Construction and Study on Evaluation Indicator System for Modern Advanced Manufacturing Industry Informationization

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Abstract

Firstly, the research status and shortage of the evaluation index system for manufacturing informatization are analyzed, on this basis, the connotation and characteristics of modern advanced manufacturing industry informatization are expounded. Then, according to the principles of modern advanced manufacturing industry informatization, the information efficiency index system is proposed to improve the evaluation index system for enterprise informatization and the existing standards, in order to provide accurate decision basis for enterprise information construction.

Keywords: Enterprise Informationization; Modern Advanced Manufacturing Industry; The information efficiency index

1. Introduction

Driving force behind the implementation of manufacturing enterprise informatization is the market competition, which is a strategic choice based on the "survival of the fittest" rules of the market economy environment, which aims to improve the overall efficiency and corporate dominance, its purpose is to improve the comprehensive benefit of enterprises and the dominant position. In the process of manufacturing enterprise informatization construction, evaluate the information level of enterprise is beneficial to understand strengths and weaknesses of the manufacturing enterprise informatization construction, improve the level of the project implementation and provide powerful guarantee to the success of enterprise informatization construction.

Manufacturing informatization is a long-term, gradual process, the development of the modern advanced manufacturing industry informatization construction is still in its infancy, the informationization evaluation work has just started, at present there is no a set of perfect manufacturing informatization evaluation index system and evaluation standard. According to the present domestic research in the field, advanced manufacturing industry informationization evaluation mainly exist the following problems:

(1) There is no unified evaluation index system and evaluation standard of authority;
(2) Describe the economic benefits of the enterprise informationization construction fuzzily and lack of quantitative indicators;
(3) The evaluation results can not reflect the characteristics of evaluated enterprise informatization;
(4) The disconnection of the evaluators and the evaluation object.

As a result of the existence of these problems, makes the study of advanced manufacturing informatization evaluation work is not ideal, but also makes the construction of enterprise informatization is difficult to find the problems.

Informatization evaluation already could not meet the requirements of the advanced manufacturing enterprises, therefore, establish advanced manufacturing industry informatization evaluation index system has important theory value and practical significance to fully grasp the informatization level of the advanced manufacturing industry, to understand the status of the manufacturing industry informatization development of various regions and trades, to evaluate the effects of the informatization of manufacturing development and the leading role of related industries.

2. The Research Status of Manufacturing Informatization Index System

The current manufacturing informatization index system of performance evaluation, gives prominence to the enterprise independent innovation ability, digital design, manufacturing, integration of collaborative reflection of technology application and so on, improves the correspondence between the data questionnaire and the entire informatization projects, at the same time continue to maintain its conciseness and operability. The current index system including manufacturing industry informatization index system of environmental performance and manufacturing industry informatization index system of enterprise performance, respectively from the two aspects of environmental quality level and ability conditions, enterprise informatization conditions, which have reflected the manufacturing industry informalization's development, level, trend and demand. The first and second index content is:

Firstly, manufacturing industry informatization index system of environmental performance, including 3 first-level indicators of policy environment, technology environment and service environment: Policy environment including manufacturing industry informatization demonstration enterprise influence, input matching ratio, the output-to-input ratio of the manufacturing industry informatization project supported by science and technology department and domestic software. Technology environment consists of domestic software usage, key technology price lower rate, technology absorption capacity, technology standardization level and independent intellectual property rights software registration number. Service environment includes service system revenue, service capability of service system and number of employees in the service system.

Secondly, manufacturing industry informatization index system of enterprise performance, including strategic status, infrastructure construction, application status, human resources, information security and efficiency index. Strategic status is reflected in the degree of importance on informatization. Infrastructure construction including total informatization investment accounted for the proportion of investment in fixed assets, computer ownership per hundred, the level of network performance. Application status including business process informatization level, product technology informatization level, electronic commerce and supply chain informatization level, management support informatization level. Human resources, including the personnel quality, informatization technology popularization rate. Information security, including costs used in information security accounted for the proportion of informatization investment, informatization security utility ratio and information system failure time. Efficiency index, including business process informatization efficiency, product technology informatization efficiency, electronic commerce and supply chain informatization efficiency, management support informatization efficiency.

