Research on the Evaluation of the Integration of Informatization and Industrialization in Manufacturing Enterprises

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Abstract: The independent innovation ability of modern industrial enterprises has been significantly improved, the modern industrial system has been formed in an all-round way, and the speed of integration of informatization and industrialization has been accelerating. In this paper, the basis, application and performance of the integration of the two modernizations were analyzed and evaluated, so as to provide reliable reference for enterprises and government decision makers, provide scientific basis for the rapid development of the integration of the two modernizations in the right direction, and promote the all-round development of Tianjin's economy. Through the construction of the evaluation index system, a theoretical basis for the evaluation of the integration of informatization and industrialization of professional enterprises was provided.

1. Introduction

In order to deepen the integration of informationization and industrialization, grasp the current situation of information technology application in industrial enterprises, understand the needs and problems of enterprise informationization construction, provide a basis for policy formulation and planning, the development level of "integration of industrialization and industrialization" in industrial enterprises was evaluated. The purpose of this work is to evaluate the development level of the integration of the two modernizations in the whole, region, industry and enterprises on the basis of grasping the basic characteristics and development trend of the integration of the two modernizations, so as to provide information construction consultation and guidance for enterprises, promote the popularization and application of new technologies, give data support for further formulation of "integration of two modernizations" related policies, and enhance the economic and social benefits of enterprise information construction.

2. Main Contents of Integration of Informatization and Industrialization

2.1. Integration of production factors

The production factors of enterprises include production equipment, human resources and technology, and external resources. Firstly, the integration of technology is the application of information technology to traditional industry to carry out auxiliary production and design process. CAD/CAE and information management and control technology belong to this level, which greatly improve the efficiency of industrial production [1]. Secondly, in the process of technology integration, continuous technological innovation has produced unprecedented products and applications, which greatly meet people's production and living needs. In the process of integration of industrialization and informationization, the quality of human resources needs to be constantly improved. Without the continuous improvement of personnel quality, the rapid development and innovation of technology can not be used. Thus, a compound talent training mechanism in industrialization and informationization is required to go hand in hand with the development of integration of industrialization and informationization [2]. The fusion change of production equipment is mainly the application of information technology in production equipment, such as the application of microelectronics technology in production machine tools, which brings the upgrade

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of CNC machine tools and promotes the accuracy and flexibility of industrialization. The integration of resources requires the addition of more information technology and other resource elements in the production function of an enterprise. An enterprise, which occupies an advantage in manpower, natural resources and other aspects, coupled with the far-ahead of information technology, rational allocation of resources in all aspects, will maintain an eternal advantage in the fierce competition.

2.2. Integration of products and business processes

Product integration refers to the use of information technology in product design and production process to achieve the expansion of product functions and added value, which may be conducive to the development of new products. Business integration refers to the integration of information technology and products with the business process of industrialization, including production, sales and management environment, lean production and agile manufacturing, etc. [3]. Management style integration includes the integration of management process and organization structure. Many of the management processes, including information transmission, can be transmitted or replaced by computers, for which the wide application of ERP and SCM that gradually realizes the flat and virtualized management and business integration mode can be a good explanation. The integration of management modes also includes the application of network marketing and e-commerce to meet the actual and potential needs of consumers, which belongs to the scope of business integration in the integration of two modernizations.

2.3. Integration of industries

Industrial convergence refers to the breakdown of industrial boundaries in the process of product, technology and resources convergence leads to the emergence of composite industries or new industries. Government plays an important role in the integration of information industry [4].

3. Construction of Indicators for the Integration of Enterprise

3.1. Principles of indicators construction

The integration of enterprise informationization and industrialization is a continuous and dynamic process. When constructing the index system, on the one hand, the integrated system of investment, use process and application results of enterprise industrialization and informationization integration should be taken into account to ensure the comprehensiveness and completeness of the index system. On the other hand, the applicability of indicators should be considered to prevent the systematic appearance of some indicators of preference for technical activities and benefits [5]. In the process of measuring the indicators of integration, the combination of macro and micro, synthesis and analysis, dynamic and static methods should be fully taken into account, because the factors of integration will be affected by enterprise personnel, culture and economic environment, and thus have strong fuzziness, which will inevitably increase the difficulty of establishing operable indicators system measurement. Based on the above guiding ideology, the following principles should be considered in the process of constructing the index system:

The principle of combining scientificity with systematicness: the construction of index system and data analysis should reflect all aspects of integration of the two modernizations on a scientific and reasonable basis, including the basis, application and performance. The scientific methods include drawing lessons from the fusion index system in the existing research, together with the investigation and research of statistical theory and practice, and finally putting forward a comprehensive and reasonable average index system [6].

The principle of combining quantitative index with qualitative index is as follows: although the final scores are calculated on the basis of quantitative indicators, the qualitative indicators should not be neglected in the construction of the index system and the design of the questionnaire. The integration is a complex process, involving many aspects of enterprises, and it seems a bit one-sided to use only quantitative indicators, so that qualitative indicators must be added to ensure the overall

integrity of the index system, thus which requires quantitative treatment of qualitative indicators in the final evaluation process [7].

