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Research Article

Evaluation and Prediction Model of Intelligent Manufacturing Capability Based on Applied Mathematical Modelling

Xiaojun Lv

School of Mechanical Engineering, Xi'an Aeronautical Institute, Xi'an, Shaanxi 710077, China

Correspondence should be addressed to Xiaojun Lv; romeolv@xaau.edu.cn

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With the exponential enhancement of manufacturing effectivity and the structural transformation of the software of manufacturing elements induced by using the new spherical of scientific and technological revolution, the sample of comparative gain of manufacturing elements in the worldwide manufacturing enterprise has passed through profound changes, progressively forming a transformation from the industrial chain to the price chain, therefore promoting the transformation of manufacturing mode and aid utilization mode. Based on the applicable theories of wise manufacturing, this paper proposes an clever manufacturing functionality assessment and prediction mannequin primarily based on utilized mathematical modelling, which integrates the contrast facts of agencies into a database, establishes the corresponding time sequence relationship of the comparison data, and establishes a relationship with the corresponding organization attributes, fashions the assessment data, and combines them into a total prediction mannequin through built-in learning. By functionality of migration learning, the prediction model applicable to large statistics is migrated to small information to recognize the distinction of the equal type alternatively special entities. Input the comparison facts of the organization to be evaluated into the prediction mannequin to reap the shrewd manufacturing functionality maturity fee of the enterprise. It realizes the automated comparison of shrewd manufacturing capability, saves human cost, and improves the accuracy of evaluation. It solves the troubles that manufacturing companies have no longer deep hold close and understanding of smart manufacturing, inaccurate identification of their very personal smart manufacturing enhancement stage, and unscientific self-evaluation and diagnosis.

1. Introduction

Manufacturing enterprise is a vital section of the country wide economy, the basis for hold competitiveness, healthful financial operation, and social stability, and the fundamental battlefield for scientific and technological innovation. It has been connected with remarkable significance through the governments of all countries, especially after the worldwide financial crisis, the usual manufacturing has regularly uncovered many troubles such as susceptible innovation capability and low scientific and technological content, and it is in pressing want of transformation and upgrading. Under this background, developed nations such as Europe and America have launched the approach of reindustrialization in an strive to catch the commanding peak of worldwide competition [1]. The most consultant international locations are Germany, the United States and Japan with developed manufacturing industries. Germany's manufacturing enterprise is very aggressive in the world. In phrases of data technology, the applied sciences represented by way of embedded structures and automation are at the world's main level. The core of its industrial four is to digitize and sensible the supply, manufacturing and income data in the manufacturing manner through the cyber bodily system, so as to gain speedy product furnish and enhance Germany's industrial competitiveness. Relying on its sturdy web capability, the United States has put ahead a country wide strategic sketch for superior manufacturing primarily based on "Internet +" manufacturing, hoping to beef up the manufacturing enterprise via the cooperation of the government, universities and enterprises [2]. The motive is to decorate the competitiveness of American manufacturing,

promote the transformation of revolutionary technological know-how into a standardized, low-budget and environment friendly neighbourhood manufacturing capacity, and realise a sustainable improvement commercial enterprise model [3]. In the early years, Japan proposed a manufacturing administration system with the renovation of the entire manufacturing machine as the core. Later, it chosen lean manufacturing as the transformation direction, and adjusted the focal factor of manufacturing employer enhancement in authentic time in accordance to the dynamics of Germany and the United States [4].

Intelligent manufacturing is primarily based on synthetic genius technology, which integrates and runs through the total manufacturing process, so that it has clever behaviour and hastens industrial transformation. Intelligent manufacturing no longer solely brings a lot of advantages to enterprises, such as decreasing costs, enhancing exceptional and standardizing work processes, however additionally promotes multidimensional integration and improvement of firms and realizes transformation and upgrading of enterprises [5]. In the modern technology of speedy improvement of records technology, vigorously and continually growing shrewd manufacturing is the great way to assist companies enhances their competitiveness. However, for a long time, the merchandise is broadly speaking focused in the centre and low-end fields and the low brought fee of merchandise are the fundamental traits and long-standing hazards of the usual manufacturing industry. It is pressing to promote the transformation and upgrading of the manufacturing enterprise from the low-end to the high-end. The improvement of wise manufacturing is most likely an essential and tremendous way to acquire the transformation and upgrading [6]. It is fundamental to give a boost to the help of shrewd manufacturing, so as to promote the growth of data science and wise technology. In addition, the improvement of clever manufacturing enterprise can practice extra energy-saving and environment-friendly superior gear and wise optimization technology, which will assist basically clear up the energy-saving and emission discount troubles in China's manufacturing process [7]. Some firms cannot completely apprehend and apprehend clever manufacturing, lack of systematic and scientific enhancement positioning and path planning, in unique the dubious definition of the enhancement stage of smart manufacturing in which the corporations are located, and lack of achievable prognosis in the constructing of smart manufacturing. Therefore, a scientific comparison technique is urgently needed [8]. Therefore, it is fundamental to find out about the contrast of sensible manufacturing functionality maturity of manufacturing enterprises.

