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Research on the Application of Intelligent Optimization Technology in Enterprise Organizational Architecture for the Digital Economy Era

Jiao Shi[1,*]
[1] Management School, Zhengzhou Shengda University, Zhengzhou, Henan, 450000, China
Corresponding authors: (e-mail: 100526@shengda.edu.cn).

Abstract In the era of digital economy, the optimization of enterprise organizational structure not only relies on the iterative upgrading of technology, but also requires a systematic approach to transform the opportunities of digital transformation into sustainable competitive advantages. Taking digital transformation as an entry point, this study combines the strategic management process and chaos evolution theory to construct a theoretical model of the transformation mechanism of knowledge advantage power. Based on the principle of synergy, a mathematical model of the five knowledge subsystems (concept, system, management, technology, and customer) is established to reveal its dynamic evolution law and its supportive role to the core competitiveness of the enterprise. Through empirical analysis, it is found that the reliability test of the knowledge management process scale shows that the Cronbach α value of each dimension is higher than 0.7, such as knowledge application α = 0.966, which verifies the reliability of the scale. The structural equation model of industrial cluster enterprises is modified to show that knowledge innovation has a significant role in driving competitive advantage, with a standardized path coefficient of 0.472, p=0.000, and the open network environment has a particularly prominent impact on innovation, with a path coefficient of 0.684.The application of financial strategy optimization program in enterprise A significantly alleviates the problem of shortage of capital, and the sustainable growth rate in 2020 is 7.04% with sales growth rate of 16.56% narrowed to 5.74% in 2024, and the financial status changed from shortage to surplus.

Index Terms enterprise organizational structure, knowledge management, synergy principle, chaos evolution theory

I. Introduction

With the rapid development of science and technology, digital transformation has become an inevitable choice for the survival and development of enterprises. In the era of digital economy, the introduction of intelligent technology has not only changed the operation mode and business processes of enterprises, but also profoundly affected the organizational structure and management style of enterprises [1], [2]. In this transformation process, the core role of enterprise organizational structure becomes more and more prominent, and it becomes the key to whether enterprises can successfully respond to market changes and achieve sustainable development.

In the face of market changes, a flexible organizational structure enables enterprises to quickly adjust their strategies, adapt to new environments, and maintain competitive advantages [3]. Organizational structure optimization has a far-reaching and critical impact on the implementation of enterprise strategy. By adjusting the internal structure of the enterprise, the distribution of authority and responsibility, and the communication mechanism, the optimized organizational structure can significantly improve the efficiency of corporate decision-making, ensure the rapid flow of information among departments, and enable the management to respond to market changes and make accurate decisions [4]-[7]. At the same time, the clear division of responsibilities and efficient collaboration mechanism promotes strategic synergy, and the work of each department closely centers on the enterprise strategy to form a synergy and jointly promote the enterprise to the strategic goals [8]-[10]. In addition, optimizing the organizational structure can also significantly improve the operational efficiency, reduce the waste of resources and improve the efficiency of resource utilization by streamlining the hierarchy and clarifying responsibilities [11], [12]. This efficient organizational model encourages employees to exert subjective initiative, stimulates innovative thinking, and injects new vitality into strategy implementation [13], [14]. Through optimization, enterprises can better integrate resources, exert synergistic effects, and achieve strategic goals, so as to stand out in the fierce market competition and achieve sustainable development [15]-[17].

With the diversification of enterprise competition in the future, enterprise development is no longer the competition of single product, but also the competition of development mode and comprehensive elements, and even more the competition of development mode and comprehensive elements [18]. How to achieve a sustainable increase in the value of the enterprise profit in the digital economy environment, and can be well prepared to fight in the future enterprise competition, it is necessary to meticulously analyze the advantages and disadvantages of the internal management of the organizational structure of the points and timely adjustments, optimize the organizational management, to create a sunny day for the enterprise [19]-[22].

This study takes digital transformation as an entry point, deeply explores its role in reshaping the organizational structure of enterprises, and proposes a theoretical model of the transformation mechanism of knowledge superiority force, combining the strategic management process and chaos evolution theory to construct a complete methodology system for enterprises to dynamically adapt to the environment of the digital economy. The article analyzes how digital transformation can reduce operating costs, improve efficiency and expand business boundaries from three aspects: simplification of management processes, stimulation of employee innovation, and flexible office mode, and lays the foundation for the flattening and agility of the enterprise's organizational structure. Based on the principle of synergy, a mathematical model is established to analyze the interaction mechanism of the five major knowledge subsystems, namely, concept, system, management, technology, and customer, and to clarify the dynamic evolution law of the knowledge superiority and its supportive role to the core competitiveness of the enterprise. On this basis, a seven-step strategy management process is proposed to emphasize the core position of knowledge analysis in strategy formulation, and the evolution path of corporate strategy from order to chaos is explained through the theory of nonlinear dynamical system. Then, through the construction of knowledge map and business process reengineering, we realize the transformation of knowledge superiority to actual business value. Finally, a nonlinear dynamical model is used to simulate the evolution of the strategic system from order to chaos, revealing the impact of bifurcation and mutation phenomena on the stability of strategy. Mathematical models are used to quantitatively analyze the impact of knowledge subsystem interactions on knowledge superiority, revealing how digital transformation can drive organizational change by streamlining processes, stimulating innovation and flexible business models.

II. Research on the construction of knowledge superiority force and strategic evolution mechanism driven by digital transformation

II. A. Opportunities of digital transformation for enterprise organization structure

II. A. 1) Streamlined management processes and data-driven decision-making

Digital transformation offers new opportunities for companies to streamline management processes and enable data-driven decision-making. Through digital technology, enterprises can digitize cumbersome manual processes with the help of automation tools to improve efficiency. For example, the adoption of Enterprise Resource Planning (ERP) systems can integrate information from different departments and give enterprises real-time access to dynamic data from various business segments, thus accelerating transparent and data-driven decision-making. Business analysis tools, on the other hand, can quickly identify market trends and potential risks, providing an important basis for efficient decision-making. In addition, digital tools can help companies identify redundant and inefficient processes and optimize or eliminate them, flatten management levels, reduce communication costs and improve operational efficiency.

