ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

Research on Dynamic Evolution of Liquid Organization based on Life Cycle Theory

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Abstract

In order to clarify the evolution process and characteristics of liquid organization, this paper constructs a new dynamic evolution model of liquid organization based on the evolution model of the Logistic equation, and uses a combination of qualitative and quantitative research methods to analyze the dynamic evolution process of liquid organization. The size of the organization determines its position in the life cycle, and divides its dynamic evolution process into five stages: formation, growth, maturity, stable, and decline (evolution), and analyze its evolution characteristics and laws.

Keywords

Life cycle; Liquid organization; Dynamic evolution.

1. Introduction

Looking at the evolution of corporate organizational forms, we find that in response to the development requirements of the times, corporate organizations are gradually evolving toward flexibility, and the degree of flexibility is getting higher and higher. In the era of big industry, the "boundaries" and "centers" of traditional bureaucratic organizations are more rigid, clear, and static. With the development of technology, organizations continue to "relax", organizational boundaries gradually become flexible and organizational centers gradually become dynamic. However, most organizations retain the characteristics of boundary, hierarchical, and centralization. Their organizational structure is still like a pyramidal rigid organizational structure, with clear division of labor and departmental walls. In addition, the relationship between business owners and employees still needs to sign labor contracts to maintain. It is the relationship between employment and be employed. It lacks sufficient flexibility in responding to changes in the external environment and co-creation, and cannot adapt well the development requirements of the future intelligent era.

However, with the development of the intelligent age, the degree of flexibility of the organization will become higher and higher. When the degree of flexibility of the organization reaches the extreme, the organization will evolve into another organizational form-liquid organization. The liquid organization has no boundaries and does not advocate "employment relationship". All members are equal, free to assemble, flow freely, and collaborate with each other. All members in the organization are in a co-creation relationship, and each member is mutually partner, it can well meet the individual and creative needs of employees. Therefore, this article believes that liquid organization is the inevitable trend of the evolution of enterprise organization in the future intelligent era, and is the representative form of enterprise organization in the future intelligent era.

At present, the development of 5G networks and smart technologies and the impact of the "new crown" epidemic have brought opportunities for the formation and development of liquid organizations. So, how to smoothly carry out the liquefaction transformation? How to promote the formation and development of flexible liquid organization? There is no experience to follow.

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Therefore, it is necessary to strengthen the related research of liquid organization and clarify people's vague cognition of liquid organization. Based on this, we need to systematically analyze the dynamic evolution process of liquid organization, deeply explore the evolution mechanism of liquid organization, and provide theoretical guidance and policy reference for the evolution of liquid organization morphology.

This paper intends to build a dynamic evolution model of liquid organization with the help of logistic model, and analyze the dynamic evolution process and characteristics of liquid organization based on life cycle theory, and reveal the dynamic evolution process of liquid organization based on this. The follow-up part of this article includes literature review, research design, dynamic evolution model construction, dynamic evolution process analysis, evolution simulation analysis and conclusions.

2. Literature Review

2.1. Related Research on Liquid Organization

The concept of liquid organization originated from people's understanding of water and the reflection of eastern culture. Water is fickle in shape, constantly changing actively to adapt to the environment, and can control the flow according to the location. These characteristics are consistent with liquid organization in the dimension of organizational morphology [1]. Lu Yadong and Fu Zhengping [2] proposed the idea of water management with "metaphor" as the method. Li Ping and Zhou Shijin [3] used water as a symbol to explain the growth and change of enterprises from start-up, take-off, and maturity to reengineering. The concept of "liquid company" was first proposed by Cong Peisheng [4] in 2005 in his book Liquid Company -- Chinese Enterprise Operation and Management. He believes that in the new economic era, Chinese enterprises should change from "solid state" to "liquid state" in order to adapt to the global environment. With the emergence of intelligent technologies such as 5G network and blockchain, the concept of liquid organization has been proposed based on the characteristics of water in academia. He Risheng [5] believes that employees in "liquid organization" are not restricted by rigid systems and can create new services by themselves. Li Jiuxin [6] applied the technical means and ideas of decentralization of blockchain to the organizational structure of the company system, and carried out chain reform, which was called "liquid organization". In the report "Deconstruction and Restructuring: Opening the Intelligent Economy", Ali Research Institute [7] mentioned that liquid organization represents a brand new mode of division of labor and collaboration, a self-organizing and self-adaptive organizational form.

2.2. Research on the Evolution of Enterprises

As the founder of modern enterprise growth theory, Penrose [8] revealed the internal driving force of enterprise growth by constructing the analytical framework of enterprise resource-enterprise capability-enterprise growth, and proposed that the services generated by enterprises' use of their own production resources are the driving force of enterprise growth. Scholars represented by Aldrich [9], Harman and Freeman [10] believe that enterprise evolution is mainly the result of natural selection of the environment, in which the fittest survive and the unfit are eliminated, so as to realize enterprise evolution. On the other hand, scholars represented by Lawrence and Lorsch [11], Nelson and Winter [12] believe that enterprise evolution depends on its adaptability, because enterprises will consciously change themselves to adapt to environmental changes, and enterprise variation is not random and undirected. Barnett & Burgelman [13] proposed that competition is an important factor to promote the evolution of enterprises, and competition will promote the better evolution and development of enterprises. Hannan & Freeman [14] proposed that technological change is the main way of enterprise external environment change, and technological change is likely to lead

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

to the rise and fall and demise of the entire industry, which is an important environmental constraint factor for enterprise evolution.

