http://ansinet.com/itj

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 11 (4): 524-527, 2012
ISSN 1812-5638 / DOI: 10.3923/itj.2012.524.527

Partner Trust Evaluation Method of Virtual Enterprise

Zheng Leina and Pan Tiejun
Zhejiang Wanli University, Ningbo, 315100, Peoples Republic of China

Abstract: Post-crisis era, the trust and reputation problems in the cooperative enterprises have highlighted the risk of virtual enterprise, Virtual Enterprise trust evaluation model is presented based on QFD method, trust evaluation set and trust evaluation grades at first. Then, project schedule optimal model base on reputation is given integrating push and pull inventory mechanism which reflects that reputation is the center of modern management concepts according to the principle of maximizing long-term interests. Finally, the relative optimal algorithm is discussed for implement during partner selection and profits distribution of virtual enterprise. Furthermore, decision-making model is given by Reputation-based incentive mechanisms.

Key words: Virtual enterprise, evaluation method, trust, QFD

INTRODUCTION

During the second half of 20th century, the rapid development of information technology promotes the globalization of markets. The users have diversified and personalized demands so that the product life cycle has become shorter and shorter. In order to adapt to the flexible market, virtual enterprise emerged and has been considered to be the main form of enterprise organization in 21th century (Bishr and Mantelas, 2008). Based on the mutual trust, it establishes a long-term alliance whose members include manufacturers, suppliers, distributors and customers (Porter, 1990). "Mutual trust" is not only the basis of cooperation and mutual success but also the precondition of the realization of the agility of virtual enterprise. The "long-term alliance" is abound to accumulate the credibility and reputation of enterprises which is the important factor for partner selection. Therefore, trust and reputation plays an important role in the operation of the virtual enterprises. With the Amerian financial crisis, the European debt crisis and international trade protectionism, the loss of credits between countries spread to the enterprises. The increase of uncertain factors led to the worse situation of losing credibility in global manufacturing industry. Trust crisis and credit deterioration in the cooperative enterprises have highlighted the risk of virtual enterprise.

TRUST EVALUATION MODEL USING QFD METHOD

QFD is applied in a wide variety of services, consumer products, military needs and emerging technology products. The technique is also used to identify and document competitive marketing strategies and tactics. We use QFD to trust evaluation of partner in virtual enterprise as shown in Fig. 1. In this hypothesis, where is:

- S_i (i = 1,2,..., m) stands for the Trust improvement demands and wi is the weight of S_i (Pan, 2001)
- Q is the autocorrelation matrix of S_i, q_{il} (i, l∈[1, m]) is the correlation coefficient of S_i and S_l
- P is autocorrelation matrix of improvement measures e_j , j∈[1, n], P_{il} is the correlation coefficient of S_i and S_l as shown in Table 1, i, l∈[1, n]
- R is relationship matrix of S_i and e_j, r_{ij} is the correlation coefficient of S_i and e_j, i, j∈[1, n]
- D is the column vector of d_i (i = 1, 2,..., m) which is the current trust improvement
- D* is the column vector of d_i* (i∈[1, m]), target trust improvement value whose grades shown in Table 2
- C is the factors affecting on trust, c_{il} (i, l = 1, 2..., n) is the correlation coefficient of e_i and c_l
- H_j is the trust improvement rate, $H_j = (\lambda_j - \mu_j)/\mu_j$, μ_j is the current value, λ_j is the improved trust value

PROJECT SCHEDULE OPTIMAL MODEL BASE ON REPUTATION

We regard reputation as a positive incentive of partner selection and profits distribution of virtual enterprise, so that increase and decrease the credibility would have incentives and penalties to business interests. Based on the above ideas, project schedule model of virtual enterprise can be setup according to the principle of maximizing long-term interests which reflects the reputation as the center of modern management concepts.

Correspdonding Author: Zheng Leina, Zhejiang Wanli University, Ningbo, 315100, Peoples Republic of China