3. The Construction of Modern Advanced Manufacturing Industry Informatization Index Synthetic Route

3.1 The Connotation and Characteristics of Modern Advanced Manufacturing Industry Informatization

Modern advanced manufacturing industry refers to the continuous absorption of high-tech achievements at home and abroad, and the advanced manufacturing technology, manufacturing mode and comprehensive management method is applied to the research and development, design, manufacture, test and service the whole process of manufacturing industry, with high technical content, good economic benefit and innovation ability, low resources consumption, little environmental pollution and service function fully, more employment and so on. All it includes not only the high-tech industry, but also includes the traditional industry being transformed with high technology and advanced applicable technology.

Modern advanced manufacturing industry informationization refers to transform traditional industries with information technology and breakthrough in informatization spurs industrialization, combining information technology, automation technology, and modern management technology with manufacturing technology, to drive the innovation of product design methods and tools, enterprise management mode and the collaboration between enterprises, to achieve informatization of product design and manufacturing and enterprise management, the intelligent of the production process control, manufacturing equipment of numerical control, consultation service of the network, in order to enhance the competitiveness of the modern advanced manufacturing industry . According to the connotation, the main content of the modern advanced manufacturing industry informatization can be summarized as the following several aspects:

(1) Integration of information technology and other advanced technology in manufacturing industry, improve the quality of the product itself, function level, technological content and high added value.
(2) In the manufacturing industry enterprise product design and manufacturing process, widely used in electronic information technology, automation technology, to achieve fast, efficient, reliable, high precision, low consumption, low cost of production
(3) In-depth development and extensive use of information resources, to achieve the optimization combination and comprehensive utilization of enterprise resources, to realize the management informatization.
(4) The construction of enterprise information network system, the development of network manufacturing, virtual manufacturing, network marketing, to form a dynamic alliance between enterprises and enhance the overall efficiency and competition ability of the enterprise and industry.
(5) Supply chain informatization is the key of the manufacturing industry informatization, to create a quick response supply chain platform based on the information technology, will be the priority for all.

3.2 Adding the Efficiency Index System of Modern Advanced Manufacturing Industry Informatization

At present the current manufacturing informatization performance index system has strategic guiding significance, and plays a macro guidance role in modern advanced manufacturing industry informatization. But combinated with the connotation and characteristics of modern manufacturing industry informatization, this paper presents the following research ideas and countermeasures:

(1) The established modern advanced manufacturing industry informatization evaluation index system should include national manufacturing industry informatization index system of performance evaluation, and reflects the characteristics and status of the modern advanced manufacturing industry , at the same time provide services for the economic development of modern manufacturing industry.
(2) The established modern advanced manufacturing industry informatization evaluation index system should be able to guide enterprise informatization to profitability, competitiveness and sustainable development direction.

Therefore, the synthesis route of modern advanced manufacturing industry informatization index not only should fit in with the synthetic route of existing national manufacturing industry informatization index, but also should add the informatization efficiency index system, which can respectively reflect the modern advanced manufacturing industry's development status and potential from three aspects of enterprises informatization status, environmental quality and the sustainable development ability. The detailed design is shown in Figure 1.

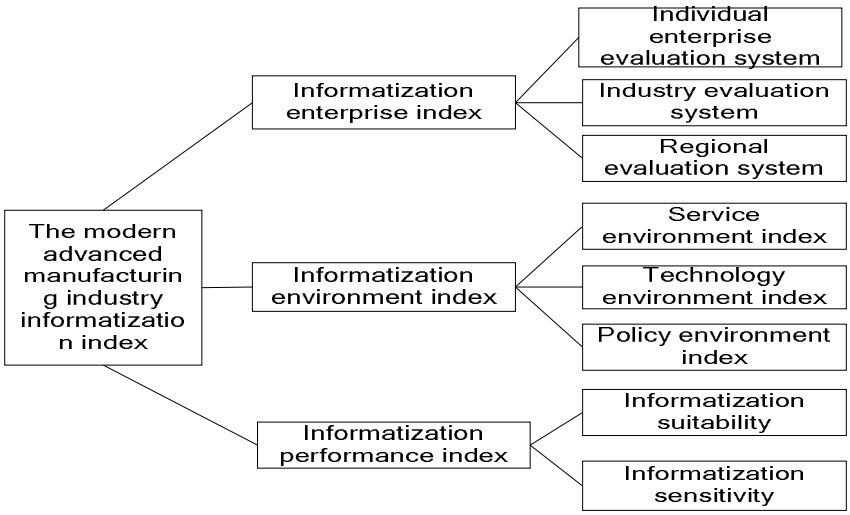

Fig.1The Synthesis Route Graph of Modern Advanced Manufacturing Industry Informatization Index

