

Supply Chain Control: a Framework based on Inter-organizational Control

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Abstract: The purpose of this paper is to provide a theoretic framework for supply chain control. It begins with the review of three perspectives, organization theory, economics and cybernetics. Then combined with the relevant research, this paper proposes four main research fields of control strategy, factors that influence the supply chain control, the impact supply chain control has to performance and the source and use of control power.

Keywords: Supply chain control, sustainable advantage, social control

I. Introduction

As the development of supply chain, people pay more attention on power and position problems in supply chain. More specifically, scholars and businessmen care about how to make the cooperation more effectively and prevent the opportunism risk. As the supply chain members become more depended on each other, the powerful company can take advantage of its own place to control other members for effective management of supply chain, and the use of these control measures will determine the sustainable competition advantage of the whole chain.

Recently, researchers begins to realize the importance of control plays in the supply chain[1][2][3]. However, the research of supply chain control mainly origins from the inter-organizational control, and has little connection with the characteristic of supply chain, which makes this area more difficult and interesting.

This paper reviews the three perspectives of inter-organization control theory. On this basis, considering the characteristics of supply chain, this paper attempts to provide an integrated theoretical framework of supply chain control for further research.

II. Inter-organizational control theory

Eisenhardt[4] believes there are two approaches of inter-organizational control, which is organization theory and economics, notably agency theory. Nevertheless, socio-cybernetics also becomes an important theory in this field.

Perspective of Organization Theory

Most scholars suggests that control is a process by which organization can influence other members act as they need[5]. In this way, the perspective of organization theory is about how this power can be established and used. For

instance, Ouchi[6] describes three fundamentally different control mechanisms, markets, bureaucracies and clans, and he also suggests, given different social and informational prerequisites, the organization will use different control mechanism to influence other members.

Scholars agree that performance evaluation is the key when deciding the control mechanism in organization theory literature[4] [6][7]. Performance evaluation can be measured by process supervision or outcome evaluation, which are behaviour based control and outcome based control as Thompson and Ouchi mentioned. Furthermore, they argues that the task characteristics such as task programmability and outcome measurability have big impact on the choice of control strategies(Fig. 1).

Figure I Organizational Theory

		Task Programmability	
		Perfect	Imperfect
Outcome Measurability	High	Behaviour control or outcome control	Outcome control
	Low	Behaviour control	Social control

As we can see from Fig I, there are three control strategies, behaviour control, outcome control and social control. Based on different task characteristic, organization can use specific control strategy, and the later researches adapt this.[8] Generally speaking, the perspective of organization is about the performance evaluation, as the task characteristics can decide how to make a performance evaluation, it can decide the final control strategy.

Perspective of Agency Theory

Agency theory is proposed by Wilson[9] based on the principles of information economics. The main point of this theory is that the existence of monitoring costs causes information asymmetry between principal and agent, which will lead to moral hazard. In order to avoid opportunistic behavior and moral hazard, organizations need to design some incentives to balance the risk-sharing and benefits. Inter-organizational cooperation such as joint venture,

alliance and supply chain can be considered as a kind of a proxy in essence, therefore, agency theory has been widely used in the study of inter-organizational relationships. Eisenhardt[4] uses this theory in the control theory, he argues that when information is complete and behaviour is easy to observe, contracts based on behaviour is the best because the agent's behaviours are the purchased commodity and both of participants know the agent's behaviour very well. However, the different preferences between principal and agent are always there, making performance uncertainty and supervisory cost and information asymmetry unavoidable. At this time, the organization can either pay extra cost for complete information or make outcome-based contract. The latter is not complete control, for bad behaviour may also lead to good result, and the transfer of risk may come out in this situation. So the key to make decision is balancing the cost of different control modes, for instance, the main cost of behaviour control comes from behaviour measurement, and the main cost of performance control comes from risk sharing and performance evaluation.

Perspective of Cybernetics

Since the 1970s, the basic ideas and principles of cybernetics are introduced into sociology and management area, and play an important role in the development of management theory. This perspective cares rules and processes, Leifer and Mills [10] defines control as 'a regulatory process by which the elements of a system are made more predictable through the establishment of standards in the pursuit of some desired objective or state', Green and Welsh [11], also mentioned that a similar view.

