Application of Soft System Methodology on Supply Chain Management

SHI Yuhui
School of Management, Hunan Institute of Engineering, P.R.China, 411104
hnxtsyh@sina.com

Abstract: The article firstly utilizes complex system theory to analyze supply chain, and from the two aspects of the complexity of complex system’s network configuration of supply chain and the complexity of node entity of constructing the complex system of supply chain probes into the source of complexity of modern supply chain system. Furthermore, it points out the nature self-organization of supply chain system, the relationship of multiple complex natures such as competition, cooperation and dynamic that are shown among entities, nonlinearity of every link, sudden quality emergency of supply chain, dynamic equilibrium between supply chain control and adaptation, and so on. On this basis it puts forward the specific steps of implementing soft system methodology to flexibly optimize enterprise’s supply chain.

Keywords: Supply chain, Complex system, Soft system methodology, Flexible optimization

1 Introduction

Because supply chain more and more tends to complexity and its environment is difficult to be forecasted, This requires enterprises to rescan its own supply chain model from the aspect of complex system theory and to flexibly optimize supply chain by soft system methodology.

2 Sources Analysis of the Complexity of Modern Supply Chain System

Modern supply chain system often refers to the system with extensive and profound complexity. The complex system of supply chain means the system consisted of comparatively large scale and quantity of supply chain node entities that can react according to local information and has the feature of intelligence and self-adaptability. Every complex phenomenon that supply chain complex system shows is made up of many components. There are a lot of relevancy and interaction among the components and cooperative effect comes into being among them. Therefore it has the features of sudden quality emergency, dynamic, nonlinearity, uncertainty, hard to forecast, and so on[1]. The complexity of supply chain roots in two aspects:
Firstly, the complexity of the network configuration of supply chain complex system. Supply chain complex system usually shows complex network structure. To specific enterprise, enterprise group or alliance, the differences of factors such as the nature of its core enterprise, product or service, the extent of business management and control and the process of production and operation make the specific supply chain complex system show different configurations, mainly including chainlike, treelike, two-way treelike and star like. In every supply chain the type of entity is diverse and the corresponding relationship of entity is also complex and diverse.

Secondly, the complexity of the node entities constructing supply chain complex system. The first is the dispersity of node entities. The node entities constructing a certain supply chain complex system usually geographically disperse. The dispersing coverage may be several areas, several cities, several countries or the world. The geographic dispersity of node entities has increased a additional complexity and difficulty. Next is the difference of nature of node entity. The node entities in supply chain complex system can be divided into dependent node entities, half-independent entities and independent entities according to their authority limits of management and decision-making. Dependent node entities and half-independent entities generally exist in the inside logistic of enterprise. Its complexity is related to the factors such as enterprise culture, functional division of entities and the relative rights and obligations, appraise criterion, and so on. Independent entities generally exist in outside logistic of enterprise. The complexity of its supply chain is related to the entities’ differences in organizational structure, enterprise culture, and information system infrastructure and resource status. The last is the large quantity of node entities that make the complexity of supply chain nonlinearly increase by magnifying multiples along with the increasing quantity of nodes[2].

3 Features of Supply Chain Complex System

Based on the source of supply chain complexity, modern supply chain shows distinct features of complex system.

1) Self-organization of supply chain system. In supply chain every enterprise makes decisions independently and needn’t take any command or orders from other enterprises. When choosing upper suppliers and lower distributors they form the supply chain network. In the supply chain member enterprises may enter and exit at any time. Every enterprise on the supply chain is equal. All have self-determination. The enterprises on this supply chain are also the participants of other supply chains. Just because of such reason the supply chain network is built up inside the industry or among industries, moreover, this network shows the characters of dynamic and complexity in structure[3].

2) The main body in supply chain is independent or self-independent economic entities. Among these entities there shows a complex relationship of competition, cooperation and dynamic. Business units,
business processes, member enterprises and the whole supply chain complex system make up of the entities on different levels. Every entity has its own goals, operational strategies, inside structure and survival driver. These entities interact through assembling in order to continuously adapt to the environment. To the overall supply chain there is not a focus control center to direct every entity’s action, but the whole supply chain still shows a orderly status. This initiative and their environmental, repeat and mutual action is just the basic driver to make the whole supply chain complex system to develop and evolve.

3) In supply chain almost every loop is nonlinear. Modern enterprises survive under the circumstances of intensive market competition and big uncertainty. A very small decision made by an enterprise under complex circumstances can largely affect the relative enterprises. For instance, under the circumstances that information couldn’t be fully communicated and shared “Butterfly Effect” and “Bullwhip Effect” would happen. This nonlinear influential effect makes enterprise survive under a uncertain circumstances.

4) Sudden quality emergency of supply chain. Sudden quality emergency of supply chain complex system refers to the quality that the system has but its components or part assembles don’t have. Supply chain is the result of the evolvement of supply chain that enterprises adapt to the environmental changes. Supply chain model is a kind of sudden quality emergency during the course of the development of enterprises’ competition and cooperation. Its made-up parts don’t have the overall quality of supply chain. It shows the quality that the whole is bigger than the aggregation of components. The development of supply chain makes it form many levels. Among which any lower level is the chaos background of the upper level; on the other hand, any upper lever is the sudden quality emergency of the lower level.

