Intelligent Development of Safety Production System under 5G+ Industrial Internet

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Abstract. As an opportunity for countries around the world to revitalize the manufacturing industry and the transformation and upgrading of our country's manufacturing industry, the production safety system is an opportunity for the development of advanced information technology, manufacturing technology and artificial intelligence. At this stage, intelligent manufacturing has set off a global research boom. This article mainly introduces the research on the intelligent development of the safety production system under 5G+ Industrial Internet. Through the intelligent research on the safety production system, the development of the early warning system model of the safety production system is carried out. This paper uses 5G + Industrial Internet combined with intelligent manufacturing technology to establish an early warning model. Increase the efficiency of the production system by 34%, greatly reducing the possibility of safety accidents. Based on the traditional safe production system, facing the development needs of intelligent manufacturing technology, and taking the training goal of advanced skilled talents as the direction, this paper deeply analyzes the requirements and characteristics of the training model for the intelligent manufacturing system, and constructs the corresponding Intelligent manufacturing safety production system.

Keywords: 5G Technology, Industrial Internet, Intelligent Manufacturing, Early Warning Model

1. Introduction
Work safety has always been an area of focus for the public. There have been shocking safety accidents, emphasizing that safety production and supervision are urgent problems in today’s society. Work safety is severe, safety production supervision information is asymmetry, and government safety supervision tasks are heavy[1]. Problems such as insufficient supervision capabilities have become increasingly prominent. In order to accelerate the informatization of production safety across the country, strengthen the interconnection of information systems.
The stage of production safety in my country, in-depth discussion of the relationship between the status of macro safety production and influencing factors and the interaction mechanism, Marco Annunziata attaches great importance to the establishment of a national and industry macro safety production early warning model, which is conducive to the study of the macro safety production in my country Stages and future development trends are conducive to grasping the internal coordination mechanism of the macro-safety system, so that scientific macro-safety intervention policies can be formulated, thereby providing technical guarantees for the coordinated development of production safety, economy and society.

The innovation of this paper is to propose an early warning model based on 5G + industrial Internet combined with intelligent manufacturing. According to the accident rate and safety threshold range during the operation of the safety production system, establish equipment and facility inspections, maintenance and necessary inspection systems in the early warning model: strengthen the investigation and rectification of hidden dangers, and improve the level of on-site safety management; to realize the safety production system. The whole process of management is dynamic and full of employees.

2. Safety Production System under the Internet

2.1 Internet Safety Production System Concept

According to the principles of the scientific risk management process of risk management, the hazard identification process should provide sufficient information for security risk control[2]. To identify risks, a systematic identification method should be adopted. The elements of the production system of an enterprise are in different states at different times of its life cycle, and the characteristics of the elements of the production system are also different. It is necessary to use different risk identification methods with specific technical characteristics to implement different life spans of the business production system. The identification of risk resources and the composition of different components during rotation. Have a deep understanding of the company, the basic elements of the production system include: equipment and facilities, operational activities, operations, environmental and environmental related.

2.2 Characteristic Analysis of Internet Production Safety System

The state perception of self-perceived manufacturing resources is a prerequisite for realizing production control. There are always many information islands in the traditional manufacturing process, which cannot realize the complete interconnection of the physical world[3]. With the rapid development of advanced information technologies such as sensor technology and IOT, The physical resources in the manufacturing process can be actively sensed and the information can be integrated and analyzed. The explicitness of the data lays the foundation for the realization of transparent production. The artificial intelligence algorithm designed for specific problems will optimally match tasks and resources according to the corresponding manufacturing task requirements (objective function, constraint conditions, etc.).

In the adaptive manufacturing process, the control strategy and scheduling plan are adjusted according to rules, knowledge bases and intelligent algorithms to reduce or eliminate the impact of production disturbances[4]. The essence of execution is to convert the decision results generated by the control system into instructions or commands that can be executed by the physical resource entity. At the same time, disturbances are found in the execution process, and the adaptive model is used for optimization to achieve collaborative feedback and optimal scheduling of the production control process.