Based on the above lookup background, this paper proposes a wise manufacturing functionality assessment and prediction mannequin based totally on utilized mathematical modelling from the applicable theories of clever manufacturing. With the assist of the prediction model after built-in studying training, the importance of every comparison parameter can be ranked, and the qualitative influence of every parameter on the last comparison conclusion can be achieved. The quantitative influence of every parameter on the closing assessment conclusion can be located via multibatch coaching and real-time monitoring based totally on it. It realizes the computerized assessment of sensible manufacturing functionality maturity, saves labour value, and improves the accuracy of evaluation.

The organization of this paper is as follows: Section 1 mainly describes the background, content framework, and main significance of the study. The related work is discussed in Section 2. Section 3 introduces relevant theories and technologies. The experimental analysis is carried out in Section 4. Section 5 summarizes the full text.

2. Related Work

As the core of the new spherical of the industrial revolution, sensible manufacturing has been surprisingly worried through the enterprise and tutorial circles. Most students basically learn about clever manufacturing from the components of development, science, and application. However, with the improvement and implementation of shrewd manufacturing, its functionality degree displays the improvement popularity of smart manufacturing and the core competitiveness of enterprises. Therefore, how to consider the wise manufacturing functionality has grown to be a new lookup hotspot. The fundamental lookup contents are summarized as follows:

Foreign scholars' lookup on the assessment of manufacturing ability basically focuses on the enhancement of the competitiveness and manufacturing potential of manufacturing enterprises. Relevant pupils trust that the improvement of shrewd manufacturing enterprise cannot be separated from the assist and improvement of records technology [9]. Intelligent manufacturing additionally promotes the enhancement of manufacturing efficiency to a sure extent. In the assessment of manufacturing capacity, the contrast index gadget is mounted in a qualitative way. In order to enhance the competitiveness of the manufacturing industry, enhancing the manufacturing and manufacturing capability of businesses and enhancing the business enterprise device are two key factors that cannot be ignored [10]. Based on these two lookup emphases, a contrast gadget of manufacturing functionality is proposed. In the surroundings of fast improvement of sensible manufacturing, the upgrading and adjustment of manufacturing technological know-how and industrial shape will have an effect on the manufacturing potential of the manufacturing enterprise to a positive extent [11]. In order to make the business enterprise higher adapt to the necessities of a shrewd manufacturing environment, the multiagent gadget is delivered to the simulation of the manufacturing system to enhance the manufacturing ability of the enterprise. Finally, the benefits of the simulation approach are demonstrated via the real data, and the manufacturing potential of the manufacturing device after the simulation is evaluated by way of the fuzzy complete assessment method [12].

Different from the lookup course of overseas scholars, some home pupils have carried out a lot of assessment and research on the processing and manufacturing capabilities of manufacturing systems. A reference gadget for evaluating

the manufacturing ability of desktop equipment and tools based totally on inexperienced manufacturing is established [13]. On this basis, a multiobjective optimization selection mannequin is established. The mixture of grey relational evaluation and the analytic hierarchy method is utilized in the ability evaluation, and the mannequin is solved [14]. The trouble of deciding on the manufacturing capability of laptop equipment and tools is correctly solved. Through summarizing the complete contrast strategies of manufacturing capacity, it is determined that there are nevertheless some deficiencies in the comparison strategies of the total manufacturing process. On this basis, a complete assessment is carried out through the usage of the proposed assessment mannequin via analytic hierarchy process. According to the improvement of manufacturing enterprise and the informatization degree of manufacturing enterprise in our country, the functionality contrast index gadget for the implementation of manufacturing informatization is constructed. When evaluating the informatization capability of manufacturing industry, AHP is used to weight the contrast indexes of every level, and a fuzzy complete contrast approach is used to analyse the informatization maturity of manufacturing enterprises [15]. Through the proper investigation and lookup of a precise consultant enterprise, the comparison index machine is used to consider the manufacturing informatization capacity of the enterprise. On the foundation of reading the improvement of manufacturing capacity, a hierarchical decision-making approach of manufacturing laptop device primarily based on fuzzy complete contrast technique is proposed, and an entire assessment mannequin of computer device manufacturing capability is established [16].

To sum up, it can be considered from the above overseas literature on manufacturing capability contrast that the lookup of overseas students on intelligent manufacturing focuses on how to enhance the manufacturing potential and typical competitiveness of manufacturing enterprises. There are few literatures on the distinction of manufacturing capacity, and the contrast penalties of manufacturing capability are essentially used to think about the trendy competitiveness of manufacturing firms [17]. Most scholars' lookup on intelligent manufacturing tends to be qualitative lookup on standards and modes, whilst quantitative lookup is less. However, this paper focuses on quantitative research, proposes a clever manufacturing functionality contrast and prediction mannequin based totally on utilized mathematical modelling, establishes a shrewd manufacturing complete functionality assessment system, realizes the automated assessment of clever manufacturing functionality maturity, saves labour costs, and improves the accuracy of evaluation [18].

