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Improvement method for business management in manufacturing industry based on MOPSO algorithm from industrial perspective

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Abstract. Improvement of business management in manufacturing industry based on lean production from industrial perspective has great significance for improving of enterprise benefit. The paper presents a kind of improvement method for business management in manufacturing industry based on multi-objective particle swarm Algorithm from industrial perspective. Firstly, super-efficiency DEA -Tobit model was used to conduct modeling for improvement method of business management in manufacturing industry from industrial perspective so as to realize quantitative evaluation for improvement of business management; secondly, a kind of PMOPSO algorithm was proposed. Preference information of decision maker was introduced in the algorithm so as to guide search process of algorithm. Moreover, several compromise solutions in the preference zone were solved in an operation so that the decision maker can be avoided making a difficult choice from numerous noninferior solutions; finally, effectiveness of mentioned algorithm was verified through simulation experiment.

Key words. Industrial perspective, Multi-objective particle swarm, Manufacturing industry, Business management.

1. Introduction

Manufacturing industry is an economic development pillar for a country. Chinese manufacturing industry is transforming from traditional manufacturing industry into modern manufacturing industry. Intelligent manufacturing has aroused wide concern since the plan of “Made in China 2025” was proposed. However, most Chinese intelligent manufacturing enterprises are in the initial stage, promotion of development

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process for intelligent manufacturing enterprises and improvement of operation efficiency for intelligent manufacturing enterprises are important to economic growth and economic transformation in China. Current performance was required to be comprehensively known so as to improve management performance of intelligent manufacturing enterprises; moreover, key factors which influences business management of manufacturing enterprises was clarified. Therefore, efficiency and influence factors of intelligent manufacturing enterprises were attempted to be researched in the paper so as to adjust attention and input direction of intelligent manufacturing enterprises, to provide new thoughts and policy suggestions for Chinese government to support intelligent manufacturing industry, and to promote rapid development of Chinese intelligent manufacturing enterprises.

Performance of representative domestic listed intelligent manufacturing enterprises are evaluated in the paper from perspective of manufacturing enterprises. As a kind of emerging industry, manufacturing industry plays an important role in boosting future green development and innovation-driven strategy in China. Development of intelligent manufacturing enterprises is the basis for national economic development in China and is an important base and driving force for scientific and technological innovation. Research on manufacturing industry has the following problems throughout current research conditions: on the one hand, some scholars conduct business management performance evaluation in manufacturing industry within a large scope. Research results are ambiguous and not objective due to wide scope and lots of branches in manufacturing industry; one the other hand, some scholars take traditional manufacturing enterprises in steel, coal, and equipment manufacturing industry as research objects; however, they barely research on business performance of emerging intelligent manufacturing enterprises.

Performance of intelligent manufacturing enterprises will be evaluated in the paper, thus operation conditions of intelligent manufacturing enterprises can be clearly known; moreover, it has long-term strategic significance and practical value for research on business management in manufacturing industry for intelligent manufacturing enterprises.

2. Description of business management performance model in manufacturing industry

2.1. *Performance indicator system*

Evaluation content of business management performance evaluation in manufacturing industry offsets blank in current research content. At present, academic researches aiming at intelligent manufacturing industry focus on theoretical research in aspects of current development conditions, mode, development path, tendency, industry transformation and upgrading, and enterprise integration. There are a few researches on business performance of intelligent manufacturing enterprises. Financial appraisal is usually considered as business management evaluation in manufacturing industry, which cannot comprehensively reflect enterprise operation performance. Therefore, aiming at business performance of intelligent manufacturing enterprises, complete and comprehensive evaluation research was given in the paper , which ha great theoretical significance. Description of index system is shown in Table 1 in detail.

Table 1. Index system

Category	Name of index
	Capital stock K
Input index	Labor input L
	Energy input E
	Technology input T
Output index	GDP in different regions
	Exhaust emission

Capital stock K: The index is usually evaluated with "perpetual inventory method". The paper mainly refers to research results[11] of Shan Junhao. Constant price in 1952 was used to evaluate capital stock of different enterprises from 1995 to 2011.

