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Enterprise Infrastructure Related to the Product Value Transferred from Intellectual Capital

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Abstract**—**The paper proposed a new theory of intellectual capital (so called IC) and a value approach in associated with production and market. After an in-depth review and research analysis of leading firms in this field, a holistic intellectual capital model is discussed, which involves transport, delivery supporting, and interface and systems of on intellectual capital. Through a quantity study, it is found that there is a significant relationship between the product value and infrastructure in a company. The product values are transferred from intellectual capital elements which includes three elements of content and the enterprise includes three elements of infrastructure in its market and product values of enterprise.

Keywords**—**Enterprise, product value, intellectual capital.

I. Introduction

THE research paper, patent permission and research paper of global economic growth have fundamentally changed since the 1970s with the rapid development of high technology, especially in integrated circuit, computers & peripherals, telecommunication, opto-electronic, precision machinery, and biotechnology engineering. Experiment, experience, and knowledge thereupon have taken the place of finance capital, human capital, and facility capital as the most important factors, especially in the competitive high technology realm.

The intellectual capital (so called IC) has seen a tremendous growth in knowledge workers and intangible assets. The growing dissociation of stock market value from book value strongly indicates the importance of intellectual capital. Nevertheless, while this discrepancy points to the scale of intellectual capital, it is not a highly useable model because, among other reasons, it is dependent on the market [1]. If it is true that non-financial variables affect performance and, in turn, share value, determining which ones have the greatest impact is critical. Understanding how intellectual capital correlate to the wealth of companies is also a key element. Finally, knowing which financial and non-financial performance measures can be integrated into one model to explain performance of intellectual capital is a necessary ingredient.

There are four categories of IC, including marketplace-related capital, mind-related capital, organization-related capital and human-related capital, has been identified [2]. The IC is separated into three categories, which include human capital, customer capital and structural capital [3], [4]. Among the best-known methods for IC measurement is Skandia IC model [5]. Skandia, one of Sweden's leading insurance companies operating internationally, is one of the pioneering companies in developing and implementing a systematic way of visualizing and measuring IC. Later, since a company's customer relationship is vital to its firm value, customer capital is therefore independent from structure capital by Hubert Saint-Onge [6]. Therefore, three forms of intellectual capital—human capital, customer capital, and structure capital which includes innovation capital and process capital—are formed. Many research adopted the similar classification of intellectual capital [3], [7]-[9]. The kind of classification is also proposed, and then divides each capital into several elements (e.g. dividing human capital into management team, professional skill, centripetal force, creativity, and informal interaction; and there are more detailed items under each element) [10]. The firm's primary activities are included producing and delivering the product to the consumer including internal logistics, production, external logistics, marketing and sales, as well as post sales service, as shown in Fig. 1 [11].

<table>
<tr><td colspan="5">Firm's Infrastructure</td></tr>
<tr><td colspan="5">Human Resource Management</td></tr>
<tr><td colspan="5">Technology Development</td></tr>
<tr><td colspan="5">Procurement</td></tr>
<tr><td>Inbound Logistics</td><td>Operations</td><td>Outbound Logistics</td><td>Marketing and Sales</td><td>Service</td></tr>
</table>

Fig. 1 Value chain (Source: Porter and Millar, 1985) [11]

Support activities involved in each of the primary activities are included providing human, material, and technological resource as well as the infrastructure to facilitate the work involved in the primary activities. The Porter's value chain is shown in Fig. 1 [11].

There are three categories of Intellectual Capital is identified, which includes customer capital, human capital, and financial capital [12]. These categories of IC can make the market value. Intellectual capital can be classified into four categories: human capital, relational capital, innovation capital, and structure capital [13]. The four categories are able to enhance its market value with customers and build up solid relational capitals to develop its superior marketing ability. The key successful factors of intellectual capital included execution of strategies,

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developing and utilizing human resource, capitalize on R&D and products, international strategic alliance, and fast penetration [13].

II. Research Method and Design

The value concept distinguishes with six sets of core processes for new construction of intellectual capital, which in turn consists of many activities as detailed in Fig. 2. In economic theory, this concept transforms the input variables into the output variables. A string of new construction represents the successive, technologically separable stages of an industry. The new construction of IC can be the fundamental building blocks of a value system but not necessarily stand-alone business opportunities. As shown in Fig. 1, the first concept of abstraction in the new construction of intellectual capital distinguishes between two strings of activities content or infrastructure services linked to the market value.

