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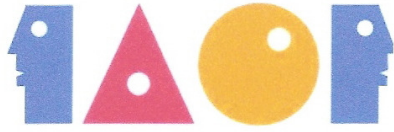
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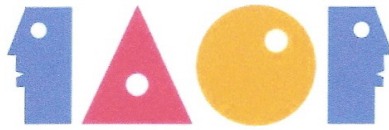
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THE RELATIONSHIP BETWEEN ORGANIZATIONAL  
CHARACTERISTICS, INNOVATION INTENSITY AND FIRM  
PERFORMANCE: FIRM EVIDENCE FROM THE U.S. SERVICES

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Abstract

This paper empirically explores the relationship between organizational characteristics, innovation intensity and firm performance for 606 US firms operating in three service sectors, literally, the supplier-dominated sector, the production-intensive sector, and the science-based and specialized sector. Generally, the three service sectors have different levels of innovation intensity (innovation intensity has a positive effect upon firm performance in terms of sales productivity and gross profit margin). Furthermore, the causal effects of organizational characteristics on firm performance as mediated by innovation intensity tend to differ among the three service sectors.

Keywords: Organizational Characteristics; Innovation Intensity; Firm Performance

## Introduction

New strains of research have extended our understanding of the effects of innovation on firm performance. While studies on the relationship between innovation and performance have been undertaken actively for the manufacturing industry (e.g., Crepon et al., 1998; Loof and Heshmati, 2006), there are much less empirical studies of this kind in the service context, especially at the firm level. More recently, a few studies have tried to empirically explore the relationship between the two variables in services at the firm level; however, they report different results (Cainelli et al., 2003, 2004, 2006; van Ark et al., 2003; Vermeulen et al., 2005; Mansury and Love, 2008; Elche and Gonzalez, 2008).

Using a longitudinal firm-level dataset that combines data from the second Community Innovation Survey, CIS II (1993–95) with other complementary information, Cainelli et al. (2003, 2004, 2006) explored the two-way relationship between innovation and firm performance in the service sector. The results show that innovation has a positive effect on firm performance in terms of productivity and economic growth. Productivity is associated not only with the presence of innovation, but also with innovation intensity (an input variable in the innovation process) including the level of financial commitment with respect to innovation and the type of innovation activities performed. Productivity differentials among firms and sectors emerge as being affected by the innovation efforts of firms and by the amount of resources devoted to the internal generation and adoption of ICTs (both software and hardware). Fur-

thermore, productivity and innovation act in a self-reinforcing manner, further boosting firm performance. These findings provide empirical support for the endogenous nature of innovation in the service context.

However, van Ark et al. (2003) showed that what effect innovation has on productivity growth is not clear, though innovation is clearly a key source of improved output and employment performance in Dutch service industries. They indicated that inadequate organizational innovations appear to play an important role in explaining the mixed results. The practice of service innovation is strongly hampered by insufficient recognition in statistics and research and policy making on the importance of organizational innovations. Therefore, they suggested that service innovation be characterized by a greater emphasis on the organizational dimensions of innovation rather than simply innovation per se; that service innovation take into account new service concepts, new client interface and new service delivery systems. In a later study, on the basis of a survey among 502 Dutch small service firms Vermeulen et al. (2005) found that new product introducers grow (by sales and employees) significantly faster than those that significantly lag behind on this effort. Differences between both groups (those that score significantly high in terms of introducing new products versus those that do not) are significant across various service sectors as well.

Elche and Gonzalez (2008) studied whether the fit between types of sectors and innovation decisions influences the firm performance of Spanish service firms' in terms of profitability

and growth. The classification of services was carried out according to innovation intensity, which measures the relationship between innovation expenses and turnover. Two groups of firms were obtained: the above-average innovation intensity group and the under-average innovation intensity group. Firm performance was assessed by five measures: return on investment, sales growth, net profit margin, market share, and general performance. In the case of services with above-average intensity innovation, research results show negative and significant correlations obtained between deviations from the ideal profile and firm performance. While firms coming closest to the optimum innovation profile achieve better firm performance, those that deviate from the ideal profile show a lack of adjustment between production and innovation strategy, and therefore their performance tends to suffer. However, in the under-average intensity innovation group, an adjustment of innovation decisions to fit the ideal profile does not guarantee superior profits.