Labor input L: The paper takes employees of different enterprises in the past years as labor input index[12] with unit of person.

Energy input E: Energy consumption of different enterprises are considered as basic data with unit of ton standard coal.

Technology input T: The paper takes three kinds of granted patents every year as technology input index.

Desirable output: The paper selects actual GDP of different enterprises from 1995 to 2011 as desirable output index.

Undesirable output: Based on research purpose of the paper, industrial exhaust emission as undesirable output index. Indirect method is indirectly used in the paper so as to properly change original data, to transform undesirable output into desirable output for treatment. $f_i^k(U) = -U_i^k + \beta_i$ proposed by Seiford&Zhu is used in the paperso as to treat undesirable output. β_i is a positive number which can guarantee undesirable output to be larger than zero after treatment. Value of β_i in the paper is 70,000.

2.2. Super-efficiency DEA model

In terms of traditional DEA model, in case several decision making units are in production frontier at the same time, causing that several decision making units are effective at the same time, the model shall fail to effectively and further evaluate and compare decision making units. The defect was offset by super-efficiency DEA model based on input orientation established by Anderson and Peterson (1993). Super-efficiency DEA model[6] is as follows:

In case there are n DMU, each DMU shall have m inputs and s outputs. Where $x_j = (x_{1j}, x_{2j}, \cdots, x_{mj})^T > 0$ and $y_j = (y_{1j}, y_{2j}, \cdots, y_{sj})^T > 0$, x_{ij} indicates No. i input of No. j DMU; y_{rj} indicates No. r output of No.j DMU. Corresponding super-efficiency of No. k DMU is shown in (1) and (2):

$$h_k = Max \sum_{r=1}^{s} u_r y_{rk} \,.$$

$$\begin{cases} \sum_{i=1}^{m} v_i x_{rj} - \sum_{r=1}^{s} u_r y_{rj} \geq 0, j = 1, \cdots, n, j \neq k, \\ \sum_{i=1}^{m} v_i x_{ik} = 1, \\ u_r \geq \varepsilon, r = 1, \cdots, s, \\ v_i \geq \varepsilon, i = 1, \cdots, m. \end{cases} \tag{1}$$

Above-mentioned dual problem is shown in (2)

min θ_k

$$\begin{cases} \sum_{j=1, j\neq k}^{n} \lambda_j x_{ij} + s_i^- = \theta x_k, i = 1, \cdots, m, \\ \sum_{j=1, j\neq k}^{n} \lambda_j y_{rj} - s_r^+ = y_k, r = 1, \cdots, s, \\ \lambda_j, s_i^-, s_j^+ \geq 0, j = 1, \cdots, n. \end{cases} \tag{2}$$

Results calculated by above-mentioned model are divided into three categories[7]:

(1) In case efficiency value $\theta > 1$, it indicates that the DMU is extremely effective or has no feasible solution;

(2) In case efficiency value $\theta > 1$, it indicates that the DMU is not effective;

(3) In case efficiency value $\theta > 1$, it can be divided into two cases: (a) not all slack variables s_i^- and s_r^+ in the model is zero, thus the DMU is weak efficient; (b) In case all slack variables and in the model are zero, it indicates that the DMU is effective but is not extremely effective.

2.3. Tobit model

Influence factors and influence degree of business management performance for manufacturing enterprises was further researched after super-efficiency DEA model is used to measure business management performance in manufacturing industry. Efficiency value evaluated with super-efficiency DEA method was divided into three sets, which belonged to interceptive discrete distribution data. Tobit model proposed by Tobin at the time of researching on requirements for durable consumer goods in 1958 could better solve modeling problems of limited or interceptive dependent variable[8]. Therefore, Tobit model is used in the paper. Tobit regression model is shown in (3):

$$Y = \begin{cases} Y^* = \alpha + \beta X + \varepsilon, Y^* > 0 \\ 0, Y^* \leq 0 \end{cases} \tag{3}$$

Y in the equation indicates interceptive dependent variable; X indicates vector of dependent variable; α indicates vector of interceptive item; β indicates vector of unknown parameter; disturbing item is$\varepsilon \sim N(0, \sigma^2)$. In case model is subject to direct regression with OLS, parameter of Tobit model shall be biased and inconsistent, thus the maximum likelihood estimation method was used in the paper so as to analyze influence factors of business management performance in manufacturing industry[9-10].

