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Quality Constraint Mechanism of Modular Outsourcing on the Mass Loss

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Abstract: The modular organization is the main organizational model in the future and modular outsourcing has become a new trend. It discusses two kinds of commitment means under the symmetry of information condition, the results cannot achieve the overall and local optimal; and it also analysis three kinds of commitment ways on mass loss under the asymmetric information condition, by determining the a reasonable internal and external commitment to quality loss coefficient, it can make the supervision level of module integrator and the prevention level of module supplier meet to the Nash equilibrium solution and the modular organization optimal solution. The results show that: the modular organization should be borne to establish the appropriate mechanisms to adequate information-shared, choose the long-term strategic partners and to build collaborative networks of modular outsourcing strategy in order to reduce the cost of supervision and constraint and enhance the quality of authority.

Key words: Modular outsourcing, mass loss, quality constraint, principal-agent

INTRODUCTION

Modular is semi-self-discipline subsystem which constitutes a more complex system through the same contact with other subsystems according to certain rules. Outsourcing is the major model of modular organization's operation, that module integrators bind contacts with module suppliers to form modular organizations (Ernst and Kamrad, 2000). In modular organizations, division of labor and cooperation between the two determine the quality of modular products. In case of quality defects that inevitably produce mass loss for internal and external. So-called internal mass loss means that module integrators find quality defects and produce mass loss before final products delivered to customers, external mass loss means that customers find the quality defects and produce mass loss after final products delivered to customers. Module integrators and module suppliers try their best to complete tasks and constraint of contract structural is important. This thesis tries to find appropriate form and ratio of mass loss and design quality constraint mechanism for different conditions of information.

RELATED STUDIES

Quality and risk in modular outsourcing: Modular outsourcing demands module suppliers to provide more modular design and research task which involve many different actors. Hence, outsourcing quality relates to both of demands' and supplies' decision-making behavior of quality policy and other subjective factors. The uncertainty of modular organization increases the risk of product quality assurance (Baldwin and Clark, 1997). Kaya and Ozer (2009) proposed the concept of quality risk in outsourcing, discussion of the relationship between private quality cost and invalidated product quality. Quality risk in outsourcing also increases the need for quality control of the process. Aron *et al*. (2008) created a dynamic game model of suppliers and buyers, took process monitoring for minimum quality standards of outsourced services and verified the validity of the model by a number of countries' empirical investigation. Test of the outsourcing quality is basis work, Choi *et al*. (2009) presented a feasibility evaluation method of outsourcing quality testing Balakrishnan *et al*. (2008) studied the quality, information and customer contractual issues of front-end business process outsourcing.

Quality contract under the agency: Actually, complex principal-agent relationship exists in modular organizations of outsourcing, information asymmetry occurs which leads to adverse selection and moral hazard (Corbet and Groote, 2000).Therefore, motivation is the key factor in the quality assurance of modular outsourcing. Starbird (2001) more in-depth considered quality control problems of supply chain contract, proposed penalties, incentives and supervision of incentive problems and

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researched adverse selection problems of principal-agent model. Baiman *et al.* (2001) systematically studied problems of quality, information and contracting, particularly in light of impact of signing information on suppliers and buyers. Zhu *et al.* (2007) discussed how supply chain parties improve the quality. In outsourcing, whether buyer or supplier undertakes quality-related costs which can improve the level of efforts to make quality better for both. Form the perspective of manufacturers' and suppliers' recovery cost of sharing products, Chao *et al.* (2009) designed to promote quality improvement of work contract, in order to reduce the impact of information asymmetry, the results show that this contract helps manufacturers reduce costs and improve product quality.

