

Full Length Research Paper

Construct intellectual capital performance model for a logistic industry

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Our country is an island-orientation country, no matter the imported and exported trade, all depend on the development of international trade, so the logistics industry can be regarded as an important equity of economic development in Taiwan. It also plays an important role among escalate enterprises' efficiency. A rapid change in information technology and business management, enterprises face more competitions and challenges in Twenty-first century. Strategy management is the key factor for businesses to survive, so managers should plan a performance evaluation management system. It is important a research issue to construct performance valuation model for logistic industry. Unfortunately, current performance evaluation management mostly focuses on financial indicators for performance evaluation without taking innovation and customer satisfaction into consideration. However, in the economic-knowledge era, there are still evaluation systems such as balanced scorecard and intelligence capital that pay attention to both financial and non-financial indicators. According to the economic department research report, there are more than one million and three hundred thirty thousand small and medium-sized enterprises in 2010. This paper would incorporate intellectual capital to construct performance evaluation model for a logistic industry.

Key words: Intellectual capital, performance valuation, logistics industry.

INTRODUCTION

In this rapidly changing 21st century, the evolvments of information, technology and corporate operation environment have been in such an incredible speed such that enterprises have been facing increasing competition and challenges. In such environment, strategic management becomes an important factor affecting enterprise sustainability. A set of control mechanism will be needed for strategic management, and this control mechanism is performance evaluation. The key to the sustainability of corporate operation is the operation performance, and it can be judged by this performance evaluation model. There are internal and external factors affecting operation performance such as human quality, organizational climate, management system, financial structure, economic prosperity, changes in consumer of Commerce,

preferences, pier competition and changes of laws and regulations. According to the statistics of the Department Ministry of Economic Affairs (MOEA), the number of small and medium enterprises (SMEs) in Taiwan would reach 1.35 million by end of November 2011. One of the key success factors for SME operation is the capability to deliver services and products to customers effectively in proper order. Only through logistics industry can products and services be delivered to customers in appropriate time, location, quality and quantity. Therefore, it is fair to say the logistics industry is not only an integral part of economic development in Taiwan but also the driven force behind the lifeline of Taiwan economy. According to the statistics of Ministry of Transportation and Communications (MOTC), Executive Yuan: the total container cargo handled by cross-strait direct shipping from January to September in 2010 has grown by 27.9%; the total container cargo handled by ports in our country from January to September in 2010 has a year-on-year

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Table 1. Container cargo handled by cross-strait by recently five years unit: ten thousand TEU · %.

year	Total		Keelung		Kaohsiung		Taichung		Taipei						
	Corss strait		Corss strait		Corss strait		Corss strait		Corss strait						
	share	share	share	share	share	share	share	share	share	share					
2006	975	-	-	158	-	-	726	-	-	90	-	-	-	-	-
2007	1,014	-	-	165	-	-	758	-	-	91	-	-	-	-	-
2008	1,006	5	0.5	160	1	0.7	752	3	0.5	94	1	-	-	-	-
2009	856	110	129	115	24	20.5	629	69	10.9	87	18	21.0	24	0.05	0.2
2010	946	141	14.9	132	32	23.9	683	83	12.2	99	26	25.7	32	1	2.0

(YoY) growth of 10.5% to reach 9.46 million TEU, where 14.9% of which is from the contribution of cross-strait direct shipping of 1.41 million TEU with the YoY growth of 27.9%. It is obvious that the competitiveness and business prosperity among port can be established by securing cross-strait business opportunities and maintaining smooth cargo transportation between Taiwan and East Asian as shown in Table 1.

While facing a market full of changes and intensive competitions, much like in other industries, the logistics industry is in imperative need of a subjective performance evaluation model in order to conduct proper performance management, to understand operation driving factors, and to guide the industry to growth and profit. Therefore, it is important to establish a subjective and comprehensive operation performance evaluation model for logistics industry.

It will take huge amounts of capital, equipments and professional staff for SMEs to establish logistics centers all by themselves, thus most businesses have outsourced logistics activities to specialized logistics service providers for the purposes of cost saving, efficiency enhancement, and better focus on core businesses. According to the result of survey conducted by Capgemini in US with respect to the outsourced logistics ser-

vices from more than 600 international businesses worldwide, more than 80% of the businesses in Northern America has outsourced their logistics activities to specialized logistics service providers, while the number for businesses in Asian Pacific region has grown significantly to 84% in 2004 from the 58% in 2003 (GS1 Taiwan, 2005). According to the survey of IEK/ITRI in 2005, 2/3 of businesses in Taiwan has outsourced logistics services to specialized logistics service providers (Department of Commerce, MOEA, 2005). With this outsourcing trend, it becomes even more important for SMEs to evaluate the operation performance of these logistics service providers.