3. MOPSO algorithm

At present, the criterion of "Pareto domination" is used in MOPSP algorithm so as to rank the group. However, "Pareto domination" is a strong ranking method, which is hard to conduct selection operation and may lead to stagnation behavior of the algorithm. Therefore, preference information of the decision maker was combined with "Pareto domination" in the proposed PMOPSO algorithm. A weak "preference over relation" was defined and used to rank the group and to generate preference solution set. Accurate objective vector value, objective weight value, and multi-objective decision coordination model were used in previous algorithm so as to express preference information. Accurate numerical value was used to express preference information and to guide algorithm search direction, leading to algorithm search region being excessively narrow. Therefore, it made algorithm easy to be converged to local extreme value, leading to prematurity phenomenon; moreover, some compromise solutions which satisfied the decision maker might be omitted due to excessively narrow algorithm search region. Meanwhile, value range of all objectives are difficult to be accurately evaluated before solving problems, causing that numerical value of preference information was unreasonable and algorithm search region was deviated from the region which really attracted the decision maker, thus a satisfying solution failed to be solved. In order to obtain a satisfying result, numerical value of different preference information was required to be subject to several times of experiments. Different from previous algorithm, preference information was not expressed with accurate numerical value in the paper but is expressed with important relation between objectives, approximate scope of weight value for all objectives, or approximate value range scope of all objectives. Therefore, it was convenient for the decision maker to give preference information; moreover, search region could be adjusted according to the problem or individual requirements. As the expression method of accurate numerical value was not used for preference information, processing method use for preference information of accurate numerical value before was hard to process preference information introduced in the paper. Therefore, the paper presents a processing method for preference information of "leading group" elected through simulating vote of organizations in human society. Pareto noninferior solution was voted through the group so as to generate preference solution set. Moreover, preference solution set was used as "leading group" of the group so as to guide group search process so that the group could search the area which attracts the decision maker, which improved search efficiency of algorithm and made solving results be focused in the preference area and facilitated final decision. The method is visualized, simple, and feasible. Moreover, it is unnecessary to set lots of parameters.

3.1. Basic definition

Preference information in the paper is introduced in "Pareto criterion". Moreover, the paper presents a relatively weak "preference over relation" used for ranking population so as to generate preference solution set. In addition, definitions of "preference over relation" and "preference solution set" are respectively as follows:

Definition 1: Preference over relation. In order not to lose generality, minimized multi-objective problem of n decision variable parameters, k objective function, and m constraint condition was taken as an example. In case decision vector a or $b \in X_f$ (X_f is a feasible solution) is feasible solution of n-dimension, objective functions of corresponding k-dimension respectively are:

$$f(a) = (f_{a1}\ f_{a2} \ldots . f_{ak})\,. \tag{4}$$

$$f(b) = (f_{b1}\ f_{b2} \ldots f_{bk})\,. \tag{5}$$

Preference function $g(x)$ was introduced, which indicated credibility when a solution is superior to the other noninferior solutions under the environment of preference information. In case a is superior to b, the following sufficient conditions are required to be satisfied: ①in case a Pareto is superior to b; ②there is no difference between a Pareto and b; moreover, preference funcition value of a is larger than that of b. The above-mentioned two conditions can be expressed as follows:

$$\begin{aligned}&(f_{ai} \le f_{bi} \wedge f_{am} < f_{bm})\vee\\ &\{(f_{al} < f_{bl} \wedge f_{am} > f_{bm})\wedge\\ &g(a) > g(b)\}\end{aligned} \tag{6}$$

$$\forall i = 1 \ldots n, \exists\ \ l\ m = 1 \ldots n$$

Definition 2: Preference solution set. The preference solution was selected from noninferior solution sets with preference information about the decision. Set constituted by preference solution is called preference solution set.

