COMPETITIVENESS MODEL OF INTERNATIONAL DISTRI-PARK USING THE VIRTUAL VALUE CHAIN ANALYSIS

Kuo-Liang LEE
Doctoral Course
Dept. of Harbor and River Engineering of National Taiwan Ocean University
P.O.BOX. 7-107
Keelung, Taiwan, R.O.C.
Fax:886-2-24635153
E-mail:f0915@mail.cjcmt.edu.tw

Wen-Chih HUANG
Associate Professor
Dept. of Harbor and River Engineering of National Taiwan Ocean University
P.O.BOX. 7-107
Keelung, Taiwan, R.O.C.
Fax:886-2-24635153
Email:huangwc@mail.ntou.edu.tw

Ming-Shin KUO
Master Course
Dept. of Harbor and River Engineering of National Taiwan Ocean University
P.O.BOX. 7-107
Keelung, Taiwan, R.O.C.
Fax:886-2-24635153
E-mail:belldandys@pchome.com.tw

Shu-Chen LIN
Master Course
Dept. of Shipping and Transportation Management of National Taiwan Ocean University
P.O.BOX. 7-107
Keelung, Taiwan, R.O.C.
Fax:886-2-24635153
E-mail:f0915@mail.cjcmt.edu.tw

ASTRACT: The distribution change of modern commodities makes the international businesses centralize the base products to the strategic distribution center, and the final commodities will be distributed to the customers according to customer's specific demand. Therefore, it is important to establish an international distri-park with competitive abilities to provide high value-added services. To achieve the purpose, firstly, the competitiveness modal of value chain was built to analyze the activities of supply value chain, which forms the competitive advantage through the total utility of value chain; secondly, the concept of competitiveness of virtual value chain was established to maximize total utility of supply chain by the strategic alliance with other partners to promote competitive advantage; finally, an example is demonstrated how the distri-park causes the competitive advantage and decides the target market and the competitive industries.

Key Words: Competitiveness, Virtual Value Chain, Distri-park

1. INTRODUCTION

The way of modern commodities distribution changes from anticipatory logistics to response-based logistics; namely, which focuses on predicting the final product demand now turns to emphasis quickly response the customer demand. Therefore, according to the order of customer's specific demand, many international businesses centralize their base semi-product to the strategic distribution center and distribute the final commodities to the customer. It's important to establish an international distri-park to provide high value-added service, which not only contributes the efficient distribution of input/output cargos but also attracts the international businesses to distribute international commodities through the logistics center. Because of economic conditions, industrial structures, and geographic locations, the areas own different competitive advantages. Consequently, it is important for public sector to determine the competitive strategy of target market and competitive industries for the international Distri-park.

Some literatures about competence are as follows: M. Porter (1980) argued that the market advantages came from the lower cost and products differentiation. Bakos (1986) proposed that the competitive model came from the negotiation power and relative efficiency. The determined factors of negotiation power include the lower cost, the product differentiation, and the transfer cost, whiles the relative efficiency includes the internal organization efficiency and inter-organization efficiency. Dornier (1998) indicated that the competitive priorities of logistics system are caused by the cost, quality, service, and flexibility. Other literatures are [2] [4][5][6][7][8].

2. LOGISTICS VALUE CHAIN COMPETITIVENESS ANALYSIS

2.1 VALUE CHAIN ACTIVITIES OF LOGISTICS

Porter & Miller argued that the processes, which firms increase the value-add of customers, include firm infrastructure, human resource management, technical development, procurement, and five primary activities including inbound logistics, operation, outbound logistics, service, and marketing. The analysis is based on the value chain to deduce the opportunities of relative efficiency and negotiable ability. The former includes internal operation efficiency and organization efficiency, and the latter contains low cost and products difference. In this article, four primary aspects of value chain are analyzed, which are as follows:

(a) Inbound logistics
It is the process that transports raw materials or semi-products for the firms, assembly center, or logistics center. According to the final product demand of customers, the logistics center will transport materials, semi-products from different vendors to the logistics center.
(b) Operation
It is the process that operates commodities from the inputs of materials or semi-products to the outputs of products. The functions of the logistics center are the operation of warehousing, inventory controlling, assembly, testing, labeling, packaging, etc.
(c) Outbound logistics
It is the process that distributes the products form firm to the target markets. The functions of the logistics center are the distribution of products to the wholesalers, retailers, and supermarkets.
(d) Service/marketing
It means that the logistics center provides a series of services and marketing for import businesses, customers, retailers, and suppliers.

2.2 COMPETITIVE INDEXS OF VALUE CHAIN

The competitive indexes include the cost, quality, service, and flexibility, which were built according to M. Porter (1980), the market advantage of cost leader and productive difference, Bakos (1986), the competitive model of negotiation and relative efficiency, and Dornier (1998), the competitive priorities of logistics system. Some detail description of the measurement is as follows:

(1) Cost
Including initial cost and lifecycle cost. The former means the cost of acquiring the product, which could be raw materials cost of a manufacturing company or finished goods cost of a distributor firm. The latter means the product cost of acquiring facilities, maintenance and disposition
(2) Quality:
Including the design quality and conformance quality. The former includes the features and styles of the product attributes that enhance fitness for use. The latter means the product conformance, which is used to set production standards.
(3) Service
Including delivery speed and delivery reliability. The former is the quickly-produce and quickly-deliver ability. The latter means the delivering process within a consistent time frame.
(4) Flexibility
Including new-product flexibility, customization, and product mix flexibility. The first one is the ability to introduce new products quickly and effectively. The second one is the ability to produce large various commodities that match the needs of a highly segmented market. The third one is the ability to efficiently and effectively adjust the production mix in response to product demand fluctuations/cyclicality.

