

Research on integration of enterprise technology innovation capability based on ant colony algorithm

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Abstract: In the modern social economic construction and development, the enterprise's technological innovation ability directly determines the enterprise's future development level, so the current enterprise management attaches great importance to the integration of enterprise's technological innovation ability. The purpose of integration is to bring the decentralized capabilities acquired after expansion into full play, which can not only get rid of the restrictions of traditional enterprise management concepts, but also correctly deal with the problems faced by time development. This paper uses the combination of quantitative and qualitative methods, focusing on the integration of enterprise technology innovation ability, according to the basic principle of ant colony algorithm, screening the development or expansion of the technical ability, after the formation of the ability integration platform, the ability integration group, in order to optimize the comprehensive level of enterprise technology innovation.

Keywords: Ant colony algorithm; Enterprise; Technological innovation; Ability to integrate

1. Introduction

Under normal circumstances, too dispersed technical capabilities can not form a strong technical advantage, so the integration of enterprise technical capabilities to obtain core advantages, to provide an effective basis for the innovation and development of modern enterprises, is the main issue discussed by enterprise managers. [1.2.3]Prahalad and Hammer define core technical competence as a harmonious combination of advanced technologies, where technology involves not only science and technology, but also organizational and marketing skills. Core technology capability is the coordinated combination of various advanced technologies and capabilities. It is the most core and fundamental content of all current enterprise capabilities, and directly affects the effective play of other capabilities. According to the accumulated experience of modern enterprise management, the core technology capability is not the simple sum of several capabilities, but the product of the enterprise's various capabilities in the combination of penetration and amplification. Nowadays, enterprise technical capability integration is a series of management measures and technical means adopted by enterprises to collect the actual required capabilities obtained from capacity expansion. It is mainly used to improve the technological advantages of enterprises in the dynamic environment, and is of great importance to the innovation and development of modern enterprises. It should be noted that not all the technical capabilities set after enterprise development and expansion need to be integrated and processed after time and market investigation, so enterprise managers should have the consciousness of ability screening and research. The screening efficiency and results of technical capabilities directly affect the future development of enterprises, and the ant algorithm is a common way of optimal screening of a variety of historical paths. According to the basic characteristics of ant algorithm, this paper studies the effective screening of enterprise technical capabilities set, and finally achieve the desired goal. In this study, the effective capability integration gives priority to identifying the capabilities of individual enterprise units and focuses on the comprehensive analysis combined with the market. After building the basic platform of the enterprise's technological capability, by setting up the decision-making group of the enterprise's technological innovation capability integration, the enterprise's technological innovation capability integration is analyzed organically and qualitatively and quantitatively, so as to optimize the enterprise's comprehensive development level.[4.5.6]

In the development of modern science and technology innovation, the computer control in the field of automatic control and optimization are two important problems, using computer to control the optimization of process information is the essence of science, so in the face of increasingly large scale problem set, scholars from all over the world according to the characters of uncertainty and nonlinear and so on to build a precise mathematical model, Under the guidance of bionics and science, a variety of intelligent optimization methods are proposed, which are mainly used to solve complex optimization problems. Among them, ant colony algorithm was proposed in the early 1990s. After practical investigation and research, it is found that ants will use pheromone materials to transmit information between individuals. In the process of movement, ants will leave pheromone in all the paths they pass, and know their direction of movement after sensing pheromone concentration. The collective behavior of the group shows a positive information feedback phenomenon. The more ants walk along a certain path, the greater the probability that the later ants will choose this path. The individual ants also use this information communication method to realize food search. When ant colony algorithm is applied to static combinatorial optimization problems, the most recent representative problems are vehicle routing, workshop scheduling, secondary allocation and so on. Among them, the algorithm flow of TSP is shown in Figure 1 below, while dynamic optimization problems are mainly reflected in communication networks, because network optimization problems have particularity. In recent years of technology development and innovation, ant colony optimization problem has slowly penetrated into many fields, practice and exploration has also achieved excellent results, among which the most successful is the combinatorial optimization problem.[7.8.9]