II. A. 2) Stimulate employee innovation and knowledge sharing

Organizational reshaping can stimulate employee innovation and promote knowledge sharing within the enterprise. Digital transformation promotes a collaborative culture, encouraging employees to work with each other on cross-departmental projects and contribute ideas for business development. Through online knowledge bases, digital training platforms and collaboration tools, employees can readily access the latest industry information and internal resources to enhance their professional capabilities. In addition, the cultivation of innovative thinking helps employees dare to experiment with new business models and processes, thus driving organizational change and continuous improvement. By building this innovative and open work environment, companies can stimulate team creativity, improve overall productivity, and provide a strong impetus for future business growth.

II. A. 3) Promotion of flexible working and new business models

Digital transformation has created the conditions for companies to introduce flexible working and new business models. Telecommuting and flexible working hours enable employees to have a better work-life balance, increasing their satisfaction and productivity. Digital platforms also allow teams to maintain real-time communication and collaboration, regardless of geographic location, to ensure that projects are progressing smoothly. Meanwhile, new technologies such as the Internet of Things, cloud computing and blockchain make it possible for companies to build online platforms, subscription services and digital offerings. This new business model is better able to adapt to changes in market demand, bringing additional revenue streams and growth opportunities to organizations.

II. B.Construction of a mechanism for transforming the power of knowledge superiority

The opportunities brought by digital transformation to enterprise organization structure are not only reflected in efficiency improvement and model innovation, but also need to be transformed into sustainable competitive advantages through the synergy of knowledge systems. Therefore, this section further explores the theoretical construction of the transformation mechanism of knowledge superiority, and reveals how the five knowledge subsystems can promote the dynamic evolution of the enterprise knowledge system through the principle of synergy.

The essence of knowledge advantage of KM-led enterprises is a knowledge system, including five knowledge subsystems. They mainly evolve and form knowledge superiority through the mechanism of “synergy principle”. The “synergy principle” is simply a principle that the overall effectiveness of each part is much higher than the sum of the individual effectiveness of each department. So, based on this principle, we first build a model to illustrate the interrelationships among the subsystem factors in the evolution of knowledge superiority. Then we can explain the operation mechanism and process of the five subsystems of knowledge by making equations through the principle of synergy:

Variable Explanation:

x_1 : subsystem of conceptual knowledge;

x_2 : subsystem of institutional knowledge;

x_3 : subsystems of managerial knowledge;

x_4 : subsystem of technical knowledge;

x_5 : subsystem of customer knowledge;

y : specialized knowledge (i.e., knowledge systems);

k: the growth rate of specialized knowledge relative to the original state, excluding the growth caused by the synergy of the five knowledge subsystems, then k_1 , k_2 , k_3 , k_4 , k_5 denote the growth rate of specialized knowledge relative to the original state, excluding the growth caused by the synergy of the five knowledge subsystems, then x_1 , x_2 , x_5 denote the growth rate of specialized knowledge relative to the original state;

h: the growth rate of the knowledge dominance force relative to the original state, caused by the synergy of the five knowledge subsystems, then h_1 , h_2 , h_3 , h_4 , h_5 denote the growth rate of the knowledge dominance force relative to the original state, caused by the synergy of the five knowledge subsystems, respectively, of x_1 , x_2 , x_3 , x_4 , x_5 growth rates;

t: time

From this, the following mathematical model can be established:

Indicator of knowledge superiority = dy / dt , i.e., the rate of change of specialized knowledge. Because the rate of change of the knowledge system is the rate of updating the total knowledge that has been organized, which predicts the innovation efficiency of knowledge and reflects where the advantage of knowledge lies. This gives the objective function:

$$dy/dt = h\left(x_1, x_2, x_3, x_4, x_5\right) + k \tag{1}$$

Equation (1) shows the impact of the synergy of the five knowledge subsystems on the evolution of knowledge dominance in the KM-dominated enterprise, and also shows that the evolution of knowledge dominance has a relationship with its pre-existing state. The impact of the synergy of the five knowledge subsystems on the evolution of knowledge dominance is the combined effect of the synergy of the five subsystems on the evolution of each individual subsystem, i.e., a summation process:

$$k = x_1k_1 + x_2k_2 + x_3k_3 + x_4k_4 + x_5k_5 \Big/ \sqrt{x_1 + x_2 + x_3 + x_4 + x_5} \tag{2}$$

$$h(x_1,x_2,x_3,x_4,x_5)=\frac{\begin{array}{l}x_1h_1(x_1,x_2,x_3,x_4,x_5)+x_2h_2(x_1,x_2,x_3,x_4,x_5)\\+x_3h_3(x_1,x_2,x_3,x_4,x_5)+x_4h_4(x_1,x_2,x_3,x_4,x_5)\\+x_5h_5(x_1,x_2,x_3,x_4,x_5)\end{array}}{x_1+x_2+x_3+x_4+x_5} \tag{3}$$

From this, it is only necessary to know the effect of the synergy of each of the five subsystems on the evolution of each subsystem, then the following equation is established:

$$dx_1/dt=h_1(x_1,x_2,x_3,x_4,x_5)+k_1 \tag{4}$$

$$dx_2/dt=h_2(x_1,x_2,x_3,x_4,x_5)k_2 \tag{5}$$

$$dx_3/dt=h_3(x_1,x_2,x_3,x_4,x_5)+k_3 \tag{6}$$

$$dx_4/dt=h_4(x_1,x_2,x_3,x_4,x_5)+k_4 \tag{7}$$

$$dx_5/dt=h_5(x_1,x_2,x_3,x_4,x_5)+k_5 \tag{8}$$

Equations (4), (5), (6), (7), and (8) point out the evolution of each subsystem of knowledge in the operation of the enterprise, i.e., the form of dx_n/dt, respectively, in relation to their own original state, and also in relation to the effect of synergy of the five subsystems of knowledge on themselves.

Then the joint equations (4), (5), (6), (7), (8), then we can get the expressions of $h(x_1,x_2,x_3,x_4,x_5)$ and k (if you bring in the data, then you should get the value of their values), which can be brought into the equation (1) to obtain the following the indicator of knowledge superiority power in the objective function. Theoretically, the larger the value of this indicator, i.e., dy/dt, the higher the rate of effective renovation of knowledge, which signals that the knowledge superiority power should also follow the pace of the times, and the greater the knowledge advantage over other enterprises. If the value tends to be constant, i.e., the rate of change is stable, it means that the growth of knowledge superiority force tends to be stable.