Related studies in China: Chinese scholars' studies about modular organization mainly focused on modular organizational design, value creation and cooperation relations (Hao and Ren, 2007), there is little literature on the quality of modular outsourcing. In related fields, some scholars researched problems of cooperative quality risks and quality contracts on several corporations. Zhou *et al.* (2006) designed the optimal effective incentive contracts for suppliers' and manufacturers' decision-making behavior. Chao and Yang (2006) achieved conformity between the global supply chain optimization and local optimization by designing the internal and external loss distribution coefficient. Hong and Chen (2007) used improving principal-agent model of some tasks to analyze supplier's product quality control and got the optimal incentive mechanism when efforts of suppliers can be observed. Yang *et al.* (2008) studied how to establish appropriate mechanisms for supply chain quality management contracts and expand the analysis of the incentive effects of reputation incentives, according to different risk attitudes.

To sum up, foreign and domestic scholars have acquired a lot of valuable research results about modular organization, quality risk of business cooperation and quality contracts, such as modular design, quality risk of outsourcing, prevention programs for decision-making, quality supervision and constraints between manufacturers (buyers) and suppliers of the supply chain. Modular outsourcing is an important way to function effectively for modular organization. The quality of their outsourcing determines modular organization's overall performance, but now researches about constraint mechanism of the quality of modular outsourcing are scarce. Therefore, this article intend to find he highest quality system of modular organization constraint mechanism through building principal-agent model and the optimization method, from the perspective of modular outsourcing, under symmetric information and asymmetric information and thus make the modular management strategy of outsourcing to reduce the mass loss of the smallest, to the maximum effectiveness of the overall modular organization.

PROBLEM DESCRIPTION AND MODEL ASSUMPTIONS

Considering a modular organization system composed by a module integrator and a supplier, they acquire common interests ultimately, including the supplier get expected return (V_S) from the integrator, the integrator obtain expected return (V_I) from the customer. To ensure products' quality, both of them need to take efforts of quality and pay cost of quality: in the process of the supplier completing modular functions and take quality prevention, its level is ρ_S, $\rho_S \in [0,1]$, the cost is $C_S(\rho_S)$ which is strictly monotone increasing convex function of ρ_S, suppose $C_S(\rho_S) = k\ \rho^2_S/2$, $k \geq 0$; The integrator requires to supervise the supplier's process quality, its level is ρ_I, $\rho_I \in [0,1]$, the cost is $C_I(\rho_I)$, the quality of supervision, the quality which is strictly monotone increasing convex function of ρ_I, suppose $C_I(\rho_I) = h\rho^2_I/2$, $h \geq 0$; If module integrator finds module supplier's quality defects, an internal quality loss $L_{iS} = (1-\rho_S)\rho\ \mu L_i$ occurs. Assuming the ratio of the mass loss bear by the supplier is μ, $\mu \in [0, 1]$, the ratio undertaken by the integrator is $1-\mu$ and the modular internal quality supplier bear the loss is $L_{iS} = (1-\rho_S)\rho_I\mu L_i$), the modular internal quality builder bear the loss is $L_{iI} = (1-\rho_S)\rho_I(1-\mu)\ L_i$; if the integrator doesn't find module supplier's quality defects, discovered by customers, an external quality loss (L_e) occurs. Assuming the ratio of the mass loss bear by module suppliers is v, $v \in [0, 1]$, the ratio undertaken by the modular integration is 1-v and the modular external quality supplier bear the loss is $L_{eI} = (1-\rho_S)(1-\rho_I)v)\ L_e$, the modular external quality builder bear the loss is $L_{eI} = (1-\rho_S)(1-\rho_I)(1-v)\ L_e$. In the process of outsourcing, both sides exist a minimum conservative revenue, that if less than conservative revenue, the activities of outsourcing cannot be produced, the integrator's retained revenue is π_I, module supplier's retained revenue is π_S. Before outsourcing contract is signed, information of modular organization is symmetric, the adverse selection problem between the integrator and supplier in the signing of the contract; after the contract is signed, the information is asymmetric, the parties cannot observe action selection of each other, asymmetry for level of quality prevention and quality supervision leads to moral hazard problem.