3. Intelligent Manufacturing System Based on Mathematical Modelling

3.1. Structure of Intelligent Manufacturing System. The digital format machine of clever manufacturing tools is special from the regular product sketch system. With the improvement of community and verbal exchange technology, in order to minimize the set up and upkeep prices of shrewd manufacturing equipment, the faraway analysis and preservation of clever manufacturing gear is the well-known trend. This requires that the digital layout and verification device of smart manufacturing tools is an open-structure gadget-based totally on the Internet. Intelligent manufacturing gear is a subsystem of a manufacturing system [19]. Therefore, it is imperative to think about the layout and verification of clever manufacturing tools below the basic framework of the manufacturing system. The format and verification machine of shrewd manufacturing tools integrates applicable manufacturing device information, and can layout merchandise that higher meet the necessities of customers [20]. In addition, when clever manufacturing gear is used, it will devour electricity and produce elements that have an effect on the environment. Therefore, shrewd manufacturing gear needs to adopt environment-oriented design [21]. Of course, modelling the environmental influence is a tremendously complicated work. The structure of the sensible manufacturing gear digital format and verification device described right here is proven in Figure 1.

3.2. Construction of Evaluation Model. Digital technological know-how refers to the technical skill of laptop hardware, software, data storage, conversation protocol, peripheral tools, and Internet. Technology is primarily based on statistics science. Digital science consists of the series of science and technological know-how in the fields of facts discrete expression, scanning, processing, storage, transmission, sensing, execution, materialization, support, integration, and networking. The extensive software of digital technological know-how in the format area has modified the regular graph technique and plan method, and fashioned the digital sketch technology. The core of digital layout is the discretization of a number fact in the graph process [22]. All facts are expressed digitally, and the design, premeeting, and simulation check are all carried out on the computer [23]. It discretizes the continuous bodily phenomena, fuzzy and not sure phenomena in nature, and human trip, and skills to understand digitization. Discrete mathematics, computational geometry, computational mechanics, and different disciplines grant theoretical help for digital design [24]. In addition to assembly the necessities of universal product design, the digital layout of wise manufacturing tools must additionally reflect on consideration on the traits of manufacturing equipment as given in the following:

(1) Because clever manufacturing tools are generally a complicated electromechanical gadget or mechanical, electrical, hydraulic, and pneumatic systems, the digital layout of smart manufacturing gear has a massive quantity of sketch statistics and complicated relationship between information. This brings positive troubles to the storage and transmission of information.

(2) The digital preassembly of sensible manufacturing equipment, mechanism action simulation, and

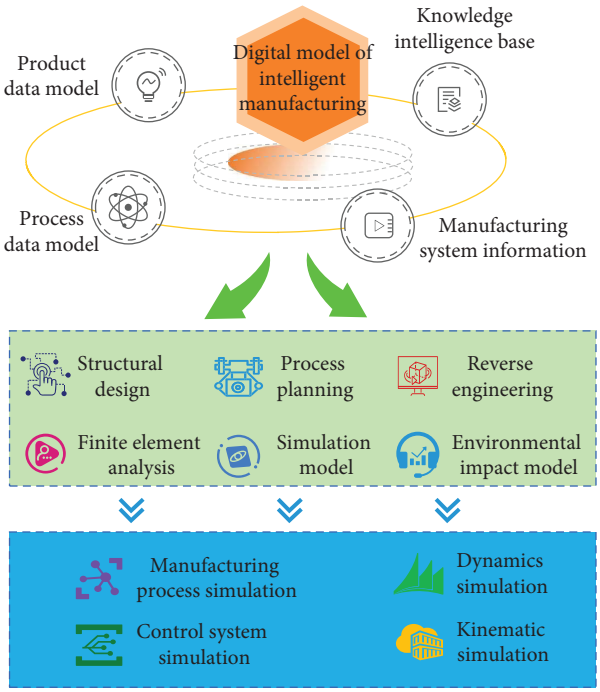


Figure 1: Architecture of digital design for intelligent manufacturing equipment.

manufacturing method simulation all require the corresponding main know-how of manufacturing, such as the modelling of bodily portions such as force, heat, sound, vibration, and error in the manufacturing process.

(3) The future sensible manufacturing machine additionally places ahead new necessities for the plan of sensible manufacturing equipment, such as the smart manufacturing gear have to be convenient to be reconfigurable.

Virtual truth technology, object-oriented technology, sensing technology, and hardware and software program science with more and more effective processing capability are the digital laboratory of sensible manufacturing tools [25]. The bodily prototype of wise manufacturing gear has a lengthy building time and excessive cost. The digital verification technique can no longer solely affirm the shape and technique parameters of smart manufacturing gear in the digital space; however, additionally visualize a variety of bodily and geometric phenomena when the tools are used [26]. Taking the sensible assembly robotic as an example, the digital verification science can be used to affirm the workspace, motion trajectory, whether or not there is interference in the assembly process, and the size of assembly stress of the designed clever assembly robotic in the computer, and even to verify the coordination between greater than one wise meeting machines and the integration of facts [27]. People immersed in the digital area will have a profound grasp of the composition and meeting manner of wise meeting robots. In addition, digital verification technological know-how based totally on digital surroundings is conducive to people's innovative thinking, similarly enhancing the brain of manufacturing tools and growing a pleasant human-machine interface. Module of intelligent closed-loop processing is shown in Figure 2.