The principle of combining purpose with availability: the construction of the capital system of the integration is mainly for the government to understand the current situation of the two modernizations of enterprises and provide reliable basis for the next policy formulation and decision support, which is mainly designed from three aspects: readiness, maturity and efficiency. However, in the process of design, it is necessary to make the definition of indicators as accurate as possible, or to use the indicators data already investigated in other reporting work as the basis for research, which is not only easy to investigate, but also simple to calculate and has high reliability.

3.2. Selection method of evaluation index

The selection of indicators for integration is very important. The scientific selection of indicators system is conducive to the accuracy and credibility of the comprehensive rating results, thus which requires considering the comprehensiveness and rationality of the indicators system. Overall requirements of indicators can't be too few, or it will produce one-sidedness, the information projected may be missing; however, too many indicators will easily lead to repeated surveys of information, so the use of professional knowledge and the scientific screening method of indicator system are very important in the evaluation indicators of integration of two cultures [8].

In the process of designing the index system, firstly, scientific methods are used to design the main index system, and necessary accessibility and correlation tests are carried out to ensure that the designed index system is closely related to the integration of the two modernizations of enterprises, and that the data can be easily obtained and guaranteed to be correct, and a comprehensive and reasonable index system can be obtained. On the basis of the index system, the corresponding questionnaire survey is designed. In order to facilitate the analysis of more comprehensive information in the future, the design of the questionnaire survey should cover all aspects of enterprise production management as far as possible. Because the questionnaire survey requires enterprises to spend a certain amount of manpower, material and financial resources, so a survey should try to investigate more relevant information.

In the specific selection of indicators, first of all, it is necessary to read the relevant references, summarize the general indicators in the previous literature on integration, and analyze their rationality. Then the key factors can be determined by investigating the relevant production and operation processes of enterprises, and the index system can be optimized and added. Finally, a scientific and reasonable evaluation index system of integration of two modernizations can be established by consulting relevant experts.

3.3. Framework of indicator system

According to the design ideas and principles of the above-mentioned index system, the evaluation system of the development level of "integration" of Tianjin industrial enterprises can be divided into several levels, including three first-level indicators, nine second-level indicators and 27 third-level indicators, followed by more detailed four-level indicators and five-level indicators. Each index corresponds to some key items in the questionnaire, following the idea of "layer-by-layer evaluation and weight aggregation", starting from the end index evaluation, synthesizing the corresponding upper index value according to the index value and index weight, and making evaluation layer by layer until the top level.

4. Efficiency Evaluation of Integration of Informatization and Industrialization

4.1. Selection of evaluation index

Readiness (basis) is the preparation of enterprises for integration of informatization and industrialization, including investment and some environmental factors within not only software and hardware investment in informatization but also some indicators in industrial basis, which can fully reflect the investment of enterprises' modernizations. And the situation that enterprises attach

importance to product management mechanism belongs to the external environmental impact of enterprise investment. Maturity (application) is the application of enterprises in various aspects of modernizations process, which is the intermediate process of enterprises' input and output, including R&D and process control input and enterprise management practice. The application situation directly affects the output effect of input, so that these maturity indicators have a certain impact on the efficiency of enterprise integration, while whether the effect of the impact is significant or not needs further verification.

Contribution (performance) refers to the performance of an enterprise after integration of informatization and industrialization. Performance refers to the outcome, i.e. the output after modernizations input. Indicators of competitiveness, innovation and sustainable development of an enterprise comprehensively reflect the output of an enterprise in integration. Based on the above analysis, the investment and external factors of enterprises are as follows: Selection of efficiency input indicators for integration of informatization and industrialization: Input indicators mainly include human, financial and material inputs and R&D and process control inputs in product production process. In this study, modernizations investment, infrastructure, organizational manpower and maturity of R&D and process control indicators in readiness were mainly selected. From the basic and application point of view, besides the direct input indicators, the external environmental factors affecting the integration efficiency mainly include: enterprise attention, product management mechanism and personnel management practice.

4.2. Correlation analysis of efficiency evaluation index

In the selection of input and output indicators, if there are relatively strong correlation indicators, there will be the problem of repeated calculation of information. Firstly, according to the principal component analysis method, the correlation between input and output indicators was analyzed, the collinearity between indicators was removed, and relatively few principal components were used to represent most of the information of all indicators. Then, the analysis was implemented by spss17 software. The direct correlation and test statistics of the three output indicators are as follows: Fig.1 and Fig.2:

		VAR00001	VAR00002	VAR00003
Correlation	VAR00001	1.000	.391	.325
	VAR00002	.391	1.000	.021
	VAR00003	.325	.021	1.000

Fig.1. Coefficient matrix

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.464
Bartlett's Test of Sphericity	Approx. Chi-Square	14.381
	df	3
	Sig.	.002

Fig.2. Test coefficient

From the above two figures, it can be seen that the correlation among the three output variables used to calculate the efficiency of integration of informatization and industrialization is not very strong, and the statistics of KMO test have not passed the test, so that the three output indicators have certain independence and can be directly used to calculate the efficiency of output.

5. Conclusion

Product fusion refers to the expansion of the function and added value of the product through the

application of information technology to the design and production process of the product, which may be beneficial to the research and development of the new product and the expansion of the function of the product. By constructing the index system of fusion, the correlation between the three output variables used to calculate the efficiency of fusion is not very strong, and the KMO test statistics have not passed the test, so the three output indicators have a certain degree of independence. It can be used directly to calculate the efficiency of output.

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