Based on these assumptions, the expected revenue of module integrators, the module supplier's expected revenue is $\prod_S$ and overall expected revenue of modular organization is $\prod$, as the ideal state:

$$\max \Pi_I = V_I - V_S - C_I(\rho_I) - L_{iI} - L_{eI} \quad (1)$$

$$\max \Pi_S = V_S - C_S(\rho_S) - L_{iS} - L_{eS} \quad (2)$$

$$\max \Pi = V_I - C_I(\rho_I) - C_S(\rho_S) - (1-\rho_S)\rho_I L_i - (1-\rho_S)(1-\rho_I)L_e \quad (3)$$

QUALITY CONSTRAINT MECHANISM OF MODULAR OUTSOURCING UNDER ASYMMETRIC INFORMATION

Best constraints of overall modular organization under asymmetric information: The relationship between module integrator and module supplier is agency. Assuming that the integrator provides a quality contract $\{V_S, \mu, v\}$.according to the supplier's capacity and profitability, they choose whether to undertake task of outsourcing. If the outsourcing revenue is less than retained earnings, not to undertake the contract; if module supplier's outsourcing revenue is not less than retained earnings which meet participation constraint (IR), expected return derived from the undertaking outsourcing can not be less than the maximum expected return, then to undertake the effect contract. At this point, the integrator should satisfy the condition of incentive compatibility constraints (IC), that the optimal decision of the supplier must be realized by the integrator's revenue maximizing policy, its decision-making model is:

$$\begin{aligned} &\max_{V_S,\mu,v,\rho_I,\rho_S} \quad \Pi_I = V_I - V_S - C_I(\rho_I) - L_{iI} - L_{eI} \\ &\text{s.t.} \quad \Pi_S \geq \pi_S \quad (IR) \\ &\quad\; \max_{V_S,\mu,v,\rho_S} \Pi_S \quad (IC) \end{aligned} \quad (4)$$

In the symmetric information, the level of module supplier's quality prevention can be observed, module supplier can only obtain the best interests depending on the actual situation of ρ_S, module integrator is not necessary to pay more than the revenue π_S to module supplier, then the incentive compatibility constraint (IC) does not work, the equality of participation constraint (IR) is established. Put the constraint (IR) into the objective function $\prod_I$, the unconstrained optimization problem of the overall modular organization occurs:

$$\max_{0\leq\rho_I\leq1,0\leq\rho_S\leq1} \Pi = V_I - C_I(\rho_I) - C_S(\rho_S) - (1-\rho_S)\rho_I L_i - (1-\rho_S)(1-\rho_I)Le - \pi_S \quad (5)$$

Derivate first-order partial derivatives of ρ_I and ρ_S for the objective function of Eq. 5 and make them equal to zero, obtain the optimal solution (ρ^e_I, ρ^e_S) of quality supervision and quality prevention of modular organization under symmetric information:

$$\rho_I{}^e = \frac{(1-\rho_S)(L_e - L_i)}{h} = \frac{(L_e - L_i)(k - L_e)}{kh - (L_e - L_i)^2} \quad (6)$$

$$\rho_S{}^e = \frac{\rho_I L_i + (1-\rho_I)L_e}{k} = \frac{L_e h - (L_e - L_i)^2}{kh - (L_e - L_i)^2} \quad (7)$$

Make:

$$\lambda = \frac{1}{kh - (L_e - L_i)^2}$$

$$\rho_I{}^e = \lambda(L_e - L_i)(k - L_e);\ \rho_S{}^e = \lambda L_e h - \lambda(L_e - L_i)^2$$

Proposition 1 can be found.