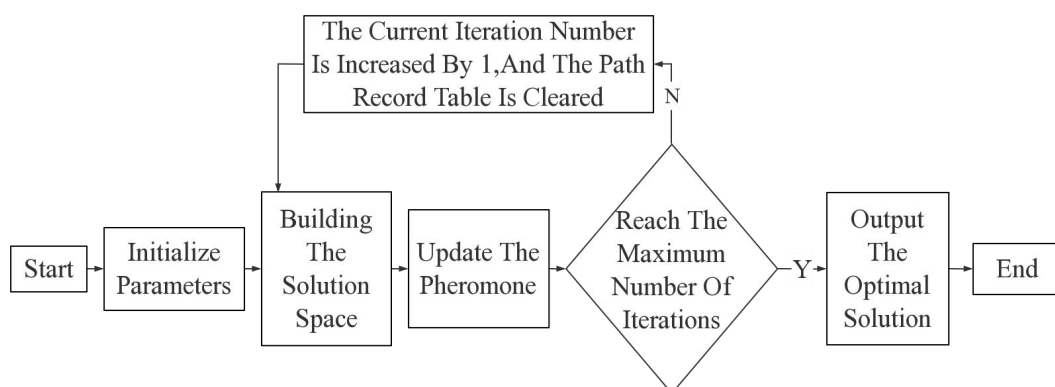


FIG. 1 Flow chart of TSP mediated by ant colony algorithm

In essence, as a distributed parallel algorithm, ant colony algorithm has strong robustness and can be applied together with other technical methods. However, the actual convergence speed is slow and the calculation time is long, so it is easy to fall into local optimum in the application process, which is not conducive to solving continuous problems. At present, the research on the application of ethanol algorithm mainly starts from specific problems, which does not have a strong universality. Ant colony algorithm model can not directly deal with practical optimization problems, although the positive feedback mechanism has strong universality, but can not meet the needs of practice development; The existing algorithms only simulate part of the sociality of natural ants, and there is still more room for intelligent ant colony behavior. Ant colony algorithm also has obvious experience, many results can only be established on the basis of experimental data, so researchers need to further determine the basic theory.

Therefore, in this paper, after understanding the basic principle of ant colony algorithm, from the perspective of the present enterprise technology innovation ability, in-depth discussion on the ant colony algorithm as the core of enterprise technology innovation ability integration results, determine the future enterprise technology development of the main measures, in order to accelerate the pace of modern enterprise innovation and innovation.[10]

2. Method

2.1 Ant colony algorithm

Under the condition of the comprehensive development of the research of biological heuristic computing, the self-organizing behavior of social animals has been widely concerned by people. When the scholars of various countries study the animal behavior and conduct mathematical modeling, the cluster intelligence has been generated. From the research point of view, the individual behavior of social animals is very simple, but under cooperative working conditions, they can show the behavioral characteristics of complex intelligence. For example, ant colonies can find a shortest path when foraging. Inspired by this, researchers put forward a new intelligent optimization algorithm in practice, which is the ant colony algorithm studied in this paper. This algorithm is mainly used to solve the famous traveling salesman problem in the early stage, and has achieved excellent results in practice. In the mid-1990s, the application of this kind of algorithm has been paid attention to by scholars in various fields, and has played an important role in path planning, function optimization, combinatorial optimization, data mining and other fields.

From a biological point of view, ants can cooperate to find the shortest path between food and the nest, but individual ants can't achieve this goal, because individual ants use pheromones to communicate information, so they cooperate to achieve the goal. According to the ant colony behavior analysis shown in Figure 2 below, the whole process is characterized by positive feedback, and the actual algorithm flow is shown in Figure 3 below:

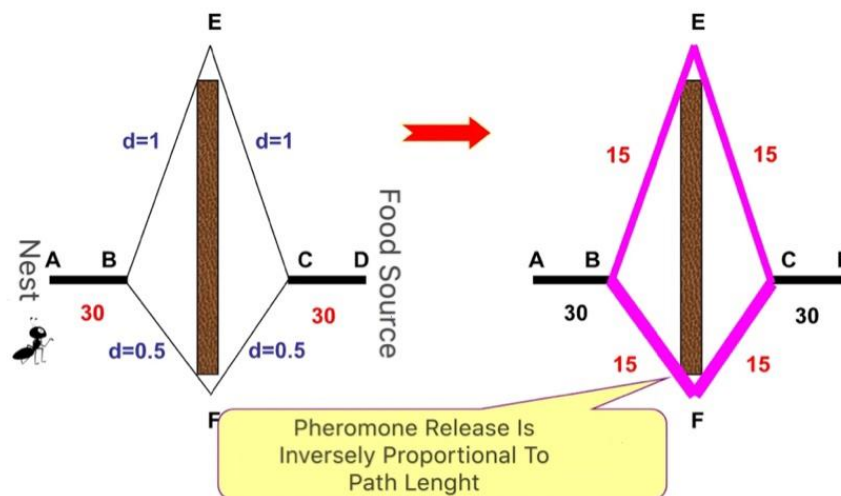


FIG. 2 Ant colony behavior

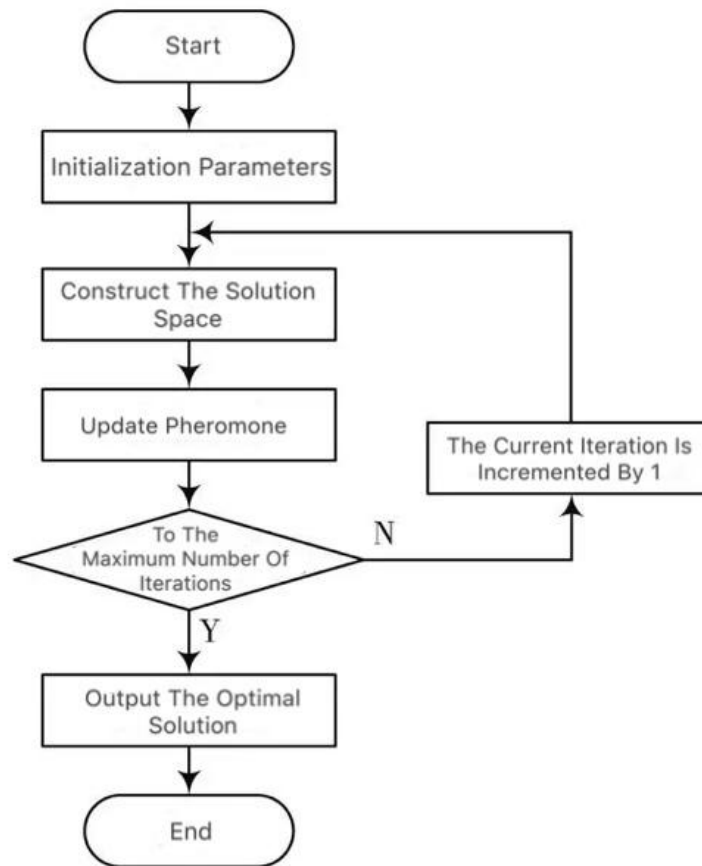


Figure 3 Flow chart of ant colony algorithm

2.2 Capability Screening

After development and expansion, an enterprise obtains n technical capabilities and selects them to form a set of technological innovation capabilities to be integrated. Where, the cost of capability i is c_i , the economic benefit obtained by integration is v_i , and the total allowable integration cost is C . In the research process, it is necessary not only to clearly screen the capability set composed of this capability, but also to comprehensively consider how to ensure that the benefits obtained after the combination of capabilities are maximized.[11.12.13]

Assuming $C > 0, c_i > 0, v_i > 0, 1 \leq i \leq n$, then find the n -dimensional 0-1 vector $(x_1, x_2, \dots, x_n), x_i \in \{0, 1\}, 1 \leq i \leq n$

The following can be obtained:

$$c_1x_1 + c_2x_2 + \dots + c_nx_n \leq C$$

And $v_1x_1 + v_2x_2 + \dots + v_nx_n$ is maximized

The integer programming problem is as follows:

$$\begin{aligned} \max \quad & \sum_{i=1}^n v_i x_i = v_1x_1 + v_2x_2 + \dots + v_nx_n \\ \text{s.t.} \quad & \begin{cases} \sum_{i=1}^n c_i x_i \leq C \\ x_i \in \{0, 1\}, 1 \leq i \leq n \end{cases} \end{aligned}$$

2.3 Algorithm Description

According to the analysis of ant colony algorithm path optimization flow chart shown in FIG. 4 below, it can be seen that the steps applied in the research of enterprise technology innovation capability integration are as follows:

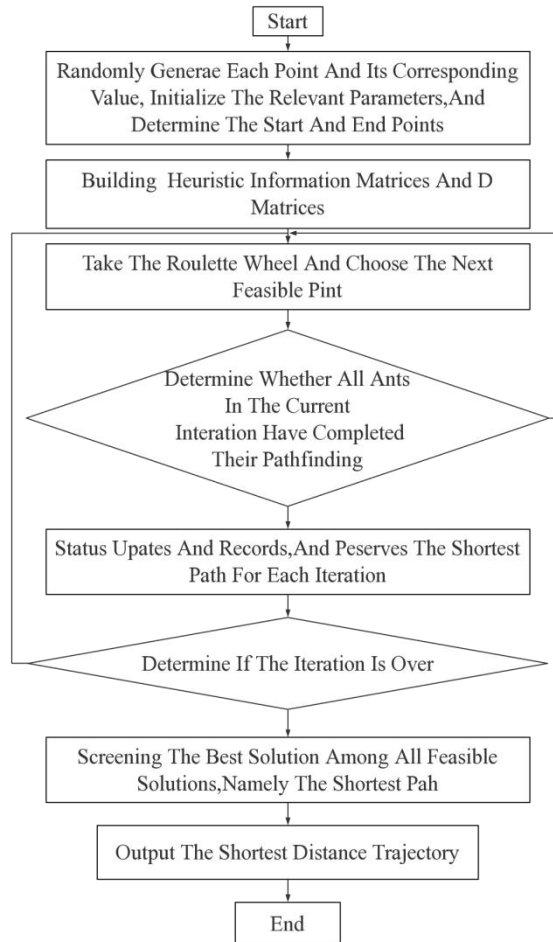


FIG. 4 Flow chart of path optimization of ant colony algorithm

First, initialize. After determining the value of each parameter, the number of ants is set as m , the maximum evolutionary algebra is $\max GEN$, the current evolutionary algebra is $GEN=0$, and the concentration of ability pheromone is $\tau_i = 1$;

Second, according to the above calculation formula, accurately grasp the probability p_i of each ability being selected, $J(k)$ represents the set of all abilities not being selected, and each ant randomly selects one ability as the initial value.