3.2. Preference information processing

Human society is constituted by various organizations; while the leading organization is prevailing in all organizations. Excellent individual can be constantly supplemented to the leading organization so as to select the superior leading members and eliminate the inferior leading members. Moreover, the leading organization leads the organization which can be larger and stronger and can be constantly developed and changed like a biological organism. The leading organization is usually not an individual but is a small group constituted by several excellent individuals. Development process of social organization is similar to research process of MOPSO algorithm through analysis from the perspective. Therefore, development process of social organization can be simulated through further improving search process of MOPSO algorithm.

At present, vote has been the most common method to generate leading organizations, which is simple, feasible, and easy to be operated, thus it is used by lots of organizations in the world. Qualifications, such as talent, morality, education background, age, physical condition, and etc. of the person to be elected in many aspects are required to be investigated in election process. In case all members in the organization have rights to be elected, "Pareto criterion" is used to judge and compare the person to be elected, the winner should be supplemented to the leading organization. As there are lots of investigation conditions, numerous winners may be generated; even all members may be winners, causing that leading group cannot be generated; organization structure is disordered; organization fails to be normally operated. Therefore, certain implicit criterion which is universally recognized are used by people to evaluate the person to be elected. For example, "morality and talent can be considered as important investigation conditions; education background and physical conditions can be considered as reference conditions at certain age". In essence, the criterion reflects preference of the person to be elected, which is a universally recognized implicit preference information. Moreover, such preference information is usually expressed with important relation between features or approximate value range of feature value, which is extremely similar to expression method for preference information proposed in the paper. In order to guarantee fairness and effectiveness of election, to avoid individual prejudice, the way of group vote is usually used. There are lots of voters in the voting process. Judgment criterion of each voter should be consistent with implicit preference information; meanwhile, individual difference should be maintained so that the more votes obtained by the person to be elected, the higher the credibility for him to be superior to other person to be elected is. In fact, voting process is a process to use preference information structure of "preference over relation" to rank the group. Therefore, the method to generate leading group through simulating "vote" of organizations in human society was used to process preference information. Its process is as follows:

Process 1: Population initialization and preprocessing of preference information. Different from using accurate numerical value before to express preference information, the following three kinds of forms in the paper were used to express preference information, which respectively was: (1) Important relation between all objectives; (2) approximate value range of weight value for all objectives; (3) approximate value range of all objective value; expression method integrating above-mentioned three kinds of forms. It was convenient for the decision maker to give preference information; moreover, algorithm search region could controller through adjusting numerical value range. Algorithm search region might not be excessively narrow at the time of properly improving algorithm efficiency.

Preference information expressed with value range of all objectives could be processed with preference information introduced in noninferior solution evaluation function. Preference information expressed in important relation for all objectives or approximate range of weight value for all objectives was preprocessed so as to guarantee that preference solution set generated through election is more effective. The minimum problem of objective 4 was taken as an example, comprehensive method was used to give preference information which indicated that “objectives 1 and 2 were important objectives; objectives 3 and 4 were reference objectives. Objective 1 was more important than objective 2; weight value range of objective 1 was between 0.4 and 0.6; value range of objective 3 was better to be smaller than 100”. In addition to initial coding of all randomly generated particles in initialization process of particle population, corresponding weight coefficient to all objectives was randomly generated for all particles so as to make weight coefficient be consistent with preference information of decision maker. Moreover, the sum was 1. Weight coefficients of all indexes for randomly generated arbitrary particle i are w_{i1}, w_{i2}, w_{i3}, and w_{i4}, thus $w_{i1} + w_{i2} + w_{i3} + w_{i4} = 1$ and $w_{i1} > w_{i2} > w_{i3}$, $w_{i1} > w_{i2} > w_{i4}$, and $0.6 > w_{i1} > 0.4$. In case above-mentioned method can be used to guarantee that there are different measurement criteria for preference solutions of all particles and to guarantee differences between particles. Effectiveness of preference solution set could be guaranteed through group vote, which avoided evaluation bias caused by using weight value of single objective.