4. Construction of the Modern Advanced Manufacturing Industry Informationization Evaluation Index System

4.1 The Synthesis Route and form of Enterprise Index

The enterprise index of manufacturing industry informatization, mainly reflects the status and trends of manufacturing industry informatization, including 6 aspects of strategy, infrastructure, application, benefits and human resources and information security, as shown in Figure 2, specific index explained in Table 1.

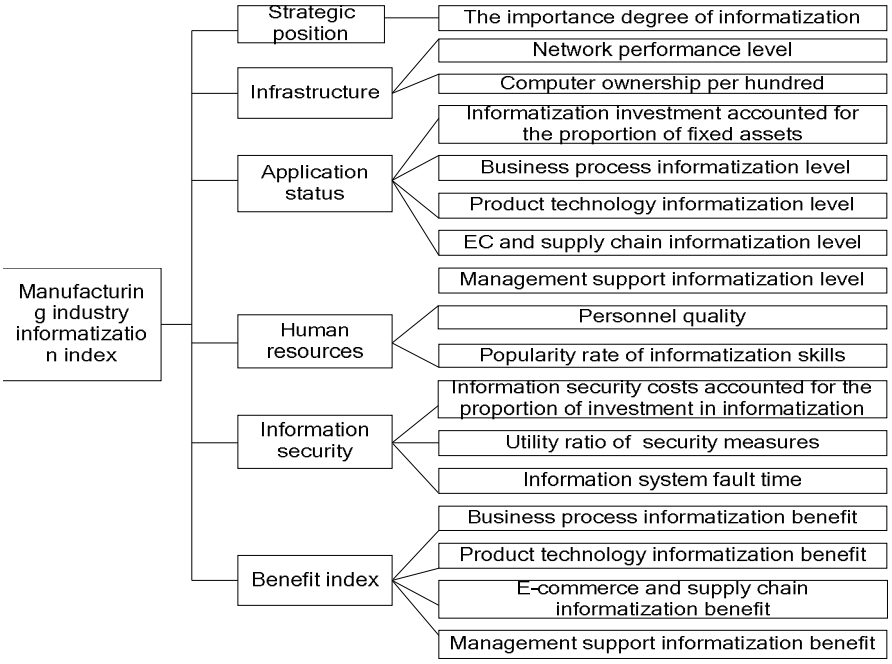

Fig.2The Enterprise Index System of Manufacturing Industry Informatization

Table 1: The Enterprise Index of Manufacturing Industry Informatization

Number	First-level index	Second-level index	Index explanation	Index data constitute
1	**Strategic position**	The degree of importance to informatization (points)	Reflect the enterprise's emphasis on informatization and informatization strategy implementation	The supreme leader's status of enterprise informatization work; The level set of the Chief Information Officer (CIO) position; Informatization planning and budget formulation
2	**Infrastructure**	Informatization investment accounted for the proportion of fixed assets （%）	Reflect the enterprise informatization investment	Software, hardware, network, human resources informatization, communications equipment and other inputs
3		Computer ownership per hundred(units)	Reflect the status of informatization infrastructure	Large, medium and small machine; server; workstations; PC machine
4		Network performance status(points)	Reflect the status of informatization infrastructure	The export bandwidth of enterprise network
5		The networking rate of computer（%）	Reflect the information-based collaborative application conditions	The proportion of the computer's access to the intranet
6	**Application status**	The informatization means coverage of information collection（%）	Reflect the enterprise's ability to access to external information effectively	Application status of informatization means to acquire information which included policies and regulations, marketing, sales, technology, management, human resources information.
7		The applications of office automation system (points)	Reflect the enterprise office automation status based on the network application	Whether to implement the scheduling, dispatch management, conference management, information dissemination, business discussions, e-mail, information flow tracking and monitoring
8		The informatization statues of decision-making(points)	Reflect the information technology support conditions on major decisions	Whether there are data analysis and processing system, plan optimization system, artificial intelligence expert system, etc
9		The infomatization status of core business process	Reflect the depth and breadth of the core business process informatization	(1) Utility ratio of computer automatic control in the production process（%） (2) Quality level of computer automatic control in the production process(points) (3) Computer aided design/manufacturing utility ratio（%）
10		Portal website construction level of enterprise(points)	Reflect the status of enterprise resource integration	The coverage of service object; Service content available
11		The utility ratio of network marketing（%）	Reflect the status of enterprise management informatization	Online purchase rate; Online sales rate
12		Application status of	Reflect the	The application coverage of