Proposition 1: In the symmetric information, according to module supplier's quality supervision ρ_S module integrator pays retained revenue π_S to module supplier, it can achieve the overall optimal of modular organization, quality supervision and prevention level of module integrator and module supplier respectively are

$$\rho_I{}^e = \lambda(L_e - L_i)(k - L_e),\ \rho_S{}^e = \lambda L_e h - \lambda(L_e - L_i)^2$$

Best constraints of local modular organization under asymmetric information: Case 1: $\mu = 1$, $v = 0$.

Once quality defects of module supplier are checked by module integrator, module supplier should undertake losses which can improve module supplier's level of quality prevention. If module supplier's quality defects occur, yet, module integrator doesn't find it, modular integrator should undertake overall external quality losses, it can help module integrator improve level of quality supervision and checking. Therefore, the undertaking way of mass loss is reasonable and it is easy to be accepted. According to the principle of maximizing their expected return, module integrator and module supplier respect select the best ρ_I and ρ_S, the expected return are follow:

$$\max_{0\le\rho_I\le1} \quad \Pi_I(\rho_I,\rho_S) = V_I - V_S - C_I(\rho_I) - L_{eI} \tag{8}$$

$$\max_{0\le\rho_S\le1} \quad \Pi_S(\rho_I,\rho_S) = V_S - C_S(\rho_S) - L_{iS} \tag{9}$$

Both decision actually is Nash equilibrium for the static game, Nash equilibrium (ρ_I^*, ρ_S^*) meet $\rho_I^* \in$ arg max$\prod_I(\rho_I^*, \rho_S^*)$, $\rho_S^* \in$ arg max$\prod_S(\rho_I^*, \rho_S^*)$.

Derivate first-order partial derivatives of $\prod_I (\rho_I, \rho_S)$ and $\prod_S (\rho_I, \rho_S)$ and make them equal to zero, obtain the Nash equilibrium (ρ_I^*, ρ_S^*).

$$\rho_I^* = \frac{(1-\rho_S)L_e}{h} \tag{10}$$

$$\rho_S^* = \frac{\rho_I L_i}{k} \tag{11}$$

According to Eq. 6 and 7, the optimal level of overall modular organization's quality supervision and prevention are:

$$\rho_I^e = \frac{(1-\rho_S)(L_e - L_i)}{h}$$

and:

$$\rho_S^e = \frac{\rho_I L_i + (1-\rho_I)L_e}{k}$$

When $\mu = 1$, $v = 0$, compared to Eq. 10 and 11, $\rho_I^* \neq \rho_I^e$, $\rho_S \neq \rho_I^e$ which means in this undertaking way of mass loss, modular outsourcing can't achieve overall optimal. Then get the second proposition.

Proposition 2: Under symmetric information, module integrator undertakes external mass loss independently or module suppliers undertake internal mass which cannot achieve the optimal of overall modular organization.

Case 2: $\mu = 1$, $0<v<1$.

In practice, the loss caused by the supplier's quality defects is passed onto the integrator which is not the optimal state, the integrator should take must take measures to share the losses for module supplier, that is $\mu = 1$, $0<v<1$. Total loss of internal quality is undertaken by module supplier which can make the supplier improve the level of quality prevention; and the external quality loss is due to the insufficient level of the supplier's quality prevention and the integrator's supervision, they need to share the loss of quality which can promote the efforts of quality inputs for both. So, their expected return is:

$$\max_{0\le\rho_I\le1} \Pi_I(\rho_I,\rho_S) = V_I - V_S - C_I(\rho_I) - L_{eI} \tag{12}$$

$$\max_{0\le\rho_S\le1} \Pi_S(\rho_I,\rho_S) = V_S - C_S(\rho_S) - L_{iS} - L_{eS} \tag{13}$$

In the above way to solve the model, the Nash equilibrium solution (ρ_I^{**}, ρ_S^{**}) is:

$$\rho_I^{**} = \frac{(1-\rho_S)(1-v)L_e}{h} \tag{14}$$

$$\rho_S^{**} = \frac{\rho_I L_i + (1-\rho_I)vL_e}{k} \tag{15}$$

According to Eq. 6, 7, 14 and 15, when $\mu = 1$, $0<v<1$, there is not v value which can meet $\rho_I^{**} = \rho_I^e$, $\rho_S^{**} = \rho_S^e$ and the organization can't achieve systemic optimal. Then get the proposition 3.