The above mathematical model describes the mechanism of transformation and formation of knowledge superiority of the KM-led enterprise, which should also be a self, spontaneous process within the successful KM-led enterprise. In this process, the evolution and growth of individual knowledge subsystems are mutually influential, interactive, mutual objects, and causal.

Thus, the strategic management system of a KM-led enterprise focuses on the evolution of each of the five knowledge subsystems and their synergistic impact on each other. From the corporate level strategy to the functional department strategy, from the top to the bottom, each business unit uses the basic process principle of enterprise knowledge management to manage knowledge, for each unit of knowledge innovation and value-added results, there are five sub-systems, the difference only lies in the proportion of their respective knowledge accounted for in the system of the size of the difference. Then through the knowledge results layer by layer transfer, sharing and absorption, although different positions and functions of the staff to learn and master the type of knowledge is different, but the evolution of knowledge and growth of each subsystem will be rapid. Meanwhile, in the process of knowledge sharing, different knowledge is transmitted and interacted in the network, and the knowledge between various subsystems is also flowing endlessly, and there is always either a causal relationship, or a containment relationship, or a cooperative combination of relationships between them. This creates synergies between subsystems of different knowledge, which further promotes the evolution and growth of each subsystem, and ultimately contributes to the slow evolution and growth of the total knowledge of the knowledge system. When the rate of change in the growth of the knowledge system tends to stabilize, the enterprise is said to have its own unique, robust knowledge advantage. Once this knowledge dominance is in place, there is a great deal of stability in the firm as a whole. At the same time, the knowledge advantage is still changing slowly rather than remaining static. It is the synergy of these knowledge subsystems that creates the knowledge advantage, and it is also more consistent with the characteristics of the organization.

II. C.Knowledge-based strategic management process

The formation of knowledge superiority relies on the synergistic evolution of subsystems, and in order to realize this theoretical mechanism into practical strategic actions, a knowledge-based strategic management framework needs to be constructed. This section proposes a seven-step strategic management process that deeply integrates knowledge analysis with business objectives, providing a concrete path for enterprises to realize the value transformation of knowledge superiority.

Re-observing and re-interpreting the enterprise structure and enterprise behavior with the viewpoint of knowledge can form new management ideas, as well as new enterprise strategy ideas. However, enterprise strategy is also a system, process, need to be implemented into the enterprise's business management actions for strategic management. Its process is:

(1) knowledge analysis of the enterprise, this knowledge analysis is the starting point for the introduction of knowledge-based strategic management.

Specifically, it can include the following: 1) Determine what is the most important knowledge for the development strategy of the enterprise? 2) What is the knowledge flow of the enterprise and its transformation process? 3) What kind of knowledge is the most important for the transformation of the original business or business innovation? 4) How can the enterprise combine knowledge management with the enterprise's existing or future products and services? 5) What are the favorable and unfavorable factors for the implementation of knowledge management in the enterprise? What are the advantages and disadvantages of implementing KM in an organization? 6) What is the start-up project for implementing KM in an organization?

(2) Analyze the specific relationship of KM to knowledge-based strategy and knowledge dominance. Identify what is the knowledge base of the knowledge superiority power of the enterprise. Specifically, this can include the following: 1) What are the principles of corporate mission and goals and knowledge management? 2) What is the definition of corporate knowledge dominance? How does it unfold?3) What is the best time for an enterprise to undertake knowledge management?

(3) Determine the corporate KM strategy.

(4) Determine the focus areas of knowledge-based strategic management. First of all, clarify what is the knowledge of the enterprise? What business of the enterprise is the focus of future development? Analyze the enterprise's existing and future revenue maximum, etc. Then determine the list of departments or processes within the organization that are prioritized for knowledge management;

(5) Introducing an analysis of knowledge-based strategic management business processes.

The introduction of knowledge-based strategic management is actually a process of business process reengineering, the results of which can form the knowledge map of the enterprise, indicating a variety of explicit and tacit knowledge, where are they stored? How to flow?

(6) Based on the above analysis, develop a corresponding knowledge-based strategic management program;

(7) Choose the time to implement the program.

II. D.Chaotic Evolutionary Pathways for Corporate Strategy Systems

Knowledge-based strategic management provides a static framework for enterprises, but in a dynamic environment, the strategic system needs to adapt to the nonlinear evolution law. In this section, chaos theory is introduced to analyze the evolution path of enterprise strategy from order to chaos through nonlinear dynamics model, to reveal the impact of bifurcation and mutation on strategic stability, and to provide theoretical basis for enterprises to find the dynamic equilibrium amidst uncertainty.

The enterprise strategy system experiences order and complexity, enters chaos, and re-establishes order. Economic activity is actually a dynamic system, that is to say, the quantities that characterize or measure its degree and level in the economy are time-dependent variables, and the equations describing the laws of economic behavior can be regarded as a dynamical system. With the help of nonlinear dynamical systems it is possible to reveal the dynamic characteristics of economic activity such as evolutionary behavior, asymptotic nature and stability. The systems dealt with by chaos theory are modeled by deterministic equations, and the corporate strategy system is a typical nonlinear dynamical system whose economic behavior can be described as

$$X_{t+1} = f_\mu(X_t) \tag{9}$$

where f is a deterministic function and $X_t = (x_1, x_2, \cdots, x_n)$ are firm state variables such as output, profit, product variety, etc. With the change of time, the stakeholders' perception of strategic uncertainty further changes, thus a sequence of random variables $X_0, X_1, X_2, \cdots X_n$ is derived; μ is the control parameter of the strategic system, including the uncontrollable external environmental variables and the controllable strategic decision variables.

Bifurcation is a phenomenon unique to nonlinear dynamical systems, which generalizes to the abrupt topological changes in their phase diagrams when the control parameters are changed. Enterprise systems are a class of nonlinear dynamical systems, and bifurcation occurs when certain parameters affecting the evolution of the enterprise system are changed. From the perspective of the bifurcation process, destabilization is the physical premise for the occurrence of bifurcation of the enterprise system, and after the bifurcation, discontinuous transitions between the different states of the enterprise system are generated, i.e., abrupt changes occur. After the bifurcation, the enterprise system has discontinuous transitions between different states, i.e. abrupt changes.

