Research on the Hyper Cycle Character of University Systems and Strategic Innovation

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Abstract The theory of hyper cycle was proposed in 1970 by German scientist Egan (Manfred, Eigen), which is called as the significant development in management philosophy. This paper analyses systematically the three basic characteristics of university as metabolism, self-replication and systems mutation, and then presents the corresponding three cycles of the development of university as reaction cycle, catalytic cycle and hyper cycle based on the theory of hyper cycle. It also proposes strategic innovation ideas from three aspects in university development based on the hyper cycle theory.
Key words Hyper cycle; Universities; Strategic innovation

1 Introduction

The theory of hyper cycle was proposed in 1970 by German scientist Egan (Manfred, Eigen) [1], which is called as the significant development in management philosophy. The theory of hyper cycle originated in the chemical evolution theory of the origin of life, which reveals there exists the law of the hyper cycle in the development process of the complex systems. The hyper cycle is an advanced cycle, which belongs to the third-level cycle and consists of a number of catalytic cycles, while the catalytic cycle is a simple composition of the reaction cycle. The hyper cycle theory has been widely applied to the other areas since it was proposed [2]. It especially inspires and promotes the whole development of theory and practice in management. University system is a multi-element and multi-level artificial system composed with teaching, research, management and service processes, which is in common with artificial systems, such as purposiveness and controllability, which is an open system of nonlinear, far from equilibrium and self-organization. Based on the hyper cycle theory, university system also has markedly the hyper cycle character [3]. This paper will probe the strategic innovation in the development of university.

2 Hyper Cycle Theory

The hyper cycle originated the theory of chemical evolution on the origin of life, which contains more complete self-organization or general evolutionary mechanism. It is the view that living systems have three major characters with mainly metabolic, self-replication and mutation, which are closely linked with three different levels cycle including reaction cycle, catalytic cycle and the hyper cycle, as shown in (Figure 1).

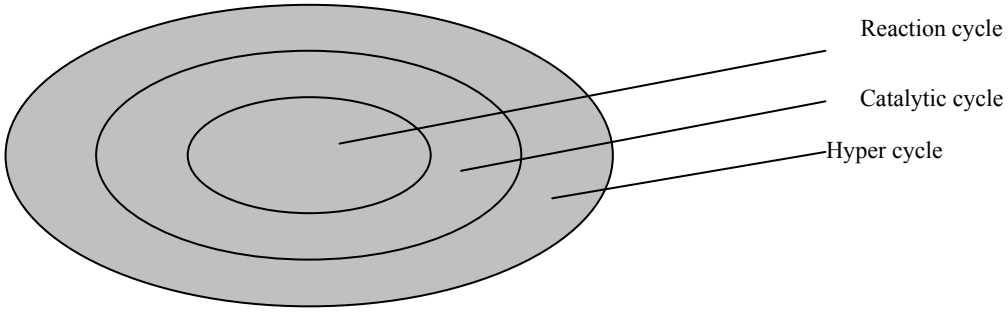

Figure 1 Classification of Circulation

The hyper cycle theory suggests that among the three cycles, the simplest cycle is the reaction cycle; the catalytic cycle is connected with the reaction cycle by a simple way. The coupling between the catalytic cycle and cycle leads to the formation of the hyper cycle.

2.1 The reaction cycle

The reaction cycle is that such a reaction sequence in which a product in any step is a reactant of the previous step. If S as a substrate, E as the enzyme, Es for the enzyme - substrate, Ep for the enzyme -

product complex and P as the product ,it can be showed in Figure 2,which is self-regeneration on the whole similar to the first character of living systems - the metabolism.

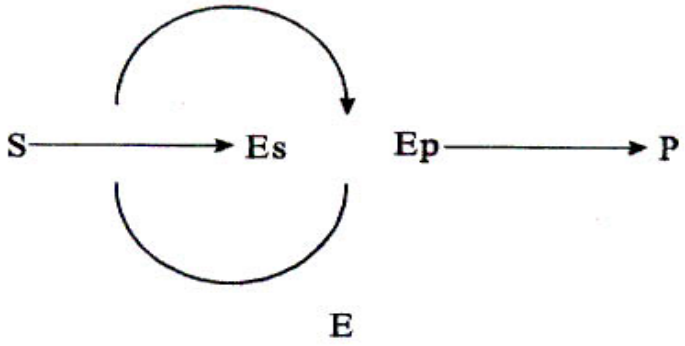

Figure 2 The Reaction Cycle

2.2 The catalytic cycle

The catalytic cycle is a secondary circular network formed by the connection of a number of the reaction cycle. The formation of catalytic cycle has two conditions: First, the product in the reaction cycle is not arbitrary, but a catalyst for catalysis, such as enzymes; second, more than a product cause to form catalysis from the reaction cycles to other reaction cycles. As shown in Figure 3