Number	First-level index	Second-level index	Index explanation	Index data constitute
		management informatization (points)	management and utilization of information resources	management informationization and data integration level
13	**Human resources**	Human resource index(points)	Reflect the overall human resource conditions of enterprise informatization	College or higher educational background employees accounted for the proportion of the total number of employees
14		Popularity rate of informatization skills(points)	Reflect the application ability status of human resources informatization	The proportion of the employees master the professional IT application technology; Informatization training coverage of non-professional IT staff
15		Electronic learning status(points)	Reflect the transformation of enterprise learning ability and culture	Electronic learning staff coverage rate;Alternative learning field of electronic learning
16	**Information security**	Information security costs accounted for the proportion of investment in informatization（%）	Reflect the safety status of enterprise informatization	Information security charges including software, hardware, training, human resource spending
17		The utility ratio of information security（%）	Reflect the safety status of enterprise informatization	Application status of information backup, prevent illegal intrusion, anti-virus, information security system and security awareness training and other measures
18	**Benefit index**	The occupancy rate stock funds（%）	Reflect the benefit status of enterprise informatization	The proportion of the average occupancy of stock funds and all circulating funds
19		Funds operating efficiency(times / year)	Reflect the benefit status of enterprise informatization	Annual turnover times of enterprise liquidity capital
20		The speed of enterprise financial final accounts(day)	Reflect the response status of enterprise informatization	The minimum time required from give a final accounts instruction to complete a full virtual enterprise final accounts
21		Growth index	Reflect the improvement status of enterprise performance	Sales revenue growth rate、Profit growth rate、The rate of overall labor productivity、The increase rate of new products、The new product development cycle shortening rate

4.2 The Synthesis Route and form of Environmental Index

The environmental index of manufacturing industry informatization, by measuring the typical environmental factors which have an important influence on the environment, reflect the environmental quality level of the manufacturing industry informatization, as shown in Figure 3, specific index explained in Table 2.