3.3. Calculation of Prediction Model. When optimizing the community parameters, the returned propagation algorithm is used to acquire the Jacobian matrix corresponding to the batch normalization of the enter vector and the typical education pattern values. The batch normalization technique requires a massive quantity of computation for the entry of all layers, and the time taken to achieve the covariance matrix is long. The following two simplified enhancement strategies are proposed as follows:

(1) The impartial batch normalization processing is used to exchange the joint normalization processing of every dimension data, and the components are as follows:

$$X^{(k)} = \frac{x_i^{(k)} - E\left(x^{(k)}\right)}{x^2 - u^2} + \frac{\sqrt{\mathrm{var}\left(x^{(k)}\right)}}{\lambda}. \tag{1}$$

Among them, the k-th dimension of the enter pattern is represented through $x^{(k)}$, the expectation is represented with the aid of $E(x^{(k)})$, and the variance is represented by means of $\mathrm{var}(x^{(k)})$. The unbiased batch normalization processing can efficiently velocity up the community education speed, however, it can't make sure the steadiness of the preliminary description of every degree of the network. In order to preserve the trade of the brought batch normalization constant, add parameters in the k-th dimension of every enter pattern $\lambda^{(k)}$ and $\beta^{(k)}$, the following components are obtained as follows:

$$y^{(k)} = \frac{\lambda^{(k)}\left[x_i^{(k)} - E\left(x^{(k)}\right)\right]}{\beta^{(k)}\left(x_i^{(k)} - x_{i-1}^{(k)}\right)}. \tag{2}$$

Among them, $\lambda^{(k)}$ equal to $\mathrm{var}(x^{(k)})$, they are all variance, which more often than not refers to the k-th dimension of the enter pattern after scale transformation; $\beta^{(k)}$ equal to $E(x^{(k)})$, they are the expectations of the input, usually referring to the dimension of the enter pattern after translation transformation.

(2) The random gradient education of convolutional neural community is carried out through microbatch samples, and the common and variance of every degree of every pattern are calculated. The gradient propagation in the contrary course can be realized through the above operation.

On the groundwork of the above mode theoretical analysis, mixed with the statistical evaluation method, the independent estimation mannequin of sensible manufacturing functionality prediction is mounted with the aid of the usage of the ordinary

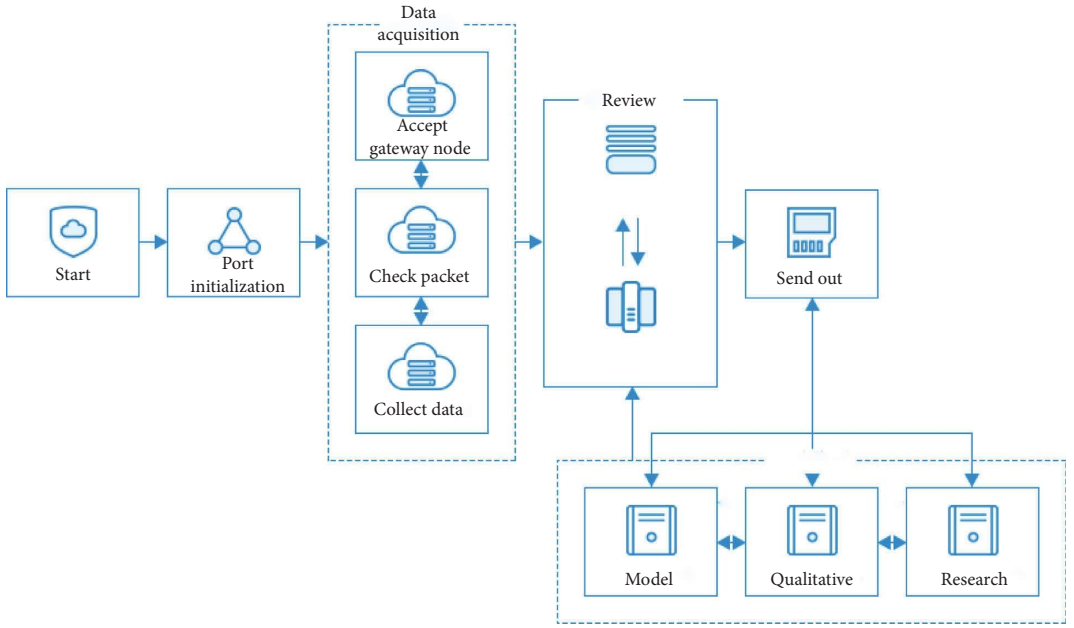


Figure 2: Module of intelligent closed-loop processing.

distribution model. The regular distribution feature is described as follows:

$$F(x) = \frac{\int_{-\infty}^{x} \exp(x-\mu)^2 \mathrm{d}x}{\sqrt{2\pi\delta}} + \frac{x^2-\mu^2}{2\delta^2} \int_{\infty}^{x} \exp\left(\frac{x}{k}\right) \mathrm{d}x. \tag{3}$$

In method

(3) μ is the self-assurance parameter of the wise manufacturing functionality comparison model; δ is a scale parameter; and k is the studying parameter of smart manufacturing functionality evaluation. According to the statistical characteristic quantity, popular ordinary evaluation is carried out to reap the self-belief distribution chance distribution characteristic of clever manufacturing functionality contrast as follows:

$$F(x) = \frac{\left(\int_{0}^{x} (x-\mu)^2/\sqrt{2\pi\delta}\right) + \int_{\infty}^{x} \exp\{\ln(x/K) - \mu\} \mathrm{d}x}{\left(x^2 - \mu^2/2\delta^2\right)}. \tag{4}$$