2.3 Influence of the Internet on the Production Safety System
Let $K$ be the unobservable net profit brought about by Internet security behavior, $Y$ represents observable behavior, $I$ represents the unobservable impact brought by Internet use, and represents whether to use the Internet. This article constructs the measurement model of $Y$ and $I$ as follows:

$$Y_{ik} = \alpha I_j + U_j \quad Y_{ik} > 0$$

In order to obtain a consistent estimate of the impact of Internet use on the safety production system, we use the "first-type Tobit model" to estimate. According to the judgment matrix, we have the following formula to find the eigenvector corresponding to its largest eigenroot, and the formula is as follows:

$$P_{ik} = \lambda I_j + vX_i + W_j$$

At present, there are many methods for business process reengineering, but there is no completely suitable method for production process reengineering, according to the characteristics of the aforementioned production process and the main problems. The incidence matrix of Petri net is an $m \times n$ integer matrix. Use $A$ to represent the incidence matrix as follows:

$$A = [a_{ij}]_{m \times n}$$

The production process reengineering method is based on the Petri net correlation matrix and combined with the requirements of intelligent manufacturing for the production process[5]. Firstly, the modeling method combining IDEFO and Petri nets is used to model the three stages of the production process; secondly, the order review stage. Order placement stage and order execution stage, according to the Peti network correlation matrix analysis of conflicts, selection, synchronization and concurrency between activities: Finally, according to the analysis results of the second step of the step, combined with the requirements of intelligent manufacturing for each stage of the production process, corresponding Reengineering the program.

### 3. Design of Production Safety System for Intelligent Manufacturing

#### 3.1 System Requirements Analysis

The development of the production safety system for intelligent manufacturing is implemented on the basis of the mixed-flow assembly line balance research and the coordinated optimization of assembly line balance and logistics scheduling considering the random fluctuations of operating time under the uncertainty of demand in this paper[6]. The ultimate goal of the system is to The PC terminal and the mobile terminal visually realize the functions of controlling the balance of mixed assembly lines. Therefore, the development of the system has the following requirements.

1. **Order management function:** The assembly workshop implements just in time production (Just in time), and the workshop production plan is mainly based on customer (market) demand order information. Therefore, the system is required to realize the query function of production orders in the ERP system, which is convenient for the balance of mixed assembly lines.

2. **Material management function:** It is required to calculate the proportion of different products and the number of corresponding parts required according to the specific demand quantity of the product order, which is convenient for enterprises to purchase materials (parts), which is a line balance and Material scheduling provides a data basis.

3. **Invoking the balance algorithm of mixed-flow assembly line:** According to the priority relationship of the product process operation and the product demand ratio and the number of workstations, the mathematical model of the mixed-flow assembly line balance problem established is called MATLAB program to solve, and the optimal workstation allocation plan, production cycle, assembly line balance rate, and process information that each workstation needs to be assembled are
displayed to the front end of the system to guide workshop managers and workers in actual production.

3.2 Overall System Design
System-based demand analysis. The system mainly includes five sub-function modules, namely order management, material management, mixed-flow assembly line balancing, assembly line logistics scheduling and system management[7]. Order management and material management are the basis for the operation of the system, providing parameter input for assembly line balance and logistics scheduling; mixed-flow assembly line balancing is the core function of this system, and the mixed-flow assembly line balance is performed by calling the intelligent algorithm written by MATLAB and the optimal assembly plan of the workstation show to the front end of the system. Contains user ID, user name, password, email and other related information. Mainly used for registration and login. The specific table structure is shown in Table 1.

| Parameter                  | Primary key | Parameter       | Specific description |
|----------------------------|-------------|-----------------|----------------------|
| Input flow                 | yes         | nchar(10) UserID|
| Vehicle speed              | yes         | nchar(10) Username|
| Front and rear flow        | no          | nchar(20) Password|
| Share                      | no          | nchar(15) authority|

4. Analysis of Traffic Safety Early Warning in the Environment of Internet of Vehicles

4.1 Analysis of the Traffic State Estimation Algorithm in the Network of Vehicles

| Early warning degree                  | Warning color | Warning index |
|---------------------------------------|---------------|---------------|
| No police                             |               | OcL<u         |
| Grade IV (light police)               | Blue          | U<Fl<ute      |
| Level III (Intermediate Police)       | Yellow        | U+o<Fl<u+20   |
| Level II (heavy alert)                | Orange        | U+2c<Fl<u+3c F3c |
| Class I (Giant Police)                | Red           | 3c<Fl         |

