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Virtual Reorganization Algorithm Based on Cluster Intelligent Multitask Production Line Manufacturing

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Industry 4.0 inspired a technological revolution in the manufacturing industry. In 2015, China proposed the Made in China 2025 strategy which is a national strategic plan and industrial policy to develop its manufacturing sector. The backbone of industry, production line manufacturing has also attracted increasing attention. To better understand the impact of the dynamic virtual reorganization algorithm on the production line, improve the production efficiency of the production line, reduce costs, and improve its competitiveness, this dynamic details dynamic virtual algorithms to simulate the existing production line. According to different deployment environments and application requirements, this paper compares the production time, production efficiency, production qualification rate, and production cost before and after production line transformation. Multi-task synchronization provides diverse solutions. The results of the study found that the production line detailed in this paper takes less time than traditional production methods, the production time is relatively stable, and the production cost is about 30% lower than traditional methods. This shows that the production line proposed in this paper is effective for enterprises and the improvement of the production line is of great significance to organisations.

Keywords: Cluster Intelligence, Multi-Task Production Line, Dynamic Virtual Reorganization, Intelligent Manufacturing

1. INTRODUCTION

With the rapid growth in the number of Internet users, the existing network architecture is unable to meet the requirements of the rapid development of the Internet, leading to network rigidity. Network virtualization technology is a new way to solve the problem of network rigidity. Using network virtualization technology, traditional network service providers are divided into infrastructure providers and service providers.

Cluster control has become a more popular frontier research field in recent years. It is inspired by biological phenomena and has been gradually transplanted into the field of human social behavior and artificial intelligence development. Through mathematical or machine language description and rigorous theoretical analysis, various clusters can exhibit stable and efcient cluster behavior. When a virtual cluster executes distributed real-time application tasks, due to

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the complexity of the virtual environment, problems such as clock drift and poor synchronization performance often occur, making it difficult to provide a high-precision time reference for the execution of real-time tasks.

A large body of research has been conducted by experts on production lines. Brundage established new indicators which use real sensor information available from the production line to analyze the energy structure of the production line to better understand the complex system dynamics and find the root cause of low energy efficiency. Baseline energy consumption, which is the minimum energy required to produce a certain number of parts on the production line, is established and this knowledge is used to define new sustainable manufacturing performance indicators to correctly monitor the performance of the production line [1]. Gundogar analyzed the spring mattress production line of a furniture manufacturer with the goal of finding bottlenecks in the production line to balance the flow of semi-finished products. These bottlenecks were investigated and several scenarios were tested to improve the current manufacturing system. Goldratt and Cox's theory of constraints and simulation-based heuristics were used to solve the problem based on eliminating bottlenecks [2]. There is currently no comprehensive method that can be used to evaluate sustainable manufacturing performance at the system level, especially at the production line and factory level. To fill this gap, Huang proposed an index-based method to comprehensively evaluate sustainable manufacturing performance at the production line and factory level, while addressing the key points of sustainability and full life cycle stages [3]. Vespoli introduced a novel decentralized scheduling method, introducing a low-level workshop controller for the Flow-Shop CONWIP production line, which has a predefined and clearly defined decision-making quotation. The controller consists of two new logic elements placed on the upstream production line, which can effectively and dynamically allocate jobs in a predefined queue according to appropriate scheduling rules. The proposed low-level controller may significantly increase productivity without changing the working parameters of the manufacturing line [4]. Sayeekumar realized safe and efficient group communication by deploying a fuzzy-based inference system in the hybrid cluster architecture of group communication. The purpose of this model is to use a fuzzy-based inference system to reduce the communication and computational complexity of the system. By implementing the proposed system, the complexity overhead is reduced due to the effective framework and minimized key management. A simulation is performed to verify the efficiency of the proposed model for the members to subscribe to the service package during the requested time period [5]. Belmansour proposed an analytical aggregation method evaluate the throughput (or productivity) of a series homogenization production line. Unlike existing aggregation methods, each machine can have multiple failure modes. The aggregation algorithm involves the cyclic replacement of dipoles by a single machine. The results show that by distinguishing different failure modes, a more accurate throughput assessment can be obtained [6]. With personalized design requirements, a more realistic virtual model reflects the real world of the manufacturing workshop, which is crucial to bridging the gap between design and operation. Zhang proposed a rapid and personalized design method for insulating glass production lines based on digital twins and developed an analysis decoupling framework based on digital twins to provide engineering analysis capabilities and support decision-making for system design and solution evaluation [7]. These studies provide a certain reference for this article. However, due to several problems in the related research, such as a_short research time and insufficient samples, the research conclusions cannot be conveyed to the public.

On the basis of combining and summarizing the research results of intelligent manufacturing and production process reengineering, this paper clarifies the concept, technical system and system characteristics of intelligent manufacturing and deeply analyzes the requirements of intelligent manufacturing for each stage of the production process which will advance the manufacturing industry in reality. The combination of production mode and production process reengineering provides guidance and reference. According to the requirements of intelligent manufacturing for each stage of the production process, the manufacturing process is reengineered, so that the advanced production mode and the production process can be matched to the greatest extent and the entire process of order review, order placement, and order execution in the manufacturing industry is intelligentized. Surveillance accelerates the intelligentization of manufacturing processes and improves competitiveness through the transformation of production lines.

2. DYNAMIC VIRTUAL REORGANIZATION ALGORITHM METHOD

2.1 Cluster Intelligence

At present, the manufacturing industry is facing many global challenges. On the one hand, the traditional manufacturing method of high-volume and small-variety production is difficult to meet consumers' increasing personalized consumer demand [8]; on the other hand, environmental pollution, resource shortage and global problems such as population aging and climate warming have become more prominent, and traditional production methods have been severely restricted. Therefore, it has become a global consensus to research and apply a new generation of intelligent manufacturing technology to improve the flexibility, transparency, and resource utilization efficiency of the manufacturing process and to realize the rapid customization of personalized products and intelligent green production [9].