Proposition 3: Under symmetric information, module supplier undertakes internal mass loss independently; module integrator and supplier undertake loss of external mass which cannot achieve the optimal of overall modular organization.

CONSTRAINT MECHANISM OF MODULAR OUTSOURCING QUALITY UNDER ASYMMETRIC INFORMATION

Quality constraint of ρ_S hidden and ρ_I measured: When module supplier's level of quality prevention is hidden to module supplier and module supplier can observe the level of module integrator's quality supervision and inspection ρ_I, module integrator is the principal, module supplier is the agent, module supplier owns moral hazard problem. Module integrator is faced with the decision:

$$\max_{V_S,\mu,v,\rho_I} \quad \Pi_I = V_I - V_S - C_I(\rho_I) - L_{iI} - L_{eI}$$

$$\text{s.t.} \quad \Pi_S \ge \pi_S \quad \text{(IR)}$$
$$\max_{\rho_S} \quad \Pi_S \quad \text{(IC)} \tag{16}$$

According to the condition of incentive compatibility constraints (IC), make:

$$\frac{\partial \Pi_S}{\partial \rho_S} = -C_S'(\rho_S) + \rho_I \mu L_i + (1-\rho_I)vL_e = 0$$

arranged:

$$\rho_S = \frac{\rho_I \mu L_i + (1-\rho_I)vL_e}{k} \tag{17}$$

Substituted participation constraint (IR) into the objective function 16, optimization problem 16 changes into:

$$\max_{\nu_S,\mu,\nu,\rho_I} \quad \overline{\Pi} = \Pi_I + \Pi_S - \pi_S$$

$$\text{s.t.} \quad \rho_S = \frac{\rho_I \mu L_i + (1-\rho_I)\nu L_e}{k} \quad \text{(IC)} \tag{18}$$

According to $\overline{\Pi} = \Pi_I + \Pi_S - \mu_S = \Pi - \mu_S$, μ_S is a constant, the optimal solution of Eq. 18 can meet Eq. 7 and 18. As the principal, the integrator can determine the quality level of supervision $\rho_I = \rho_I^e$, Subcontractors select ρ_S based on Eq. 18, compared to Eq. 7 and 18, make $\rho^S = \rho_S^e$, $\rho_I L_I + (1-\rho_I)L_e = \rho_I \mu L_I + (1-\rho_I)\nu L_e$, then get the proposition 4.

Proposition 4: When ρ_S is hidden, ρ_I is observed, if happened internal mass loss, then $\mu = 1$, $v = 0$; if happened external mass loss, then $\mu = 0$, $v = 1$, that whether happened internal mass loss or external mass loss module supplier should undertake the whole.

Quality constraint of ρ_I hidden and ρ_S measured: When module integrator's level of quality supervision ρ_I is hidden to module supplier and module integrator can observe the level of module supplier's quality prevention ρ_S, module supplier is the principal, module integrator is the agent, module integrator owns moral hazard problem. Module supplier is faced with the decision:

$$\begin{aligned} &\max_{\nu_S,\mu,\nu,\rho_S} \quad \Pi_S \\ &\text{s.t.} \quad \Pi_I \geq \pi_I \quad \text{(IR)} \\ &\quad\;\; \max_{\rho_I} \quad \Pi_I \quad \text{(IC)} \end{aligned} \tag{19}$$

According to the condition of incentive compatibility constraints (IC):

$$\frac{\partial \Pi_I}{\partial \rho_I} = -C_I'(\rho_I) - (1-\rho_S)(1-\mu)L_i + (1-\rho_S)(1-\nu)L_e = 0$$