A domestic scholar, Shang Huiyong [15], believes that the driving force for the evolution of enterprises comes from the internal dynamical system dominated by the pursuit of capital proliferation and the external dynamical system dominated by competition. Wang Chenyou [16] believes that divides the growth and evolution forces of enterprises into endogenous forces, market forces and policy forces based on the three boundaries of enterprises, market and government. Wu Ying believes that [17] the evolutionary forces of enterprise innovation ecosystem mainly include entrepreneurship, profit attraction, enterprise incentive system, global technological progress, market consumption demand, government institutional support, etc. Ye Hongyu and Zhang Zhen [18] believe that the essence of enterprise evolution is actually the evolution process of technological innovation. Under the promotion of external and internal driving factors, technological innovation can be realized through imitative innovation, cooperative innovation or independent innovation, so as to realize the evolution of enterprises. Xing Yiqun and Tian Yuan [19] according to different impact on the evolution of the way, the evolution of the enterprise factors summed up in three categories: basic factors, behavior factors and constraints. The basic factors of different lead to the differences of corporate behavior factors and behavior factors determines the enterprise evolution path, the constraint factors restrict the enterprise during the process of evolution.

2.3. Research Related to Life Cycle Theory

Organizational life cycle was first proposed by Haire M [20]. He believed that the growth of an enterprise is similar to that of biological organisms, and there is a cycle phenomenon from birth, growth, maturity, decline and death. Adizes [21] and Steinmetz [22] also pointed out that enterprises can be viewed from the viewpoint of "life cycle" in biology, believing that the development of enterprises also conforms to the growth curve in biology. Subsequently, the theory of enterprise life cycle has been continuously improved, and the research system has been more in-depth and systematic. According to the capital structure of listed companies, Tanveer et al. [23] divided the life cycle of an enterprise into three stages: growth, maturity and recession. Greiner [24] proposed a five-stage model of organizational growth and development. He believed that the growth of an organization can be roughly divided into five stages: entrepreneurship, convergence, standardization, maturity, re-development or decline. Adizes [25] divided an enterprise into 10 stages: gestation, infancy, toddler, adolescence, prime, aristocratic, early bureaucratic, bureaucratic and death stages.

In 1995, Chen Jiagui [26] opened the prelude of domestic scholars' research on life cycle theory and divided the life cycle of an enterprise into six stages: gestation period, survival period, rapid development period, maturity period, decline period and transformation period. Song Chang et al. [27] divided the enterprise life cycle into growth period, maturity period and decline period according to the different characteristics of enterprises in the turbulent period. Based on the life cycle theory, Li Jianfang [28] divided the life cycle of an enterprise into four stages: the start-up stage, the growth stage, the stability stage and the decline stage. Ma Weimin and Zhang Ranran [29] divided the life cycle of technology-based small and medium-sized enterprises into five stages according to their own development characteristics: seed stage, initial start-up stage, growth stage, maturity stage and decline stage.

2.4. Review of Existing Research

Existing research does not give a complete scientific definition of liquid organization, and lacks a systematic discussion on the evolution of liquid organization, and fails to theoretically construct a dynamic evolution process model of liquid organization. This article will try to improve the above problems.

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3. Definition of Liquid Organization

3.1. Concept of Liquid Organization

In the future "post-industrial" intelligent era, with the support of intelligent technologies such as artificial intelligence, 5G network and blockchain, the super flexible organizational form of self-organization, self-adaptation, sharing and co-governance by all employees, breaking through corporate boundaries, and social and collaborative network integration can be fully realized.

Compared with the traditional organization, on the one hand, the liquid organization has no rigid hierarchical structure, and its internal members are fully equal. On the other hand, there is no clear organizational boundary, and the cross-border flow of members is almost unobstructed. With the support of the new generation of information technology and intelligent technology, liquid organization can maximize the release of employees' innovation potential, maximize the effectiveness of the organization, and then get rid of the rigid, passivation, aging diseases.

3.2. Characteristics of Liquid Organization

In the liquid organization, the enterprise will move from management to governance, and for the first time realize the sharing, co-governance and co-management of all staff. In this paper, it is considered that liquid organization has four remarkable characteristics and shows great innovation vitality:

First, it's highly flexible. Liquid organization has no boundaries, no employment relationship, can "freely combine, freely come and go", all members are equal.

Second, natural order. Relies on blockchain and smart contracts, the rights and interests of relevant participants can be accurately differentiated and automatically distributed, making the operation of the organization more coordinated and orderly.

Third, decentralization. There is no central node and hierarchical management structure in liquid organization. The collaborative relationship between each member forms a similar spherical multi-direction network, and large-scale network collaboration is carried out on the basis of consensus.