Newly, Mansury and Love (2008) examined the effect of different levels of innovation (new-to-market and new-to-firm) on the performance of 206 U.S. business service firms (classified as *SIC 73*). They proposed a theoretical framework relating firm performance in terms of growth and productivity to innovation outputs and external linkages, and taking into account specific determinants of service innovation and a set of internal resource and other firm characteristics. Their study found that internal resource indicators and other firm characteristics have a consistently positive effect on sales and employment growth, but no effect on productivity. Their results also showed that

external linkages have an overwhelmingly positive effect on firm performance, regardless of whether innovation is measured as a discrete or continuous variable, and regardless of the level of innovation considered.

On the whole, although the above studies extend our understanding concerning the relationship between service innovation and firm performance at the firm level, their estimated results are different due to different data sources, types of theoretical frameworks, estimation methods, and definition of variables. Furthermore, the effects of organizational characteristics on innovation intensity are diverse. For example, while Cainelli et al. (2003, 2004, 2006) presented a positive relationship between firm size and firm performance, Mansury and Love (2008) found that firm size (i.e., employment) shows a U-shaped relationship with growth, but has no effect on productivity. Moreover, since other organizational characteristics such as market position (Pearce and Robinson, 1996; Oerlemans et al., 2005) and diversification (Besanko et al., 2006; Pavitt et al., 1989; Hughes, 1988) can also influence innovation intensity and firm performance, it is worth examining whether these variables too may have direct and indirect effects on firm performance and whether the relationship between these variables and firm performance may be mediated by innovation intensity.

The present study therefore explores the relationship between organizational characteristics, innovation intensity and firm performance in the service context. In this paper, service innovation is defined as services and processes that are both: (i) new or sub-



stantially improved with respect to the market and (ii) new or substantially improved only with respect to the firm. Altogether, the study adds to our knowledge of service innovation in three ways. Firstly, it uses data from the US service industries; except Mansury and Love (2008), most of the previous studies concerning the effects of innovation in service industries have been from Europe (e.g., Elche and Gonzalez, 2008; Cainelli et al., 2004, 2006; Vermeulen et al., 2005). Secondly, an important difference between this paper and those described earlier is that we adopted more comprehensive measures of organizational characteristics, including firm size, past performance, market position and diversification. Finally, instead of treating the type of service sector as a regressor of innovation intensity or of economic performance, care was taken in the empirical identification of sectoral differentials in the cases of understanding causal relationships among organizational characteristics, innovation intensity and firm performance. This study thus divided the firms that constituted the sample into three distinct service sectors, namely the supplier-dominated sector, the production-intensive sector, and the science-based and specialized sector (Miozzo and Soete, 2001), and thereafter analyzed their organizational activities accordingly.

The structure of the paper is as follows: In the first section, i.e. Introduction, the focus of the study was established. The second section specifies a theoretical framework and provides definition of variables. Causal relationships among organizational characteristics, innovation intensity and firm performance are proposed. The third section discusses the research method-

ology and data analysis. Data from COMPUSTAT enabled this study to measure organizational characteristics, innovation intensity and firm performance and investigate their relationship with each other. In section four, the empirical estimation of their relationship will be shown and discussed. The estimated results from the theoretical framework are presented; comparisons are made between three types of service sectors: supplier-dominated, production-intensive, and science-based and specialized and specialized services. Finally, the paper concludes with basic conclusions and suggestions for future research.