2.3 THE MODEL OF COMPETITIVENESS OF VALUE CHAIN

Referring to the value chain model established by Porter & Miller (1985) and competitive index of logistics system built by of Dornier (1998), the competitiveness model of value chain

was established and shown as Fig. 3-1. Inbound logistics is the purchasing processes of material or semi-products form suppliers to competitive units (CMU), examples of CMU are such as distri-park or logistics center. Operations are the internal processes of CMU, which include warehousing, modularity, testing, shipment, and etc. Outbound logistics are the processes form CMU to target markets. Marketing can promote the target markets, whiles services are provided to vendors, final customers and so on.

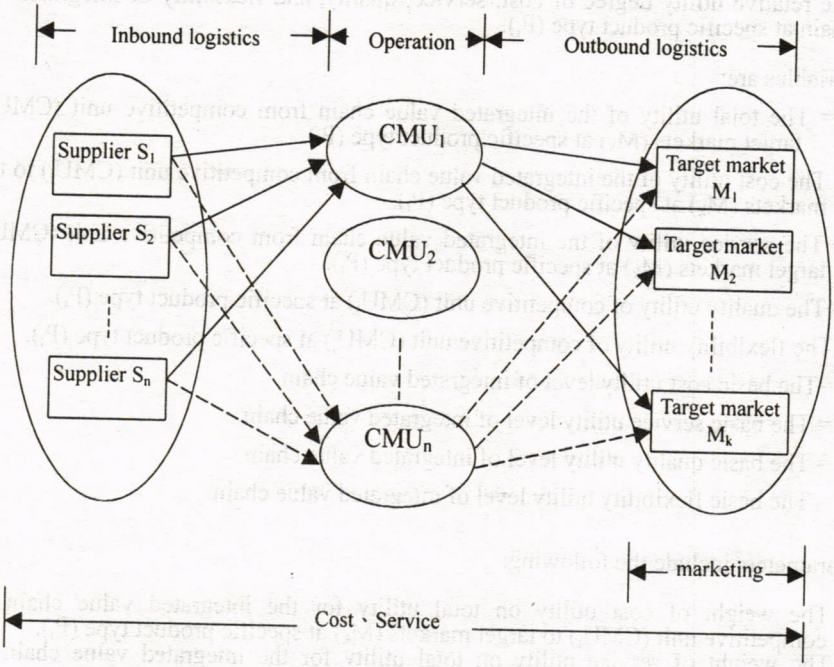

Fig.3-1 The competitive activities of value chain

According to the competitive activities of value chain, the target function of competitiveness of value chain was established. The competitiveness of each CMU based on the product types, P_i, of supply chain from different suppliers to different target markets. The function is as follows:

$$MAX.\ TU_{ijk} = \alpha_i U^C_{ijk} + \beta_i U^S_{ijk} + \gamma_i U^Q_{ijk} + \lambda_i U^E_{ijk} \qquad (1)$$

Subject to

$$U^C_{ijk} \geq I^C_{ijk} \qquad \forall i = 1,2,3....m\ ;\ j = 1,2,3...n\ ;\ k = 1,2,3....r \qquad (2)$$

$$U^S_{ijk} \geq I^S_{ijk} \qquad \forall i = 1,2,3....m\ ;\ j = 1,2,3...n\ ;\ k = 1,2,3....r \qquad (3)$$

$$U^Q_{ijk} \geq I^Q_{ijk} \qquad \forall i = 1,2,3....m\ ;\ j = 1,2,3...n\ ;\ k = 1,2,3....r \qquad (4)$$

$$U^E_{ijk} \geq I^E_{ijk} \qquad \forall i = 1,2,3....m\ ;\ j = 1,2,3...n\ ;\ k = 1,2,3....r \qquad (5)$$

$$\alpha_i + \beta_i + \gamma_i + \lambda_i = 1 \qquad \forall\ i = 1,2,3.....m \qquad (6)$$

Model illustration:

(1) --The total utility of cost, service, quality, and flexibility of the value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).
(2) -- The cost utility of the value chain from competitive unit (CMU_j) to target markets (M_k)

at specific product type (P_i) have to reach the level of I_{ijk}^{C}.

(3) -- The service utility of the value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i) have to reach the level of I_{ijk}^{S}.

(4) -- The quality utility of the value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i) have to reach the level of I_{ijk}^{Q}.

(5) -- The flexibility utility of the value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i) have to reach the level of I_{ijk}^{E}.

(6) --the relative utility degree of cost, service, quality, and flexibility of integrated value chain at specific product type (P_i).

Model variables are:

TU_{ijk} = The total utility of the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

U_{ijk}^{C} = The cost utility of the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

U_{ijk}^{S} = The service utility of the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

U_{ijk}^{Q} = The quality utility of competitive unit (CMU_j) at specific product type (P_i).