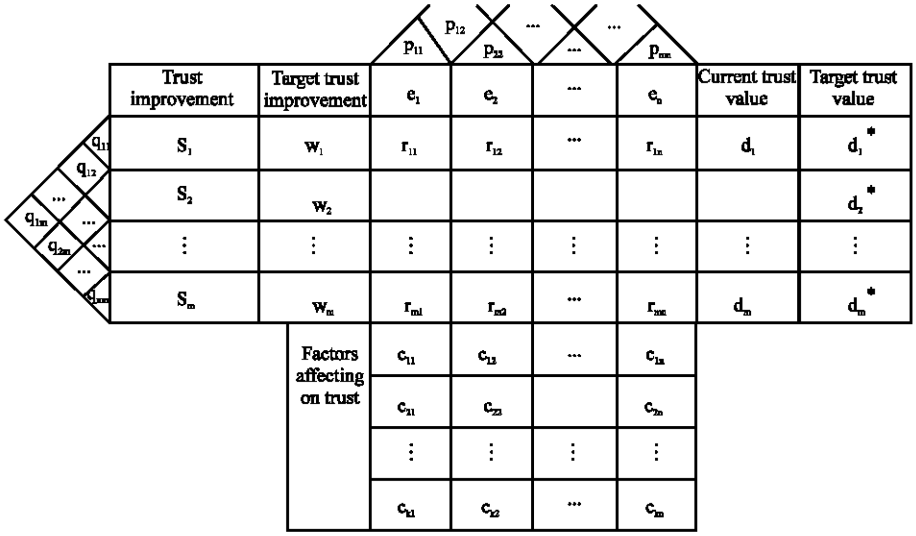

Fig. 1: QFD House of trust evaluation

Table 1: Trust evaluation set

Variable	Class	Variable	Class
X_1	Business situation	X_8	Honor
X_2	Human Resources	X_9	Credit rating
X_3	Financial situation of enterprises	X_{10}	Third-party credibility
X_4	Service Pledge	X_{11}	Recommended number of vehicles
X_5	Quality of service	X_{12}	Recommended vehicle accident rate of default
X_6	Performance Quality	X_{13}	Recommended vehicle accident rate for Speed
X_7	Qualification	X_{14}	Record of vehicle license lack

Table 2: Trust evaluation grades

Variable	Class
C_1 (AAA)	Stable or growing businesses, financial strength, reputation, leadership position, have a dominant market share of large, top-notch competitive, performance has always been good
C_2 (AA)	Stable or growing business, a good reputation, corporate profits comparatively good, with excellent competitiveness, industry leadership, non-market financing difficulties
C_2 (A)	Low industry risk, the industry forefront, reputable, have excellent competitive market should have no difficulty raising funds
C_2 (BBB)	A decline trend, there is industry risk but a good profit, reputation is also good, competitive general
…	…
C_2 (D)	The problem is extremely serious, there is the phenomenon of loss of quality of service very poor, very poor reputation, blacklisted

Suppose virtual enterprises should complete m tasks to produce n products within the planning period [1, T], d_i (t) is the order quantity of product i in day t. It is known the w_{ij} stands for unit production capacity of product i needs the resources j, α_i is cost to keep a contract , β_i is the cost to break a contract , i = 1, 2,..., n. The enterprise available capacity of day t is C_j (t), j = 1, 2,..., m, t = 1,2,..., T. The initial storage capacity of product i is Ii, $I_i<0$ indicates less production, i = 1, 2,..., n. Establishment of incentive mechanisms based on I_i will play a positive role for the maintenance of enterprise credit. Assuming a dynamic credit of enterprise V_i is with proportional to Ii, there are: $V_i = K\times I_i+N$ (Shi-Hua and Yong-Lin, 2000).

Storage capacity can be expressed as Ii = (Vi-N)/K, K>0. K is the proportionality constant, N is fixed constant:

$$\begin{aligned}&\min_P F(P)=\sum_{i=1}^{n}\sum_{t=1}^{T}[\alpha_i((V_i-N)/K+\sum_{k=1}^{t}p_i(k)-\\&\sum_{k=1}^{t}d_i(k))^+ +\beta_i(\sum_{k=1}^{t}d_i(k)-\sum_{k=1}^{t}p_i(k)-(V_i-N)/K)^+\\&\text{s.t.}\sum_{i=1}^{n}w_{ij}p_i(t)\le C_j(t),t=1,2,\cdots,T,j=1,2,\cdots,m\\&p_i(t)\ge 0,i=1,2,\cdots,n,t=1,2,\cdots,T\\&(x)^+\text{ stands for }\max\{0,x\}\end{aligned} \quad (1)$$

The planned production capacity of product i in day t is p_i (t), i = 1, 2,..., n, t = 1, 2,..., T, then keep or break contract plan model (P0) as follows, namely, how full use of the effective resources to breach the minimum amount of punishment during planning period.

Since, the objective function of the above plan (P0) is nonlinear, can not use ordinary mathematical programming method for solving. Let x_i (t) and y_i (t) were

Table 3: Business factors affecting on keeping or breaking contract

W_{ij} relative weight of factors (%)	α_{ij} factors affecting on keeping contract	β_{ij} factors affecting on breaking contract
20	Occupy liquidity	Penalty for breach of contract
30	Increase credibility	Decrease credibility
2	Resource scheduling costs	Loss of market
5	Increased raw material costs	Management fees
10	Exchange rate losses	New opportunities missed
…	…	…

the more or less on the production of product i, taking into account the role of credit rating maintained, there:

$$x_i(t) = ((V_i - N)/K + \sum_{k=1}^{t} p_i(k) - \sum_{k=1}^{t} d_i(k))^+, y_i(t) = (\sum_{k=1}^{t} d_i(k) - \sum_{k=1}^{t} p_i(k) - (V_i - N)/K)^+, i = 1, 2, \cdots, n, t = 1, 2, \cdots, T \quad (2)$$

Definition: x_i (0), y_i (0) are yield or less production of product i at end of the last plan period, apparently $I_i = x_i(0) - y_i(0)$, according to the significance of each variable, the following recurrence formula:

$$x_i(t) - y_i(t) = x_i(t-1) - y_i(t-1) + P_i(t) - d_i(t), \quad i = 1, 2, \cdots, n, t = 1, 2, \cdots, T \quad (3)$$

