligent manufacturing with open arms.

Specific initiatives to carry out the boutique lecturer group: The boutique lecturer group is based on helping young employees to grow and become successful and to understand the most frontier technology knowledge, management innovation methods and tools application, and work literacy enhancement.

Innovation methodology courses

“Innovation Methods and TRIZ Theory”, “3D Digital Inspection Technology for Digital Machined Structural Parts”, etc. The courses mainly teach the basics of “Invention Problem Solving Theory”, the principles of invention and innovation, methods of solving invention problems, technical contradictions and application cases, etc., providing effective guidance for young employees to carry out innovation work.

Frontier technology knowledge courses

“S-shaped Test Pieces and the Road to International Standardization”, “AlphaGo and Intelligent Manufacturing”, etc. (some of the courses are taught in English), the course mainly teaches the development of SK enterprise S-shaped test pieces from its birth to becoming an international standard. In order to enhance the enthusiasm of young employees to learn English, the course will be taught in full English, and may set up English exchange speech sessions to strengthen technical exchanges and communication with foreign countries, and visiting scholars are required to make reports in full English upon their return to China.

Courses on the application of management innovation methods and tools

“Introduction to Lean Six Sigma”, “Thinking and Practicing Smart Manufacturing”, etc. the courses mainly teach the basics of Lean Six Sigma and application, so that young employees can understand the current advanced management improvement and management innovation

concepts and tools , and help them improve their problem-solving skills and facilitate their development of innovative topics.

Work literacy enhancement courses

“Effective Communication Skills” and “The Two-Eight Principle”, which introduce effective communication methods and skills, correct attitudes towards work and lessons learnt from successes, and guide young employees to establish correct work attitudes and find the right ways to enhance work literacy, so that they can better communicate with team members and better carry out innovative work.

(3) As a very important intermediate layer of the “three-dimensional learning model”, The Management Forum plays a very important role in the five generations, i.e. “one generation of products, one generation of equipment, one generation of technology, one generation of management and one generation of talents”, carrying on the top and starting the bottom, linking products, equipment, technology and talents. The organic combination of advanced equipment, advanced technology and complex talents is the new requirement of intelligent manufacturing for the construction of talents teams. The Management Forum is a bridge and a link that gives life to advanced new technologies and new management theories and ideas, so that they can really blossom in the enterprises. The Management Forum has built a very good platform for knowledge dissemination, experience sharing and answering questions and doubts. The source of the idea of building such a platform is to combine Maslow’s theory of need. Technical employees work overtime for a long time and are closed in their jobs for a long time, busy with business work every day, not to mention what social interaction, all technical employees in the minds of everyone is “mute and dull”, not smiling, lack of interest in life, but in fact, each has its own needs, at different stages have different needs of their lives.

The Management Forum has an open attitude and is not bound by the content and form of the topic, there are talks about management awareness, life perceptions, technology advancement, food and shopping, the local customs, cultural relics and antiques and so on. The topics are unlimited, the forms are unlimited, and it is very popular among the technical employees because it is an open platform, and an open platform brings inevitable open thoughts, especially for the post-90s, who enjoy it, a kind of buffer for the pressure of life, a soft introduction to the frontier technology and management, and sometimes a new thought and a new idea will spread rapidly among the group. Through such a platform not only to spread knowledge, more importantly, is to exercise the comprehensive quality of employees’ ability, for the later part of the comrades of the management position to explore the “ability spiral” appointment has laid a very solid foundation.

(4) The Technology Lecture Hall is the most direct and effective external core for the introduction of advanced technology under the situation of intelligent manufacturing. Technical Lecture Hall is a more professional learning platform, but also o build a platform to solve technical problems, technical discussion collision. The Management Forum may be aimed at those who are willing to deal with people, while the Technical Lecture Hall is more for the technical employees who are happy to work in the technical research path. It is a more customize platform for the research of new technologies for intelligent manufacturing, through which more technical problems are solved on site and a group of technical experts and technical chiefs are trained.

The Technology Hall is divided into three main sections: “point, line and surface”. Firstly, the Technical Lecture Hall is very grounded, turning the whole into shards, focusing on a certain technical point of SK enterprises for internal exchange and discussion, such as multi-axis CNC machine tool spatial error detection and compensation, machine tool dynamic accuracy CNC system control principle, the new situation of aircraft process design work introduction, wall plate processing process plan and process preparation of common problems, manufacturing

outline site paperless change operation standards. Secondly, the Technical Lecture Hall will be organized by the technical section of SK enterprises to carry out technical exchanges in the face of the pilot work of intelligent manufacturing undertaken by SK enterprises, such as atypical process preparation requirements for STC flexible lines, introduction of VB825A flexible production lines, implementation of intelligent component assembly, status and development trend of research and application of processing status monitoring technology, etc. Thirdly, the Technical Lecture Hall by SK enterprises will invite domestic well-known manufacturing industry expert to the unit to speak for the technical employees of frontier technology such as 3D printing technology promotion and application research, the rapid programming of South China Airlines, the manufacturing system operation optimization and MES technology of Huazhong University of Science and Technology, 618# institution's information technology, etc. On-site technical problems were effectively solved, promoting the implementation of flexible production lines for intelligent manufacturing in SK enterprises.

5. Conclusion

(1) Firstly, this paper investigates and summarizes the challenges faced by the construction of CNC technical talents in SK enterprises under the new situation of smart manufacturing from five aspects.

(2) Secondly, according to the new situation of intelligent manufacturing, the challenges faced by the construction of CNC technical talents in SK enterprises, new construction requirements are proposed from four aspects: "selection, training, employment and retention".

(3) Finally, the construction plan of SK enterprises NCN technical talents based on the "Eagle Plan" is proposed. The "Eagle Plan" sets out the training stages for new employees, establishes a double mentor system of: job mentor" plus "ideological mentor" for the training of technical talents, and builds a three-dimensional learning model.

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