Multiple cycle bifurcation leading to chaos is the most studied route, the basic principle is that the state of the dynamical system from the stable equilibrium point with the change of a parameter changes, first of all, the state of the system from the stable equilibrium point through a bifurcation to form a cycle solution, and then through countless bifurcations to repeat the process of times the cycle, when the parameter reaches a certain value, the system will gradually lose the cyclic behavior and enter the chaotic zone. When the system enters into chaos through the multiply-period bifurcation, its quantitative relationship will show a certain regularity, which is Feigenbaum's constant, which is common to all multiply-period bifurcations, reflecting the regularity of the multiply-period bifurcation leading to chaos.

From Eq. (9), let $\mu = rN_{\max}$, to describe the corporate strategy system evolution process by a simple one-dimensional nonlinear Logistic mapping, we get:

$$x_{n+1} = f(x_n, \mu) = \mu x_n (1 - x_n) \tag{10}$$

Solve the equation:

$$x = \mu x(1 - x) \tag{11}$$

Two equilibrium points can be obtained: $x_1^* = 0$ and $x_2^* = \dfrac{\mu - 1}{\mu}$.

Due to the Jacobi determinant $J = \dfrac{\partial f}{\partial x} = \mu - 2\mu x$ for the linear part of the immovable point, it is known that the stability of the strategic system depends on the parameter μ. For the strategic system, as the control parameter μ changes, the state X_{t+1} of the system will go from a single equilibrium state through continuous bifurcation into a multiplicative periodic state and into chaos.

As the value of the control parameter μ increases, the strategic system shows multiplicative cycle bifurcation, and stable $1, 2, 4, 8, 16, \cdots, 2^n$ cycle points appear, but the range of values of the corresponding μ values at the time of stable cycle orbits becomes smaller and smaller until the strategic system enters into a chaotic state. When the strategic system enters into the chaotic region, it is not chaotic, but there are still some period windows in the chaotic region, and these period windows are constantly bifurcated by times period, and this structure repeats infinitely, forming a self-similar structure.

When the strategic system is transformed from orderly to chaotic, under the non-equilibrium nonlinear conditions, when the change of some parameters reaches a certain critical threshold, the temporal behavior of the strategic system is suddenly orderly and suddenly chaotic, and oscillates irregularly and alternately between the two, with the proportion of the periodical portion gradually decreasing. The chaotic evolution pathway of the strategic system reflects the regularity of the destabilization and mutation of the strategic system, and while the strategic system is regularly evolving, destabilization and mutation appear by chance, changing the direction of the evolution of the strategy and making the strategy complex.

III. Knowledge management validity test, cluster network empirical evidence and financial strategy optimization effect assessment

Based on the theoretical model, Chapter 2 reveals the synergistic evolution mechanism of knowledge advantage power and the chaotic characteristics of strategic system under digital transformation, providing a theoretical framework for enterprise strategic management in dynamic environment. In order to further verify the practical effectiveness of the theory, Chapter 3 examines the credibility of the knowledge management system through empirical research, analyzes the impact of the knowledge network on the competitive advantage of enterprises in industrial clusters, and evaluates the application effect of the optimization scheme based on the financial data of Enterprise A, so as to transform the theoretical mechanism into an operable practical path.

III. A. Validity and Reliability Tests of Enterprise Knowledge Management (EKM)

Regarding the research on enterprise knowledge management, the article centers on three factors: knowledge management strategy (KMS), knowledge management facilitation (KME) and knowledge management process capability (KMPC). The KMS factors include A1: system-oriented strategy, A2: people-oriented strategy; KME

(Knowledge Management Enhancement), KME includes five factors, A3: technology, A4: decentralization, A5: standardization, A6: organizational culture, A7: innovation factors; KMPC (Knowledge Management Process Capability), KMPC includes A8: external knowledge acquisition, A9: internal knowledge acquisition, A10: knowledge upgrading KMPC includes six factors, namely A8: external knowledge acquisition, A9: internal knowledge acquisition, A10: knowledge upgrading, A11: knowledge protection, A12: knowledge transformation and A13: knowledge application. The following is a reliability analysis of the KMPC scale for knowledge management process competencies.

III. A. 1) Reliability analysis of the knowledge management process capability scale

The variance-maximizing rotation was used to establish the structural validity analysis of knowledge management process competence. The number of factors depends on the eigenvalues greater than 1. The validity of knowledge management process capability studied in this paper contains four dimensions: knowledge acquisition, knowledge protection, knowledge transformation and knowledge application. The eigenvalues show that knowledge management process capability contains six factors: external knowledge acquisition, internal knowledge acquisition, knowledge upgrading, knowledge protection, knowledge transformation and knowledge application, which explain 95.42% of the total variance.

The external knowledge acquisition factor contains two entries, B1: the company has an internal process of generating new knowledge from existing knowledge and B2: the company has a process of diffusing knowledge through the organization; the internal knowledge acquisition consists of three entries, B3: the company has a process of acquiring knowledge of new products in the industry, B4: the company has a process of acquiring knowledge of new services in the industry, and B5: the company has a process of interacting with external partners; knowledge upgrading also consists of three entries; knowledge upgrading explains 95.42% of the total variance. Processes; Knowledge upgrading likewise includes 3 entries, B6:The company has a process for benchmarking performance among employees and departments, B7:The company has a process for identifying and upgrading best practices, and B8:The company has a process for replacing old knowledge with new knowledge; Knowledge protection factor contains 5 entries under B9; The company has techniques to protect knowledge from improper use that leads to the leakage of the paper to the outside of the organization, B10:The company has techniques, such as cryptography systems, for controlling expertise resources. systems technology to control the protection of expertise resources, B11: The company has processes to protect knowledge from inappropriate use leading to paper leakage outside the organization, B12:The company has processes to identify restricted knowledge, B13:The company is well aware of the importance of knowledge protection at the enterprise level; Knowledge Transformation consists of 6 entries, B14:The company has processes to convert competitive intelligence into action plans, B15. The company has a process for filtering and evaluating knowledge, B16:The company has a process for converting organizational knowledge into personal knowledge, B17:The company has a process for converting personal knowledge into organizational knowledge, B18:The company has a process for absorbing knowledge from its partners, B19:The company has a process for integrating different resources and types of knowledge; Knowledge application factor includes 7 entries under the factor, B20:The company has a process for using past experience feedback to improve future projects, B21: the company has a process for learning from past mistakes, B22: the company has a process for using knowledge to solve new problems, B23: the company has a process for matching knowledge resources to problems or challenges, B24: the company has a process for using stored knowledge to improve efficiency, B25: the company has a process for using knowledge to adjust strategy, and B26: the company has a process for quickly linking available knowledge resources to the solution of problems. B26: Companies have processes for quickly linking available knowledge resources to problem solving.