According to the poor bias of smart manufacturing functionality evaluation, the chance distribution characteristic of reliability distribution of wise manufacturing functionality is obtained via the usage of the technique of binary parameter evaluation as follows:

$$F_L(x) = \frac{\int_{0}^{x} (\delta/k)(x/k)^{\delta-1} \exp\{\ln(x/k) - \mu\} \mathrm{d}x}{x^2 - \mu^2} + \int_{-\infty}^{x} \exp\left(-\frac{x}{k}\right) \mathrm{d}x. \tag{5}$$

Combined with statistical decision and fuzzy decision method, the generalized extreme value distribution function of intelligent manufacturing capability evaluation is obtained as follows:

$$F_G(x) = \frac{\int_{0}^{x} \exp\left\{[1 + (k/\delta)(x-\mu)]^{(1/k)}\right\} \mathrm{d}x}{\left(x^2 - \mu^2\right) \int_{-\infty}^{x} \exp(-(x/k)) \mathrm{d}x}. \tag{6}$$

The gamma probability distribution function is as follows:

$$F_G(x) = \frac{\int_{-\infty}^{x} (x-\mu)^{k-1} \exp[\mu - x/\mu] \mathrm{d}x}{\Gamma(k)} + \frac{\int_{0}^{x} \exp\left\{[1 + (k/\delta)(x-\mu)]^{(1/k)}\right\} \mathrm{d}x}{x^2 - \mu^2}. \tag{7}$$

According to the above distribution feature shape for the contrast of wise manufacturing capability, the following complete inspection components for clever manufacturing functionality is fashioned by way of the usage of the traits of goodness of in shape take a look at method:

$$H = \frac{(F_T(x,y)/\partial\theta)(\partial F_T(x_{t-1},y)/\partial\theta)(\partial F_T(x_{t-2},y)/\partial\theta)\cdots(\partial F_T(x_1,y)/\partial\theta)}{\alpha_{jy}\left(\chi^2\right) + \beta(ks) + \gamma(\delta)} + \frac{P_{tj}(PP) - R_{tj}(RM)}{P_{av}(PP) - R_{av}(RM)}. \tag{8}$$

4. Experiment and Analysis

4.1. Analysis of Digital Maturity Score. The pattern facts and the anticipated output cost of the pattern statistics transformed from the assessment indexes have been determined. It is solely critical to divide the information in accordance to the coaching set and the take a look at set, carry them into the community assessment mannequin for education and testing, and then evaluate and analyse the accuracy of the take a look at consequences of one-of-a-kind community comparison models, so as to decide that the assessment mannequin proposed in this paper is extra appropriate for this research. Finally, the mannequin after the education is used to consider the ultimate assessment index records of the subsidiaries, and the smart manufacturing functionality maturity degree is bought to pick out its sensible manufacturing level.

Take the four-dimension symptoms as an example, as proven in Figure 3 the case corporation has a notably excessive diploma of digital maturity at the strategic and ecosphere levels and a surprisingly low diploma of operational science and cultural enterprise ability. In particular, the diploma of digitization at the operational science degree is nearly equal to the authentic state. It can be inferred that the employer management has realized the significance of digitization and formulated applicable strategies; however, great measures nonetheless want to be implemented. From the standpoint of operation technology, the very best rating of order administration digitization maturity is solely 0.792, whilst the ratings of manufacturing fine management, actual logistics, and grant chain collaboration are low, which are 0.070, 0.261, and 0.284, respectively. This suggests that the digitization of the case organization in the fields of production, manufacturing, and provide chain has no longer but commenced or has simply started, which is the weak spot of organization digitization.

According to the classification approach and blended with the precise data of the surveyed enterprises, character businesses are categorised and adjusted, and the digital maturity rankings of manufacturing organizations of exceptional industrial kinds are calculated, respectively, as proven in Figure 4.

It can be viewed from Figure 4 that capital-intensive manufacturing organizations have the easiest digital maturity of 2.343 points, accompanied by way of technological know-how-intensive companies with 2.255 points, and labour-intensive companies have the lowest digital maturity of 2.003 points. This end result additionally essentially conforms to the digital maturity popularity of manufacturing enterprises, that is, the labour-intensive companies with the lowest dependence on technological know-how and gear regularly lack the riding pressure for digital construction, and the digital stage is low, whilst the technological know-how-intensive organizations with the very best dependence on technological know-how and gear regularly make investments solely a small quantity of money in key science lookup and improvement due to the lack of authentic accumulation of funds. The funding in the digitalization has been correspondingly reduced, and the

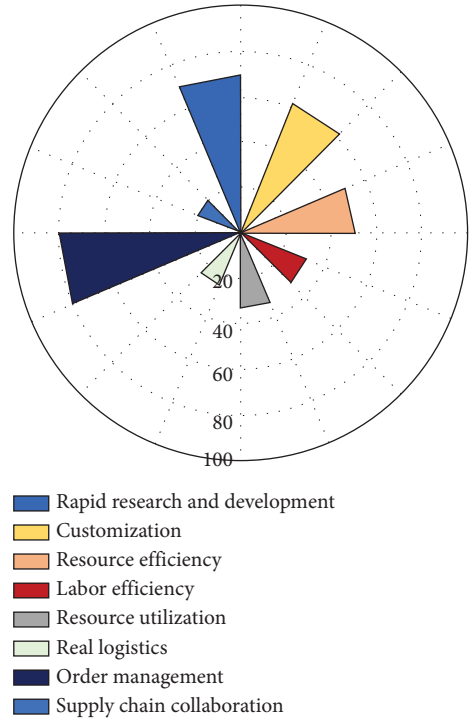


Figure 3: Comparison of digital maturity evaluation index scores of operation technology dimension.