U_{ijk}^{E} =The flexibility utility of competitive unit (CMU_j) at specific product type (P_i).

I_{ijk}^{C} =The basic cost utility level of integrated value chain.

I_{ijk}^{S} = The basic service utility level of integrated value chain.

I_{ijk}^{Q} = The basic quality utility level of integrated value chain.

I_{ijk}^{E} = The basic flexibility utility level of integrated value chain.

Model parameters include the following:

α_i = The weight of cost utility on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

β_i = The weight of service utility on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

γ_i = The weight of quality utility on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

λ_i = The weight of flexibility utility on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

◎cost utility (U_{ijk}^{C}) --

The reciprocal of the average cost from specific competitive unit(CMU_j) to all target markets ($\sum M_k$) at specific product type (P_i) divided by the average cost from all competitive units($\sum CMU_j$) to all target markets ($\sum M_k$) at specific product type (P_i).

$$U_{ijk}^{C} = 1/\left[\frac{AC_{ijk}}{\sum_{j=1}^{m} AC_{ijk}}\right] = 1/\left[\frac{\sum_{k=1}^{p} TC_{ijk}/p}{\sum_{j=1}^{m}\left(\sum_{k=1}^{p} TC_{ijk}/p\right)}\right]$$

$$= 1/\left[\frac{\sum_{k=1}^{p}\left(TC_{ijk}^{IB} + TC_{ijk}^{OP} + TC_{ijk}^{OB}\right)/p}{\sum_{j=1}^{m}\left(\sum_{k=1}^{p}\left(TC_{ijk}^{IB} + TC_{ijk}^{OP} + TC_{ijk}^{OB}\right)/p\right)}\right] \quad (7)$$

Sub-model variables are:

TC_{ijk}^{IB} = The total cost of inbound logistics from the specific competitive unit(CMU_j) to target markets (M_k) at specific product type (P_i).

TC_{ijk}^{OP} = The total cost of operation from the specific competitive unit(CMU_j) to target markets (M_k) at specific product type (P_i)..

TC_{ijk}^{OB} = The total cost of outbound logistics from the specific competitive unit(CMU_j) to target markets (M_k) at specific product type (P_i).

p = The numbers of target markets.

◎service utility (U_{ijk}^{S})—including the two utilities of just in time, JIT, real time, RT.

◎◎The utility of JIT (U_{ijk}^{JIT})
The reciprocal of the average time differentiation from specific competitive unit(CMU_j) to all target markets (ΣM_k) at specific product type (P_i) divided by the average time differentiation from all competitive units(ΣCMU_j) to all target markets (ΣM_k) at specific product type (P_i).

◎◎The utility of RT (U_{ijk}^{RT})
The reciprocal of the average time from specific competitive unit(CMU_j) to all target markets (ΣM_k) at specific product type (P_i) divided by the average time from all competitive units(ΣCMU_j) to all target markets (ΣM_k) at specific product type (P_i).

$$U_{ijk}^{S} = \omega_1 U_{ijk}^{JIT} + \omega_2 U_{ijk}^{RT} = \omega_1 \Big/ \frac{AT_{ijk}^{\varepsilon}}{\sum_{i=1}^{n} AT_{ijk}^{\varepsilon}} + \omega_2 \Big/ \left(\frac{AT_{ijk}^{RT}}{\sum_{i=1}^{n} AT_{ijk}^{RT}} \right)$$

$$= \omega_1 \frac{\sum_{k=1}^{m} TT_{ijk}^{JIT} / p}{\sum_{j=1}^{m} \left(\sum_{k=1}^{p} TT_{ijk}^{JIT} / p \right)} + \omega_2 \frac{\sum_{k=1}^{m} TT_{ijk}^{RT} / p}{\sum_{j=1}^{m} \left(\sum_{k=1}^{p} TT_{ijk}^{RT} / p \right)} \qquad (8)$$

Subject to

$$\omega_1 + \omega_2 = 1$$

Sub-model variables are:

TT_{ijk}^{JIT} = The total time differentiation from the specific competitive unit(CMU_j) to target markets (M_k) at specific product type (P_i).

TT_{ijk}^{RT} = The total time from the specific competitive unit(CMU_j) to target markets (M_k) at specific product type (P_i).

p = The numbers of target markets.

Sub-model parameters include the following:

ω_1 = The weight of JIT utility on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

ω_2 = The weight of RT utility on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

◎ Quality utility (U_{ij}^{Q}) --including the two utilities of product complexity (U_{ij}^{CM}) and technical consistency (U_{ij}^{CN})

◎◎the utility of product complexity (U_{ij}^{CM})
The utility ratio of the product complexity ability at specific competitive unit(CMU_j) and all competitive units(ΣCMU_j) at specific product type (P_i).

◎◎the utility of technical consistency (U_{ij}^{CN})
The utility ratio of the technical consistent ability at specific competitive unit(CMU_j) and all competitive units(ΣCMU_j) at specific product type (P_i).

$$U_{ij}^{Q} = \delta_1 U_{ij}^{CM} + \delta_2 U_{ij}^{CN} = \delta_1 \frac{AA_{ij}^{CM}}{\sum_{j=1}^{m} AA_{ij}^{CM}} + \delta_2 \frac{AA_{ij}^{CN}}{\sum_{j=1}^{m} AA_{ij}^{CN}} \quad (9)$$

subject to

$$\delta_1 + \delta_2 = 1$$

Sub-model variables are:

AA_{ij}^{CM} = The product complexity ability at specific competitive unit(CMU_j) at specific product type (P_i)..