There are various methods for evaluation of operation performance. Beaver (1966) and Altman et al. (1968) pointed out that non-quantitative information is difficult to obtain and its representativeness tends to be questioned, thus traditional financial analysis methods have been mostly used to obtain individual management indicator. Financial statements are accounting outputs integrating business operation activities which are audited by certified public accountant (CPA), monitored by securities authority, publicly and periodically disclosed with undoubted importance and reliability. However, in this era of knowledge economy, the key success factors for

businesses have been gradually shifted from the management of tangible assets to the intangible management capability for human intelligence and system (Quinn et al., 1996). Peter Drucker thinks that a knowledge manager should convert knowledge into organizational "asset", apply knowledge management to improve organizational performance, and to become the most important contributor for organizational growth. Throuow (2000) believes knowledge is the basis for the creation of wealth, and knowledge workers emphasize efficacy and doing the right things. Businesses should emphasize on utilization, accumulation and innovation of knowledge in order to create ultimate values. According to the survey by Morgan Stanley's World Index, the average values of all businesses in worldwide stock markets are twice the book values, while for US businesses they are two to nine times the book values (Edvinsson and Malone, 1997). There is no exception for the logistics service providers in Taiwan. According to the MOEA's whitepaper of SME, there have been as many as 1.35 million SMEs in Taiwan by end of 2010 which account for more than 98% of all businesses. The domestic logistics service providers' play the roles of crucial value chain partners for domestic SMEs from the perspectives of logistics and marketing, such that

the performance improvement of logistics service providers should help SMEs to achieve the win-win situation with upstream and downstream integration.

From the stock price information announced by government securities and futures commission, the YoY growth of stock prices among logistics industry has been significant. The gap between the stock price and net worth indicates that there is certain hidden value in this business which has been neglected. The motivations for businesses to create values and enhance operation performance cannot be evaluated if our government does not emphasize and evaluate this. To obtain this motivation, the hidden value must be evaluated and all evaluation indicators must be established to achieve high quality operational performance. In management theory we call this value "Intellectual capital". In addition to tangible assets, all intangible assets contributing to company value are called "Intellectual capital". It has been proven in past studies that intellectual capital has been influential to business operational performance, therefore in this study we plan to construct evaluation model for operational performance of logistics industry by integrating perspective of intellectual capital.

LITERATURE REVIEW

As a part of organizational performance, logistics performance can be defined as the level of achievement of the organizational targets of speed, reliability, quality, quantity and time of delivery (Chow et al., 1994; Schramm-klein and Morschett, 2006). Summarizing past literature, Chow et al. (1994) has divided logistics performance into "hard" measures and "soft" measures. "Hard" measures are financial related indicators such as net profit, rate of return and profit rate; "soft" measures are indicators related to service satisfaction such as customer satisfaction and quality. Lai et al. (2002) have divided the performance evaluation indicators for the supply chain of logistics industry into the three aspects of effectiveness, operational efficiency, and trustee service validity, and they have established the 26-item scale; Schmitz and Platts (2004) have divided the logistics performance evaluation indicators into eight categories such as strategic planning and classification, management information, coordination with suppliers, decision selection and improvement of suppliers, coordination and appliance, supervision of suppliers, and learning capability; it has been pointed out by Morris and Carter (2005) that logistics performance should be defined as the capability and efficiency of in-time delivery of goods from suppliers to customers; Schramm-klein and Morschett (2006) have divided logistics performance into the two kinds of evaluation indicators such as logistics cost and logistics quality based on whether they are financial indicator or not. Among domestic literature related to logistics industry, Hung (2003) has detailed logistics

performance indicators from the perspectives of warehousing and transportation according to the four aspects of enterprise competitiveness (finance, productivity, quality and response time); while Sun (2003) thinks the logistics performance evaluation indicators can be divided into cost, quality, flexibility and productivity based on the logistics operational capability.

From all aforementioned literature regarding the exploration of operational performance evaluation of logistics industry, only a small portion of them put the emphasis on the importance of financial and non-financial performances, while most literature only focus on the aspects of quality and efficiency of delivery, and the relationship between suppliers and logistics industry. In recent years, there have been certain revolutions of performance evaluation among many industries where originally regarded as the foundation of performance evaluation, financial indicator has now become only one of the many indicators. Other non-financial indicators such as quality, customer satisfaction, innovation, and market share usually are capable of better representation of company's economic status and development background than net profit. The company will face danger of stagnated growth if it relies on forecast based solely on accounting information. More and more enterprise managers have modified their performance evaluation system by the addition of non-financial indicators. Kaplan and Norton (1992) have introduced a system for evaluation of enterprise performance called "Balanced scorecard". The overall operational performance of given enterprise can be effectively evaluated through the four aspects of this "Balanced scorecard" such as finance, internal process flow, customer, and learning and growth.