Third, each ant should construct a solution independently, add temporary data $temp$, and ensure that the initial data and probability are consistent. Ant k has to choose the next ability j according to the roulette wheel and verify the ability j . If the overall cost of choosing capability j is lower than C , then capability j is chosen and solution $(k, j) = 1$. Otherwise, capability j cannot be selected and solution $(k, j) = 0$. In this cycle, Ant k must wait until the end of all the ability tests;

Fourth, assuming that m ants have constructed their own solution, then they can directly go to the next step, otherwise continue to carry out the third step;

Fifth, find the ant r with the largest total efficiency in this generation, and update the global pheromone according to the calculation formula.

Sixth, if the conditions are met, the optimal solution should be output; otherwise, $GEN+GEN=1$ should be transferred to the second step for further research.[10.15]

3. Result analysis

In this research experiment, in order to better verify the application performance of ant colony algorithm, IEEE-14, IEEE-30, and IEEE-57 are selected as the study cases, in which the number of ants is set as 20, and the iteration times of ant colony algorithm is set as 2000. Finally, after 20 optimization analyses, the results shown in Table 1 are obtained as follows:

Table 1 Analysis of optimization results

1	0.1230	0.1229	0.12273	0.12274	0.12274	0.12293	0.12284	0.12318	0.12275	0.12294
4	489813	638230	04943	53651	88736	67553	67992	90365	52376	80717
	0.1227	0.1227	0.12294	0.12322	0.12296	0.12274	0.12322	0.12274	0.12274	0.12318
	371800	351056	65675	71630	41915	27440	92328	08482	22974	74953
3	0.1607	0.1607	0.16073	0.16058	0.16058	0.16031	0.16064	0.16048	0.16102	0.16094
0	224700	463525	72217	30901	50877	66573	09255	20136	09023	78517
	0.1605	0.1606	0.16046	0.16066	0.16125	0.16178	0.16065	0.16066	0.16102	0.16095
	671616	543943	44025	32848	53764	45390	67325	49633	10244	68606
5	0.2400	0.2386	0.24388	0.24032	0.24693	0.23487	0.26167	0.25305	0.25089	0.23758
	263104	263787	43455	81354	47276	09049	70088	35689	95003	47513
7	0.2318	0.2316	0.23367	0.23330	0.26551	0.25532	0.25586	0.24428	0.24159	0.25529
	638621	694844	28675	35386	68787	76827	57626	22952	75682	09584

Combined with the above analysis, it is found that the performance of ant colony algorithm is relatively stable, which can effectively solve the problems related to the integration of technological innovation capability of enterprises, and meet the basic requirements of modern enterprise construction and management.

Because the screened enterprises have different technological innovation capabilities and are respectively in different links of the value chain, in order to ensure that the technological innovation capabilities of enterprises are fully integrated, the method of and should be used to study and ensure that the value activities undertaken by all departments of enterprises can run simultaneously. Nowadays, there are three forms of integration of enterprise technology innovation capability: first, internal integration. This way is to integrate the existing internal capabilities, management system, organizational structure, etc., to form a unified external enterprise technology core capabilities; Second, internal and external integration. This method is to reintegrate the market, management, capital, technology and other resources between enterprises, which can improve the scale efficiency of enterprises and reduce the pressure of investment risk, and form a strong collaborative advantage. Finally, strategic integration. This method means that under the influence of business philosophy and core values, the opportunities and challenges brought by the external business environment are deeply discussed, and with the help of its original core technological capabilities and advantages, a new strategic development direction is determined, and the enterprise is actively cultivated to enter the core capabilities.

4. Conclusion

To sum up, this paper studies from the perspective of qualitative quantitative, probes into the integrated method of enterprise technology innovation ability, and connecting with the previous algorithm, the basic principle of integrated filtering the ability of enterprise development and expansion, on the basis of the ability to build integrated platform, determine the future competitive advantage of enterprise development technology innovation ability. The experimental results show that ant colony algorithm plays an important role in the integration of technological innovation capability of enterprises. Therefore, scholars and enterprises in various fields should strengthen the research of ant colony algorithm and pay attention to the application value of ant colony algorithm in practice.

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