The six factors of knowledge transformation and their 26 entries were analyzed for the reliability of the scale of corporate knowledge management capabilities as shown in Table 1.

Table 1 shows that the Cronbach's α values for external knowledge acquisition, internal knowledge acquisition, knowledge upgrading knowledge transformation and knowledge application are 0.917, 0.897, 0.931, 0.904, 0.914, and 0.966, respectively, which are higher than 0.7, which indicates that the knowledge management process scale is reliable.

III. A. 2) Analysis of Convergent and Simultaneous Validity of Organizational Characteristics

Organizational characteristic profiles contain: software business type, number of employees, annual sales, and main product/service life cycle. Pearson r character coefficient was used to analyze the relationship between number of employees, annual sales and knowledge management scale. ANOVA was used to analyze the concurrent validity between software company type, main product/service life cycle and knowledge management scale. The aggregated validity of the KM subvariables is shown in Table 2.

Table 1: Reliability analysis of Enterprise Knowledge Management Capability Scale

Factor	Cronbach α	Entry	Cronbach α
A8: External knowledge acquisition	0.917	B1: Endogenous Innovation process	0.920
		B2: Knowledge Diffusion Process	0.901
A9: Internal knowledge acquisition	0.897	B3: Acquisition of industrial knowledge	0.770
		B4: Acquisition of industrial services	0.789
		B5: External Interaction process	0.829
A10: Knowledge upgrade	0.931	B6: Performance Benchmarking process	0.810
		B7: Best Practice Enhancement	0.861
		B8: The replacement of old and new knowledge	0.796
A11: Knowledge protection	0.904	B9: Anti-leakage technology	0.791
		B10: Password protection technology	0.856
		B11: Knowledge Protection Process	0.801
		B12: Restrictive recognition	0.832
		B13: Awareness of knowledge protection	0.913
A12:Knowledge transformation	0.914	B14: Intelligence transformed into action	0.918
		B15: Knowledge Filtering Evaluation	0.931
		B16: Personal to Organizational knowledge	0.772
		B17: Organization to Individual knowledge	0.821
		B18: Cooperative knowledge absorption	0.804
		B19: Resource integration process	0.933
A13:Knowledge application	0.966	B20: Experience feedback improvement	0.898
		B21: Incorrect learning process	0.808
		B22: Knowledge solves new problems	0.854
		B23: Knowledge Resource matching	0.828
		B24: Storing knowledge for efficiency	0.833
		B25: Strategic adjustment Strategy	0.863
		B26: Knowledge resource links	0.788

Table 2 demonstrates the results of the convergent validity analysis of the knowledge management subvariables. The correlation coefficients and significance levels among the subvariables indicate that there are multilevel associations within the KMS. In terms of Knowledge Management Strategy (KMS), System Oriented Strategy A1 is significantly positively correlated with Human Oriented Strategy A2 at moderate strength ($r=0.342$, $p<0.001$), indicating that there is a synergy between the two in terms of strategy design. Among the Knowledge Management Enablers (KME) subvariables, the correlation coefficients of Normative A5 with Technology A3 and Decentralization A4 were 0.387 ($p<0.001$) and 0.462 ($p<0.001$), respectively, indicating that Normative is closely related to Technology and Decentralized Management. In addition, the highest correlation coefficient ($r=0.576$, $p<0.001$) was found between innovation factor A7 and normalization A5, suggesting that innovation-driven KM requires the support of highly normalized processes.

In the knowledge management process capability (KMPC) dimension, the correlation coefficient between external knowledge acquisition A8 and internal knowledge acquisition A9 is 0.199 ($p<0.01$), indicating that there is a weak positive correlation between the two; whereas knowledge upgrading A10 has a stronger correlation with external knowledge acquisition A8, with $r=0.304$, $p<0.001$, suggesting that the input of external knowledge has a facilitating effect on knowledge upgrading. The correlation coefficient between knowledge protection A11 and external knowledge acquisition A8 is as high as 0.508 ($p<0.001$), highlighting that external knowledge integration needs to be closely integrated with the protection mechanism. The correlation coefficient between knowledge transformation A12 and knowledge application A13 is 0.492 ($p<0.001$), further verifying the direct impact of knowledge transformation on practical application.

Overall knowledge management performance (KM performance) is significantly and positively correlated with all the sub-variables, with the strongest correlation with knowledge application A13, $r=0.548$, $p<0.001$, indicating that knowledge application is the core link driving performance improvement. In addition, the number of employees has the highest correlation coefficient with Knowledge Transformation A12, $r=0.458$, $p<0.000$, and annual sales has the most significant correlation with Knowledge Transformation A12, $r=0.379$, $p<0.000$, reflecting the dependence of organizational size and market performance on the efficiency of knowledge transformation.

The ANOVA values and Turkey post hoc analysis of the knowledge management scale with the main product/service cycle are shown in Table 3.

Table 2: Aggregated validity of knowledge management sub-variables

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13
A2	.342***												
A4			.532***										
A5			.387***	.462***									
A6			.193**	.382***	.020								
A7			.267**	.405***	.576***	.438***							
A9								.199**					
A10								.304***	.210**				
A11								.508***	.354***	.425***			
A12								.403***	.254**	.112	.399***		
A13								.244**	.388***	.509***	.492***	.244**	
KM Performance	.468***	.317***	.359***	.337***	.477***	.235**	.381***	.484***	.235**	.247***	.324***	.483***	.548***

Table 3: ANOVA values of knowledge management scale and Turkey post hoc analysis

Variable	F	P	Post Hoc Turkey
Total KMS	0.973	0.317	
A1 Maturity > Growth	4.299	0.008	0.001
A2	0.624	0.326	
Total KME	1.450	0.245	
A3 Growth > Early Stage	4.595	0.033	0.007
A4 Growth> Maturity	5.539	0.06	0.006
A5	0.176	0.834	
A6	1.036	0.450	
A7	0.817	0.441	
Total KMPC value	1.009	0.496	
A8 Maturity > Growth	4.795	0.024	0.013
A9	0.605	0.573	
A10	2.863	0.131	
A11 Growth > Early Stage	8.883	0.000	0.000
A12	2.443	0.158	
A13	0.588	0.792	
KM Performance Growth > Early Stage	3.873	0.027	0.049