The three aspects of balanced scorecard (internal process flow, customer, and learning and growth) are identical to the perspective of intellectual capital. Moreover, nowadays the evaluation of enterprise operational performance cannot be just based on financial factors. For maintaining competitiveness, enterprises will invest in human resources, operational process flow and supplier-customer relationship. In addition to profit, these investments will improve the competitiveness. Intellectual capital is regarded as the ownership equity of a knowledge-based enterprise (Masoulas, 1998); Osborne (1998) has further pointed out that the level of contribution of intangible assets to the creation of enterprise value can be as high as 80%. However, it is difficult to use GAAP to identify the true value of intangible assets such that the gap between the book value and market value of enterprise will only get bigger. During the review of all studies in the past related to intellectual capital and enterprise operational performance, Canibano et al. (2000) indicated items of intellectual capital such as process capital, human capital and customer capital can all affect enterprise performance. Among the literatures related to the effect of process capital on enterprise performance, the study by Lin and

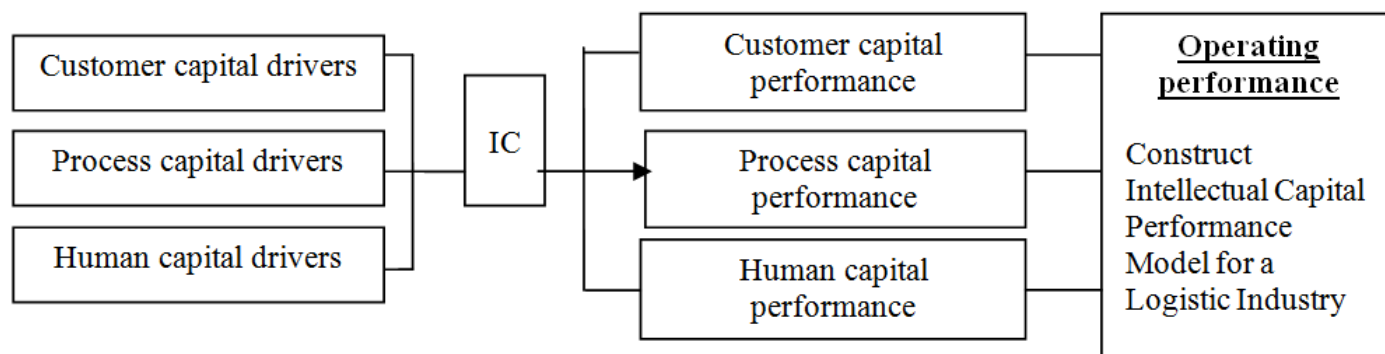


Figure 1. Research framework.

Shih (2003) targeting domestic manufacturing industry indicates that the integration and coordination capability and official standardization procedure of the organizational structure can facilitate by ISO 9000 certification, leading to strengthened enterprise competitiveness and enhanced organization performance. Wu and Chang (2003) contend that the value chain of enterprise process capital can be used as the management procedure for development of intellectual capital such that enterprise operational performance can be improved by the establishment of process capital; as for the literatures related to the influence of human capital on enterprise operational performance. The study by Huang (2002, 2003) pointed out that the performance of organization with high innovation and high human capitals is obviously better than any other kind of organization, therefore, there should be significant positive correlation between human resources management and organizational performance. Other domestic literatures have all pointed out this positive correlation between human resources management and organizational performance (Chen and Hsu, 1999; Tsai and Yu, 2000; Lee, 2001); from the perspective of studies related to customer capital, many scholars have emphasized the importance of customer capital with respect to the operational performance and even the survival of enterprises (Wu and Liu, 2001; Pfeffer, 1994; Kogut and Zander, 1996; Uzzi, 1996). Heskett et al. (1994) further pointed out the positive correlations between customer satisfaction, customer loyalty, market share and financial performance.

Therefore, in this study we plan to apply the concept of intellectual capital in conjunction with multivariate analysis to help enterprise locate key success factor and core capability and achieve superior operational performance. The establishment of all indicators for evaluation of intellectual capital should help management to enhance the profitability of enterprise. In this study we apply the performance evaluation model constructed based on this concept to the logistics industry which is the crucial to the logistics and marketing activities of all SMEs in Taiwan hoping to provide certain contribution to

the industry and academia.