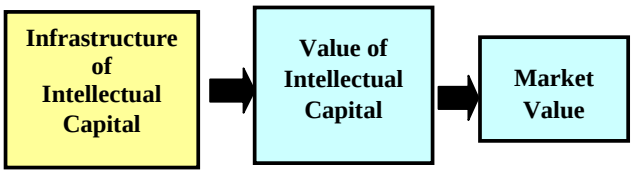

Fig. 2 Research framework of intellectual capital

In intangible asset planning the researchers have integrated finding in linking tangible to objective intellectual capital measures, but had not better success with subjective measures of performance in product value by using infrastructure of organization. Some researchers have questioned the performance from intellectual capital. However, recent studies in intellectual capital have found a positive relationship between performance and infrastructure of organization. Hence we hypothesize that the infrastructure of enterprise is positively related to the product value transferred from intellectual capital.

Hypothesis 1: Finance cost of enterprise is positively related to the product value transferred from intellectual capital.

Hypothesis 2: Labor cost of enterprise is positively related to the product value transferred from intellectual capital.

Hypothesis 3: Facility cost of enterprise is positively related to the product value transferred from intellectual capital.

The survey of National Science and Technology Activity was initially proposed by the Science & Technology Consulting Committee of the Executive Yuan in 1990. From 1981 to 1987, the Chin-Lin Research Center on National Taiwan University was commissioned to plan and conduct a trial survey, and in 1983 it became an annual event [14]. The China Productivity Center has been assisting in the private enterprise survey from 1988 to 1986. Since 1997, the National Science Council delegated the Taiwan Institute of Economic Research responded the whole process of survey [14].

III. Research Result and Discussion

The outcome of intellectual capital valuation is the positive impact infrastructure and content of intellectual capital, which can be measured by using production value. The census contains 366 companies. 432 of the computer systems design companies are selected by stratified random sampling and stratified according to number of employee, shown in Table I [14].

TABLE I
Description Statistic of Sampling
(Source: Indicators of Science and Technology R.O.C. [14] and Arrangement in This Study)

Target			Survey method	Number of survey
Universities			Census surveyed portion	2,753
Research institutes			Census surveyed portion	408
Industries	Public companies		Census surveyed portion	60
	Science-Based Industrial Park		Census surveyed portion	366
	Computer design	Employee <50	Random sample portion	134
		Employee >50	Census surveyed portion	298
	Private companies	expenditures of R&D<10 million	Random sample portion	1,256
		expenditures of R&D≥10 million	Census surveyed portion	1,634
	Others		Census surveyed portion	7
Total of Sample				6,916

The relatively larger number of finance cost in R&D expenditures was found in this study by secondary data in surveying the important links between the R&D expenditures. The main result of this study is that the large R&D expenditures and finance cost, not only in integrated circuit and optical electronic industries, but also in telecommunication and computer industries, is used across electronic industries, as shown in Table II.

TABLE II
Finance Expenditures of R&D by Industry, 2001 in Taiwan
(Source: Indicators of Science and Technology R.O.C. [14] and Arrangement in This Study) (Unit: Million N.T. Dollars)

Industry	R&D expenditures (Finance cost) (Source: Indicators of Science and Technology R.O.C.[14])	Percentage of R&D expenditures (%) (Source: this study)
Integrated circuits	30,595	66.5
Computers & peripherals	5,858	12.8
Telecommunication	2,954	6.4
Opto-electronics	5,490	11.9
Precision machinery	198	0.4
Biotechnology	905	2
Total	46,000	100%

The data used in this study are from Indicators of Science and Technology R.O.C. Table III shows that integrated circuit industry in total expenditures of developed new product was significantly not higher than telecommunication and biotechnology. In this data, the average total expenditures of developed new product of non integrated circuit,

telecommunication or biotechnology industry is 737.3, ranging from 577.8 to 957.4 million N.T. Dollars. Table IV reports the studying results for estimating total expenditures of developed new product by industry, 2001 in Taiwan.