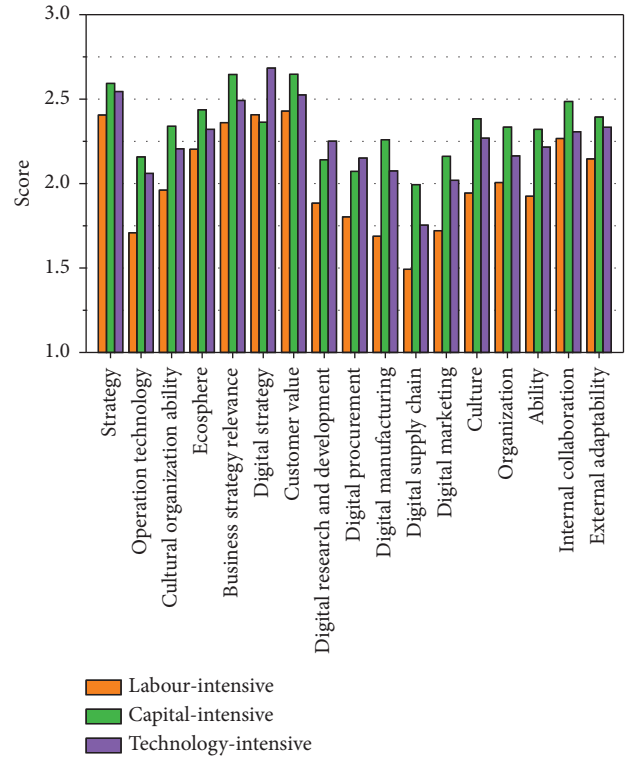


Figure 4: Digital maturity scores of manufacturing enterprises of different industrial types.

digitalization maturity is barely decreasing than that of capital-intensive enterprises. However, capital-intensive corporations with enough capital accumulation and

mature science accumulation normally have higher functionality and motivation to put into impact digital initiatives. That is, although the modern utilized sciences of these corporations are very mature, it is these mature utilized sciences that make these organizations regularly face technological understanding dependence inertia. Therefore, companies are eager to make structural adjustment via digital upgrading, break the historical science lock, and gather new leapfrog development.

As proven in Figure 5, the digital maturity of the four-dimension segmentation warning signs of specific kinds of manufacturing firms can be plotted. It can be considered from the parent that capital-intensive companies have benefits in phrases of relevance to commercial enterprise strategy, focusing on purchaser value, digital manufacturing, digital provide chain, digital marketing, culture, organization, ability, inside cooperation, and exterior adaptability. Technology-intensive agencies have blessings in long-term digital approach oriented, and digital procurement. Labour-intensive organizations have no indications with apparent advantages. Manufacturing corporations of distinctive industrial kinds have specific emphasis on digital upgrading. For example, capital-intensive businesses have increased benefits in the area of digital manufacturing, while science-intensive companies have apparent benefits in the subject. When one-of-a-kind kinds of businesses behaviour digital upgrading, they have to absolutely think about their very own attributes and characteristics, hold the first mover gain in their fields, and research from the incredible digital ride of different sorts of enterprises, so as to comprehend the complete digital upgrading of enterprises.

4.2. Comparative Analysis of Evaluation Model Training and Testing. Through theoretical research, it is located that the populace measurement and the wide variety of iterations have an excellent have an impact on the optimization impact of the optimization algorithm. When the populace is too small, the algorithm converges quickly; however, the opportunity of nearby extremum is high, which makes it tough to iterate to the most fulfilling fitness. If the variety of populations is too large, the complexity of optimization will be extensively increased, and the search time of the algorithm will be prolonged. In addition, too much iterations will limit the variety of the population. Therefore, excellent populace dimension and generation instances are useful for the algorithm to discover the fantastic solution. Therefore, this paper compares the overall performance of the BP model, the PSO-BP model, the SSA-BP mannequin, and the FASSA-BP mannequin proposed in this paper from the same, most useful populace dimension and generation times.

After placing the parameters of every model, the preprocessed pattern information is entered into the FASSA-BP model, the SSA-BP model, the PSO-BP mannequin and BP mannequin, respectively, for education and testing. First, the education samples are entered into the 4 fashions for training. After the education is completed, the take a look at stage is entered. After countless iterations, the assessment