The construction of an intelligent production system is based on the company's initial information management system, with MES as the core, connecting intelligent production systems, including logistics warehousing systems, human resource systems, and scheduling order systems [10]. An overview of the system is shown in Figure 1:

A manufacturing execution system (MES) is a production management technology and real-time information system for first-line manufacturing enterprises [11]. Based on the

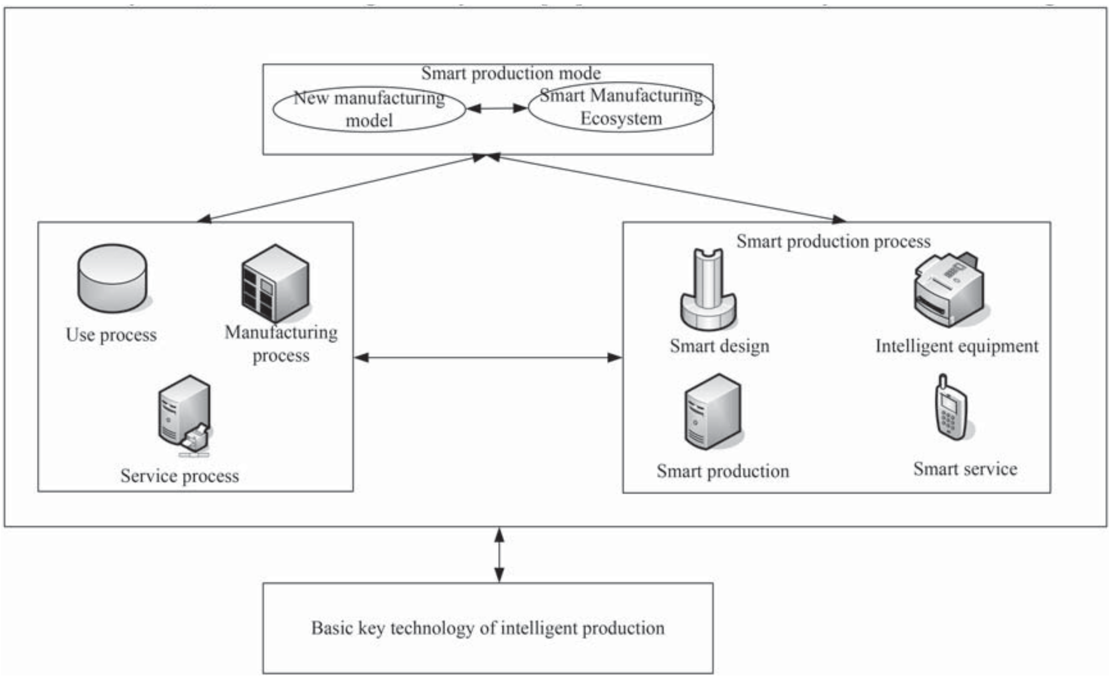

Figure 1 Intelligent manufacturing system.

network+Internet platform, it not only realizes the automation of laboratory production information and improves the overall management and control level of the laboratory, but also acts as an "information bridge" for cross-platform information systems. It integrates with the ERP system to allow process generation and actual production information results; it connects to the production line, it manages command prompts and collects data on operating conditions. It is a basic engineering method to realize flexible construction business processes and realize the flexibility of laboratory production [12–13].

The functions of the intelligent production machine with MES as the core include laboratory resource allocation, process control, quality control, maintenance management, data collection, performance analysis and application management [14]. It is the basic technical means to improve laboratory information and realize automation and agility in production management. The purpose of MES is to provide support for a wide range of production characteristics, collect work-related information and store it in a unified database to manage different tasks, such as the information contained in the repository data [15].

2.2 Construction of Multi-task Production Line Manufacturing Model

Under the conditions of Internet+ intelligence construction, the original network cable must be broken through walls and digging, resulting in problems such as cracking. Hence, a training-based CNC management application not only performs static control functions, it also performs data processing and network services. This kind of effective information collection of source integration should adapt to the intelligent building culture [16].

To ensure the smooth implementation of an intelligent production system, this project uses an online form based on the B/S architecture, using a computer to fill in the form, and a mobile phone to scan the QR code to place an order to obtain information. To make it easier to enter customer information, a purchase status option was added [17]. The link directly connects the company's ERP control, links the production performance module in the business management module, and realizes real-time interaction and information monitoring [18].

Based on this text-to-speech creation, real-time information at work can also be streamed in real-time through specific Internet links and on-site smart camera applications. Customers can monitor the progress from time to time, study the progress of the production work, and monitor the machines in the manufacturing field [19–20]. The status data essentially includes the switch mode, equipment startup time, equipment power supply and other data which are transmitted to the machine calculator in real time, and many statistical reports are generated. Application analysis and equipment status information on equipment use, development and maintenance provides management personnel with information on equipment time and supply, equipment operating conditions and production and process planning in related fields, as well as reliability statistics for the use of various materials, and provides other applications for application-related functions [21].

The information flow structure is shown in Figure 2. When an enterprise places an order, it scans the QR code through a computer or mobile phone, connects to the ordering system, submits processing information to the information processing platform, and receives application functions designed by the specific solution platform through the scope.