5) In supply chain complex system control and system adaptation keep a dynamic equilibrium. Control is to ensure the stability and order of supply chain. Once it is found that one member enterprise does not behave normally, control and restricting mechanism will stop it and make the whole system return to the equilibrium status. Meanwhile, it is a fully complex environment that supply chain faces; the random of member enterprises plays a very important role during the course of searching all the optimal possibilities for the system. Some important overall qualities of complex system are produced during the course of chaos and random. This also needs to grant the members of the system more freedom. Only such a supply chain with flexibility, adaptation, response ability and fast innovation ability can become the most vital supply chain with optimal operational structure under the prevailing complex circumstances.

4 Application of Soft System Methodology in Optimizing the Flexibility of Supply Chain Complex System
Because modern supply chain is a complex system, during the course of planning and optimizing supply chain the past methods of system analysis and system planning which are traditional, rigid and structurized are hard to adapt to the changes of the environment and the supply chain itself, particularly the limitation of bad flexibility becomes more prominent. Applying soft system methodology to the process of planning and flexibility optimization to complex supply chain model will effectively improve the adaptation flexibility of supply chain.

Soft System Methodology was established by the British scholar Check Land in the 1980s to solve some uncertain and non-structurized problems that generally exist in organization. Applying it to the concrete implementation process of flexibility optimization of modern complex supply chain, according to the logic way there are seven stages, as follows:

1) Identify and determine the scene of non-structurized problems. On the basis of clear goals of supply chain construction and optimization problem scene is fully determined, that is, separate the actual problems from the symptoms, and determine the interior components and its environment. In this stage the relative expert firstly investigates deeply, perceives what the problem could be and what problems there are. And through an “abundant chart” the problem scene is shown vividly. The so-called “abundant chart” is a very useful instrument that can lead the related persons to the discussion of the problem scene. And through coordination analysis, social analysis and competence analysis the stakeholders can find out the reasons of the problem from their own different angles.

2) Description of problem scene. The general structure and concept that can use “abundant chart” to describe problems is a all-directional description from different perspectives and different angles. In the two stages problem scenes should be established as much as possible. To perceive a problem in problem scene status graph should be tried to use to show the configuration, process and their interrelationship of problem status.

3) Root defining of constructing the relative system. Root defining is based on problem identification and description to construct the imagination system of studying problems. The so-called root defining of relative system refers to the process in which according to the formed assumption that different people use different methods to observe the problem scene, a certain opinion on the system is regarded as input, then through the system’s transfer it is translated into the opinion of system personnel as output. What root defining constructs is not a “should exist” system; instead it is a system convenient for observation in compliance with problem environment. Root defining stipulates the coverage and direction of modeling. The elements of root defining include: C (Customer ), beneficiary of system; A (Actors ), actor of system (T, actor of transfer); T (Transformation Process ), transfer of system input and output; W ( worldview ), implies the practical content of root defining; O (Owner), owner of system; E (Environmental Constrains ), Environmental Constrains of system. Through describing the operational
relationship between the elements of root defining the corresponding concept model is established.

4) Modeling of concept model. It is the establishment of concept model according to root defining. Because root defining describes system as a process of transferring input into output, the concept model is the configuration model that assembles the necessary activities in the process of system transfer. Every activity in the concept model need to clearly point out its specific goal, content and process. From root defining to concept model it mainly depends on logic thinking, just like the concept plan in artificial intelligence (AI). The verbs denoting the activities are sorted in turn according to the logic way and correspondingly the correlated components are gradually established.

5) The concept model is compared with the problem scene to quest expected and feasible changes. The purpose of constructing concept model is to ensure that the system obtained through observation can adapt to the existing problems in the real world. After accomplishing the construction of concept model, return the real world immediately, compare the concept model in the last stage with the problem scene. In form it is the comparison of concept model and problem status, but in essence it is the comparison of “what to do” of concept model and “how to do” of real problem. One “what to do” can correspond several “how to do”. This needs to fully observe the goal of problem and the possibility of change, and find out the difference between concept model and problem status and the reasons.

6) Determine feasible and expected reform scheme. Through detailedly analyzing the advices made in last stage and by the together discussion of experts, consensus can be achieved and then the expected and feasible reform scheme is determined. In discussion due to people’s different world views and values disputes about the problem may not be fully eliminated, but it is acceptable as long as consensus can be achieved to take concerted actions for common goal.

7) Implement the feasible reform scheme. Once the feasible reform scheme is determined, the concrete actions and measures should be established and implemented

By the seven stages the problem can be evolved into a new status, problem settlement can stride up to a new step, and then a new cycle begins from the first step until to reach a satisfactory state.

5 Constructing the system of flexibility optimization of enterprise supply chain based on Soft System Methodology

When optimizing the flexibility of enterprise supply chain complex system by Soft System Methodology the core activity is to construct the flexibility optimization system of supply chain and the information of customer’s need changes can be transferred and shared in the whole supply chain. The main activities involved in enterprise supply chain include six: research and development, resources allocation, manufacture, logistic, information and decision making. Combined with enterprise actual situation the method of utilizing Soft System Methodology can correspondingly divide the flexibility
system of enterprise supply chain into the above six sub-system flexibilities and aimed at the coverage and functional structure that the subsystems of supply chain cover implement sub-system flexibility optimization target. On the basis of analyzing the elements that are closely correlated to every activities of subsystems, the index assemble that subsystems can change the state when responding the changes of outside environment and the index assemble of the abilities that realize the state changes are built up to implement and appreciate the level of its flexibility optimization.

6 Conclusion

Soft System Methodology is not only an ideology, but also a methodology. Its core is the question of complex system that faces dynamic changes. Understanding the blur nature of complex system, using soft ideology to think and solve the problems of complex system, constructing the supply chain that can be able to solve ever-changing and complex real problems provides a new thinking way and a new approach.

References