METHODOLOGY

Research structure

This research is mainly the application of intellectual capital concept to operational performance of logistics industry. According to reviewed literature, the positive correlation between intellectual capital and enterprise operational performance has been proven by many studies (Pfeffer, 1994; Kogut and Zander, 1996; Uzzi, 1996; Standifird and Marshall, 2000; Grover and Malhotra, 2003; Wu et al., 2001; Huang, 2003). Kaplan and Norton (2001) further pointed out that among the non-financial aspects of the balanced scorecard, in the aspects of staff learning and growth, internal process and customer will eventually be reflected in the corporate financial performance. And the content of non-financial aspects and intellectual capital concept are identical (Bukh et al., 2002; Andriessen, 2004; Wu, 2005). Therefore in this research we plan to construct the evaluation model for operational performance of logistics industry based on intellectual capital concept with the research structure as shown in Figure 1.

Research design

Samples and variables

In this research, we use the professional warehouse and transportation businesses in the business directory collected by the "2010 research database of TOP 5000 businesses" of China Credit Information Service, Ltd. as our research samples, among which we select 56 warehouse and transportation businesses for establishing the performance evaluation models. We also construct the evaluation model for operational performance of logistics industry based on intellectual capital concept. For the performance evaluation indicators for intellectual capital, we adopt the concept of Bontis (1999) and divide intellectual capital into three categories of human capital, process capital and customer capital. Intellectual capitals of enterprises are mostly not quantifiable indicators such that it is difficult to obtain the performance of intellectual capital through questionnaire filling. In light of this deficiency, we adopt the selection criteria among past related literatures where intellectual capitals are quantized by surrogate variables (Standifird and Marshall, 2000; Grover and Malhotra, 2003; Wu et al., 2001; Huang, 2003). For human capital, the four performance evaluation indicators selected are average years of service, number of staff with education level of a master's degree or above, educational

Table 2. Factor analysis of driving factors for intellectual capital.

Aspects of driving factors for intellectual capital	Factor loadings	Eigenvalue	Cumulative variance (%)
Aspects of driving factors for customer capital			
- Number of product lines of logistics industry	0.55823	1.331	62.7
- Market share	0.75583		
- Market growth rate	0.56254		
Aspects of driving factors for process capital			
- Operating expense ratio	0.76742	1.458	70.7
- Fixed asset turnover	0.47753		
- Accounts receivable turnover	0.76461		
Aspects of driving factors for human capital			
- Average years of service	0.51520	1.276	82.5
- Number of staff with education level above master	0.69485		
- Educational training expense ratio	0.64721		
- Sales revenue per employee	0.50513		

training expense ratio, and sales revenue per employee; for process capital, we select operating expense ratio, fixed asset turnover and accounts receivable turnover as the three performance evaluation indicators; for customer capital, the three performance evaluation indicators selected are number of production lines of logistics industry, market share and market growth rate.

Research methods

The objective of this research is to construct operational performance evaluation model for logistic industry based on the concept of intellectual capital. The multivariate analysis method used here is factor analysis. In factor analysis, operational performance aspects most relevant to logistics industry are extracted among numerous evaluation indicators for financial ratios and intellectual capitals, and then the operational performance evaluation model based on concept of intellectual capital is constructed through naming of factors.

EMPIRICAL RESEARCH

We use the professional warehouse and transportation businesses in the business directory collected by the "2010 research database of TOP 5000 businesses" of China Credit Information Service, Ltd. as our research samples. Fifty-six warehouse and transportation businesses are selected from the service providers ranked from the 33rd place to the 4824th place. In terms of performance indicators for intellectual capital, ten indicators are selected among human capital, process capital and customer capital. After factor analysis by statistic software SPSS version 14.0, we found the correlation among variables. Therefore, we decided to use factor analysis method for further analysis in this research in order to obtain indicators which are capable of representing actual operation status of logistics industry.

RESULTS

Factor analysis

In the process of factor extraction, according to the data

collected by the "2010 research database of TOP 5000 businesses" of China Credit Information Service, Ltd., ten evaluation indicators have been selected for intellectual capital performance for conducting factor analysis. Three performance factors with eigenvalue larger than 1 have been extracted, thus we obtain the three aspects of driving factor for intellectual capital as customer capital, process capital and human capital as shown in Table 2. The three performance factors include intellectual capital indicators. In customer capital, market share indicator has highest factor loadings; in process capital, operating expense ratio indicator has highest factor loadings; in human capital, number of staff with education level above Master indicator has the highest factor loadings.