The information collection process is shown in Figure 3:

The production management process is shown in Figure 4. In addition to preparing the master production plan, the design

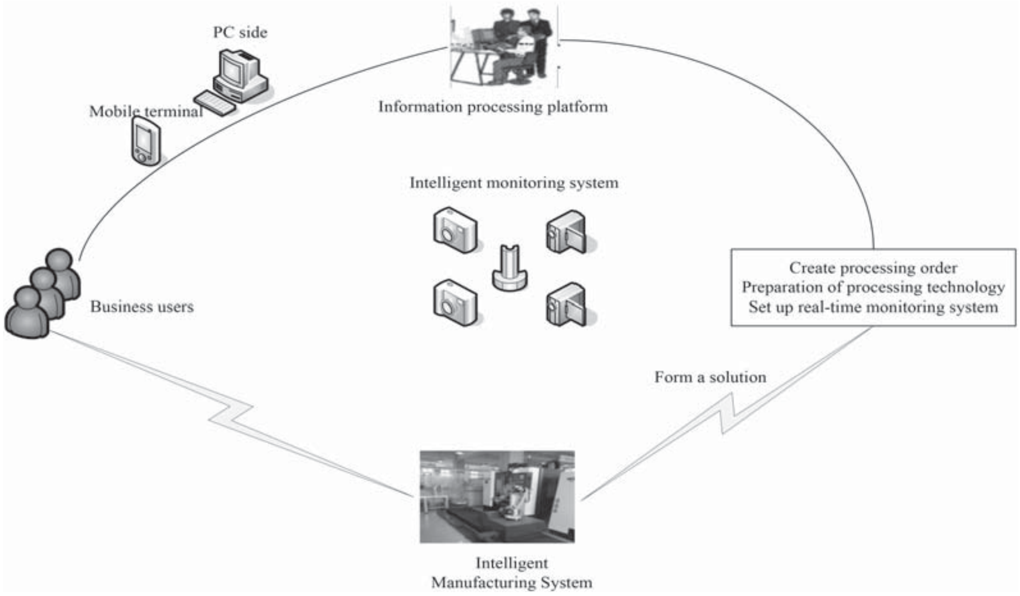

Figure 2 Structure diagram of information flow.

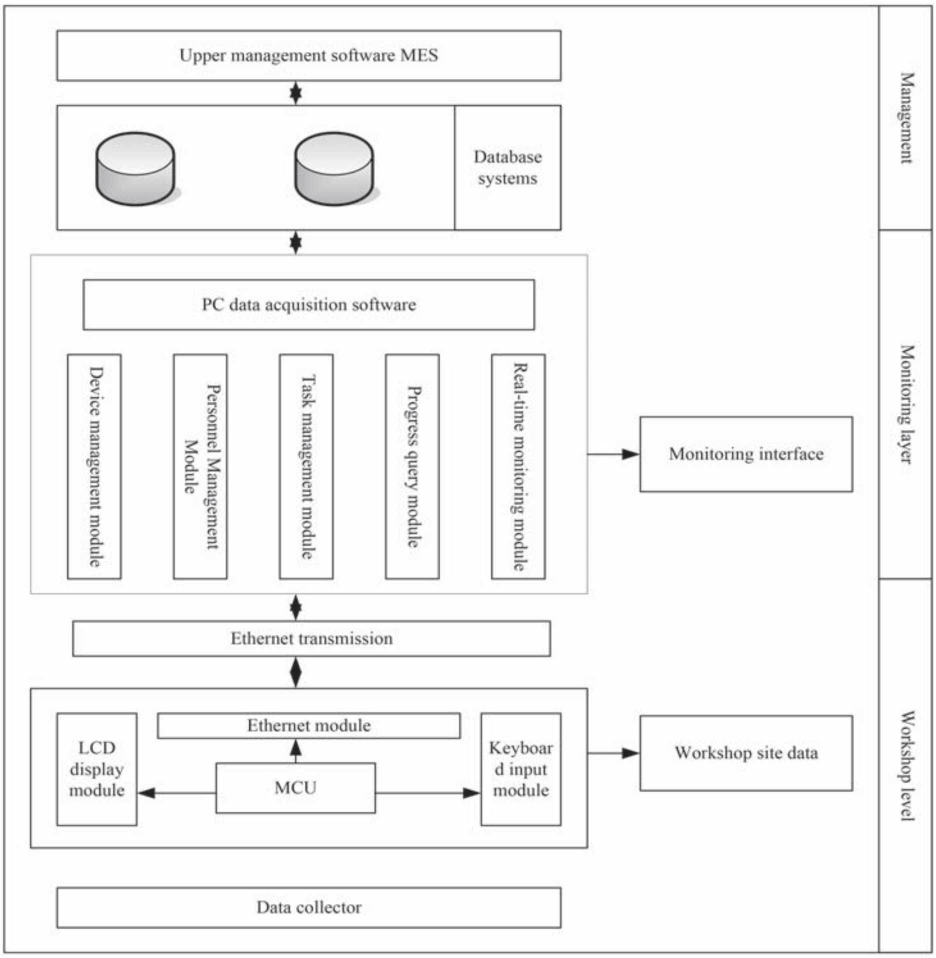

Figure 3 Information collection process.

module also directly prepares a single, coordinated detailed operation plan. The detailed operation plan is reported to the work department, and the work department is responsible for the implementation of the work plan [22]. The labor department has the right to fine-tune the work plan according to the production situation to complete the main production plan. The planning section only supervises the specific implementation of the work plan. Aft er each work plan is completed and inspected, the production information is fed back immediately. The planning, scheduling and department