AA_{ij}^{CN} = The technical consistent ability at specific competitive unit(CMU_j) at specific product type (P_i).

Sub-model parameters include the following:

δ_1 = The utility weight of product complexity on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

δ_2 = The utility weight of technical consistent on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

◎The utility of flexibility(U_{ij}^{E})--including the ability of flexible manufacture quickly and the ability of handling the demand of customers.

◎◎the utility of flexible manufacture quickly (U_{ij}^{EM})
The utility ratio of the ability of flexible manufacture quickly of specific competitive unit(CMU_j) at specific product type (P_i) and the ability of flexible manufacture quickly of all competitive units(ΣCMU_j) to all target markets (ΣM_k) at specific product type (P_i).

◎◎the utility of handling the demand of customers (U_{ij}^{EC})
The utility ratio of the ability of fitting the demand of customers' of specific competitive unit(CMU_j) at specific product type (P_i) and the ability of handling the demand of customers of all competitive units(ΣCMU_j) to all target markets (ΣM_k) at specific product type (P_i).

$$U_{ij}^{E} = \eta_1 U_{ij}^{EM} + \eta_2 U_{ij}^{EC} = \eta_1 \frac{AA_{ij}^{EM}}{\sum_{j=1}^{m} AA_{ij}^{EM}} + \eta_2 \frac{AA_{ij}^{EC}}{\sum_{j=1}^{m} AA_{ij}^{EC}} \quad (10)$$

subject to

$$\eta_1 + \eta_2 = 1$$

Sub-model variables are:

AA_{ij}^{EM} = The flexible manufacture quickly ability at specific competitive unit(CMU_j) at specific product type (P_i)..

AA_{ij}^{EC} = The ability of fitting the demand of customers at specific competitive unit(CMU_j) at specific product type (P_i).

Sub-model parameters include the following:

η_1 = The utility weight of quickly and flexible manufacture on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

η_2 = The utility weight of fitting the demand of customers on total utility for the integrated value chain from competitive unit (CMU_j) to target markets (M_k) at specific product type (P_i).

2.4 THE ANALYSIS OF COMPETENCE OF VALUE CHAIN

Through the establishment of the competitive model of value chain, we can acquire the total utility of the integrated value chain from each supplier (S_i) to each competitive unit (CMU_j) at specific product type (P_i) (see Tab. 2-1), and we can also obtain the total utility of the integrated value chain from each competitive unit (CMU_j) to each target markets (M_k) at specific product type (P_i) (see Tab. 2-2). Tab. 2-1 and Tab. 2-2 gives clear illustrations that each competitive unit (CMU_j) has its competence in different suppliers and target markets, which is the base of each organization to construct the competence.

Tab 2-1 the total utility of value chain from suppliers (S_i) to competitive unit (CMU_j) at specific productive type (P_i).

Product P_i	CMU_1	CMU_2	CMU_3	------	CMU_n
S_1	TU_{i11}	TU_{i12}	TU_{i13}	------	TU_{i1n}
S_2	TU_{i21}	TU_{i22}	TU_{i23}	------	TU_{i2n}
S_3	TU_{i31}	TU_{i32}	TU_{i33}	------	TU_{i3n}
!	!	!	!	------	!
S_m	TU_{im1}	TU_{im2}	TU_{im3}	------	TU_{imn}

Tab 2-2 the total utility of value chain from competitive unit (CMU_j) to target markets (M_k) at specific productive type (P_i).

Product P_i	M_1	M_2	M_3	------	M_p
CMU_1	TU_{i11}	TU_{i12}	TU_{i13}	------	TU_{i1p}
CMU_2	TU_{i21}	TU_{i22}	TU_{i23}	------	TU_{i2p}
CMU_3	TU_{i31}	TU_{i32}	TU_{i33}	------	TU_{i3p}
!	!	!	!	------	!
CMU_n	TU_{in1}	TU_{in2}	TU_{in3}	------	TU_{inp}

3. COMPETITIVE ANALYSIS OF VIRTUAL VALUE CHAIN

3.1 VIRTUAL VALUE CHAIN

From the viewpoint of business logistics, how does one manage, structure and control logistics in virtual supply chain? Three elements of the logistics operating structure appear to the critical in the example of Dell computers:

(1) The application of postponement throughout the entire chain (in purchasing, manufacturing and shipment)
(2) The integration of the chain via information flow.
(3) The extensive degree of outsourcing and subcontracting.

Postponement is used to achieve customization and efficiency within one operating system. Integration of the flow of information is needed to achieve a seamless integration of functions and the large number of partners involved in the physical sphere. The partner achieves control not through ownership, but rather by mastering the flow of information while focusing its competitive lead on the quality of its responsiveness to customers. The purpose of outsourcing is to make sure the enterprise to develop the core competitive abilities from its limited resources (Fig. 3-1).