Fourth, distrust. Organizations use smart contracts to solve the problem of incomplete contracts, comprehensively rewrite the relationship between organizations and individuals, protect the individualization of intellectual property rights, encourage everyone to participate in social and economic cooperation, and realize the sharing, co-creation and win-win intelligent trust society.

3.3. Form of Liquid Organization

Liquid organization is a "borderless, multi-flow" super flexible organizational form in the future "post-industrial" intelligent era. Liquid organization cannot only minimize unnecessary intermediate links, and achieve a high degree of mobility of internal organization and talents, but also can easily break through the constraints of boundaries, freely allocate resources around different business scenarios, give organizations and talents more opportunities for inclusiveness and symbiosis and provide more possibilities for innovation and cooperation under the technical conditions of networking and intelligence. The free flow and free combination of talents in the liquid organization form a large-scale collaborative network to meet the needs of business development and achieve highly networked and decentralized business collaboration, thereby self-renewing, stimulating creativity, and quickly responding to external competition and changes. The schematic diagram of the liquid organization is shown in Figure 1.

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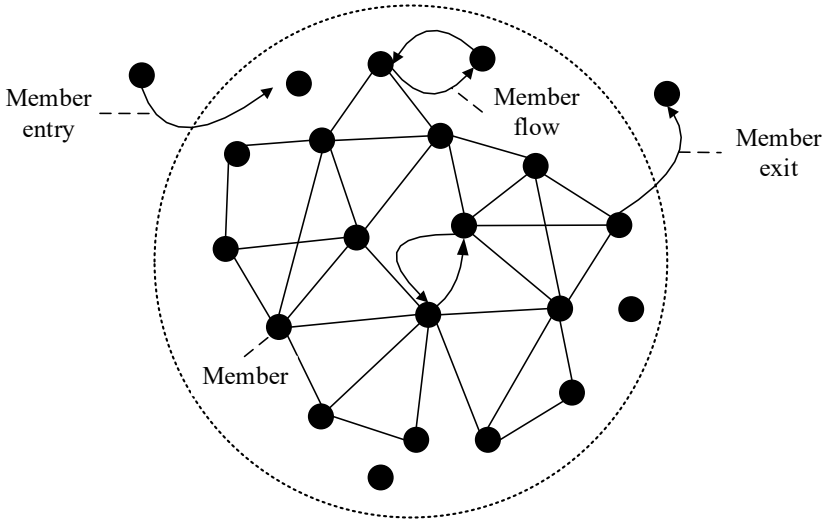

Figure 1. Schematic diagram of liquid organization form

4. Dynamic Evolution Model of Liquid Organization

4.1. Interpretation of Variable Symbol

In order to simplify the model and facilitate understanding, variable symbols are used instead of words. The variable symbols and their definitions in the dynamic evolution process model of liquid organization are shown in Table 1:

Table 1. Variable symbol and its interpretation

Variable symbol	interpretation
$\frac{dX_{(t)}}{dt}$	The speed at which the scale of liquid organization evolves at any moment
$X_{(t)}$	The size of the liquid organization at time t
M	The maximum size of liquid organization at t_M
p	Natural growth rate of liquid organization size
X_0	When t=0, the initial scale of liquid organization
$\frac{d^2X_{(t)}}{dt^2}$	Acceleration of the evolution of liquid organization scale at any moment
$\frac{d^3X_{(t)}}{dt^3}$	The acceleration of the evolution speed of liquid organization at any moment
$c = e^{-\tilde{c}}$	$\tilde{c}$ is the integral constant, which is determined by the initial state value of the system
X_1	The size of the liquid organization at time t_1
X_2	The size of the liquid organization at time t_2
X_3	The size of the liquid organization at time t_3
X_M	The size of the liquid organization at time t_M
t_M	The time when the liquid organization size reaches the maximum M

4.2. Hypothesis of Evolutionary Model

H1: The dynamic evolution process of the liquid organization is the result of competition and cooperation among the elements of the organization, the internal elements of the organization, and the external elements of the organization.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

H2: Within a limited time and space, the evolution of the organization is constrained by economic development requirements, various resource sharing (technical level, human resources, capital, etc.).

H3: The overall development scale of each stage of its evolution can express the evolution parameters of the liquid organization. Its growth rate has a significant impact on the evolution of the organization, which is mainly obtained by evaluating the number of members of the liquid organization.

H4: Taking into account the limitations of the individual elements of the liquid organization and other factors, its overall development scale has an upper limit, and considering the periodicity, its evolution state curve before reaching maximum size is shown as "S" type. But reach the upper limit of scale development, the evolution of the liquid organization status has risen in a spiral curve existence, stability and the decrease of the recession.