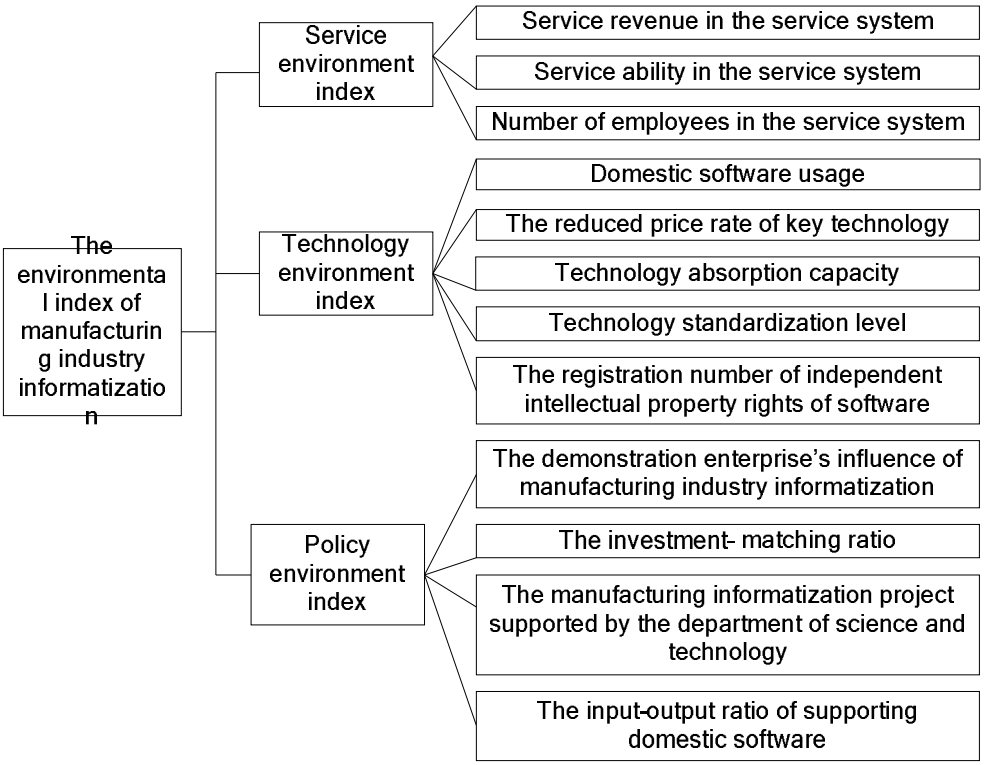

Fig.3The Synthesis Route Graph of Manufacturing Industry Informatization Environmental Index

Table 2: The Environmental Index of Manufacturing Industry Informatization

Number	First-level index	Second-level index	Index explanation	Index data constitute and data resources
1	**Service environment index**	Service revenue in the service system	Consultation, mediation, training institutions and other enterprises and institutions's annual income, which service the manufacturing informatization as the main business.	The first data acquisition is the service organizations' annually consulting supported by the Ministry of science and technology, Intermediary income, research subject income, total Training income
2		Service ability in the service system	The ability of information service system, the main business of which is service for manufacturing informatization.	The total number of training of not less than 2 hours; The number of supervision and consultation project; The number of acceptance and review project; Service mode; Income structure of service system
3		Number of employees in the service system	The number of employees in third-party consulting, brokerage, training institutions which cultivated and supported by informatization-related departments	The number of consulting, training institutions which cultivated and supported by science and technology, information, trade, industry and commerce, taxation and other departments
4	**Technology environment index**	Domestic software usage	The proportion of the annual use of domestic software in a region	The sample enterprises using quantity of a software enterprise (or software sets) as the denominator, to these enterprises adopt corresponding to the number of domestic software enterprises (or software sets) for molecular,calculation of the domestic software market share.
5		The reduced price rate of key technology	The price reduction rate of hardware and software, communication services used	The price reduction rate of mainstream brand enterprise server, OA software, CAD, CAM, ERP, CRM, PDM and so

Number	First-level index	Second-level index	Index explanation	Index data constitute and data resources
			by measured enterprises in a region(The data of hardware and software prices, communication prices are needed at least two years）	on;The price reduction rate of communications
6		Technology absorption capacity	The number of professional and technical personnel within the region	College degree or above number in a region ; College degree or above number in measured enterprise; The coverage of training and training time of measured enterprise
7		Technology standardization level	The level of manufacturing product coding and management coding standardization ; Technology service platform construction and service level	The proportion of enterprises use industry, national and international code ; The proportion of enterprises accept industry, regional platform service
8		The registration number of independent intellectual property rights of software	Support ability of independent intellectual property rights of the software on the informatization construction	The number of independent intellectual property rights of software registration in the software department
9	**Policy environment index**	The demonstration enterprise's influence of manufacturing industry informatization	Industry coverage of demonstration enterprise、Regional economic coverage;Industry economic coverage	Industry coverage = The industry number of demonstration enterprise / The industry number of regional manufacturing industry; Regional economic coverage = Demonstration enterprise output/Regional manufacturing output(From the regional statistics) Industry economic coverage = Demonstration enterprise's economy in the industry / Total amount of industry economy
10		The investment-matching ratio	The new investment amount of the competent departments / Total amount of matching funds enterprises implement	The current government departments at all levels in the total amount of capital invested in manufacturing enterprises, the hardware and software development companies, consulting and training companies/ Total amount of matching funds enterprises implement
11		The manufacturing informatization project supported by the department of science and technology	The number of projects that supported by all levels of departments related to informatization in the new projects of regional manufacturing industry informatization.	Include: OA, hardware, software, database, automatic control equipment, process control systems, integrated system, CAD/CAE/CAM system, etc
12		The input-output ratio of supporting domestic software	The software sales of supporting domestic software enterprise / The total investment	The annually accumulating software sales of supporting domestic software enterprise / The annually accumulating total investment

4.3 The form of Performance Index

Performance index of advanced manufacturing industry informatization is an evaluation system which can measure and evaluate the practical effect that enterprise informatization achieved, also known as the performance index. The purpose is to guide the enterprise informatization into profitable, competitiveness and sustainable development direction, make the enterprise informatization with overall corporate strategy, enable the business leaders to correct understand and implement the enterprise informatization work, emphasis on practical results, avoid to repeat construction, reduce waste. Performance index of enterprise informatization is divided into two parts, suitability and sensitivity.