In order to determine a reasonable warning limit, the change trend of the warning index should be grasped first. When the change trend of the warning index is stable, the fixed base index should be used as the warning warning limit. For example, the data of the average annual temperature of a place fluctuates around a certain value[8]. When the early warning indicators have a large upward or downward trend, the ring-on-quarter early warning index should be used as the early warning limit. Assuming that the fixed-based early warning index is used as the early warning limit, it is likely that the accident index will be in a state of no warning for several years in the future. This obviously loses the significance of the early warning model. Therefore, when setting the warning limit, it is necessary to analyze the trend of the indicator first, and select the fixed-base warning index or the chain warning index as the measurement standard of the warning limit according to the trend analysis. According to the calculation formula of the index, we can define the method of measuring the warning limit of the fixed-based warning index as a state warning, and the method of measuring the warning limit of the
chain warning index as a trend warning[9]. The specific warning limits and warning levels are shown in Table 2. Among them, FI stands for safety production early warning index.

According to the calculation formula of the comprehensive early warning index, the comprehensive early warning index of production safety is calculated, and the analysis conclusion of the early warning warning limit can be used to make a short-term early warning diagram of the production safety system risk, as shown in Figure 1:

![Figure 1. Safety warning diagram](image)

The results show that the early warning index is in a light alarm state, that is, the overall safety production level of our country's production safety system is gradually improving, but the rate of improvement is slower than the average value of the previous 11 years.

4.2 Selection of Accident Index Prediction Methods

According to the domestic and foreign research status of accident prediction and early warning, the prediction methods of accident indicators include time series method, grey mathematics method, trend analysis method, support vector machine method, regression analysis method, econometrics, fuzzy mathematics and other methods. It is a widely used quantitative forecasting method. Its task is to determine the relationship between the predicted value and the influencing factor. It is only suitable for medium and long-term forecasting under the condition of ensuring the causal relationship between the forecast object and the factor. Grey system theory is a theory that studies and solves grey system analysis, modeling, forecasting and control with partly known and partly unknown information. It is not suitable for forecasting time series with drastic changes. Differential autoregressive moving average model equation (ARMA) can analyze time series data and use it for forecasting and control. The model is relatively complete in mathematics and has high prediction accuracy. Exponential smoothing is usually for time series without significant trend changes, or time series with long-term trends but short-term trends often change. Exponential smoothing is a method that can automatically track changes in data and continuously adjust estimates of short-term trends contained in the series[10]. Using this method will usually receive better short-term forecasting results. The system dynamics model is suitable for nonlinear, high-level, multivariable, and multiple feedback complex systems. The application of system dynamics modeling can ensure the rationality of the results through causal logic analysis, and the model can be guaranteed through data fitting verification.”

The prediction accuracy of the model is reliable, but the process of building and verifying the model is more complicated. In summary, this paper mainly uses the system dynamics method to make
short-term and mid-to-long-term predictions. For those that are not involved in the SD model Accident indicators, using the time series quadratic exponential model for short-term forecasting, this method not only retains the time series fluctuation components and trend development components, but also simple and convenient.

After the model is constructed, the fixed asset value of the secondary industry can be calculated by simulation. Similarly, the fixed asset value of the primary industry and the tertiary industry can be calculated. As shown in Figure 2, it can be seen that the fixed assets of the primary industry remain on average. Second, the fixed assets of the tertiary industry rose.

![Figure 2. Error optimization performance of the modified model](image)

The fixed asset variable of the secondary industry is a state variable. The inflow rate of fixed asset investment in the secondary industry is formed, and the fixed asset investment in the secondary industry is a variable that increases year by year. Therefore, a structure with only inflow rate is created, while the rate value investment growth is the depreciation rate of fixed assets obtained by adjusting the coefficient to obtain a good fit between the fixed asset investment in the secondary industry and the actual data. The equation that is difficult to establish in the economic subsystem is the equation of the added value of the three industries. It is established according to the Cobb Douglas production function. This theory is used to predict the production and analysis of the production development of the industrial system or large enterprises in the country and region. Economic mathematical models play an important role in research and application.

5. Conclusions

The production process plays an important role in the business process of an enterprise. Due to the lack of manufacturing equipment and technology input and the relative backwardness of production process and production mode, the international competitiveness of our country’s manufacturing industry is insufficient. This article starts from the theory of production process reengineering and uses the method of production process reengineering to propose an approach for intelligent manufacturing. Due to the limitation of manpower, material resources, financial resources, etc., the intelligent research of safety production system in this paper is not comprehensive, and further research is needed in future work.
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