4.3. Establishment of Evolution Model

The Logistic growth curve equation was first proposed by P. F. Verhulst, which describes the basic law of population growth in a limited space. It is mainly used in the study of population growth, biological growth and development or reproduction processes, and is also widely used in the study of socio-economic phenomena. Therefore, this paper uses the Logistic equation to show the overall development scale growth of liquid organization. According to the previous hypothesis, this paper builds the liquid organization evolution process model based on the improvement of the original logistic standard equation$X_{t+1} = pX_t(1 - X_t)$ as Equation 1:

$$\frac{dX_{(t)}}{dt} = pX_{(t)}\left(1 - \frac{X_{(t)}}{M}\right) \tag{1}$$

The dynamic evolution model of liquid organization scale can be obtained by solving equation (1):

$$X_{(t)} = \frac{M}{1+c\ exp(-pt)} \tag{2}$$

Let $X_{(0)} = X_0$, which represents the initial state of liquid organization size, and $0 < X_0 < M$. Therefore:

$$X_{(t)} = \frac{M}{1+\left(\frac{M}{X_0}-1\right)e^{-pt}} \tag{3}$$

4.4. Derivation of Evolution Model

By taking the derivative of Equation (1), the evolution acceleration of the size of liquid organization at any moment can be obtained:

$$\frac{d^2X_{(t)}}{dt^2} = p^2X_{(t)}\left(1 - \frac{X_{(t)}}{M}\right)\left(1 - \frac{2X_{(t)}}{M}\right) \tag{4}$$

Let $\frac{d^2X_{(t)}}{dt^2} = 0$, the inflection point of the evolution trajectory curve of the liquid organization scale can be obtained. Because 0<X<M, when the inflection point of the evolution equation is at $X_2 = \frac{M}{2}$, substituting this result into equation (4), the inflection point moment is $t_2 = \frac{lnc}{p}$, that is, $X_2\left(\frac{lnc}{p}, \frac{M}{2}\right)$.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

At this point, the growth rate of liquid organization size is:

$$\frac{dX_{(t)}}{dt}|_{t=t_2} = \frac{pM}{4}$$

Next, continue to derivate equation (4), we can get:

$$\frac{d^3X_{(t)}}{dt^3} = p^3X_{(t)}\left(\frac{M-X_{(t)}}{M}\right)\left[\frac{M-(3+\sqrt{3})X_{(t)}}{M}\right]\left[\frac{M-(3-\sqrt{3})X_{(t)}}{M}\right] \quad (5)$$

Let $\frac{d^3X_{(t)}}{dt^3} = 0$, Two inflection points of the scale evolution speed curve of liquid organization can be obtained:

$$X_1 = \frac{M}{(3+\sqrt{3})}, X_3 = \frac{M}{(3-\sqrt{3})}$$

Substituting X_1 and X_3 into equation (3), we can get:

$$t_1 = \frac{lnc-ln(2+\sqrt{3})}{p}, t_3 = \frac{lnc+ln(2+\sqrt{3})}{p}$$

That is, $X_1\left(\frac{lnc-ln(2+\sqrt{3})}{p}, \frac{M}{(3+\sqrt{3})}\right)$, $X_3\left(\frac{lnc+ln(2+\sqrt{3})}{p}, \frac{M}{(3-\sqrt{3})}\right)$

At this time, the growth rate of the liquid organization scale is:

$$\frac{dX_{(t)}}{dt}|_{t=t_1=t_3} = \frac{pM}{6}$$

Among them, $\left(t_1, \frac{pM}{6}\right)$ and $\left(t_3, \frac{pM}{6}\right)$ are two inflection points of the evolution velocity curve of liquid organization size, $\left(t_2, \frac{pM}{4}\right)$ is the maximum value of the evolution velocity curve. Through the above calculation, an inverted U-shaped curve, namely the evolution velocity curve of liquid organization size, can be obtained, as shown in Figure 2:

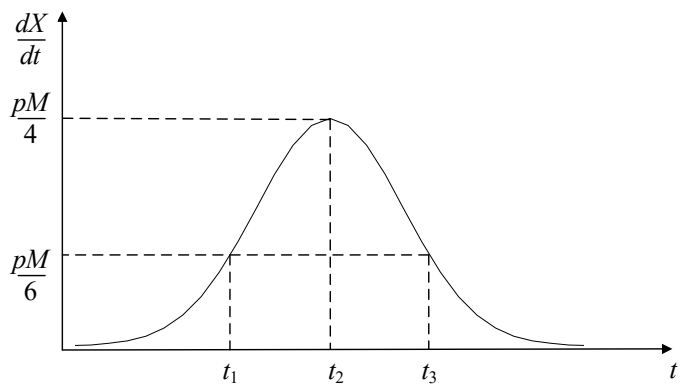

Figure 2. Evolution velocity curve of liquid organization

According to the evolution trajectory equation (3) of liquid organization size and the indicators of liquid organization size $X_1 = \frac{M}{(3+\sqrt{3})}$ and $X_3 = \frac{M}{(3-\sqrt{3})}$, a graph similar to the life cycle theory curve of the Logistic equation was made by using the distribution rule of network characteristics, namely, the evolution trajectory curve of liquid organization size, as shown in Figure 3.