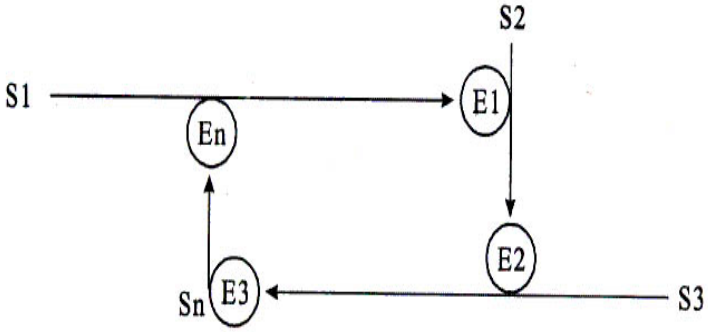

Figure 3 The Catalytic Cycle

In Figure 3, S as substrate, E as catalysis. Each intermediate -Ei is derived from high-energy substrate, which not only can command self-replication, but also generate catalysis for Ei +1. Catalytic cycle is equivalent to the second character of living systems - self-replication.

2.3 The hyper cycle

The hyper cycle is the third level of the chemical reaction cycle that is constituted of coupling together with the catalytic cycle in function, which is the cycle, formed by the loop. If I is on behalf of the catalytic cycle, as shown in Figure 4.

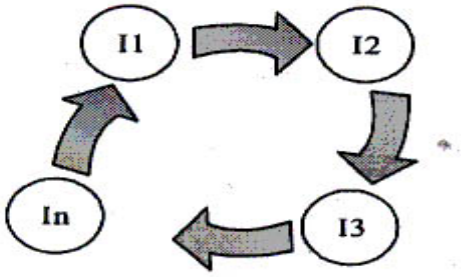

Figure 4 The Hyper Cycle

Each element in the hyper cycle not only can reproduce itself, but also can provide catalysis to the next element. The hyper cycle system can do not only self-regeneration, self-replication, but also self-selection, self-optimization, which make to evolve the higher ordered state presenting a third character of living systems - mutation. So that the system evolves to the diversity and complexity

3 The Catalytic Cycle and Hyper Cycle in University System

3.1 The catalytic cycle in university system

Each subsystem in university system interconnects to form catalytic cycle in the timeline; each subsystem (the reaction cycle) at a certain stage provides experience, lessons and catalytic support for the next stage of work. For example, the catalytic loop in research subsystem is internal succession and internal innovation .Each scientific research work S forms based on accumulated scientific research experience and scientific achievements, but the research will support catalytic E for the next stage ; Students subsystems also form the catalytic cycle, in which student problems S have been solved in practical work through constantly summed up experiences so as to improve the overall quality of the students, and the results not only enrich our experience , but also may create much more deeper new issues E in the new dimension, there is constant circulation like this. As shown in Figure 5

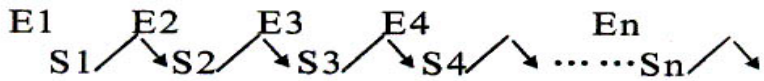

Figure 5 The Catalytic Cycle in University System

3.2 The hyper cycle in university system

The hyper cycle in university system is formed through coupling together various subsystems (catalytic cycle) in function to provide catalytic support for each other. In Figure 6, R is on behalf of research subsystem, L-logistics subsystem, T- teaching subsystem, S -the students subsystem, A - the enrollment and employment subsystem。

On the basis of the selection and evaluation principle in the hyper cycle theory，each subsystem coming into being the hyper cycle selects and evolves to stimulate the development of university through both competition and collaboration .The research subsystem R and the enrollment and employment subsystem A as an example, they are coupled together interdependently and mutually constraining. On the one hand, competition exists between R and A which is manifested mainly in college of human, material resources, financial resources and other resources, on the other hand, they are each other's "catalyst". Scientific research capacity and core competitiveness of university are proved to improve while R enhances which leads to increase A, A can appeal to high quality students, but also can broaden employment channels and enhance the employment level to deliver more students to the competitive workplace. So A provides intellectual support and partnership opportunities for R. A enrolls excellent undergraduate, graduate and PhD Candidates to involve gradually or directly scientific research for enhancing the R system in scientific research; those who assigned to the strong company graduates are more likely to carry out scientific research with R, and further enhance the R systems. From the above analysis, through coupling between R and A, they can be a catalyst to support each other resulting to speeding up each other's development in a higher level. Such a coupled modes in catalytic cycle subsystem forms the competitive and cooperative hyper cycle, as shown in Figure 6, so as to promote to a higher level develop of university system continuously and promote the university to move forward.