Arranged:

$$\rho_I = \frac{(1-\rho_S)(1-\nu)L_e - (1-\rho_S)(1-\mu)L_i}{h} \tag{20}$$

Substituted participation constraint (IR) into the objective function 19, Optimization problem 19 changes into:

$$\max_{\nu_S,\mu,\nu,\rho_I} \quad \overline{\Pi} = \Pi_I + \Pi_S - \pi_I$$

$$\text{s.t.} \quad \rho_I = \frac{(1-\rho_S)(1-\nu)L_e - (1-\rho_S)(1-\mu)L_i}{h} \quad \text{(IC)} \tag{21}$$

Based on $\overline{\Pi} = \Pi_I + \Pi_S - \pi_I = \Pi - \pi_S$ and π_I is a constant, the optimal solution of Eq. 21 can meet Eq. 6 and 20. At this point, as the principal, module supplier can determine the quality level of prevention, module integrator selects ρ_I based on Eq. 20, compared to Eq. 6 and 21, make $\rho_I = \rho_I^e$, it should meet the condition of:

$$(1-\rho_S)L_e - (1-\rho_S)L_i = (1-\rho_S)(1-\nu)L_e - (1-\rho_S)(1-\mu)L_i$$

Then get the proposition 5.

Proposition 5: When ρ_I is hidden, ρ_S is observed, if happened internal mass loss, then $\mu = 0$, $v = 0$.

if happened external mass loss, then $\mu = 0$, $v = 0$, that whether internal mass loss or external mass loss happened module integrator should undertake the whole.

Quality constraint of ρ_I and ρ_S hidden: When the integrator can't observe the supplier's level ρ_S and the supplier can't observe the level of module integrator's quality supervision and inspection ρ_I, the organization is the virtual principal, module integrator and module supplier are the agent, double moral hazard exists, the decision modular organization facing is:

$$\begin{aligned} &\max_{\nu_S,\mu,\nu} \quad \Pi \\ &\text{s.t.} \quad \Pi_I \geq \pi_I \text{ and } \Pi_S \geq \pi_S \quad \text{(IR)} \\ &\quad\;\; \max_{\rho_I} \quad \text{and} \quad \max_{\rho_S} \quad \Pi_S \quad \text{(IC)} \end{aligned} \tag{22}$$

According to the condition of IC:

$$\frac{\partial \Pi_I}{\partial \rho_I} = -C_I'(\rho_I) - (1-\rho_S)(1-\mu)L_i + (1-\rho_S)(1-\nu)L_e = 0$$

$$\frac{\partial \Pi_S}{\partial \rho_S} = -C_S'(\rho_S) + \rho_I \mu L_i + (1-\rho_I)\nu L_e = 0$$

Equation 17 and 20 are the optimal first-order conditions of planning Eq. 22. At this point, module supplier selects ρ_S based on Eq. 17, module integrator selects ρ_I based on Eq. 20, according to Eq. 6 and 7, to make module supplier select $\rho_S = \rho_S^*$, module integrator selects $\rho_I = \rho_I^e$ and should satisfy:

$$\rho_I L_i + (1-\rho_I)L_e = \rho_I \mu L_i + (1-\rho_I)\nu L_e \quad (23)$$

$$(1-\rho_S)L_e - (1-\rho_S)L_i = (1-\rho_S)(1-\nu)L_e - (1-\rho_S)(1-\mu)L_i \quad (24)$$

Based on Eq. 23 and 24, obtain:

$$\mu = \frac{L_e - \rho_I^e(L_e - L_i)}{L_i},\ \nu = \frac{L_e - \rho_I^e(L_e - L_i)}{L_e}$$

$$1-\mu = \frac{(L_i - L_e)(1-\rho_I^e)}{L_i},\ 1-\nu = \frac{\rho_I^e(L_e - L_i)}{L_e}$$

According to $\mu \in [0, 1]$, $v \in [0, 1\}$, $0 \le 1-\mu \le 1$, $0 \le 1-v \le 1$, then get the proposition 6 and 7.