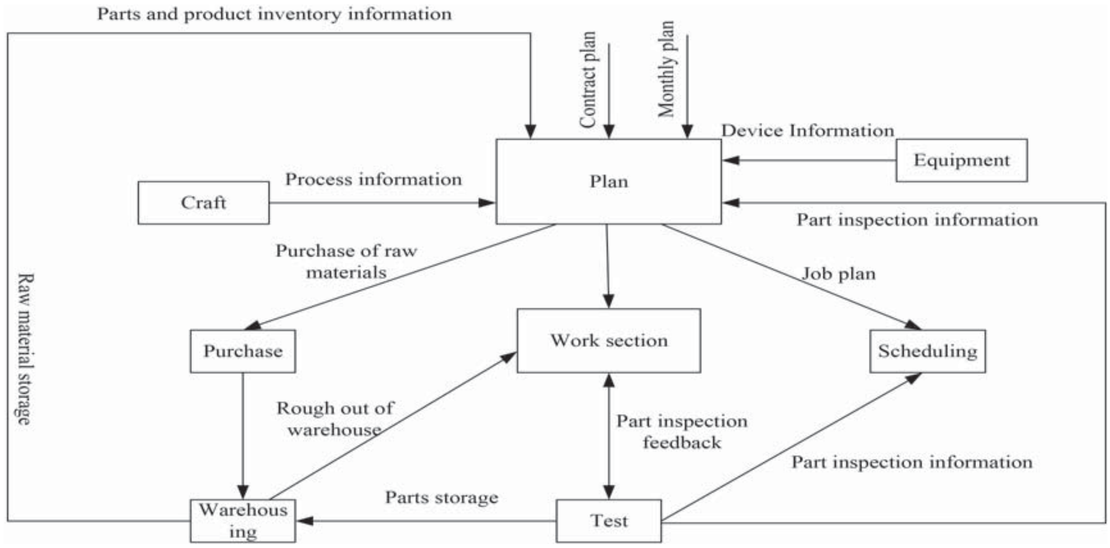

Figure 4 Flow chart of production management.

can schedule and supervise the work plan in time, based on timely feedback to ensure that the project is completed on time [23].

2.3 Virtual Reorganization Algorithm

Today's cloud computing data centers contain more devices than ever before. Many devices are further subdivided into virtual machines or virtual networks, such as servers, network devices, storage systems, and security devices, hence the number of IP addresses and network routing and security rules have increased dramatically, hence traditional network management techniques are not sufficient to provide a scalable and automated method to manage these next-generation networks [24]. Furthermore, users want more control over the network, and they also want the network to be more flexible and deployed faster.

Network virtualization technology is the key to the realization of a cloud computing virtual network. It decouples the upper-layer virtual network fr om the lower-layer network facilities so that users do not need to care about the details of the underlying implementation [25]. The upper layer of virtualization technology is the logical view of the cloud computing virtual network and the lower layer is the physical view.

The definition of the distance function is as follows: for all $\vec{x}_1 \in \Gamma$.

$$d(\vec{x}) = \min(|\vec{x} + \vec{x}_1|) \tag{1}$$

From the definition, when the unknown point is on the boundary, the function value is 0. After finding the closest point on the boundary and marking the closest point, the value of the distance function is:

$$d(\vec{x}) = |\vec{x} - \vec{x}c| \tag{2}$$

From the definition of the distance function, the specific definition of the signed distance function is:

$$\begin{aligned} \varphi(\vec{x}) &= d(-\vec{x}) = 0,\ \vec{x} \in \Gamma \\ \varphi(\vec{x}) &= -d(\vec{x})\ \vec{x} \in \psi \end{aligned} \tag{3}$$

The signed distance function is a subset of the implicit function and has all the properties of the implicit function discussed in the previous section. Using the signed distance function can simplify many level set methods for dealing with implicit functions.

$$Z_i = T^T(x_{nm} - f \notin R^n \tag{4}$$

This transformation should be reversible, where Z_j is the mapping result X_{ij}, and Z_j can also be obtained by doing the inverse transformation X_{ij}. d is the translation vector and m is the spatial dimension after projection and satisfies the orthogonal normalization condition, namely:

$$b_j^T b_k = \delta_{jk} \tag{5}$$

which is at the time $j = k,\ \delta_{jk} = 1$ otherwise $\delta_{jk} = 0$

$$X'_{ij} = d + BB^T(X_{ij} - d) = d + BZ_j \tag{6}$$

The formula is inverse transformation. In actual operation, due to the influence of noisy data or different transformation methods, there are errors between X'_{ij} and X_{ij}, as shown below:

$$\varepsilon_j = X_{ij} - X'_{ij} = X_{ij} - d - BB^T(X_{ij} - d) \tag{7}$$

Objective optimization operations are performed on B and d. The specific formula is as follows:

$$\min\left\{ \sum_{j=1}^{k} \omega_j \|\varepsilon_j\|^2 \right\} = \min\left\{ \sum_{j=1}^{k} \omega_j \|X - d1^T - BZ\|^2 \right\} \tag{8}$$

where ω_j is the weight of the error ε_j. According to feature decomposition, the minimum weighted mean square value of B is obtained. S is the weighted covariance matrix of neighboring points. Then the minimum mean square value of the translation vector d is calculated as follows:

Table 1 Test model configuration.