As a whole, the F-values for KM strategy and KM facilitation are 0.973 (p=0.317) and 1.450 (p=0.245), respectively, neither of which reaches the level of significance, indicating that there is no significant difference between firms at different life cycle stages in terms of overall strategy and facilitation dimensions. However, some of the subvariables show significant differences: the F=4.299 (p=0.008) for system-oriented strategy A1, and the Turkey test shows that the maturity stage scores are significantly higher than the growth stage (p=0.001), suggesting that mature firms rely more on systematic knowledge management. F=4.595, p=0.033 for Technology Facilitation A3, technology adoption in the growth stage is significantly better than in the early stage, p=0.007, reflecting the key role of technology drive in the growth stage. F=5.539, p=0.006 for Decentralization A4 is close to significance and decentralized management scores are higher in the growth stage than in the maturity stage, implying that growth stage firms prefer decentralization to enhance flexibility. F=8.883 (p<0.001) for knowledge protection A11, and the knowledge protection ability of growth stage is significantly better than that of early stage (p<0.001), which highlights that growth stage firms attach great importance to knowledge security. The total KM performance KM's F=3.873, p=0.027, and the growth stage performance is significantly better than the early stage, p=0.049, suggesting that KM contributes more significantly to business outcomes in the growth stage.

Overall, the study reveals the differentiated needs for KM subsystems at different stages of the product/service lifecycle: mature firms rely more on systematic strategies, while growth-stage firms need to strengthen technological investment and decentralized management, while knowledge protection and performance transformation are particularly critical in the growth stage.

III. B. Empirical Research on Knowledge Networks and Competitive Advantage of Cluster Firms

Through the reliability and validity test of the knowledge management scale, the study confirms the reliability and relevance of the knowledge management subsystem. On this basis, the study further focuses on industrial cluster enterprises, empirically analyzes the mechanism of knowledge network on competitive advantage through structural equation modeling, and reveals the synergistic effect of external network characteristics and internal knowledge capability.

III. B. 1) Descriptive analysis of the sample of firms

Through the field survey of industrial clusters, a total of 315 samples of effective cluster enterprises were obtained in this study. The number of active employees in the enterprise is used to indicate the size of the enterprise, and the size distribution and the distribution of years of experience of the sample enterprises collected by the study are shown in Table 4.

Table 4: The scale distribution and years distribution of the sample enterprises

Enterprise scale	Frequency	Proportion
Less than 300 people	214	67.94%
301 to 500 people	52	16.51%
501 to 1,000 people	30	9.52%
More than 1000	19	6.03%
Enterprise years	Frequency	Proportion
More than three years	62	19.68%
Four to five years	78	24.76%
6 to 10 years	102	32.38%
11 to 20 years	58	18.41%
More than 20 years	15	4.76%

The size of the collected sample firms is more concentrated, including 214 SMEs with less than 300 employees, accounting for 67.94% of the total sample; For the rest, there are 52 sample enterprises with 301-500 employees, accounting for 16.51%; 30 sample enterprises with 501-100 employees, accounting for 9.52%; and 19 sample enterprises with more than 1,000 employees, accounting for 6.03%.

For the distribution of the years of establishment of enterprises is more scattered, of which 62 samples have been established for less than 3 years, accounting for 19.68%; 78 samples have been established for 3-4 years, accounting for 24.76%; 102 samples have been established for 6-10 years, accounting for the most, 32.28%; 58 samples have been established for 11-20 years, accounting for 18.41%; only 15 enterprises have been established for more than 20 years, accounting for 4.76%.

III. B. 2) Preliminary estimation and evaluation of the model

After the initial path diagram was created in AMOS and the corresponding data were exported, the first iteration of AMOS Graphics was run to obtain the individual metrics estimated by the model. The fitting results show that the initial model fit has a value of χ^2 of 2004.214 and a degree of freedom of df=811, while the value of χ^2 is insignificant and the value of χ^2/df of 2.471<3 from p=0.000<0.05,. The requirement that χ^2 is not significant can therefore be ignored, which suggests an acceptable fit; however, the RMSEA value of 0.091 for this initial model is outside the recommended acceptable range of 0.05- 0.08; the SRMR value of 0.074 is less than the reference value of 0.080; the critical normal fit index, NFI = 0.804, is not greater than 0.9, and the value of CFI, 0.825, is also smaller than the reference value of 0.900, which indicates that the initial model did not fit the sample data well, and that further improvements to the initial model are needed to make it more consistent with the model reflected in the data.

Regarding the paths of the initial measurement model of knowledge network and firm competition designed in this paper are as follows:

There are 6 paths of knowledge acquisition, which are as follows

L1: Knowledge acquisition <-- network size

L2: Knowledge acquisition <-- network openness

L3: Knowledge acquisition <-- network centrality

L4: Knowledge Acquisition <-- Relationship Strength

L5: Knowledge Acquisition <-- Relationship Stability

L6: Knowledge Acquisition <-- Relationship Quality

There are also 6 paths for knowledge absorption, which are as follows

L7: Knowledge Absorption <-- Network Size

L8: Knowledge absorption <-- network openness

L9: Knowledge Absorption <-- Network Centrality

L10: Knowledge Absorption <-- Relationship Strength

L11: Knowledge Absorption <-- Relationship Stability

L12: Knowledge Absorption <-- Relationship Quality

There are also 6 paths of knowledge innovation, which are as follows

L13: Knowledge innovation <-- network size

L14: Knowledge innovation <-- network openness

L15: Knowledge innovation <-- network centrality

L16: Knowledge Innovation <-- Relationship Strength

L17: Knowledge Innovation <-- Relationship Stability

L18: Knowledge Innovation <-- Relationship Quality

There are 5 paths to competitive advantage, which are as follows

L19: Competitive Advantage <-- Knowledge Acquisition

L20: Competitive Advantage <-- Knowledge Absorption

L21: Competitive Advantage <-- Knowledge Innovation

L22: Competitive Advantage <-- Firm Age

L23: Competitive Advantage <-- Firm Size

The path parameter estimates for the initial measurement model are shown in Table 5.