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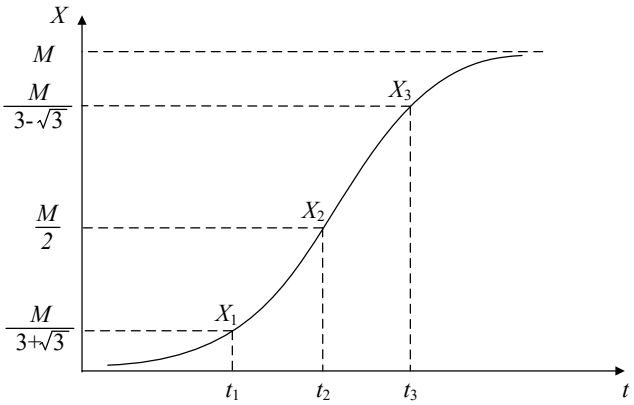

Figure 3. Evolution curve of liquid organization

4.5. Discussion of Evolutionary Model

However, not every liquid organization follows the process of formation, growth, stabilization, decay, and death. In the process of liquid organization development, due to the combined effects of external environment, talent demand and enterprise development, liquid organization can acquire new vitality and enter the next new organization life cycle, otherwise it will enter the decline period, as shown in the dotted line in Figure 4.

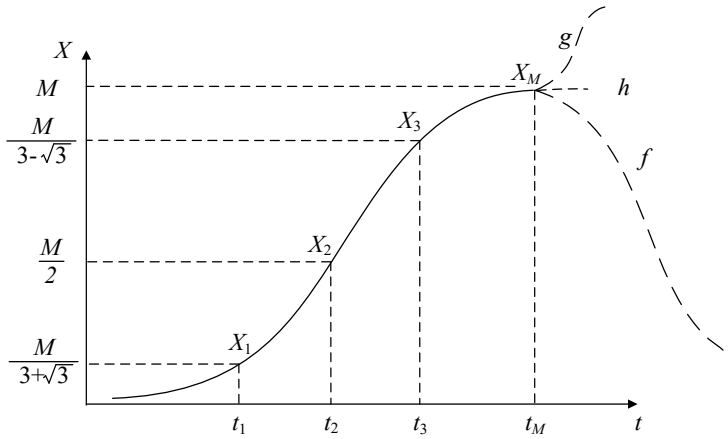

Figure 4. Scale evolution curve of liquid organization

At the end of the stable phase of liquid organization, that is, at time t_M the scale of liquid organization no longer grows. However, under the influence of factors such as technology, market, society, talents, and internal enterprises, the evolution of liquid organization may appear in three situations:

(1) The liquid organization structure is upgraded, the organization function is continuously improved, and the intelligent technology empowers to increase the carrying capacity of the liquid organization, which promotes the continuous growth of the scale of the liquid organization and evolves in a more advanced direction. The development path is a virtual curve g. (2) The scale of the liquid organization continues to stabilize, the internal elements of the liquid organization are locked, and the development path is a virtual curve h. (3) The rapid changes in the external environment of the liquid organization, the continuous increase in the level of talent demand, and the deterioration of the internal environment of the enterprise. The liquid organization is no longer suitable for the market environment, unable to meet the needs of talents, has accelerated the withdrawal of liquid organization members, number of members are greatly reduced, resulting in shrinking the size of liquid organization, lead to liquid organization degradation, development path for virtual curve f.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

Therefore, in the life cycle of liquid organization, the appearance of virtual curve f should be avoided as far as possible, and various factors in liquid organization should be adjusted to make it evolve and upgrade along the direction of virtual curve g or h.

5. Dynamic Evolution Process of Liquid Organization

By solving the evolution equation, it can be seen that the evolution rate of liquid organization has two inflection points, namely $\left(t_1, \frac{pM}{6}\right)$ and $\left(t_3, \frac{pM}{6}\right)$. The corresponding size of liquid organization is $X_1 = \frac{M}{(3+\sqrt{3})}$ and $X_3 = \frac{M}{(3-\sqrt{3})}$, respectively. When the evolution size of liquid organization is $X_{(t)} \to M$, the evolution rate $\frac{dX_{(t)}}{dt} \to 0$.

It can be concluded that the evolution of liquid organization is accompanied by the change of the time parameter x. According to the phase characteristics of the evolution and development of liquid organization, the evolution process of the system can be divided into five stages: formation period, growth period, maturity period, stable period, and decline period (evolution period), as shown in Table 2. The influencing factors of the organization's evolution will have different mechanisms of action at different stages, and help the organization's evolution.

Table 2. Dynamic evolution process characteristics of liquid organization

Evolution period	t	$X_{(t)}$	$\frac{dX_{(t)}}{dt}$	$\frac{d^2X_{(t)}}{dt^2}$	$\frac{d^3X_{(t)}}{dt^3}$	Evolution characteristics
Formation period	$(0, t_1)$	$+, \nearrow$	$+, \uparrow$	$+$	$+$	Growth slowly
	t_1	$\frac{M}{3+\sqrt{3}}$	$\frac{pM}{6}$ Turning point	$+$	0	
Growth period	(t_1, t_2)	$+, \uparrow$	$+, \uparrow$	$+$	$-$	Growth fast
	t_2	$\frac{M}{2}$	$\frac{pM}{4}$	0	$-$	
Maturity period	(t_2, t_3)	$+, \uparrow$	$+, \downarrow$	$-$	$-$	Growth Continuously
	t_3	$\frac{M}{3-\sqrt{3}}$	$\frac{pM}{6}$ Turning point	$-$	$-$	
Stable period	(t_3, t_M)	$+, \rightarrow$	$+, \downarrow$	$-$	$-$	Growth Stagnantly
	t_M	M	$\rightarrow 0$	$-$	$-$	
Decline period (Evolution period)	$(t_M, +\infty)$	$+, \uparrow$	$+, \uparrow$	——	——	Upgrade
		$+, \rightarrow$	0	——	——	Continuously stable
		$+, \downarrow$	$-$	——	——	Decline