The meanings of virtual value chain are to approach the competitiveness of organization under the principle of integrated maximum utility, and to form strategic alliances with other partners at specific integrated supply chain. Therefore, the competence of virtual value chain is to match the competitive industries and other conditions of advantage, such as information flow and cash flow of organization, or of nations, and to develop the value-added service with core competence, such as assembly, testing, labeling, packaging, etc. Through the corporation, example of outsourcing, with other strategic partners, CMU forms maximum total utility of

integrated value chain from vendors to target markets, createS relative competitiveness of value chain, and finally formS competitiveness with other competitive units.

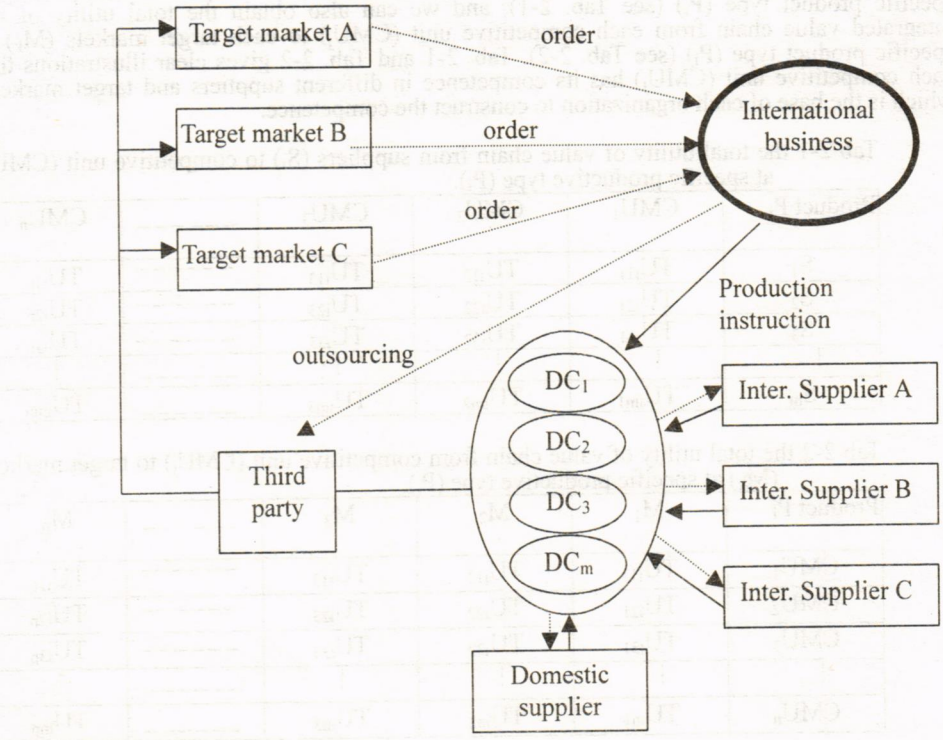

Fig.3-1 the integrated concept of virtual logistics

3.2 COMPETITIVE MEASUREMENT OF VIRTUAL VALUE CHAIN

The measurement of the competitiveness for the international distri-park, we used the utility model of CVC, competitiveness of value chain, to create the competitive indexes (see tab.3-1). First, we analyzed the utility (U_{il}) of each criteria for each CMU and acquired the eigenvalue. Finally, we synthesized the weights of products (I_i), competitive index (w_j), criteria (C_{ik}) and the utility of CMU to acquire the total utility value of competitiveness for each CMU, which is as follow.

$$TU_l = \sum_{i=1}^{m}\sum_{j=1}^{J}\sum_{k=1}^{K_j} I_i w_j C_{ik} U_{il} \qquad (11)$$

4. EXAMPLE OF COMPETETITIVENESS ANALYSIS OF INTERNATIONAL DISTRI- PARK

The developments of modernization and internationalization of logistics includes three modes, consumer logistics, local logistics, and international logistics. The purpose of international logistics was improved the relation of domestic logistics center and international partners through the providing of seaports and airport to upgrade the efficiency of logistics. In example of the competitive relation of international Distri-park in Taiwan, Dell computers, ordered the OEM manufactures in Taiwan when it received the order from the customer of Singapore. The