Proposition 6: When ρ_I and ρ_S are hidden, if $L_I > L_e$, then $1-\mu<0$ which is incompatible with the assumption. At the point, if internal mass loss happened, in addition to all the internal commitment of the mass loss, module supplier need to pay an additional penalty fees, module integrator need to introduce punishment mechanism to balance its oversight cost and external cost of loss prevention; If external mass loss happened, module integrator exists monitoring errors, module supplier exists prevention errors, so the loss should be shared externally, the ratio between the two sharing respect is:

$$\nu = \frac{L_e - \rho_I^e(L_e - L_i)}{L_e}$$

and:

$$1-\nu = \frac{\rho_I^e(L_e - L_i)}{L_e}$$

Proposition 7: When ρ_I and ρ_S are hidden, if $L_I \ge L_e$, then $1-v \le 0$ which is incompatible with the assumption, at the point, if internal mass loss happened which means that the cost of module integrator's quality supervision is too high, so that, the cost exceeds possible losses caused by quality defects, the loss should be shared by the two, the sharing ratio is:

$$\mu = \frac{L_e - \rho_I^e(L_e - L_i)}{L_i},\ 1-\mu = \frac{(L_i - L_e)(1-\rho_I^e)}{L_i}$$

If external mass loss happened, no co-understanding solution and shows L_I??L_e which is contradictory with the condition that the external loss always larger than the internal loss.

MANAGEMENT IMPLICATONS OF MASS LOSS CONSTRAINT MECHANISM FOR MODULAR OUTSOURCING

Establishing appropriate mechanisms of loss undertaking and strengthen the function of outsourcing quality constraint: From the model results, the appropriate risk-sharing means the mass loss mainly in the following situations: First, module integrator and module supplier share in proportion to the external loss and internal loss; Second, module integrator undertakes the whole of internal loss and external loss; Third, module integrator undertakes the whole of internal loss and external loss; Fourth, module supplier undertakes the whole of internal mass loss and need to pay additional penalty charges. Therefore, in the module outsourcing, we should be screening all kinds of information, different conditions should be signed in the design of contracts, establish appropriate mechanisms of loss undertaking and strengthen the function of outsourcing quality constraint.

Building efficient information shared platform, reduce the opportunistic behavior of outsourcing: Information in-completion or distortion is the basic condition factor to information asymmetry. It's a real issue that information asymmetry exists in modular organization, Therefore, it's possible for interactive opportunistic behavior which will result in moral risks. While information sharing is helpful to information screening, it will reduce the opportunistic behavior of outsourcing effectually, in the condition of building efficient information shared platform, to manifest the ability of modular integrator on quality management ability, quality management system and the quality prevention and controlling of the modular supplier.

Finding long term strategic partner, enhance the confidence on outsourcing cooperation: Both parties need to pay the cost of quality effort in order to decrease the quality lost in modular outsourcing business which is basically related to the confidence of both parties. Meanwhile, for the sake of information in-completion and information asymmetry, there will be big lost on anticipation and afterwards costs, searching costs before award of contract, negotiation costs and contracting costs; supervisory cost, implementation cost and litigation cost after award of contract. While long term strategic partner relationship can increase the confidence on outsourcing business, greatly reduce the quality effort cost and the expense on the costs.

Construct synergetic modular outsourcing network, promote the quality level of outsourcing products: Outsourcing activity of modular organization appears three types: Firstly, outsourcing of manufacturing process and service module, such as manufacturing process outsourcing; secondly, productive service modular outsourcing, such as outsourcing of designation, sale etc business flow, cooperatively research, build sales network, share benefits; thirdly, finally outsourcing of customer service functional module. The related objects of these three types outsourcing activities constitute the whole modular network and the synergetic relationship between the objects influence on the quality of final products and such caused quality lost. Synergetic outsourcing network gives benefits to modular organization to build optimized interactive ally of intergrowth and coexist, in order to motivate quality innovation, improve the quality of outsourcing products and reduce the quality lost.