5.1. The First Stage: Formation Period

$0 < t < t_1$. Calculations from equation (4) and equation (5) show that $\frac{d^2X_{(t)}}{dt^2} > 0$, $\frac{d^3X_{(t)}}{dt^3} > 0$, indicating that the scale growth rate and acceleration of the liquid organization are increasing at the same time, that is, the scale growth rate of the liquid organization increases exponentially. When the scale growth rate curve rises to the first inflection pointt_1, the growth acceleration of the liquid organization scale reaches Maximum value. From Figure. 2 and Figure. 3, it can be found that there are two poles at the end of the formation period t_1, namely $\left(t_1, \frac{pM}{6}\right)$ and

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

$\left(t_1, \frac{M}{(3+\sqrt{3})}\right)$, at this time $\frac{d^3\boldsymbol{X}_{(t)}}{dt^3} = 0$, they indicate that the evolution speed and scale of the liquid structure at the end of the formation stage have shown an upward trend.

At this stage, the net inflow of members is greater than zero, that is, the amount of member entry is slightly greater than the amount of member exit, and the size of the liquid organization slowly grows. Therefore, in the initial stage of the formation of liquid organization, the evolution characteristics of liquid organization are: a few members join the liquid organization, the members of the liquid organization begin to gather, the net inflow of members is greater than 0, and the number of liquid organization members grows slowly. As the degree of relationship between members of the organization gradually increases, the amount of member entry gradually increases, as shown in Figure 5. This stage, the liquid group, although there is a strong development prospects, but also is not stable, has not been full recognition of the market. It is easy to be hit from all sides, the role of the external environment will be more outstanding, technology updates, the influence of the policy, the change of the market will largely affect the liquid evolution process of the organization.

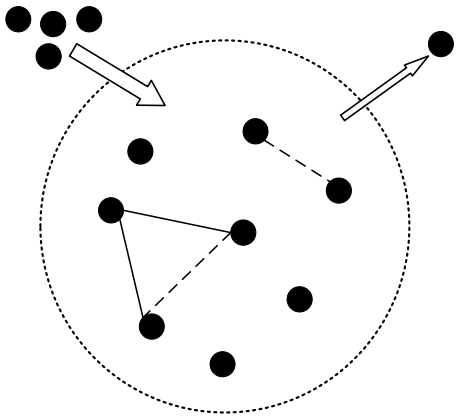

Figure 5. Liquid organization formation period

5.2. The Second Stage: Growth Period

$t_1 < t < t_2$. Calculations from equation (4) and equation (5) show that $\frac{d^2\boldsymbol{X}_{(t)}}{dt^2} > 0$, $\frac{d^3\boldsymbol{X}_{(t)}}{dt^3} < 0$, indicating that the liquid organization maintains a continuous increase, but the acceleration of the growth of the liquid organization has begun to gradually decrease, and the scale of the liquid organization is rapidly expanding. From Figure. 2 and Figure. 3, it can be found that at the end of the growth period, the evolution speed of liquid organization reaches the highest value, namely $\frac{dX}{dt} = \frac{pM}{4}$, and the scale of liquid organization reaches half of the maximum value, namely $X = \frac{M}{2}$, The inflection point X^* of the dynamic evolution of liquid organization appears.

At this stage, the net inflow of members is far greater than zero, that is, the amount of member entry is far greater than the amount of member exit, and the size of the liquid organization is growing rapidly. Therefore, during the growth period of liquid organization, the evolutionary characteristics of liquid organization are: as the ability of old members in liquid organization continues to increase. The amount of member entry rises rapidly, attracting more and more related members to join, and the net inflow of members is far greater than zero, the scale of the organization has been rapidly expanded, as shown in Figure 6. At this stage, driven by technology, policy, society, market, talents and other factors, new members are constantly joining the evolution process. The development of liquid organization is growing rapidly, the scale of liquid organization is growing, and the shape and function of liquid organization are gradually improving.