The analysis between production value and infrastructure variables in all industries in 2002 in Taiwan are shown in Table IV. The hypothesis between production value and infrastructure variables is listed as follow. Infrastructure of enterprise is positively associated with the product value. After the data is arranged, the hypotheses are confirmed as following statement. Firstly, finance cost of enterprise is positively associated with the product value transferred from intellectual capital. Secondly, labor cost of enterprise is positively associated with the product value transferred from intellectual capital. Finally, the facility cost of enterprise is positively associated with the product value transferred from intellectual capital.

The regression analysis between product values (Y) and infrastructure of industry including finance cost (X1), labor cost (X2), and facility cost (X3) in 2002 in Taiwan is shown in equation of Table V. The first issue of this study exhibits the critical factors of intellectual capital. In this research, it may show that this relationship is generalized to content and infrastructure of firms. Further research may show that this relationship can be generalized to other content and performance all industries.

TABLE III
TOTAL EXPENDITURES OF DEVELOPED NEW PRODUCT BY INDUSTRY, 2001 IN TAIWAN (UNIT: MILLION N.T. DOLLARS)

Industry	Total expenditures of developed new product (Source: arrangement in this study)	Percentage (%) (Source: this study)
Integrated circuits	1181.7	21.2
Computers & peripherals	577.8	10.3
Teleccommunication	1035.6	18.5
Opto-electronics	957.4	17.1
Precision machinery	677.4	12.1
Biotechnology	1161.8	20.8
Total	5591.3	100%

TABLE IV
THE ANALYSIS BETWEEN PRODUCT VALUES AND INFRASTRUCTURE BY INDUSTRY, 2002 IN TAIWAN (UNIT OF ALL COSTS: MILLION N.T. DOLLARS (%) AND UNIT OF PRODUCT VALUE: BILLION N.T. DOLLARS (%)) (SOURCE: ARRANGEMENT IN THIS STUDY)

Industry	Finance cost	Labor cost	Facility cost	Product values
Integrated circuits	30,595 (66.5%)	26,684 (67.2%)	13,036 (68.7%)	652.9 (32.5%)
Computers&peripherals	5,858 (12.8%)	5,264 (13.3%)	1,859 (9.8%)	47.9 (2.4%)
Telecommunication	2,954 (6.4%)	2,598 (6.5%)	761 (4.0%)	251.5 (12.5%)
Opto-electronics	5,490 (11.9%)	4,248 (10.7%)	2,878 (15.1%)	630.9 (31.5%)
Precision machinery	198 (0.4%)	195 (0.5%)	59 (0.3%)	404.9 (20.2%)
Biotechnology	905 (2.0%)	690 (1.8%)	395 (2.1%)	17.8 (0.9%)

TABLE V
THE REGRESSION ANALYSIS BETWEEN PRODUCT VALUES (Y) AND INFRASTRUCTURE (X) BY ALL INDUSTRIES IN 2002 IN TAIWAN (SOURCE: THIS STUDY)

Variables	Coefficient
Predictor constant	243
Finance cost (X1)	0.095
Labor cost (X2)	-0.23
Facility cost (X3)	0.28
$Y=243 + 0.095(X1) - 0.23 (X2) + 0.28 (X3)$	
$R^2=0.70$	

Furthermore, this new model gains the widespread use for senior managers and chief knowledge officers alike previous model. Infrastructure of enterprise is positively related to the product value transferred from intellectual capital. Finance cost of enterprise is positively related to the product value transferred from intellectual capital significantly. Labor cost of enterprise is positively related to the product value transferred from intellectual capital significantly. Facility cost of enterprise is positively related to the product value transferred from intellectual capital.

IV. CONCLUSIONS

This research discusses the result of a new intellectual capital model which is carried out to determine the relationship between production value and infrastructure of organization and enterprise by quantity study. In the past, several case studies to determine the concept framework of intellectual capital have been although carried out, but those studies have just aimed mostly measurement or key factors of intellectual capital. In this study, the research has filled the gap, and by comparing the different industries shows the misalignment between infrastructure and product value of organization and enterprise for management performance. In addition, the financial cost, and labor cost of enterprise are all positively related to the product value transferred from intellectual capital significantly. However, the facility cost of enterprise is significantly not positively related to the product value transferred from intellectual capital.

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