Process 2: Candidate solution set was generated after primary selection. In order to keep candidate solution in calculation process, an external file was required to be set. Preference solution set generated in previous election was firstly copied in external file in each generation of calculation process. All particles was decoded and value of all objectives are calculated in the calculation process. All particles and solutions in external file were compared according to Pareto domination relation. In case both the particle and all solutions are not under the control of Pareto, information about the particle shall be kept in external file, which indicates that the particle obtains “candidate qualification” and becomes a candidate solution. In case the particle in Pareto is superior to certain candidate solution in external file, “candidate qualification” of the solution shall be cancelled, which indicates that the candidate solution shall be deleted from external file. A candidate solution set including several candidate solutions could be obtained through above-mentioned steps.

Process 3: Vote. In order to guarantee diversity of preference solution, diversity of weight coefficient for all objectives could be maintained in preprocessing process for preference information, causing that different particles have different selection standards for preference solution. It indicates that selected preference solution is different for different particles in the same candidate solution set. In order to select preference solution set satisfying decision maker in candidate solution set under above-mentioned conditions, a kind of processing method about simulating “vote” of organizations in human society was used. “Vote” is a common method to generate leading organization in organizations in human society. Although evaluation standard of each voter to candidate is different in election process, satisfying leading organization can generated through vote. The method is sample and effective, thus it has been a common method to generate leading organization. Meanwhile, it provides a simple and effective processing method for problems in the paper. Specific process is as follows:

All particles have the same voting opportunities in voting process. All particles were specified in the paper to vote for an optimal candidate solution and had to vote a candidate solution. Preference degree of particle to all candidate solutions had to be calculated at the time of voting particles. The method of projection pursuit was used in the paper so as to calculate preference degree of particles to candidate solution. Preference degree of particle i to candidate solution j was recorded as $F_{ij} = \sum_{o=1}^{4} w_{io}(\max f_o - f_{jo})/\left|\max f_o - \min f_o\right|$. f_{jo} indicates No. o index value of candidate solution j. In case No. o target is in preset value range of the decision maker, $\max f_o$ shall be the maximum preset value range of No. o index. Otherwise, it shall be the maximum of No. o index for all solutions in external file. In case $\min f_o$ is the minimum of No. o for all candidate solutions in external file. Votes of all candidate solutions were calculated after vote completion of all particles. The more the vote for candidate solution is, the higher credibility for it to be superior to other candidate solutions under preference information region is. Therefore, votes for all candidate solutions will be taken as preference function value for them. Moreover, candidate solution will be ranked according to preference function value size. The larger the preference function value is, the higher the priority of the candidate solution is; the smaller the preference function value is, the lower the priority is.

Process 4: Generation of preference solution. Certain candidate solutions (which were determined according to storable preference solutions in global file) were selected as preference solution set from higher to lower according to priority of candidate solution. They were stored in global file, played roles of leading organizations as the global optimal position in the iterative calculation for algorithm, and guided evolution of the whole population.

Process 5: Preference solution set was used to guide population evolution. In order to make algorithm search towards the direction attracting decision maker, preference solution set was take as global optimal position so as to guide algorithm search process. In order to avoid algorithm prematurity under the condition of algorithm convergence, the paper presents a kind of mixed selection strategy for optimal position. Firstly, whether previous generation of particles has generated preference solution should be judged. In case it has generated, the preference solution should be searched in global file information. In case it is not replaced by new ones, global optimal position of the preference solution should be selected. In case the particle has not generated preference solution or the preference solution has been replaced by new ones, preference solution of the received particle vote should be selected as global optimal solution. Use of above-mentioned mixed selection strategy can guarantee that features of preference solution be inherited to the next generation in different probability according to priority level, can guide the algorithm to search towards the direction attracting the decision maker, can guarantee algorithm convergence, and can avoid algorithm prematurity.