Suitability index is divided into five categories: strategic suitability, application suitability, investment suitability, resource matching suitability, organizational culture suitability.

Sensitivity index is divided into four categories: information sensitivity, management operation sensitivity, external response sensitivity and innovation sensitivity. Specific index explained in Table 3 and Table 4:

Table 3: Performance Suitability Index of Manufacturing Industry Informatization

Number	First-level index	Second-level index	Index explanation
1	**Strategic suitability**	Enterprise strategy matching (points)	Reflect the coordination degree between the enterprise informatization strategy and corporate strategy, an enterprise always need coordinated development, not simply the development, if not match, the entire operation is not science.
2		Technology strategy suitability (points)	Reflect the coordination degree between the enterprise informatization technology strategy and technology environment, such as the information technology strategy of the strategic partner and so on.
3	**Application suitability**	Management informationization application suitability (points)	Reflect the rationality of the management informatization level, such as the depth and breadth of marketing management application.
4		Database application suitability (points)	Reflect the rationality of database application, such as database integration field and so on.
5		Security application suitability (points)	Reflect the rationality of the enterprise information security status, such as investment in security and so on
6	**Investment suitability**	Investment philosophy suitability (points)	Reflect the enterprise leaders correct understanding level to enterprise informatization, such as value-oriented investment and so on.
7		Investment dynamics suitability (points)	Reflect the rationality of the enterprise informatization investment, such as investment scale, etc.
8	**Resource matching suitability**	Customer Value suitability (points)	Reflect the actual value level of informatization investment brought by the upstream and downstream customers and final customers, that is customer satisfaction.
9		Investment structure of informatization suitability (points)	Reflect the rationality and allocation status of informatization investment between each element. Such as how the training effort and commitment.
10		Suitability of human resource structure	Reflect the rationality of the informatization of human resource structure, such as the structure of the employees, the CIO business background, how various aspects ability, how are the background of the whole business.
11		The coordination degree of system operation	Reflect the rationality of the system running status and functional status, such as information system average trouble-free running time.
12	**Organizational culture suitability**	Network degree of enterprise organization	Reflect the rationality of enterprise structure and the rationality of enterprise behavior of the network status. Such as the set up of informatization management department, product coding standardization status.
13		Enterprise culture suitability	Reflect the extent to which enterprise culture support for enterprise informatization, such as management subjects coding standardization status, employee learning situation.

Table 4: Performance Sensitivity Index of Manufacturing Industry Informatization

Number	First-level index	Index explanation
1	Information sensitivity (points)	Reflect the enterprise's channels, means and speed levels to collect a variety of external information, and the reaction mechanism of the market. Such as the terminal customer, customer feedback speed, data mining conditions and so on.
2	Management operation sensitivity (points)	Reflect intelligence and speed level of the enterprise management operation. Such as the speed of the virtual financial accounts, etc.
3	External response sensitivity (points)	Reflect the intelligent, breadth and comprehensive speed level of enterprise external response.
4	Innovation sensitivity (points)	Reflect the innovation capacity of enterprises. For example, product innovation sensitivity that reflect the the level of innovation, according to the market and customer demand.

5. Conclusion

Manufacturing industry informatization evaluation index system and the construction of evaluation standard play an important role in evaluation of enterprise informatization. In practical measurement, by using analytic hierarchy process (AHP) to determine the weight of the indexes at all levels, according to the survey data, choose the fuzzy clustering analysis (FCM), artificial neural network (ANN) and data envelopment analysis (DEA) method, to scientific and reasonable evaluation of enterprise information maturity, thus provides the accurate decision-making basis for the construction of enterprise information

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