Component	Manufacturer	IP address	Hardware Configuration
Physical machine 2	Assembly	192.168.1.197	Intel's Pentium G620 processor Processor frequency 2.60 GHz Kingston 4 G RAM
cable	Neglect	–	LC-2020C model Super Category 5, 3 meters
Physical machine 1	Assembly	Neglect	Intel's i7-5820K processor Processor frequency 3.30 GHz Kingston 32 G RAM

$$d = \frac{\sum_{j=1}^{k} w_j X_{ij}}{\sum_{j=1}^{k} w_j} \tag{9}$$

$$S = \frac{1}{k}\sum_{j=1}^{k} w_j (X_{ij} - d)(X_{ij} - d)^T \tag{10}$$

When the above formula is transformed, the size ω is related ε. The weight of the sample point reflects the possibility that the point is noisy data. If the error is large, this means that the point is likely to be noise, otherwise the point is less likely to be noise. The customization of data is based on the premise of which distribution it conforms to, and then the training and analysis are carried out according to the hypothetical distribution model. Therefore, learning the distribution of feature data according to the energy model can solve all the above problems. Later

$$E(v, h|\theta) = -\sum_{i=1}^{n} a_i v_i - \sum_{j=1}^{m} b_j h_j \tag{11}$$

where θ is the parameter model, a_i is the bias of the visible layer unit, b_j is the bias of the hidden layer unit, and W_{ij} is the connection weight between the visible layer and the hidden layer. The joint probability distribution (v, h) that can be obtained according to the energy function is as follows:

$$Z\theta = \sum_{v,h} e^{-E(v,h|\theta)} \tag{12}$$

where $Z(\theta)$ represents the normalization factor in the joint probability calculation. The likelihood function is solved through specific calculations and the formula can be expressed as:

$$p(v|\theta) = \frac{\sum_h e^{-E(v,h|\theta)}}{Z(\theta)} \tag{13}$$

According to the state of the hidden layer unit, the formula for obtaining the visible layer unit in reverse is:

$$P(v_i = 1|h, \theta) = \sigma\left(a_i + \sum_j W_{ij} h_j\right) \tag{14}$$

When the value of a is true, $\delta(x) = 1$, otherwise, $\delta(x) = 0$. Based on the formula bi-clustering B(I, J), the maximum number max N of similarities of gene i is defined as follows:

The formula to calculate the similarity between clusters is:

$$ext = \min(wi - wj) = \min\sqrt{w_{i1} - w_{j1}^2} \tag{15}$$

where wi and wj are the centroids of the cluster and respectively. The larger the value of ext, the smaller the similarity between clusters, and vice versa.

When the value of w is true, $\delta(x) = 1$, otherwise, $\delta(x) = 1$. Based on the formula bi-clustering B(I, J), the maximum number of similarities of gene i is defined as follows:

$$\max N = \sum j \in J\delta(b'_{ij} = b'_{i'j}) \tag{16}$$

Any three genes of cluster B(I, J) are defined as follows:

$$CSI(i1,\ i2,\ i3) = \frac{\sum j \in J\delta(b'i_1 j = b'i_2 j = b'i_3 j)}{\max N} \tag{17}$$

Each data point has neighbor points.

$$Z_j = B^T(x_{ij} - d) \in R^m \tag{18}$$

Suppose the entire data of the classification object is $X = \{x_1, x_2\chi_m\}$, each of which x_i can be characterized by a set of data (m feature indicators) as follows:

$$x_i = (x_{i1}, x_{i2}, \ldots, x_{im}) \in (R^+),\ i = 1, 2, \ldots, n \tag{19}$$

This prevents errors in the original data system when calculating the distance between the object and all other objects (A or B).

$$n \geq fn + \frac{N}{|v|}\log\frac{1}{\delta} + \frac{N}{|v|}\sqrt{(\log\frac{1}{\partial})^2 + 2f|v|\log\frac{1}{\varepsilon}} \tag{20}$$

As the iteration progresses, the reference point will be closer to the true cluster center, the evaluation index function ε will become smaller, and the clustering effect will improve.

3. EXPERIMENTS AND RESULTS OF DYNAMIC VIRTUAL REORGANIZATION ALGORITHM

3.1 Virtual Reorganization

In the test scenario, the usual switch is not used, instead it is directly connected through the power cord to avoid introducing factors that may affect the synchronization performance. The processor of the physical machine where VM1-I and VM1-2 are located is an Intel i7-5820K with a frequency of 3.30 GHz, and the memory is 32G Kingston memory. The physical machine where Host2 is located is an Intel Pentium G620 processor with a frequency of 2. 60 GHz, and the memory is 4G Kingston memory. The detailed configuration description of each component is summarized in Table 1.

We performed a virtual reorganization of the model of the production line and experimented with data such as the

Table 2 Digital characteristics of synchronization error.

	No load conditon		Load 50%	
	Hardware synchronization	Software synchronization	Hardware synchronization	Software synchronization
Average value	858	32103	635	63069
Standard deviation	1047	42116	827	82307
Max	3739	125721	3857	247321

Table 3 Virtual reorganization advantages.

	Traditional data center	Virtual reorganization algorithm
Programmable interface	not support	support
Scalability	Poor	excellent
Management convenience	Manual configuration	automation
Network topology	1h	127s
flow	125M	1G
Recovery	slow	Faster
Virtual technology application	Few	A lot of

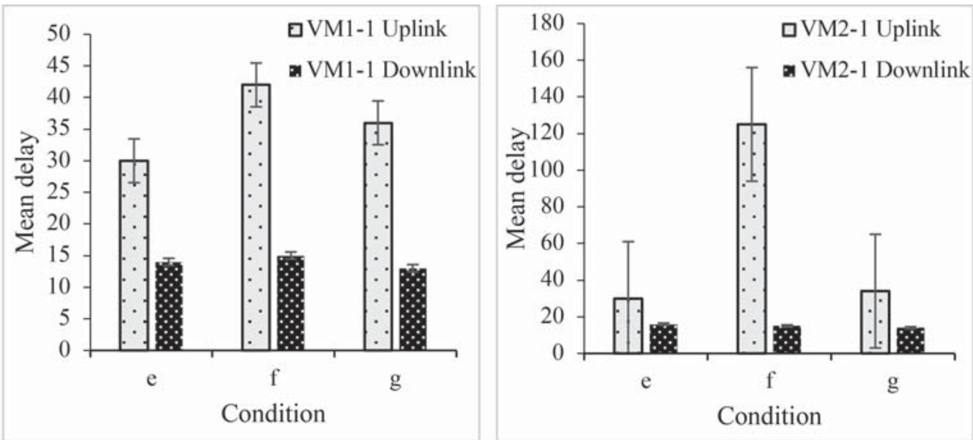

Figure 5 The average residence time of the host core.