3.3. Particle velocity and position

In order to solve problems in the paper, expression of particle velocity and position in Literature [14] was improved as follows:

$$\begin{aligned} v_{ion(t+1)} = rand(c_1)(rand_{iont} - x_{iont}) + \\ rand(c_2)(p_{iont} - x_{iont}) + \\ rand(c_3)(arc_{(\forall i)ont} - x_{iont}) \,. \end{aligned} \tag{7}$$

$$x_{ion(t+1)} = x_{iont} + v_{ion(t+1)} \,. \tag{8}$$

Where x_{iont} is the position of No. o working procedure in encoding for No. n workpiece in No. i particle in No. t generation. p_{iont} indicates the position of No. o working procedure in encoding local optimal solution for No. n workpiece in No. t generation. Local optimal solution could be selected from local file of particles. $arc_{(\forall i)ont}$ indicates the position of No. o working procedure for No. n workpiece in No. t generation in global optimal solution encoding. Global optimal solution can be selected from global file according to rules in Section 2.2. $rand_{iont}$ indicates a random position for No. o working procedure of No. n workpiece for particle i in No t generation in encoding. $rand(c_1)$, $rand(c_2)$, and $rand(c_3)$ are integers of 0 and 1, which are randomly generated under influences of c_1, c_2, and c_3.

3.4. PMOPSO algorithm flow

Specific algorithm steps are as follows:

Step 1: Initialization of control parameter: population size is P;the maximum iteration algebra is *gen*; file scale of candidate solution set, file scale of preference solution set, algorithm control parameters c_1, c_2, and c_3 were given according to comprehensive way of preference information.

Step 2: In case $gen = 0$, P particle encodings could be randomly generated; moreover, preference information could be preprocessed; objective weight value of all particles can be randomly generated according to preference information.

Step 3: All particles were decoded; moreover, value of all sub-objectives was calculated.

Step 4: Preference of the previous generation was copied into candidate solution file; moreover, Pareto criterion was used to compare all particles so as to generate candidate solution set.

Step 5: Preference degree of all particles to all candidate solutions was calculated; all particles votes for the optimal candidate solution.

Step 6: Votes for all candidate solutions are calculated; moreover, candidate solution was ranked from high to low according to votes.

Step 7: Certain candidate solutions (which were determined according to global file scale) were selected from high to low according to priority so as to be copied in global file.

Step 8: Global optimal position was selected according to rules in Section 2.2;

particle velocity was calculated; moreover, particle position was updated.

Step 9: $gen \leftarrow gen + 1$, in case specified cyclic algebra could not reached, calculation should be stopped; otherwise, turn to Step 3.

Step 10: Preference solution with votes not being 0 in file of output preference solution was the final search result of the algorithm.

4. Experimental analysis

Input and output indexes of 25 intelligent listed manufacturing enterprises in China were respectively introduced in traditional DEA model, cross efficiency DEA model, and improved cross efficiency DEA model, which was operated with Matlab software and Deap software programming so as to calculate business management performance of intelligent manufacturing industry under each method. Comparison of evaluation result for three models are shown in Fig. 1. Overal features and conditions of business management performance for Chinese intelligent manufacturing industry is obtained through comparison eventually.

It is found through evaluation result curves of three models in Fig.1 that tendency of three curves is similar, which indicates that DEA cross efficiency integrating entropy weight information guarantees that original tendency is not greatly changed. Only ranking results of some enterprises are slightly changed. Enterprises with efficient value of 1 is effectively distinguished; moreover, curve measured with improved cross efficiency DEA model is lower than self-evaluated curve. It indicates that improved cross efficiency DEA model integrated self evaluation and mutual evaluation is more objective. Mutual correlation problems of all decision units is considered; the problem caused by extreme weight distribution of traditional DEA model is overcome; the problem of average weight for cross efficiency DEA model is overcome; credibility to use DEA model to evaluate business management performance in intelligent manufacturing industry is improved.