Take x, y as variables, the P0 can be transformed into the following standard form linear program (P):

$$\begin{aligned} &\min_{x,y} F(P) = \sum_{i=1}^{n}\sum_{t=1}^{T}[\alpha_i x_i(t) + \beta_i y_i(t)] \\ &\text{s.t.} \sum_{i=1}^{n} w_{ij}[x_i(t) - y_i(t) - x_i(t-1) + y_i(t-1)] \le C_j(t) - \sum w_{ij} d_i(t), \\ &t = 1, 2, \cdots, T \\ &x_i(t) - y_i(t) - x_i(t-1) + y_i(t-1) \ge d_i, i = 1, 2, \cdots, n, t = 1, 2, \cdots, T \\ &x_i(t) \ge 0, y_i(t) \ge 0 \\ &i = 1, 2, \cdots, n, t = 1, 2, \cdots, T \end{aligned} \quad (4)$$

Solving the linear problem, the production of i in the day t, namely P (t), can be determined by the formula:

$$P_i(t) = d_i(t) + x_i(t) - y_i(t) - x_i(t-1) + y_i(t-1), \quad i = 1, 2, \cdots, n, t = 1, 2, \cdots, T \quad (5)$$

The key to solving the problem is as follows:

Step 1: Determination of α_i and β_i the business factors affecting on keeping or breaking contract of Virtual Enterprise are shown as Table 1. Let α_{ij} is the j kind of cost to keep contract of product i, W_{ij} is the weight of stocking cost in advance which can be given by AHP method or empirical formula. The calculation of the cost to break contract is similar to keep it, there are:

$$\alpha_i = \sum_{j=1}^{j} w_{ij} \times \alpha_{ij}, \beta_i = \sum_{j=1}^{j} w_{ij} \times \beta_{ij} \quad (6)$$

In general, α_i and β_i are proportional to the price of contract. To simplify, let P_i is contract price for product i, α and β are respectively for early and tardiness factor, α_i and β_i can be solved using the following formula:

$$\alpha_i = \alpha \times p_i, \beta_i = \beta \times p_i \quad (7)$$

Step 2: The constraint number of original problem (P0) is m×T, when m is large, the scale of the problem becomes too large to solve

With the increasing of uncertainties in the world, whether keeping contract or not depends not only on the task of capacity constraints but also on exchange rates, raw material costs. Removing the force majeure, such as trade regulation, trade protection, only the real capacity constraints of those "bottleneck task" determine whether a company keep contract or not. The "bottleneck task" refers to the task with longer completion time on the critical path, it can be pointed by setting a time threshold. The task whose occupied time longer than the threshold is the "bottleneck task" (Pan, 2004).

Suppose J_{it} is the "bottleneck task" located at time t which constituted by tasks taking the j kind of resource to produce the i products, i = 1, 2,..., n, t = 1, 2,..., T. RP is a plan with relaxation and constrained only by j_{it}.

Based on the above analysis, we give the following virtual enterprise project schedule algorithm:

- According to the nature of virtual enterprise, manufacturing process framework and its sub-classification process are setup
- Taken the centralized control tasks in the framework to compose a directed graph G for task network
- Identify the critical path in the directed graph
- Identify the "bottleneck task" on the critical path, namely $\{j_{it}\}$
- Solving RP only constrained by $\{j_{it}\}$ and get the optimal solution x *, y * and p *
- Check all constraints on the feasibility of p*, if all constraints can be satisfied, then p* is the optimal solution, stop; Otherwise, all the constraints not meet are added to the Relaxed Plan (RP) and will turn (Table 3)

CONCLUSION

In this study, we presented our experience on optimizing project schedule of virtual enterprise. The trust evaluation applied QFD analysis to analyze the factors of trust crisis and credit deterioration in the countries, then cooperative enterprises and afterwards inside their own enterprise. We obtained preliminary results on trust crisis in virtual enterprise is of the increase of uncertain factors. Our results based on truest evaluation indicate that decision-making model should be based on reputation and trust incentive mechanisms should be built ASAP to avoid the risk of partner selection in virtual enterprise.

ACKNOWLEDGMENT

The authors wish to thank the Humanities and Social Sciences Foundation of Chinese Education Ministry (2324), Science and Technology Major Soft Science Foundation (2008GXS1D042), Ningbo Natural Science Foundation (2011A610106), Zhejiang philosophy and social sciences key research base-port modern service and creative industries research center, under which the present work was possible.

REFERENCES

Bishr, M. and L. Mantelas, 2008. A trust and reputation model for filtering and classifying knowledge about urban growth. Geo J., 72: 229-237.

Pan, T.J., 2001. Study on the process integration and key questions of virtual enterprise. Ph.D. Thesis, Zhejiang University, Hang Zhou.

Pan, T.J., 2004. Study of virtual enterprise process integrated methodology based on value analysis. Syst. Eng. Theory Practice, 24: 54-60.

Porter, M.E., 1990. The Competitive Advantage of Nations. Free Press, New York.

Shi-Hua, M. and L. Yong-Lin, 2000. Supply Chain Management. Mechanical Industry Press, Beijing.