Table 4 Status of the company.

	Options	Number of people	Proportion
Business Location	First-tier and provincial capital cities	85	42%
	Prefecture-level city	62	30.7%
	Towns and villages	55	27.3%
Number of Workers	1–20 people	60	29.8%
	20–50 people	31	15.6%
	above 50	19	9.8%
Years in Business	Less than 1 year	29	14.6%
	1–3 years	48	23.9%
	3–5 ears	24	12.2%
	More than 5 years	14	7.3%

average value, standard deviation, and maximum value. The results are shown in Table 2:

Generally speaking, the cloud computing virtual network has more advantages than the traditional data center network, as shown in Table 3:

We measured the residence time of guests VM1-I and VM1-2 on the uplink and downlink of the host core under a variety of conditions for a time length of 40,000 seconds, which is about 11 hours. The measurement results are shown in Figure 5.

The host time VM1-I can be seen on the left at the upper and lower connections of the host kernel, and the residence time of the managed VM1-2 can be seen on the right of the upper and lower connections of the host kernel. Condition e does not add additional conditions, condition f is that processing the load of the device increases by 80%, and condition g is that the load of the downstream network increases by 80%.

The statistics on the status of the surveyed enterprises are shown in Table 4:

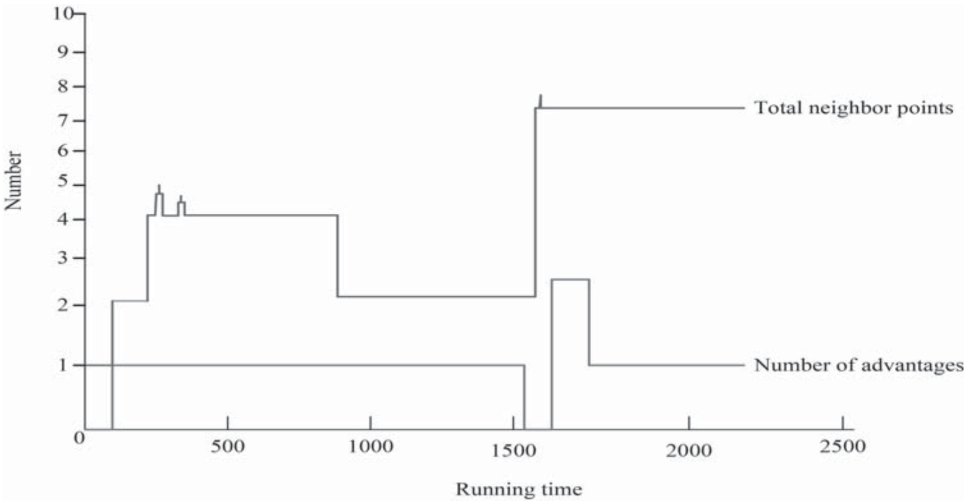

Figure 6 Path comparison.

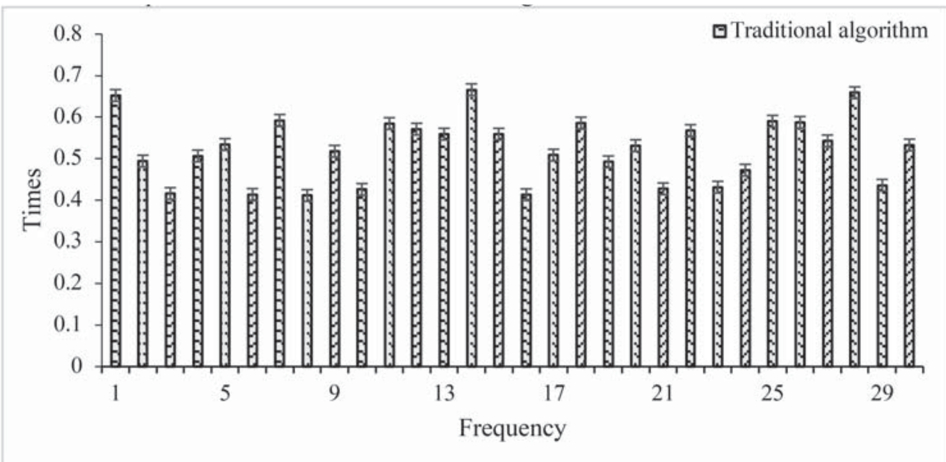

Figure 7 Production time comparison.

We compare the total number of neighbors in the cluster's intelligent neighborhood and the number of neighbors whose paths are better than their own, and the results are shown in Figure 6.

It can be seen that the total number of neighbors in the cluster intelligent neighborhood and the comparison of the number of paths are better than the number of neighbors. Furthermore, although the number of neighbors is up to about 5 in many periods, the agent is only attracted by a neighbor with a better path due to the path-first strategy adopted by the algorithm.

3.2 Comparison Before and After Optimization

We compare the following: traditional production method with the production line of the cluster intelligent virtual reorganization algorithm, production time, production efficiency, production qualification rate, production cost, etc., and we also compare the difference between the method described in this article and the traditional method. The time is compared and the results are shown in Figure 7.