The condition of "isotonicity" should be satisfied at the time of using super efficiency DEA method to establish efficiency measurement model, which indicates that various outputs of decision unit increase with increase of input. Pearson correlation coefficient was used in the paper to research on correlation between input and output variables, which was shown in Table 2. The other input and output variables were in significant position correlation relation in 0.01 level, which satisfied the condition of "isotonicity" except Hebei capital input and industrial exhaust were significant in 0.05 level. Therefore, it is guaranteed to use to sample to establish credibility of research result for energy efficiency model of super efficiency DEA.

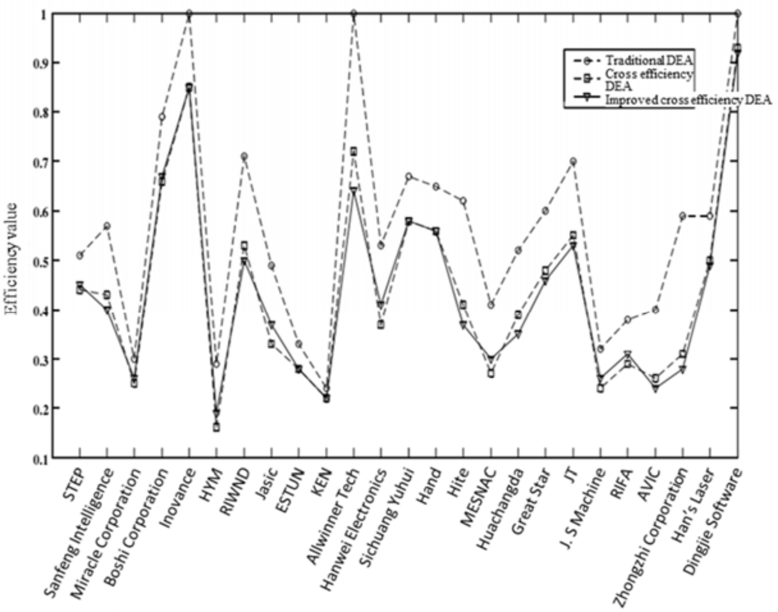

Fig. 1. Comparison of performance evaluation result for DEA model

Table 2. Pearson correlation coefficient between input and output variable

	Input-output (actual GDP)				Input-output (industrial waste gas)			
	Capital input	Labor input	Energy input	Technology input	Capital input	Labor input	Energy input	Technology input
STEP	0.955**	0.957**	0.994**	0.933**	0.809**	0.865**	0.880**	0.778**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sanfeng Intelligence	0.998**	0.948**	0.994**	0.974**	0.919**	0.836**	0.939**	0.896**
	0.000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
Miracle Corporation	0.660**	0.996**	0.988**	0.933**	0.618*	0.965**	0.971**	0.908**
	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Boshi Corporation	0.990**	0.958**	0.991**	0.970**	0.856**	0.811**	0.862**	0.792**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inovance	0.996**	0.995**	0.981**	0.944**	0.995**	0.985**	0.970**	0.961**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: ** indicates there is significant correlation in 0.01 level (on both sides); * indicates there is significant correlation in 0.05 level (on both sides).

5. Conclusion

The paper presents a kind of improvement method for business management in manufacturing industry based on MOPSO algorithm from industrial perspective. Super-efficiency DEA -Tobit model was used to conduct modeling for improvement method of business management in manufacturing industry from industrial perspective. Moreover, a kind of PMOPSO algorithm was proposed, which narrowed search space of algorithm and improved algorithm efficiency. In addition, several compromise solutions in the preference zone were solved in an operation so that the decision maker could be avoided making a difficult choice from numerous noninferior solutions. Effectiveness of mentioned algorithm was verified through simulation experiment.

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