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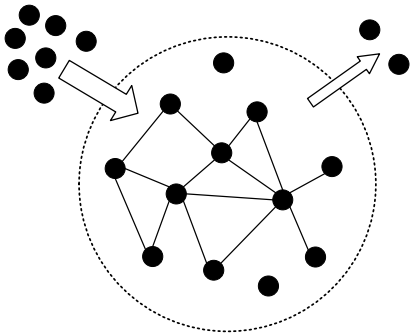

Figure 6. Liquid organization growth period

5.3. The Third Stage: Maturity Period

$t_2 < t < t_3$. Calculations from equation (4) and equation (5) show that $\frac{d^2X_{(t)}}{dt^2} < 0, \frac{d^3X_{(t)}}{dt^3} < 0$, indicating that the evolution speed and acceleration of the liquid organization scale have slowed down significantly, that is, the growth momentum of the liquid organization has been significantly weakened, but the liquid organization scale is still expanding. From Figures 2 and 3, it can be found that at the end of the maturity period, the growth rate curve of liquid organization reaches the inflection point t_3 of the descending segment, and the evolutionary growth rate has dropped to $\frac{dX_{(t)}}{dt_3} = \frac{pM}{6}$, The absolute value of the evolution acceleration has reached the maximum, and the liquid organization scale has reached $X_3 = \frac{M}{3-\sqrt{3}}$.

At this stage, the net inflow of members is far greater than zero, that is, the amount of member entry is far greater than the amount of member exit, and the size of the liquid organization continues to grow rapidly. Therefore, in the mature period of liquid organization, the evolutionary characteristics of liquid organization are: after the mature period of liquid organization, the scale of liquid organization has been further expanded in order to seek a more stable and sustainable state, and the market position is gradually consolidated and stabilized. The liquid organization management model and operating mechanism system are also becoming more and more perfect, and the connections between members within the organization are getting closer, as shown in Figure 7.

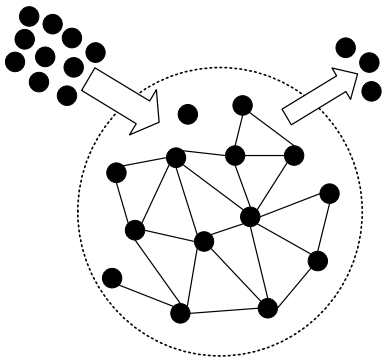

Figure 7. Liquid organization maturity period

5.4. The Fourth Stage: Stable Period

$t_3 < t < t_M$. Calculations from equation (4) and equation (5) show that $\frac{d^2X_{(t)}}{dt^2} < 0, \frac{d^3X_{(t)}}{dt^3} > 0$, indicating that the evolution speed of liquid organization is significantly slowed down. From Figure. 2 and Figure. 3, it can be found that at the end of the stable phase, the scale of liquid organization approaches the maximum M, and the evolution speed of liquid organization tends to 0, but the evolution acceleration is still increasing. That is, the growth rate of liquid

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

organization scale becomes slower and slower, and the number of liquid organization members is getting closer to the maximum capacity M in the organization. At this stage, the development speed of the liquid organization slowed down, and gradually approached the maximum value of the organization scale, the evolution became stable, the cooperative relationship between the members of the liquid organization was harmonious and stable, and the attraction between the members was relatively balanced. The liquid organization structure has been optimized, and the communication between member nodes and the organization environment has been strengthened, so that the liquid organization continues to maintain a dynamic and stable state.

At this stage, the net inflow of members is approximately equal to zero, that is, the amount of member entry and member exit is almost the same, and the size of the liquid organization remains unchanged. Therefore, in the stable period of liquid organization, the characteristics of the evolution state of liquid organization are: more and more frequent interactions between members, and weak links turning into strong links. The amount of member entry reaches the maximum, and the size of the organization's membership reaches the limit. Despite the entry and exit of members, the net inflow of members is approximately zero, and the overall size of the liquid organization tends to be in dynamic equilibrium, as shown in Figure 8.

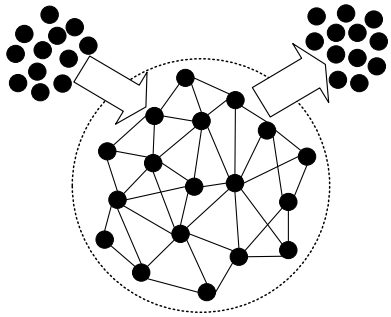

Figure 8. Liquid organization stable period

5.5. The Fifth Stage: Decline Period (Evolution Period)

$t_M < t < +\infty$. It can be found from Figure 4 that the evolution path of liquid organization has three trends: (1) The liquid organization structure is optimized, reorganization, evolution and upgrading, and the organization scale continues to expand. (2) The liquid organization maintains a sustained and stable stage, and the organization scale is in dynamic equilibrium. (3) The liquid organization has reached the stage of degradation, with members withdrawing on a large scale and the size of the liquid organization decreasing.

If the liquid organization is in the upgrade and optimization stage, refer to Figure 6 and Figure 7 for the dynamic evolution process. If the liquid organization is in a continuous and stable stage, refer to Figure 8 for the dynamic evolution process. If the liquid organization is in the decline stage, the net inflow of members is less than 0, that is, the amount of member entry is less than the amount of member exit, and the size of the liquid organization begins to decline. Therefore, during the decline period of the liquid organization, the characteristics of the evolution of the liquid organization are: the structure of the liquid organization is loose, most of the members have withdrawn from the liquid organization, the number of members is greatly reduced. And the net inflow of members is less than zero, resulting in the continuous shrinking of the liquid organization. Moreover, the communication frequency between the member nodes decreases, the member entry speed continues to decrease, the original liquid organization decays and disintegrates, and a new liquid organization appears, as shown in Figure 9. If the liquid organization is in the recession stage, introducing new technologies and improving management and organizational models based on actual conditions may cause the evolution of

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

the liquid organization to change from recession to evolution, and an inflection point will appear. The liquid organization will reorganize, upgrade, and enter a new evolution cycle.