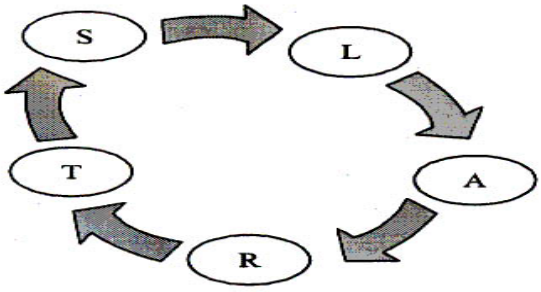

Figure 6 The Hyper Cycle in University System

4 Strategic Innovative Ideas in University Based on the Hyper Cycle Theory

4.1 Promotion of the open

Open is the premise of the existence and development of universities; university systems like other systems will inevitably lead to the increase of entropy to disorder in a closed state [4]. Only open university can exchange with the outside world for material, information and energy; such as introducing high-level expertise, scientific educational ideology and scientific management method and the valuable information; Only open university can absorb the negative entropy flow outside to offset the internal entropy so that university system is non-equilibrium or far from equilibrium, which is the external conditions to cause the orderly development of university system; Only open university can output positive entropy to the outside world, for example, dismissing incompetent teachers, expelling unqualified students, discarding outdated management methods. University reform in China proved that only completely full all-round open the universities can contact better and exchange more information for the outside world in order to survive better.

Open including both internally and externally open: the former requires to recycling use full of the resources within the university system, step up communication and coordination among in various functional departments, faculties ,departments, between teaching and research, between disciplines, between cadres and the masses, among teachers, between teachers and students to rationalize the relationship, reduce friction and increase internal energy. The latter requires exploiting domestic and foreign education markets, to use of two educational resources promoting exchange with the outside world for human resources, financial resources, material resources and information in order to absorb the outstanding achievements in the environment, strengthen the interschool cooperation and complement each other's advantages and share resource. With the development of economic globalization and educational internationalization, the university should step up the pace to go out, increase and expand the degree of open to occupant a place in international educational activities to widen more development space.

4.2 Intensity of the training of people oriented

Human resources are the first resources and the basic element of university system. The fundamental task of universities is promoting the development of people, which is the fundamental driving force of university development. Either the reaction cycle, the catalytic cycle or the hyper cycle has to rely on human to promote, a triple loop will lose a fundamental driving force if no human. Therefore, the people oriented strategy is the fundamental strategy for university development, which requires through people-oriented promoting the comprehensive development. First of all, it emphasizes the student-centered to promote the overall development, not only in the teaching process, but also in the choice of education including study time, method and content. Maximize subjective consciousness of the students to develop students character, independence, initiative and creativity and do a series of reforms from educational ideology, teaching content and methods to management system; Second, it stresses the teacher-centered, not only care about teachers, train teachers, respect teachers to make the teachers play a leading role, but also create good conditions for teachers to grow and develop. For achieving the development goals of universities, we must rely on the majority of teachers to have full use of one's faculties.

4.3 Cooperation with competition

Based on the selection and evaluation principle in the hyper cycle theory, moderate and reasonable competition mechanism allows the system self-evaluation, self-selection, to select the superior and eliminate the inferior and fully mobilize the enthusiasm of various elements. For the university system, the reasonable and adequate competition can make the best use of everything and use one's ability to the full to create a dynamic mechanism.

Therefore, in employing system, university should be possible to create an open, fair and impartial mechanism for selecting the best members through a competitive process. Besides, it should achieve the open in following four aspects: positions, employment standards, employment system and competition results to make the competent people stand out from the crowd. During the material purchasing of bid inviting and bid, competition mechanism should be introduced .It decides the winner through public performance, quality, purpose ,request , time schedule, qualifications, standards, based on the principle of combining with expert assessment and leadership decisions ,democracy and centralism.

It should be noted that internal competition should be based on cooperation and be appropriate. Because of excessive competition will cause the gap and information monopoly. In fact, any

achievement of research and teaching in university requires team effort & cooperation between different departments and different majors. Forming a lot of creative teams in this process is a significant signs to enhance core competitiveness of universities. Therefore, it is necessary to establish appropriate internal competition mechanism and teamwork to generate synergies of knowledge and maintain the vitality of university.

5 Conclusions

The hyper cycle theory has been widely used in many other fields since it was proposed. University as a multi-level complex artificial system not only has the distinctive character of living systems, but significant character of the triple loop: the reaction cycle, the catalytic cycle and the hyper cycle. Therefore, the university's development must follow the law of hyper cycle to carry out innovative strategy for promoting open, overcome the entropy, strengthen people-oriented, increase circulation, cooperative competition and get win-win.

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