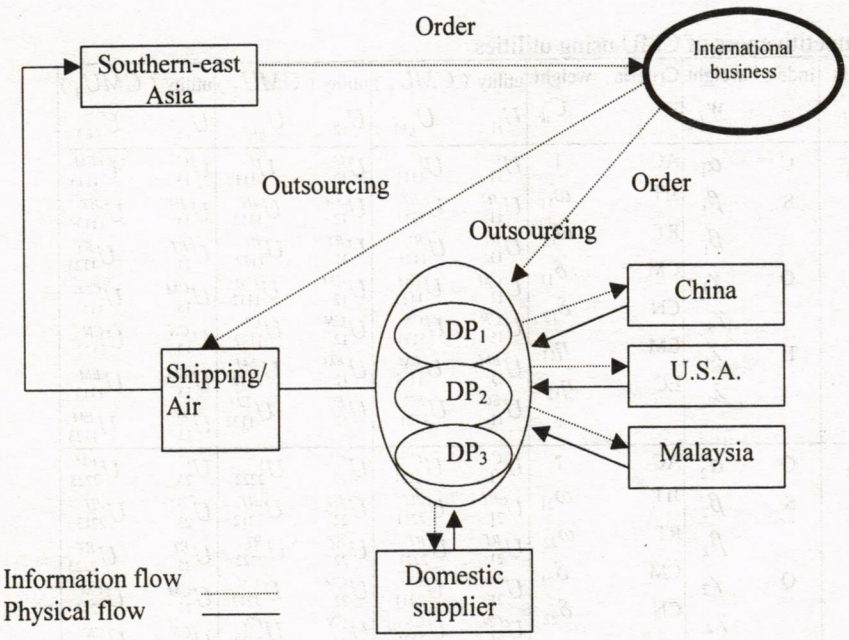

Fig.4-1 the integration of virtual logistics in CMU

To illustrate the operationability of the CVC model, it was given the hypothsis of the international businesses for 3C industry to establish the distribution center of southern-east Asia from one of the three CMU (distri-park, DP). We give the following virtual data (see tab. 4-1, 4-2, 4-3). Tab. 4-1 presents the parameter of the relative important degree of different products for international logistics, we suppose that the information products had higher weight of value-added than electric products. The index parameter of service (β) of information products had higher weight than others and the index parameter of cost (α) of electric products had higher weight than others. The criteria parameter of RT (ω_2), CM (δ_1) of information products had higher weight than others and the criteria parameter of JIT (ω_1),

Tab. 4-1 the parameter of relative important degree of different products for international logistics

	Productive Value-added	Index parameter				Criteria parameter					
	π_i	α	β	γ	λ	ω_1	ω_2	δ_1	δ_2	η_1	η_2
Information Products	0.65	0.25	0.40	0.20	0.15	0.30	0.70	0.60	0.40	0.45	0.55
Electric Products	0.35	0.40	0.10	0.25	0.25	0.60	0.40	0.35	0.65	0.40	0.60

CN (δ_2) of electric products had higher weight than others. Tab. 4-2 presents the competitive condition of information products from CMU_i to southern-east Asia, we suppose that the CMU_2 had lower value of total cost, the CMU_1 and CMU_2 had higher service utility of JIT and CMU_2 had higher service utility of RT, CMU_1 had higher quality utility of CM and CMU_2 had higher quality utility of CN, and CMU_3 had higher flexibility utility of EM and CMU_2 had higher flexibility utility of EC. Tab. 4-3 presents the different assumption on the competitive condition of electric products from CMU_i to southern-east Asia. The problem of independent of utility values in equation (1) with one another, it was suggested that used the method of gray relation analysis to choice the independent variables of utility

Tab. 3-1 competitiveness of CMU using utilities

Productive weight I_i	Index	weight w_j	Criteria	weight C_{ik}	utility (CMU_1) U_{i1}	U_{ijk1}	utility (CMU_2) U_{i2}	U_{ijk2}	utility (CMU_3) U_{i3}	U_{ijk3}
π_1	C	α_1	AC	1	U_{11}^{C}	U_{1111}^{C}	U_{12}^{C}	U_{1112}^{C}	U_{13}^{C}	U_{1113}^{EM}
	S	β_1	JIT	ω_{11}	U_{11}^{JIT}	U_{1111}^{JIT}	U_{12}^{JIT}	U_{1112}^{JIT}	U_{13}^{JIT}	U_{1113}^{JIT}
		β_1	RT	ω_{12}	U_{11}^{RT}	U_{1121}^{RT}	U_{12}^{RT}	U_{1122}^{RT}	U_{13}^{RT}	U_{1123}^{RT}
	Q	γ_1	CM	δ_{11}	U_{11}^{CM}	U_{1111}^{CM}	U_{12}^{CM}	U_{1112}^{CM}	U_{13}^{CM}	U_{1113}^{CM}
		γ_1	CN	δ_{12}	U_{11}^{CN}	U_{1121}^{CN}	U_{12}^{CN}	U_{1122}^{CN}	U_{13}^{CN}	U_{1123}^{CN}
	E	λ_1	EM	η_{11}	U_{11}^{EM}	U_{1111}^{EM}	U_{12}^{EM}	U_{1112}^{EM}	U_{13}^{EM}	U_{1113}^{EM}
		λ_1	EC	η_{12}	U_{11}^{EC}	U_{1121}^{EC}	U_{12}^{EC}	U_{1122}^{EM}	U_{13}^{EC}	U_{1123}^{EM}
π_2	C	α_2	AC	1	U_{21}^{C}	U_{2221}^{C}	U_{22}^{C}	U_{2222}^{C}	U_{23}^{C}	U_{2223}^{EM}
	S	β_2	JIT	ω_{21}	U_{21}^{JIT}	U_{2211}^{JIT}	U_{22}^{JIT}	U_{2212}^{JIT}	U_{23}^{JIT}	U_{2213}^{JIT}
		β_2	RT	ω_{22}	U_{21}^{RT}	U_{2221}^{RT}	U_{22}^{RT}	U_{2222}^{RT}	U_{23}^{RT}	U_{2223}^{RT}
	Q	γ_2	CM	δ_{21}	U_{21}^{CM}	U_{2211}^{CM}	U_{22}^{CM}	U_{2212}^{CM}	U_{23}^{CM}	U_{2213}^{CM}
		γ_2	CN	δ_{22}	U_{21}^{CN}	U_{2221}^{CN}	U_{22}^{CN}	U_{2222}^{CN}	U_{23}^{CN}	U_{2223}^{CN}
	E	λ_2	EM	η_{21}	U_{21}^{EM}	U_{2211}^{EM}	U_{22}^{EM}	U_{2212}^{EM}	U_{23}^{EM}	U_{2213}^{EM}
		λ_2	EC	η_{22}	U_{21}^{EC}	U_{2221}^{EC}	U_{22}^{EC}	U_{2222}^{EM}	U_{23}^{EC}	U_{2223}^{EM}
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
π_m	C	α_m	AC	1	U_{m1}^{C}	U_{mmm1}^{C}	U_{m2}^{C}	U_{mmm2}^{C}	U_{m3}^{C}	U_{mmm3}^{EM}
	S	β_m	JIT	ω_{m1}	U_{m1}^{JIT}	U_{mm11}^{JIT}	U_{m2}^{JIT}	U_{mm12}^{JIT}	U_{m3}^{JIT}	U_{mm13}^{JIT}
		β_m	RT	ω_{m2}	U_{m1}^{RT}	U_{mm21}^{RT}	U_{m2}^{RT}	U_{mm22}^{RT}	U_{m3}^{RT}	U_{mm23}^{RT}
	Q	γ_m	CM	δ_{m1}	U_{m1}^{CM}	U_{mm11}^{CM}	U_{m2}^{CM}	U_{mm12}^{CM}	U_{m3}^{CM}	U_{mm13}^{CM}
		γ_m	CN	δ_{m2}	U_{m1}^{CN}	U_{mm21}^{CN}	U_{12}^{CN}	U_{mm22}^{CN}	U_{m3}^{CN}	U_{mm23}^{CN}
	E	λ_m	EM	η_{m1}	U_{m1}^{EM}	U_{mm11}^{EM}	U_{12}^{EM}	U_{mm12}^{EM}	U_{m3}^{EM}	U_{mm13}^{EM}
		λ_m	EC	η_{m2}	U_{m1}^{EC}	U_{mm21}^{EC}	U_{12}^{EC}	U_{mm22}^{EM}	U_{m3}^{EC}	U_{mm23}^{EM}
TU_l						TU_1		TU_2		TU_3