As shown in Figure 7, in terms of production time, the traditional method takes along time, and as the production quantity changes, the time consumed increases. Our proposed method uses two virtual clients and the simulation shows that the time required for production is less than that of traditional production methods, and the production time is relatively stable without significant fluctuations.

We compared the production efficiency of the production line under different methods and the results are shown in Figure 8.

It can be seen from Figure 8 that after adopting the proposed method, the production efficiency improves significantly by approximately 30% and in the simulation machine of VM1-2, the overall production efficiency is also higher than that of VMl-l. Different simulation methods can be selected for different requirements and better results are achieved.

The statistics on the quality of the products produced by different methods and a comparison of the differences are shown in Figure 9.

It can be seen from Figure 9 that the production pass rate of the traditional method is relatively low, with an average value of only about 65%. This is because the traditional production line is produced by a mixture of manual and

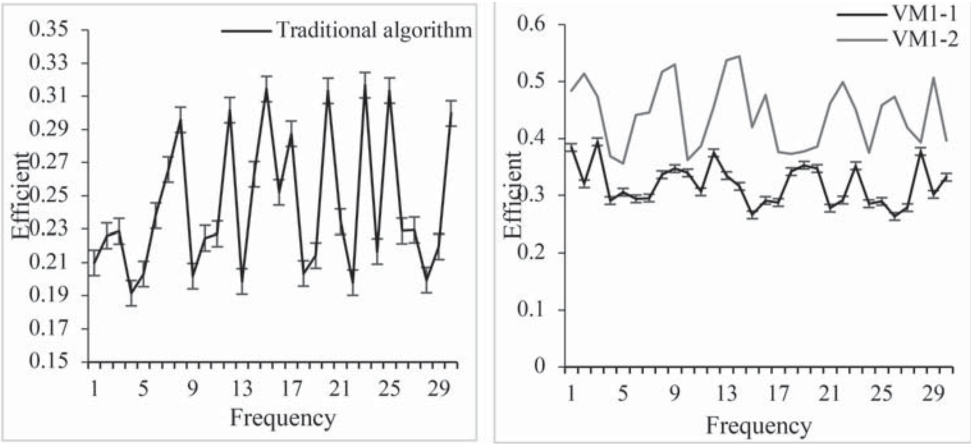

Figure 8 Production efficiency comparison.

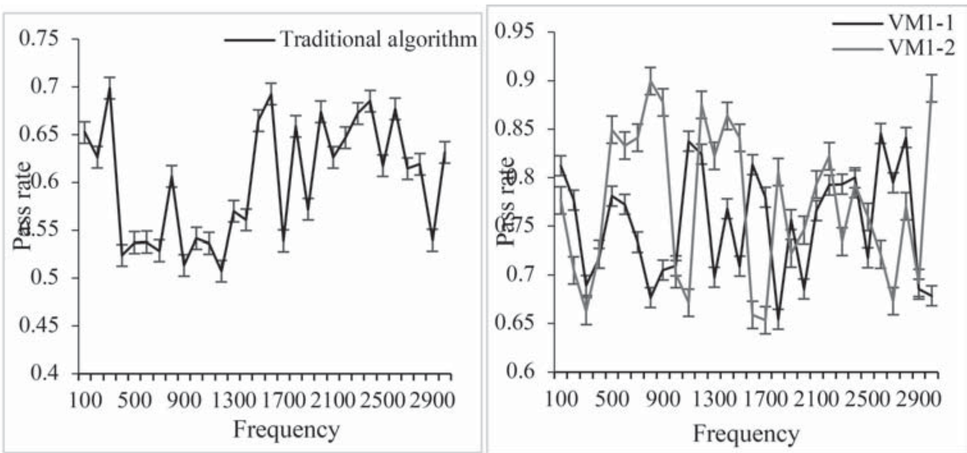

Figure 9 Comparison of pass rate.

machine labor, the production process is cumbersome and the process is complicated, resulting in a poor product pass rate. However, the intelligent multitasking line used in this article can effectively reduce the difficulty of production and increase the quality of the product to about 82%.

The most important part of the production process is cost. To understand the cost of production under different methods, did compared the costs of the two methods. The results are shown in Figure 10:

It can be seen from Figure 10 that under the traditional method, the production cost is difficult to control, the average price being around 25 yuan which is relatively high. However, under the proposed method, the cost drops significantly, the average price being only around 17 yuan which is a decrease of approximately 30%. This shows that the proposed method can play a greater role in cost control.

4. DISCUSSION

4.1 Virtual Reorganization Algorithm

The rapid development of the field of computer modeling has created an urgent need for physics-based animation modeling tools, and naturally, it has also resulted in the development of engineering technologies such as simulating natural phenomena in the real world and modeling natural scenery. In recent years, the application of these simulation technologies in computer visualization, graphics, virtual reality, image processing and other fields has become increasingly widespread. The continuous improvement of computing performance and storage performance, and the rapid development of various high-precision numerical solution methods and numerical tools also provide the possibility for dynamic and rapid reconstruction, and its application has been further expanded.