CONCLUSION

The modular organization is the main organizational model in the future and modular outsourcing has become a new trend. According to different commitment ways on internal losses and external losses, it discusses two kinds of commitment means under the symmetry of information condition, the results cannot achieve the overall and local optimal; and it also analysis three kinds of commitment ways on mass loss under the asymmetric information condition, by determining the a reasonable internal and external commitment to quality loss coefficient and build Suitable restraint mechanism for the quality, it can make the supervision level of module integrator and the prevention level of module supplier meet to the Nash equilibrium solution and the modular organization optimal solution. By analysis, module organization should take the following strategies on outsourcing management: establish appropriate mechanisms of loss undertaking and strengthen the function of outsourcing quality constraint; build efficient information shared platform, reduce the opportunistic behavior of outsourcing; find long term strategic partner, enhance the confidence on outsourcing cooperation; construct synergetic modular outsourcing network, promote the quality level of outsourcing.

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REFERENCE

Aron, R., S. Bandyopadhyay, S. Jayanty and P. Pathak, 2008. Monitoring process quality in off-shore outsourcing: A model and findings from multi-country survey. J. Oper. Manage., 26: 303-321.

Baiman, S., P.E. Fischer and M.V. Rajan, 2001. Performance measurement and design in supply chains. Manage. Sci., 47: 173-188.

Balakrishnan, K., U. Mohan and S. Seshadri, 2008. Outsourcing of front-end business processes: Quality, information and customer contact. J. Oper. Manage., 26: 288-302.

Baldwin, C.Y. and K.B. Clark, 1997. Managing in an age of modularity. Harvard Bus. Rev., 75: 84-93.

Chao, G.H., S.M.R. Iravani and R.C. Savaskan, 2009. Quality improvement incentives and product recall cost sharing contracts. Manage. Sci., 55: 1122-1138.

Chao, J. and C.J. Yang, 2006. A game analysis on quality failure of supply chain. Chinese J. Manage. Sci., 1: 25-29.

Choi, M., M. Brand and J. Kim, 2009. A feasibility evaluation on the outsourcing of quality testing and inspection. Int. J. Project Manage., 27: 89-95.

Corbet, C.J. and X.D. Groote, 2000. A supplier's optimal quantity discount policy under asymmetric information. Manage. Sci., 3 : 445-450.

Ernst, R. and B. Kamrad, 2000. Evaluation of supply chain structures through modularization and postponement. Eur. J. Oper. Res., 3: 495-510.

Hao, B. and H. Ren, 2007. Design of modular organization: Basic principle and theoretical structure. China Ind. Econ., 6: 80-87.

Hong, J.T. and J.F. Chen, 2007. The incentive mechanism on supplier quality control. Manage. Rev., 3: 49-52.

Kaya, M. and O. Ozer, 2009. Quality risk in outsourcing: Noncontractible product quality and private quality cost information. Naval Res. Logistics, 56: 669-685.

Starbird, S.A., 2001. Penalties, rewards and inspection: Provisions for quality in supply chain contracts. J. Oper. Res. Soc., 52: 109-115.

Yang, Y.P., Y.C. Liu and W. Liu, 2008. Incentive strategy of quality control in supply chain based on principal-agent theory. J. Log. Technol., 2: 99-101.

Zhou, M., Y. Zhang, Y. Li and B. Dan, 2006. The optimal contract design in supply chain quality management. J. Ind. Eng. Eng. Manage., 3: 120-122.

Zhu, K., R.Q. Zhang and F. Tsung, 2007. Pushing quality improvement along supply chains. Manage. Sci., 53: 421-436.