From Table 2 we can see that among the 10 performance indicator variables selected by this research, factor analysis extraction has been conducted in three aspects, with the cumulative variance explained up to 82.5%. Zaltman and Burgur (1975) suggested that the result of factor analysis can be regarded as successful when eigenvalue is larger than 1, the absolute value of factor loading is larger than 0.3, and the cumulative variance explained is larger than 40%.

Establishment of performance evaluation model for intellectual capital of logistics industry

Prior to the establishment of performance evaluation model, due to different importance of each factor, specific weight should be assigned during summing to prevent loss of correctness. There are many methods for determination of this weight, while they can roughly be divided into two categories of "Subjective weight" and "Objective weight".

Subjective weight is generated according to the subjective preference of decision maker, thus this weight

Table 3. Factor weighting.

Factor aspect	Aspect name	The explanatory of total variation (before adjustment)	The explanatory of total variation (after adjustment)
1	customer capital	0.218	0.3007
2	process capital	0.345	0.4757
3	human capital	0.162	0.2236
		0.725	1

tends to be interfered by factors related to decision maker and compromises the result of performance evaluation. Other than direct determination by decision maker, there are other methods such as expert assessment method, eigenvector method, and fuzzy weight method; objective weight is usually calculated from actual performance value, thus when the performance value is stable, so is the weight value. We adopt eigenvector method with objective weight, and we use the percentage of explained variance of each factor with respect to total explained variance as the weight to obtain the weight for performance evaluation.

We however obtain three factor aspects from factor analysis. After standardization of each aspect, the score of each factor will be converted into percentage point by Equation 1 before being substituted into the formula.

$$F = \frac{1}{1 + e^{-z}} \times 100 \quad (1)$$

Different weight will then be assigned according to the level of explained variance of each aspect as shown in Table 3, and the equation for the score of operational performance strength can be obtained (Equation 1.2) where F is the point for each factor, and Z is the score of factor after standardization. In the end the total sum of all points will be the score of operational performance for each enterprise. From Table 3 we can get the operational performance evaluation model of logistics industry as:

$$Y = 0.3007F1 + 0.4757F2 + 0.2236F3 \quad 2$$

Y= score of operational performance strength
 F1= factor point of "customer capital" aspect
 F2= factor point of "process capital" aspect
 F3= factor point of "human capital" aspect

From Table 3, we can see that the weight of process capital driving factor is as high as 0.4757, indicating the importance of process flow for logistic industry. The process flow management for logistics industry includes various aspects such as "Logistics operation process flow", "Process flow information and status", "Status of technology equipment in process flow management", "Structure/Department management methods", "Coordination between logistics and information", and "Flow and distribution of human resources". This has reflected the

spirit and essence of balanced scorecard, whereas the creation of customer value will affect the sophistication and production process of internal process flow based on whether or not the internal process of enterprise has any advantage. And the advantage of internal process flow will be affected by whether or not there have been complete and proper staff learning and educational training in this enterprise. Therefore, the balanced scorecard is emphasizing that the learning and growth of staff will affect enterprise internal process flow, which will affect customer aspect, and eventually affect the financial performance of this enterprise. This is why the financial related aspect has higher weight than the aspect of intellectual capital performance. In Table 3, we find that the weight for human capital aspect is only 0.2236. The indicators for human capital are: average years of service, number of staff with education level above Master, educational training expense ratio, and sales revenue per employee. These indicators are focused on the years of service, educational level, and the training expenses leading to weaker driving factor.

Logistics industry is mainly for providing service to customers and maintaining relationships with suppliers by adoption of strategies such as Just-in-time (JIT), speedy response to customers, and customer satisfaction. Therefore, logistics industry should emphasize external relationship management, and the enhancement of external image and status. This study indicates customer capital driving factor has positive correlation with and has been the most influential to the intellectual capital of enterprises related to domestic logistics industry.

CONCLUSION AND SUGGESTION

In this research, we use the professional warehouse and transportation businesses in the business directory collected by the "2010 research database of TOP 5000 businesses" of China Credit Information Service, Ltd. as our research samples, among which we select fifty-six warehouse and transportation businesses and ten intellectual capital driving factors for establishing the performance evaluation models for intellectual capital. The model is established based on the concept of intellectual capital. Three aspects are extracted by factor analysis such as customer capital, process capital and human capital. This established model is not only capable of improving the deficiency of traditional operational

performance evaluation only focused on financial analysis, but also taking into consideration the intellectual capital indicators such as educational level of employee, human performance, service quality, and market share. To improve the applicability and reliability of this model, follow-up researchers can compare the evaluation result of the performance evaluation model for logistics industry established in this research to the ranking of logistics industry among TOP5000 businesses of China Credit Information Service, Ltd. This model can also be modified and applied to the performance evaluation for other industries.

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