parts for the needs of the OEM manufactures in Taiwan comes from several different areas, which CPU comes from U.S.A., shell and power supplier comes from China, and PCB comes from Malaysia. After assembling these parts into the semi-product with Main Board and DRAM, the semi-products was sent to Singapore and monitors was sent to Singapore, at the same time, as well. Finally, Dell pays the OEM manufactures in Taiwan. From the viewpoint of virtual logistics, for example in Fig. 4-1, it was the application of postponement for the DP, the OEM manufactures of distri-park, to assemble the semi-products after receiving the order from international businesses. So, the specific CMU focus on the core competitive parts, for example of Main Board, and the other parts comes from another area (countries), the application of outsourcing. Finally, assembly will take place at the specific CMU_l. The competitiveness was measured, from the viewpoint of virtual value chain, with cost, service, quality, and flexibility to analyze the position, competitive industries and target markets, of international Distri-park at specific CMU.

value. Finally, we acquire the total utility of competitiveness, according to the data (tab.4-1. 4-2, 4-3) we assumption and the function (11), for each CMU (see tab. 4-4). The results present the CMU_2 relative competitiveness than the others on the target market of southern-east Asia at the 3C industry.

Tab. 4-2 the competitive condition of information products from CMU_i to southern-east Asia

Information Products	Cost (USD) ($TC^{IB}+TC^{OP}+TC^{OB}$)	Service utility JIT	RT	Quality utility CM	CN	Flexibility utility EM	EC
CMU_1 (DP_1)	300	0.35	0.20	0.40	0.30	0.20	0.30
CMU_2 (DP_2)	245	0.30	0.40	0.35	0.45	0.35	0.50
CMU_3 (DP_3)	270	0.35	0.30	0.25	0.25	0.45	0.20

Tab. 4-3 the competitive condition of electric products from CMU_i to southern-east Asia

Electric Products	Cost (USD) ($TC^{IB}+TC^{OP}+TC^{OB}$)	Service utility JIT	RT	Quality utility CM	CN	Flexibility utility EM	EC
CMU_1 (DP_1)	240	0.25	0.30	0.40	0.20	0.35	0.25
CMU_2 (DP_2)	220	0.40	0.30	0.40	0.35	0.35	0.35
CMU_3 (DP_3)	230	0.25	0.40	0.20	0.45	0.30	0.40

Tab. 4-4 the comparison of competitiveness for the DMU from CMU_i to southern-east Asia