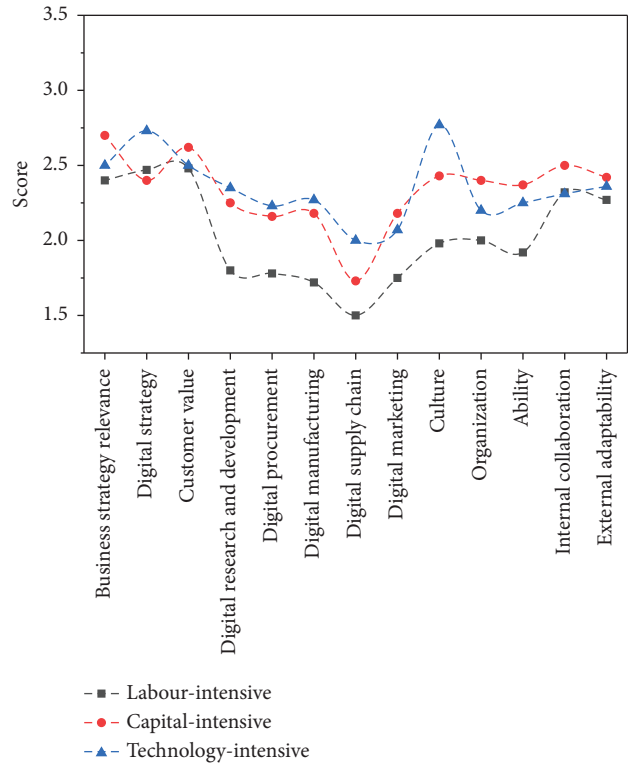


Figure 5: Digital maturity score of four-dimension segmentation indicators of different types of manufacturing enterprises.

consequences between the contrast values and the actual values of the samples of the mannequin check set are obtained, as proven in Figure 6.

In consideration of the exceptional outcomes of every run of the neural community algorithm and the smart optimization algorithm, the 4 algorithm fashions are run for 30 instances, respectively, and the common price of the experimental effects of the overall performance comparison indexes of the special fashions is compared, as proven in Figure 7.

In order to in addition take a look at the superiority of the FASSA-BP algorithm, the top-of-the-line parameters of the FASSA-BP algorithm, the SSA-BP algorithm, and the PSO-BP algorithm underneath the ultimate health are chosen and their algorithm overall performance is analysed through experiments. Similarly, the preprocessed pattern facts are entered into the FASSA-BP model, the SSA-BP mannequin, the PSO-BP mannequin, and the BP model, after various iterations, the comparison values of every mannequin are obtained and in contrast with the actual values, as proven in Figure 8.

The FASSA-BP model, the SSA-BP mannequin, and the PSO-BP mannequin are respectively set with the finest populace dimension and the quantity of iterations. Since the strolling time of the three algorithm fashions is too lengthy below the situation of the top-of-the-line populace dimension and the wide variety of iterations, the FASSA-BP model, the SSA-BP mannequin, and the PSO-BP mannequin are run for 20 instances, respectively, and the common cost of the experimental end result facts of every mannequin in

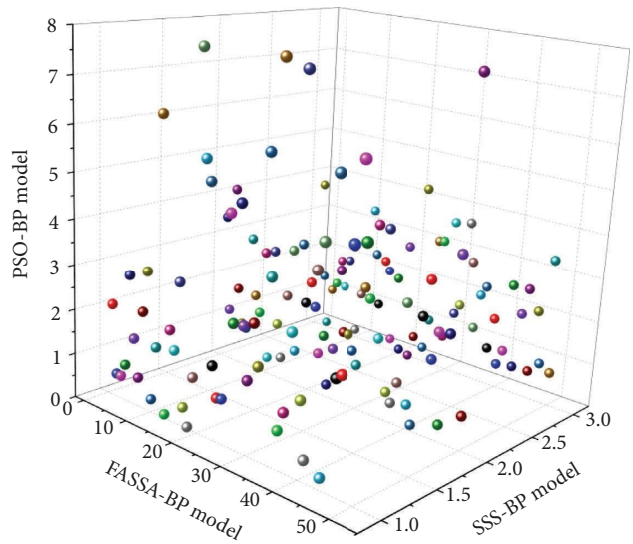


Figure 6: Expected output value and actual output value of different model test sets.

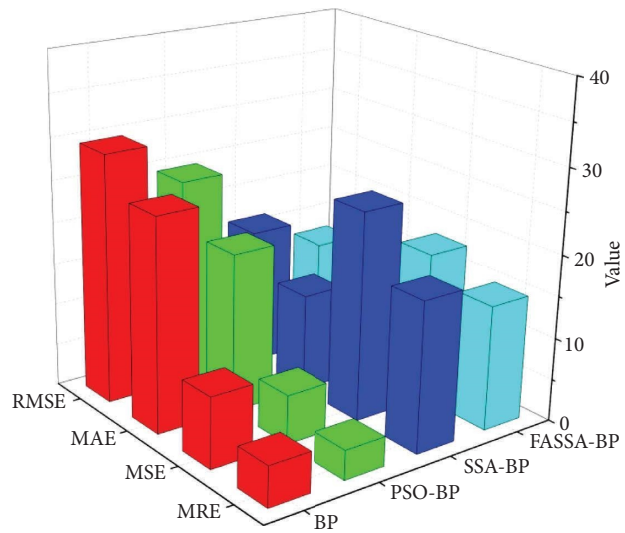
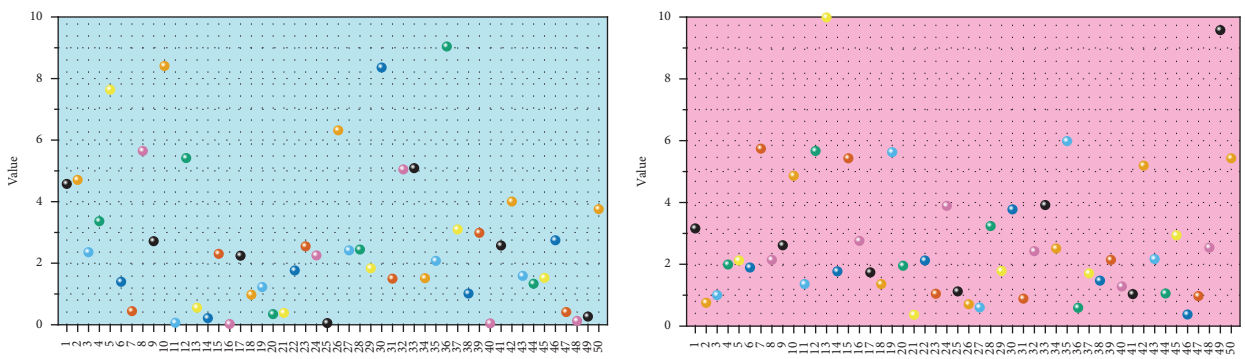