The cybernetics perspective provides sufficient mathematical tools to analyze supply chain problems, especially the dynamic problems such as bullwhip phenomenon, so it's widely used in optimizing one function problems of inter-organization relationship, such as inventory control, quality control, service controls [12]. Christopher [3] reviews research efforts regarding the application of cybernetics theory to the supply chain management problem. They found the common tools used in the supply chain control areas are like classic control theory, dynamic programming and optimal control. Model predictive control, robust control, approximate dynamic programming. With no doubt, cybernetics makes great achievement in the supply chain control areas.

Cybernetics is a common theory used in the supply chain control areas, but it is different from the perspective of organization and agency theory. It focuses on the optimize of one function through abstraction and modeling.

Comparison of the three perspectives

These perspectives do have something in common. All of them are rational and try to find which factors will influence the choice of control strategy, so that they can improve the

supply chain efficiency. And information plays an important role, which is the basic of control mode.

However, there are differences summarized in Table 1.

Table I Comparison of Three theories

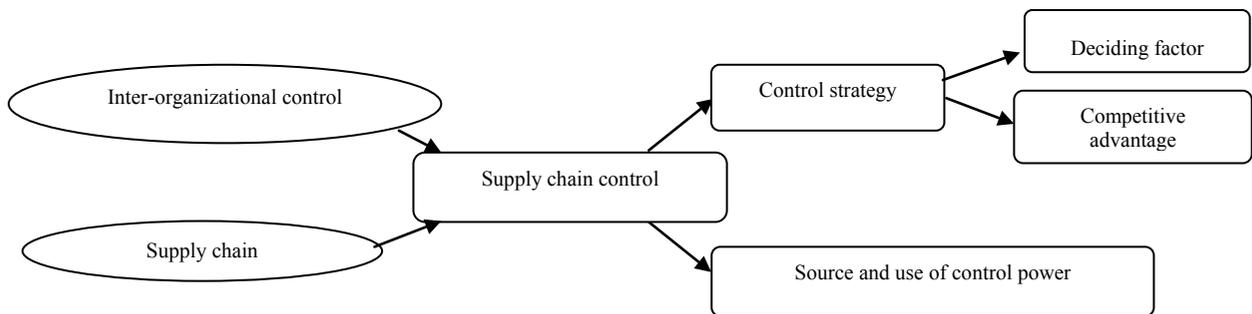
		Organization	Agency theory	Cybernetics
Differences	Determinants	Ability to measure	Cost	independent variables
	Social control	May reduce divergent preferences	Basic contradiction, only to a certain extent	Not involved
	Result measure	No specific index	No specific index	Dependent variables
Similarities		Rational Concerned with determinants of control strategy Efficiency oriented Information is a basic factor		

Firstly is about which factor is more significant when deciding the control strategy, in the organization literature, the ability to evaluate the performance is important, and agency theory thinks it is the cost measurement, while in the cybernetics theory, the choice and change of independent variable is most important; Secondly, the agency theory believes social control can help improve efficiency by reduce divergent preferences, and basically, organization theory agree to this although there is still some divergence[4], meanwhile, cybernetics theory tells little about social control; finally, the cybernetics usually can get a optimal result, which doesn't exist in the other two theories. In all, the review of inter-organization control can provide us with a basic analysis method: the organization theory emphasizes on the supply chain structure and task characteristics; agency theory do some research on the relational characteristics and social control, and cybernetics help to optimal the function of supply chain and improve the chain competitive advantage. Since supply chain is one type of inter-organization relationship, it is in essence different from other relationships because there is no property relation or legal authority between most of the organizations, which makes the research of supply chain control an interesting topic.

III. Research framework of Supply Chain Control

This section is a summary of research in the field of supply chain control according to the literatures above, Figure II is the framework of supply chain control.