Industrial weight I_i	Index	weight w_j	Criteria	weight C_{ik}	utility (CMU_1) U_{i1}	U_{ijk1}	utility (CMU_2) U_{i2}	U_{ijk2}	utility (CMU_3) U_{i3}	U_{ijk3}
0.65	C	0.25	AC	1	0.30	0.0478	0.37	0.0601	0.33	0.0536
	S	0.40	JIT	0.30	0.35	0.0273	0.30	0.0140	0.35	0.0163
		0.40	RT	0.70	0.20	0.0364	0.40	0.0728	0.30	0.0546
	Q	0.20	CM	0.60	0.40	0.0312	0.35	0.0273	0.25	0.0195
		0.20	CN	0.40	0.30	0.0156	0.45	0.0234	0.25	0.0130
	E	0.15	EM	0.45	0.20	0.0088	0.35	0.0154	0.45	0.0198
		0.15	EC	0.55	0.30	0.0161	0.50	0.0268	0.20	0.0107
0.35	C	0.40	AC	1	0.32	0.0448	0.35	0.0490	0.33	0.0462
	S	0.10	JIT	0.60	0.25	0.0053	0.40	0.0084	0.25	0.0053
		0.10	RT	0.40	0.30	0.0042	0.30	0.0042	0.40	0.0056
	Q	0.25	CM	0.35	0.40	0.0122	0.40	0.0122	0.20	0.0061
		0.25	CN	0.65	0.20	0.0114	0.35	0.0199	0.45	0.0256
	E	0.25	EM	0.40	0.35	0.0123	0.35	0.0123	0.30	0.0105
		0.25	EC	0.60	0.25	0.0131	0.35	0.0184	0.40	0.0210
TU_i						0.2874		0.3642		0.3078

5. CONCLUSIONS AND FURTHER RESEARCH

In order to provide high value-added service, the establishment of international distri-park is important, which not only contributes the efficient distribution of import/export cargos, but also attracts the international businesses to distribute international products via the distribution center. Because of difference of the economic conditions, industrial structure, and geographic location, each CMU has its competitive advantages. Therefore, it is important

for the CMU to select the target market and the competitive industries of the international Distri-park. The results and suggestions are shown as follows:

1. According to four indexes, competitive priorities cost, quality, service, and flexibility, a model of competitiveness of value chain was built with one main function and four sub-functions. The functions description are as follows:
   (1) The total utility function--the cost, service, quality, and flexibility of the value chain go through from vendors, through competitive unit, to target markets at specific product type.
   (2) The cost utility function--the ratio of the average cost from vendors, through specific competitive unit, to target markets and the average cost from vendors, through all competitive units, to target markets at specific product type.
   (3) The service utility function –the ratio of the time, including average time and average time differentiation, from vendors, through specific competitive unit, to target markets and the time from vendors, through all competitive units, to target markets at specific product type.
   (4)The quality utility function – the ratio of the ability, including the abilities of handling and technical consistent, from vendors, through specific competitive unit, to target markets and the ability from vendors, through all competitive units, to target markets at specific product type.
   (5)The flexibility utility function of –the ratio of the ability, including the abilities of flexible manufacture quickly and fitting the demand of customers, from vendors, through specific competitive unit, to target markets and the ability from vendors, through all competitive units, to target markets at specific product type.

2. Through the establishment of the competitive model of value chain, the total utility of the integrated value chain could be acquired from each supplier to each competitive unit at the specific product type. The total utility of the integrated value chain could also be acquired from each competitive unit to each target markets at specific products type.
3. The concept of virtual value chain was adopted to approach the competitiveness of competitive unit. Under the principle of integrated maximum utility, the organization seeks other partners by strategic alliances way in specific integrated supply chain. That is, the competence of virtual value chain can go with the competitive industries and other conditions of advantage of CMU, and develop the value-added service with core competence. Through the corporation, such as outsourcing, with other strategic partners forms maximum total utility of integrated value chain from vendors to target markets, creates relative competitiveness of value chain, and finally forms oneself competitiveness with other competitive units.
4. This paper presents an example to illustrate the operation method of competitiveness model of international Distri-park at specific CMU, which is from the viewpoint of virtual value chain with cost, service, quality, and flexibility. However, There is not enough practical analysis of the utility value of the competitive model. Consequently, it was suggested that the following researchers used the model on the researches.

REFERENCES

Bakos, J. Yannis. (1992), Information Technology Investments, **MIS QUAERTERLY**, Sep., pp. 335-352.
Chen, T. (1997), Competitive Advantages of Container Ports, **Transportation Planning Journal**, 16/3, pp. 449-472.
Dornier P.P., Ernst R., Fender M., Kouveilis P. (1998), **Global Operation and Logistics**, John Wiley & Sonic Inc., New York.
Dutta, B. K.; W. R. King, (1980), A Competitive Scenario Modeling System, **Management Science**, 26/3, pp261-273.
Heaver, T. D., (1995), The Implications of Increased Competition Among Ports for Port Policy and Management, **Maritime Policy and Management**, 22/2, pp125-133.
Jayanthi, S.; B. Kocha; K. K. Sinha, (1999), Competitive Analysis of Manufacturing Plant: An Application to the US Processed Food Industry, **European Journal of Operational Research**, 118, pp217-234.
Miyajima, M.; K. S. Kwak, (1989), Interport Competition in Container Cargo, **Maritime Policy and Management**, 16/2, p48.

Oral, M.; C. R. Dominique, (1989), An analytical approach to competitive strategy formulation in mature industries, **IIE Transactions, 21/3**, pp271-278.
Porter, M. E. And Millar, V. E. (1985), How Information Gives You Competitive Advantages, **Harvard Business Review**, July-August, pp.149-160.