In terms of the path coefficients between variables given by the initial modeling results, except for a few path coefficients, most of the C.R. values corresponding to the path coefficients in the structural equation model are greater than the reference value of 1.96, which is statistically significant at the level of p≤0.05. Among them, the paths that did not meet the fitting requirements of the structural equation modeling

L1: Knowledge acquisition <- network size; L4:Knowledge acquisition <- relationship strength; L7:Knowledge uptake <- network size; L10:Knowledge uptake < a relationship strength; L13:Knowledge innovation <- network size; L16:Knowledge innovation <- relationship strength; L20:Competitive advantage <- knowledge uptake and L22:Competitive advantage <- age of firm.

Few models can be fitted successfully after only one operation, which is more common for the analysis of the resulting model, either because the constructed conceptual model itself does have some problems or because of the bias caused by the data obtained through the questionnaire. Therefore, in view of the above initial model's unqualified fitting results as well as some of the results that cannot pass the path system test, it is necessary to fine-tune and correct the initial model and test whether its various fitting indicators can reach the standard model.

Table 5: Path parameter estimation of the initial measurement model

	Path	Standardized path coefficient	Path coefficient	C.R	P
Knowledge acquisition path	L1	0.075	0.044	0.568	0.486
	L2	0.257	0.198	2.213	0.013
	L3	0.211	0.158	3.529	0.000
	L4	0.113	0.107	0.828	0.644
	L5	0.087	0.043	2.441	0.028
	L6	0.518	0.212	7.627	0.000
Knowledge absorption path	L7	0.026	0.052	0.611	0.471
	L8	0.173	0.089	2.234	0.041
	L9	0.202	0.254	4.519	0.000
	L10	0.224	0.128	1.029	0.274
	L11	0.227	0.267	3.692	0.001
	L12	0.418	0.085	6.744	0.000
Knowledge innovation path	L13	0.117	0.087	1.717	0.136
	L14	0.682	0.477	7.672	0.000
	L15	0.146	0.108	1.999	0.107
	L16	0.034	0.031	0.351	0.678
	L17	0.208	0.179	3.798	0.004
	L18	0.235	0.142	2.370	0.000
Competitive advantage path	L19	0.160	0.141	2.836	0.028
	L20	0.006	0.067	0.719	0.986
	L21	0.483	0.282	10.004	0.000
	L22	0.048	0.038	1.638	0.207
	L23	0.062	0.017	2.404	0.025

III. B. 3) Model Revision and Evaluation

The correction of the model in this study was carried out in two main ways, one of which was to increase the correlation between the residuals by using the modification indicator MI, which was given simultaneously by AMOS 5.0 in the results of the model test that could be used for reference. Because if the modification index of the variables is relatively large, it means that the original model does not take into account the strong correlation between these variables, which makes it impossible to achieve the conditions of the path analysis, and it is necessary to make adjustments to the model and recognize the correlation between these variables, and this adjustment is mainly to increase the covariance relationship between the residuals. In general, if when a = 0.05 level, it is appropriate to modify the parameter paths for MI>3.84 and above.

Secondly, according to the results of the path coefficient test in the initial model test, the model can be fine-tuned by adding or deleting the path relationship between independent variables.

After combining the modification indexes of the above two aspects, especially on the basis of relevant literature research and the practical significance of the relationships between variables, this study believes that although eight paths did not pass the validation in the first validation and their paths have lower C.R values and higher P values, considering that the data and the model did not simulate well in this operation, when fine-tuning the model, this paper does not make any adjustments to the above mentioned path relationships that did not pass the validation, and the model can be adjusted by adding or deleting path relations among independent variables. path relationships that passed the validation, but first fine-tuned the model for the first time by increasing the covariance relationship between the residuals according to the modification index provided by AMOS in order to gradually eliminate the simulation bias. The obtained path parameter estimates of the modified model are shown in Table 6.

The fitting results show that the second revised model fits a χ^2 value of 1021.626 with degrees of freedom df=617, from p=0.00<0.05, χ^2 is not significant, and the value of χ^2/df of 1.656<2 can be ignore the requirement that χ^2 is not significant, indicating a good fit; the RMSEA value of the model is 0.066, which is within the suggested acceptable interval of 0.05 - 0.08; the SRMR value is 0.053, which is less than the reference value of 0.080; and the values of the NFI and the CFI are 0.951 and 0.967, which are both greater than the reference value of 0.900. After this model correction, all C.R. values corresponding to the path coefficients in the obtained structural equation model are greater than the reference value of 1.96. Among them, the path L21:Competitive Advantage<--Knowledge Innovation has the best performance, with a standardized path coefficient of 0.472, a C.R. value of 10.005, and a significance p=0.000, followed by L14:Knowledge Innovation<--Network Openness, with a standardized path coefficient of 0.684, a C.R. value of 6.672, and a significance p=0.001, which highlights the importance of an open network environment for innovation. The importance of the The standardized path coefficient of L6:Knowledge Acquisition<--Relationship Quality in the knowledge acquisition path is 0.622, with a C.R value of 5.615 and a significance of p=0.000. Taking into account the judgments of the above fitting coefficients, the fit of the model to the data obtained from the second revision of the initial model passes the test.

Table 6: Path parameter estimation of the corrected model

	Path	Standardized path coefficient	Path coefficient	C.R	P
Knowledge acquisition path	L1	0.195	0.143	3.594	0.004
	L2	0.183	0.177	2.199	0.023
	L3	0.222	0.286	4.559	0.002
	L4	0.322	0.201	2.839	0.000
	L5	0.097	0.122	2.429	0.004
	L6	0.513	0.622	5.615	0.000
Knowledge absorption path	L7	0.208	0.252	3.624	0.001
	L8	0.056	0.038	2.026	0.050
	L9	0.177	0.324	3.509	0.001
	L10	0.418	0.255	4.004	0.005
	L11	0.147	0.161	3.267	0.002
	L12	0.419	0.472	4.748	0.000
Knowledge innovation path	L13	-0.097	-0.075	1.735	0.002
	L14	0.767	0.684	6.672	0.001
	L15	-0.154	-0.106	1.982	0.086
	L16	0.081	0.073	4.331	0.186
	L17	0.189	0.177	3.781	0.004
	L18	0.228	0.265	2.389	0.017
Competitive advantage path	L19	0.189	0.213	2.841	0.035
	L20	0.212	0.341	3.736	0.004
	L21	0.557	0.472	10.005	0.000
	L22	0.043	0.037	1.927	0.043
	L23	0.072	0.035	2.424	0.031

III. C. Evaluation of the effectiveness of the optimization program of the enterprise's financial strategy

After clarifying the knowledge network's driving path to competitive advantage, the study turns to the on-the-ground practice of enterprise strategy, taking Enterprise A as a case study, combining the financial strategy matrix with the capital state prediction, and quantitatively evaluating the enhancement effect of the optimization scheme based on the knowledge superiority power on financial sustainability.