Figure II Framework of supply chain control research



Supply chain control strategy

A common research approach is to divide supply chain control into formal control and informal control. The formal control uses formal rules, procedures and policies to acquire performance with external metrics [2] [13], Ouchi [6] says based on different evaluation performance, there are two types of formal control as behaviour control and outcome control. In supply chain, supply chain contracts, information sharing and communication, profit distribution mechanism, inventory management policy and so on can be regarded as concrete methods of formal control, but when using this strategy, it will be different depends on the structure and features of specific supply chain, which will be discussed in next part.

Informal control cares consensus about internal values such as norms, culture, and attitude. The new economic sociology helps us to understand the use of informal control strategy, and Ouchi also argues that informal control can enhance the competitive advantage by reducing the members' goal inconsistency and preference dispersion.

Deciding factors of control strategy choice

From the perspective of organization theory, Das and Teng [2] introduces inter-organization control theory of Ouchi into supply chain research, and argues that the task programmability and outcome measurability is deciding factors; however, from the point of agent theory, after analyzing the cost and risk source of supply chain formal control strategy, Eisenhardt [4] bring up a new approach to control strategy choice. Further research finds trust level, risk taking, goal consistency and members will also influence the control strategy [14] [15]. The control strategy may be different in different structure supply chain. Dekker [16] describes the formal and informal control mechanics in the railway safety systems supplier network, and believes factors as interdependence, task uncertainty, asset specificity, environment uncertainty and frequency may influence control strategy; however, Sengun [17] makes a research into the Turkey pharmaceutical supply chain, and finds no outcome control behaviours in this industry, and

social control and behaviour control is not the same as Dekker's research.

The impact control strategy has on competitive advantage

The aim of supply chain control is to improve the competitive advantage of whole supply chain, so a proper supply chain control strategy is crucial. So far, this research is based upon supply chain performance and risk management.

Yan and Gray [14] study the relationship between performance control and performance, find mutual trust and common goals are moderators in this relationship. However, this research is based on a comparative case study, it needs further testing when used other places.

Many researches are about risk management, probably because the early control research is to prevent opportunist behaviour. Provan and Skinner [18] find that supplier control is related to the deal's opportunist behaviour, and Parkhe [19] also verifies the relationship between control and risk. Das and Teng argues that behaviour control can reduce the relational risk and outcome control can reduce the performance risk in theory, then Sengun [17] test this theory in the pharmaceutical supply chain and confirm that outcome control can help reduce performance risk taking, but they find no proof of behaviour control used in this supply chain. Scholars pay more and more attention on social control, Hatfield and Pearce [14] suggest that social control can reduce relational risk taking and performance risk taking, which is widely shared.

Proper use of control power

Pfeffer [20] provides the source of organization power, then Munson and Rosenblatt et al. Extends it into supply chain. At present, the popular research on supply chain borrows from the organization theory, regard the supply chain power as expert power, referent power, reward power, coercive power, legitimate power and so on [21] [22] [23]. Basically, supply chain control is a kind of exercise of a power, so the study on sources and types of power can provide a good

research approach for the exercise and effect of supply chain control.

Besides the source, how to use control power correctly is becoming a hot spot in the field of theory and practice. Almost every scholar on the supply chain control mentioned the adverse effects of abusing the control power, including higher risk, loss of competitive advantage, Munson et al[1] provide the possible retaliatory measures such as boycotting, competing directly, increasing the dependence of channel leaders, forming coalitions with other firms in the same position, seeking legal solutions, which do serious harm to the supply chain.

IV Summary

Obviously, the supply chain control research, has great value no matter in theory or in practice.

In theory, control is always a hot spot of organization and social areas, likewise, in supply chain, study on control problems can help coordinate competition and cooperation problems, make a more effective management. However, on the whole, this kind of research is scattered and in confusion. This paper provides a research framework based on three inter-organizational control perspective, describes the current situation of four factors. This overview will help future further research in this areas.

In practice, as we all know supply chain will be the focus of competition, so enterprises need to improve competition advantage through effective supply chain control. For the core enterprise in a supply chain, this study will help them analyzes the features of their supply network, formulates a proper control policy; for other enterprises, they can understand the control strategy better, then they can fight for the best benefit, and improve themselves as well as the whole chain.

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