Figure 7: Performance evaluations of four models based on the same population size and iteration times.



(a) (b)

Figure 8: Continued.

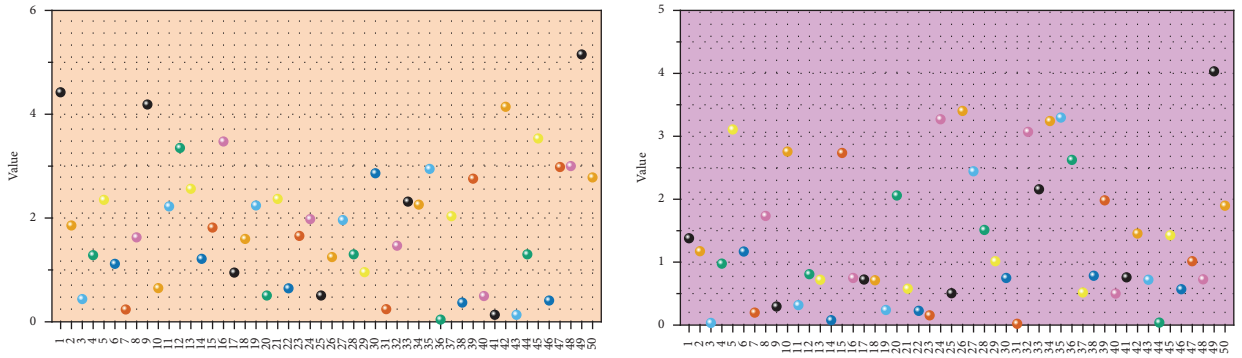


Figure 8: Test sets of each model based on the optimal population size and iteration times. (a) BP. (b) PSO-BP. (c) SSA-BP. (d) FASSA-BP.

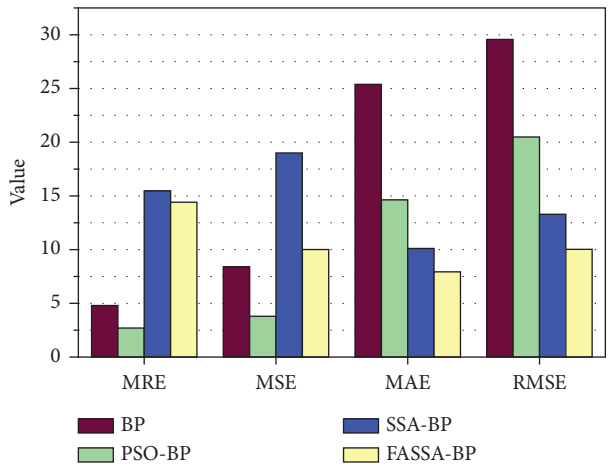


Figure 9: Data results of four model performance evaluation indexes based on optimal population size and iteration times.

the overall performance contrast index is calculated to analyse and evaluate the overall performance of these models, as proven in Figure 9.

5. Conclusion

Aiming at the issues that companies cannot completely apprehend and recognize the wise manufacturing capability, lack of systematic and scientific improvement positioning and course planning, especially the doubtful definition of the improvement stage of intelligent manufacturing in which firms are located, and lack of capability analysis in the development of shrewd manufacturing, this paper constructs an shrewd manufacturing functionality comparison and prediction mannequin-based totally on utilized mathematical modelling. Design a preliminary evaluation index computing device to apprehend the distinction of the equal sort then again one-of-a-kind entities. Input the comparison facts of the business enterprise to be evaluated into the prediction mannequin to gain the sensible manufacturing functionality maturity fee of the enterprise. It realizes the computerized comparison of clever manufacturing capability, saves human cost, and improves the accuracy of evaluation. It solves the troubles of manufacturing agencies such as lack of deep grasp and appreciation of smart manufacturing, inaccurate identification of their personal sensible manufacturing improvement stage, unscientific self-evaluation and diagnosis, and can assist businesses analyse the troubles in clever manufacturing construction, Formulate measures to enhance the maturity degree of business enterprise-shrewd manufacturing abilities and promote the transformation and upgrading of agency sensible manufacturing. There are moreover some troubles to be improved in this study. In the study, the constructing of the evaluation index computer of smart manufacturing performance maturity wants to be increased scientifically. How to think about the dynamic have an impact on elements at unique tiers in the improvement of shrewd manufacturing and optimize the mannequin through the use of smart optimization algorithms.

Data Availability

All data, models, and code generated or used during the study appear in the submitted article.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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