Apply the theoretical model designed in this paper based on the transformation mechanism of knowledge superiority power, the strategic management process and chaos evolution theory of knowledge management enterprise financial strategy optimization scheme to the actual enterprise management, take enterprise A as the experimental object, and start to carry out the financial strategy optimization scheme designed in this paper on that in 2021. Next, the state of the enterprise's capital utilization is calculated to predict and analyze as well as the matrix analysis of its financial strategy.

III. C. 1) Calculation and analysis of the state of utilization of the enterprise's funds

Included in the analysis of the state of use of funds is the calculation of the formula for:

$$\text{Sustainable growth rate} = R0E \times \text{Revenue retention rate} \tag{12}$$

$$\text{Sales growth rate} = \frac{\text{Sales volume}_{\text{current year}} - \text{Sales volume}_{\text{last year}}}{\text{Sales volume}_{\text{last year}}} \tag{13}$$

Based on the above formula, combined with the annual reports of Enterprise A from 2010-2019, a forecast of the capital status of Enterprise A from 2020-2024 can be produced as shown in Table 7.

Table 7: Forecast of the financial status of Company A from 2020 to 2024

	2020	2021	2022	2023	2024
ROE (%)	17.96	15.76	18.43	17.07	17.74
Revenue retention rate (%)	48.53	25.13	45.82	38.67	37.36
Sustainable growth rate (%)	7.04	5.08	4.2	5.07	5.74
Sales growth rate (%)	16.56	11.63	-16.94	1.49	-4.93
Sales growth rate -Sustainable growth rate (%)	9.52	6.55	-21.14	-3.58	-10.67
Capital status	Shortage	Shortage	Remainder	Remainder	Remainder

From the forecast table, it can be seen that during the period of 2020-2024, except for the first two years when the capital is in short supply, after that, all of them are showing surplus of capital.In 2020, the ROE of the company is 17.96%, but the sustainable growth rate is 7.04%, which is lower than the growth rate of sales of 16.56%, which leads to a shortage of capital. After the implementation of financial strategy optimization in 2021, the ROE decreased to 15.76% and the revenue retention rate decreased to 25.13%, but the gap between the sustainable growth rate and the sales growth rate narrowed to 5.08%.After 2022, the company's sales growth rate fluctuates a lot, -16.94% in 2022, but through the strategic adjustments, the sustainable growth rate gradually rebounded, reaching in 2024 5.74%, and the fund status turns to surplus. This shows that the optimization plan effectively alleviates the problem of capital shortage and enhances the financial stability.

III. C. 2) Financial strategy matrix analysis

By calculating and analyzing the state of development of the company between 2020-2024, so as to construct the financial strategy matrix seen in the year 2020-2024 is shown in Figure 1.

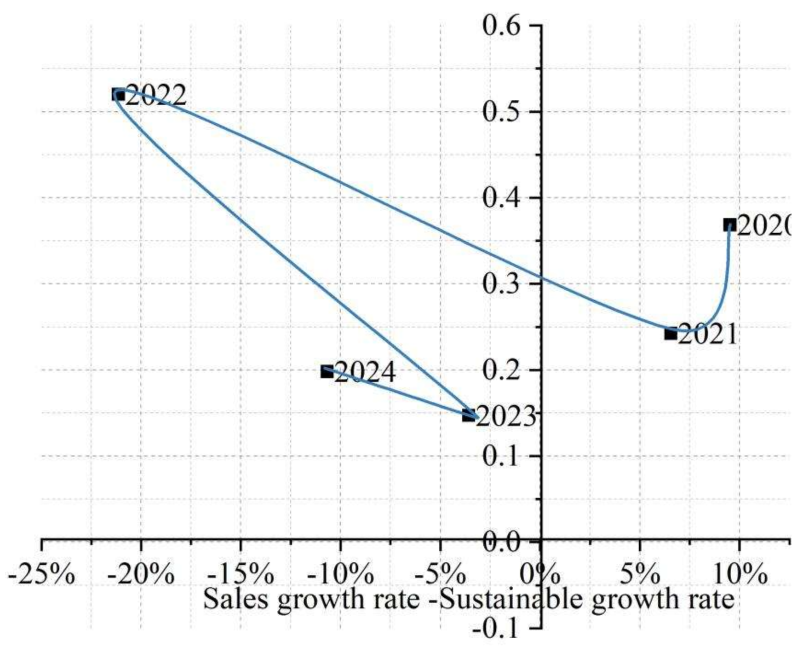

Figure 1: Prediction of the financial strategy matrix of Enterprise A

According to the financial strategy matrix, Figure 1, the basic trajectory of enterprise A between 2020-2024 can be seen. Overall, the trend of enterprise A during 2020-2024 is located in the upper half of the financial matrix, indicating that the value of the enterprise maintains a value-added status. Its capital status is in the state of shortage in 2020-2021, after which the forecast of the enterprise's capital is in the state of surplus, and the capital trend changes from deficit to surplus.

IV. Conclusion

This study reveals the key role of intelligent optimization techniques in enterprise organization structure by combining theory and empirical evidence. The main conclusions are as follows.

The confidence validity test of knowledge management process energy scale shows that the dimensions of external knowledge acquisition Cronbach α=0.917 and knowledge application α=0.966 are highly reliable, and the correlation coefficient between knowledge protection and external knowledge acquisition is as high as 0.508, which is significantly correlated with each other, highlighting the importance of the knowledge integration and security mechanism.

The empirical results of industrial cluster enterprises show that knowledge innovation is the core driver of competitive advantage, with a path coefficient of 0.472, and network openness promotes innovation most significantly, with a path coefficient of 0.684, suggesting that an open and collaborative environment is the key to enterprise success in the era of the knowledge economy.

In the case of enterprise A, the financial strategy optimization scheme reduces the proportion of capital shortage from 16.56% in 2020 to -4.93% in 2024, and the sustainable growth rate stabilizes at 5.74%, which verifies the practical value of the theoretical model.

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