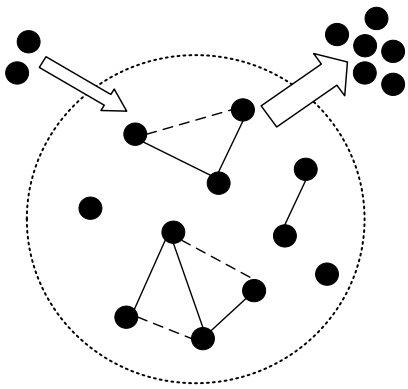

Figure 9. Liquid organization decline period (evolution period)

5.6. Summary of Dynamic Evolution Process

According to the above analysis, it can be known that the liquid organization is constantly affected by factors such as the external environment, talent requirements, and enterprise development during the evolution process, resulting in changes in each stage of the evolution process. At the same time, various influencing factors interact and influence each other, and jointly promote the sustainable development of liquid organization. Therefore, the evolution of the liquid organization can be shown through a dynamic evolution logic diagram, as shown in Figure 10. In the different stages of the liquid organization's life cycle, the scale of the liquid organization undergoes a dynamic process of change. In the initial period when the liquid organization was formed, the organization members began to gather and the organization size increased slowly. A period of rapid and sustained growth. After reaching a certain height, the liquid organization will be in a stationary state; Finally, with the passage of time, the evolution speed will gradually reduce, the organization members will also slowly reduce, such changes will be accompanied by the liquid organization evolution of the whole process.

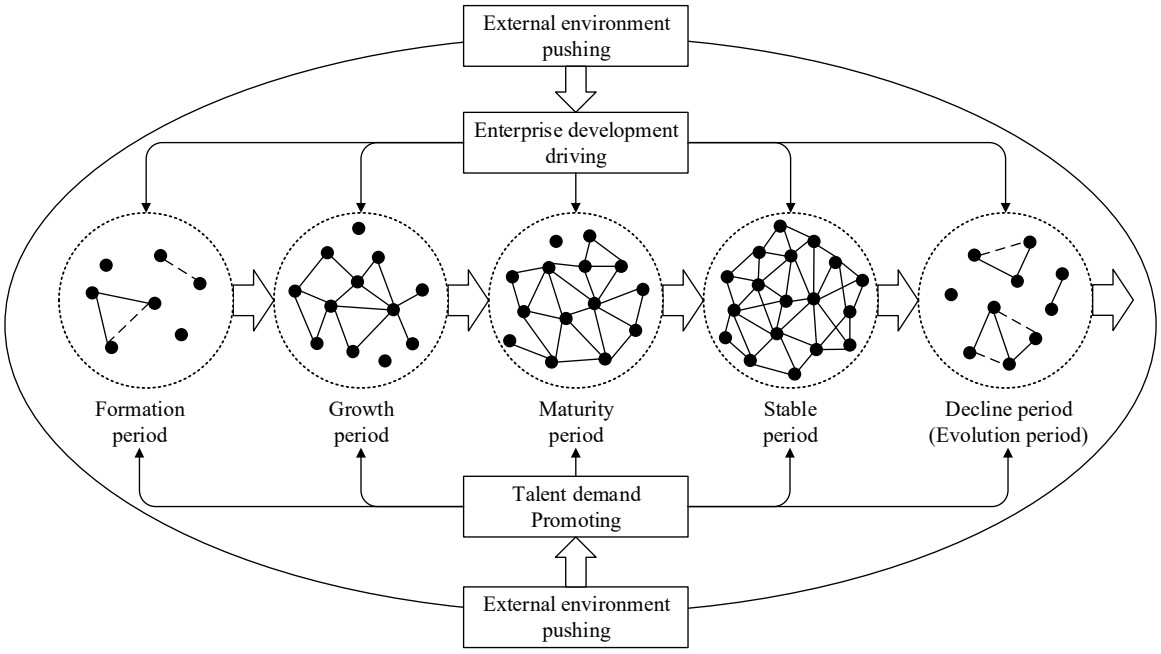

Figure 10. Logical diagram of dynamic evolution process of liquid organization

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202104_4(4).0057

6. Conclusion

This paper uses the life cycle curve of the Logistic equation to describe the dynamic evolution process of the liquid organization scale in detail. According to the continuous change of the evolution speed and acceleration of the curve, the dynamic evolution process of the liquid organization is divided into the formation period, the growth period, the maturity period, and the stable period. There are five stages, including the period and the decline period (evolution period), and the dynamic evolution characteristics of each stage are analyzed.

Acknowledgments

Fund Project: Humanities and Social Science Research Project of the Ministry of Education "Research on the Construction Mechanism of Leading National Innovation System in the Intelligent Era" (20YJA790012).

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