The development of the Internet is going through a golden period, as reflected in the continuous increase in the scale of the network, the increasing number of Internet users, the increasing demand for network services and the increasingly varied types of applications provided by the network. In this context, the disadvantages of the traditional Internet's architecture are exposed, most notably in its rigid and closed architecture, poor scalability, poor service quality, and poor network security. It is difficult to cater for the increasing number of users and business volume. How to solve this shortcoming has become an important research issue. Of the currently known methods, network virtualization is the most mainstream solution, that is, multiple user requests within a certain range are established as individual virtual requests through the network virtualization technology, and these virtual requests are then distributed to the physical

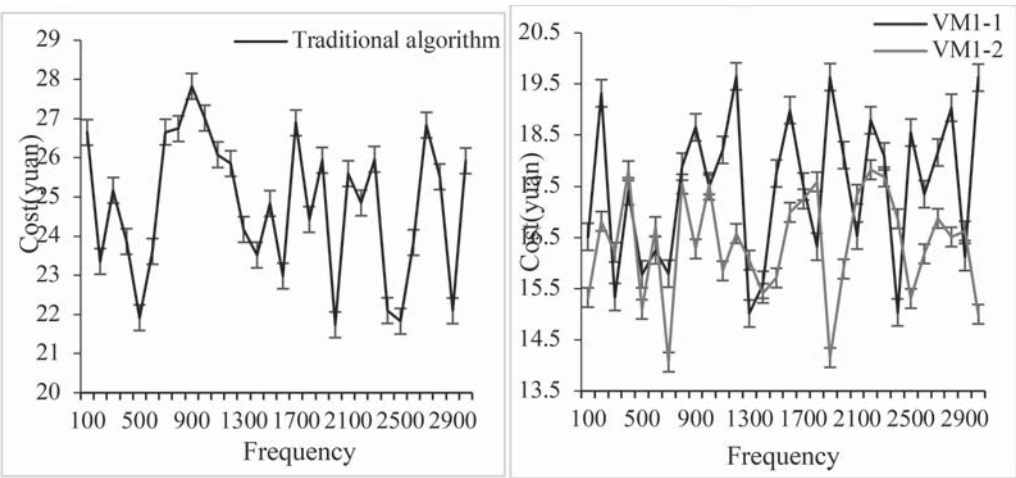

Figure 10 Production cost comparison.

network. To devise an efficient distribution plan, scholars have conducted in-depth research and proposed a variety of methods, finding that the expected efficiency cannot be achieved by only studying the mapped virtual network, rather it is also necessary to reconfigure the mapped virtual network to reintegrate the fragmented resources generated due to the expiration of the virtual request. In doing so, the entire underlying physical network becomes more capable of receiving mapping.

When virtual clusters perform distributed real-time application tasks, due to the complexity of the virtual environment, problems such as clock timing, low clock synchronization, and poor synchronization capabilities may occur, making it difficult to provide an accurate time measurement in real time. To solve these problems, this article starts with applications and software, and proposes application-based applications and software-based upgrade solutions for different development environments and application requirements to provide better and different types of solutions for virtualization. It solves the synchronization problem faced by real-time distributed virtual reality applications and has very practical application value.

In general, the reliability and stability of the virtual configuration algorithm is an order of magnitude higher than that of the traditional method, and it is almost unaffected by a 50% increase in processor load, showing better synchronization performance. The synchronization and stability of the software-based development concept is improved by about 50% compared with the previous improvement The virtual configuration algorithm can perform their duties under different development environments and application requirements, provide real-time solutions for virtual teams, perform distributed tasks in real time in a cost-effective manner, and provide synchronization in multi-functional areas for virtual cluster solutions.

4.2 Enterprise Development

In the era of the knowledge economy, market competition has intensified and product cycles have shortened. Innovation is an important way for companies to maintain along-term competitive advantage. Through knowledge management activities, companies can effectively encourage new ideas, cultivate new ideas, maximize employees' participation in activities that generate suggestions and opportunities for cooperation, and jointly develop new products or provide new services, thereby improving the level of technology.

A conservative corporate culture makes enterprises complacent, which is not conducive to the implementation of green innovation activities of high-tech small and medium-sized enterprises. Therefore, companies should move from a conservative culture and build a learning culture. To do this, attention should be given to the role of employees in building a learning culture. Companies must provide ongoing training opportunities to employees to improve their ability to think, learn and accept new knowledge. Managers must take measures to create a strong learning atmosphere in the company and encourage a change in passive mental models of employees, increase the green sensitivity of the organisation and contribute to the company's green innovation strength. Secondly, managers should call on all employees to engage in lifelong learning and should lead by example, accepting new ideas and absorbing new knowledge. They should improve the learning ability of the enterprise by asking for feedback.

Innovation presents both opportunities and risks in the development of high-tech SMEs, but long-term inertial thinking has become a hindrance to the development of green innovation. The ideological tendency of managers determines the direction and prospects of the development of high-tech SMEs. Therefore, if managers of technology-based SMEs want to exploit the market opportunities of green innovation and seize development opportunities to gain a competitive advantage, they must break the inherent thinking, strengthen their adventurous resolve, and increase their risk prevention awareness.

5. CONCLUSIONS

This paper introduces the development history and research status of workshop scheduling problems and elaborates on the characteristics and mathematical models of cluster intelligent multi-task line production. The theory of the virtual reorganization algorithm is summarized, and based on the user's order demand and manufacturing resource status, through a simulated manufacturing production scenario, the difference between the traditional algorithm and the virtual reorganization algorithm is compared, and the effectiveness of the algorithm is verified through experiments. Of course, the research in this article also has certain shortcomings. The research in this article is carried out in two-dimensional space. How to extend the results and ideas of this article to three-dimensional space is very worthy of further study. In addition, this article does not consider time lag or other irrational factors, nor does it consider the volume of the agent itself. In addition, in nature and engineering applications, the sensing ability of each individual in the cluster is not necessarily ideal, its sensing ability is not necessarily a regular geometric figure, and the individual may only be able to sense objects within a certain angle in front of the body. Hence, there will be a blind spot in the sensing range. In this kind of limited sensing range, research on how to realize the intelligent cluster is necessary.

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