

Intelligent Transformation of Small and Medium-sized Enterprises through University-enterprise Cooperation

-- Taking Manufacturing Enterprises for Example

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Abstract. At present, a new round of industrial revolution is profoundly affecting human production and life style. The traditional manufacturing industry will further develop towards intelligence under the background of industry 4.0. In the development of local economy, local small and Medium-sized enterprises play an important role. However, small and Medium-sized enterprises often lack the ability of capital, technology and reform and development. Their hardware equipment is still at a low level in the field of modern industry, and their profits are greatly affected by labor costs. Local small and Medium-sized electrical appliance manufacturing enterprises promote the intelligent transformation of enterprises through in-depth cooperation with local universities and collaborative innovation, so as to provide reference experience for the transformation and upgrading of small and Medium-sized enterprises.

Keywords: School-enterprise Cooperation; Small and Medium-sized Enterprises; Manufacturing Enterprises; Intelligent Transformation.

1. Introduction

Relying on the school enterprise cooperation platform and the standard of "high starting point, new technology and development", an "intelligent construction team" composed of intelligent manufacturing professional teachers and enterprise technicians was established to investigate small and Medium-sized enterprises in the electrical industry, evaluate the intelligent level, and finally formulate an intelligent transformation plan to provide intellectual support for the transformation and upgrading of small and Medium-sized enterprises [1, 2].

2. Formulating Enterprise Intelligent Manufacturing Evaluation Standards

In order to objectively evaluate the intelligent level of equipment in small and Medium-sized enterprises, the "intelligent construction team" has formulated intelligent manufacturing evaluation indexes of three first-class indexes, seven second-class indexes and eighteen third-class indexes according to the intelligent manufacturing evaluation guide, as shown in Table 1 below [3]. According to these indexes, the production equipment of some small and Medium-sized electrical enterprises is diagnosed, Evaluate the intelligent manufacturing level of the enterprise.

Table 1. Evaluation criteria for intelligent manufacturing of electrical enterprise

Numble	Primary index	Secondary index	Tertiary indicators
1	Personnel management	Organizational strategy	Enterprise strategic planning
			Enterprise organizational structure
		Personnel skills	Management personnel
			Technical application talents
2	Information construction	Data	Data technology and data management
		Integrate	System integration
			Big data\ Artificial intelligence

		Information safety	Storage backup and recovery
			Application of information security technology
3	Production equipment	Equipment	Numerical control equipment
			Automatic production line
			Industrial robot
			Intelligent equipment production line
			Warehousing and logistics equipment
			Inspection and testing equipment
			Energy, environmental protection and safety facilities
			Network
			Network resource
		Industrial interconnection	

3. Evaluating the Intelligence Level of Enterprises

In order to clarify the main problems existing in small and Medium-sized electrical enterprises, some small and Medium-sized electrical appliance manufacturing enterprises were selected to evaluate their intelligent manufacturing level according to the "intelligent manufacturing evaluation.

3.1 Personnel Management

Some enterprise leaders have low awareness of information management and do not have a complete set of long-term strategy for enterprise information development. They believe that the current situation of enterprise information and automation is very good and lack of information theoretical knowledge. At the same time, many production enterprises lack professional information-based talents and information management software, which leads to the fact that enterprises need more oral management or paper document communication at the management level, and the management efficiency is not high, which leads to the lag of information construction.

3.2 Information Construction

Most enterprises use ERP system for daily production and financial management, but the modules of the whole system are not perfect. The missing modules mainly include workshop production, quality management, equipment management and other basic modules [4]. Therefore, the system cannot effectively provide data control and data support, resulting in the inability to provide any effective data support to the management and decision-making levels in time, resulting in a large number of manual data processing and collection, increasing labor costs, making the enterprise's internal control risk high and the risk cannot be effectively controlled.

3.3 Equipment Automation

Most enterprises use automation equipment in some processes. On the whole, the degree of automation is still at the lower middle level. In particular, the intelligent level of product assembly equipment is low. In the process of equipment assembly, it is mostly carried out in the way of manual assembly, and robots and automatic equipment are rarely used for main production, resulting in the lack of necessary assembly parameters such as whether the assembly is in place and whether the screw torque is reasonable in the whole assembly process, and the product quality is easy to go wrong; In addition, the routine inspection and maintenance methods of equipment are relatively traditional, which is easy to cause equipment shutdown, affect the service life of equipment and restrict the development of enterprises.

4. Formulating Enterprise Intelligent Transformation Plan

4.1 The Scheme of R&D Design and Process Improvement

In view of the problems of easy loss of documents and easy disclosure of important data in the R &D process of some manufacturing enterprises, it is suggested that small and Medium-sized manufacturing enterprises should use product data management (PDM) as soon as possible. The PDM is a technology used to manage all product related information (including component information, configuration, documents, CAD files, structure, authority information, etc.) and all product related processes (including process definition and management) [5]. The implementation of PDM can realize the electronic archiving and version management of various drawings and documents (drawings, process documents, etc.) in the product design stage, which can improve the design and development efficiency of electrical manufacturing enterprises, facilitate the coordinated management of the whole life cycle of electrical appliances, and standardize the production workflow of electrical appliances.

4.2 The Scheme on Automatic Reconstruction

As part of the small and Medium-sized electrical appliance enterprises that still belong to labor-intensive industries, they involve many categories of electrical products and belong to typical multi variety and small batch production. The production relies too much on labor and traditional process technology. It is urgent to accelerate the transformation and upgrading of production lines through the integration of information and intelligent technology and industry. The upgrading and automation transformation of electrical production equipment can be divided into three stages: the first stage is to realize the digital modeling and Simulation of workshop overall design, process flow and layout, and resort out the process, station, logistics and equipment placement, so as to maximize the logistics efficiency; The second stage is to improve the automatic equipment such as cutting, detection and packaging, so as to realize the assembly line, detection automation and packaging automation of the production line; In the third stage, through the collaborative manufacturing of intelligent NC equipment and industrial robots, the production automation is realized. The role of manpower is mainly to carry out system design, assembly, adjustment, inspection, supervision of production process, quality control and maintenance of NC equipment. Through the transformation of man-machine combination, enterprises can effectively reduce the amount of manual work, realize the whole process automatic production, and improve production efficiency and product quality.

4.3 Improvement Scheme of Information Management System

In view of a series of problems existing in logistics, people flow, financial flow and information flow management of small and Medium-sized enterprises, the ERP management system should be built and used well. The construction of ERP management system can be divided into three stages: The first stage is to realize the launch of ERP module. Enterprises can first use the purchase, sales and inventory and production modules to make the production operate automatically, and let employees gradually get familiar with the process; In the second stage, the bar code system is launched to establish the traceability of logistics; The third stage is to implement the integration of electronic system to make the production site visible and transparent [6]. By using ERP enterprise management system, the enterprise integrates material resources, capital resources and information to realize comprehensive, resources information-based monitoring and management.

5. Summary

Focusing on the intelligent transformation and upgrading of small and Medium-sized enterprises, small and Medium-sized enterprises implement intelligent transformation through cooperation with colleges and universities, which improves the comprehensive competitiveness and sustainable development ability of enterprises, and then promotes the improvement of the overall local economic

level. At the same time, the intelligent transformation of small and Medium-sized electrical appliance enterprises is highly representative. Therefore, analyzing China's experience in supporting the transformation and upgrading of small and Medium-sized enterprises in the field of intelligent manufacturing can provide more direct reference for relevant enterprises.

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