## Theoretical Backgrounds and Hypotheses

### *The Effects of Service Types on Innovation Intensity*

Previous studies identified sectoral differentials in the cases of exploring the impact of innovation activities on the economic performance of service firms (Davide, 2007; Evangelista, 2006; Cainelli et al., 2003, 2004, 2006; Vermeulen et al., 2005). With regard to sectoral differentials that might exist in the consideration of service innovations, a classification of services structured according to functional criteria is needed. Considering the industry nature, sources of innovation and implications for technology strategy and innovation management, Pavitt (1989) proposed five major technological trajectories and defined services in the 'supplier-dominated' category, signifying services usually are the passive user of technology. However, with the growing of service economy, the difference in patterns of

technological innovation is expected to increase.

A simple generalization of service sector is no longer suitable within today's context; as a result, Miozzo and Soete (2001) took a new taxonomic approach with special consideration of the functional characteristics of service activities and reclassified service sector into the following three categories of service groups.

The supplier-dominated services: they can mainly be found in personal services, (i.e., restaurants and hotels, laundry, repair services, barber, and beauty services) and in public and social services like healthcare and public administration. They are often small firms with little in-house R&D, engineering capability or software production. Competition rarely depends on technological advantage, rather through professional skills, aesthetic design, trademarks, and advertising. Most innovation comes from suppliers of equipment, information and materials.

The production-intensive services: this group consists of large firms in sectors such as transport and travel, wholesale trade, financial and insurance, and distribution feature large-scale processes with a high division of labor, simplification of task, use of machinery and IT applied for efficiency purpose. In this group, while technological innovation mostly comes from manufacturing suppliers, the nature of these innovations is strongly specified by service use. Still, large scale and information network firms might undertake R&D and usually do substantial work on system design,

specification, configuration and integration.

The science-based and specialized services: they are business services closely related to R&D, software, and the development and application of information technologies, e.g., professional, scientific and technical service firms and other knowledge intensive business services (KIBS). They have substantial expenditure on innovation compared to most of the economy and focus more on R&D than other services.

Miozzo and Soete's (2001) classification offered a richer picture of the variety of innovation activities involved in services. Similar studies based on their classification have provided evidences of sectoral differences within service sectors as well (Davide, 2007; Vermeulen et al., 2005). Accordingly, this study adopts their service taxonomy and proposes that,

H1: Service types have impact on innovation intensity.

#### The Effects of Organizational Characteristics on Innovation Intensity

Several organizational characteristics have been found to be related to innovation intensity in service industries, namely, firm size, market position, past performance, and diversification. Firstly, innovation intensity found to increase with firm size (Hipp et al., 2000; Vossen and Nootboom, 1996). Small firms differ in terms of access to resources (Tidd et al., 1997), resulting in a lower propensity to innovate. However, Vermeulen et al. (2005) proposed that while large firms generally enjoy resource advantages, they are

relatively slow and reluctant to react to changes in the environment; in other words, they may well be less prone to introduce innovations. Moreover, some empirical studies have found a non-linear U-shaped relationship between innovation intensity and firm size (Mansury and Love, 2008; Acs and Audretsch, 1988; Pavitt et al., 1987). That is, small firms and very large firms have higher innovation intensity. Likewise, market position accounts for the level of innovation intensity. Schumpeter (1942) proposed that firms with better monopoly capability are more capable of engaging in innovation activities. The same relationship may well apply in the service sector as well (Oerlemans et al., 2005; Pearce and Robinson, 1996). Developing a stronger market position enables firms to provide innovative outputs in terms of providing faster, cheaper or higher quality services (Jong et al., 2003). With regard to the effect of past performance on innovation intensity, Cainelli et al. (2003, 2004, 2006) indicated that past performance does affect the amount of resources devoted by service firms to the innovation process. Chen (2003) further indicated that past performance determines a firms' decision concerning a future propensity for technological innovation, with firms engaging in more innovation when past performance is far above average. In order to better manage diversified businesses, continuous innovation is expected to achieve competitive advantages (Tidd et al., 1997); moreover, highly diversified firms enjoy economies of scale in innovative outputs across different businesses, and thus have a higher tendency to innovate compared to less diversified firms (Besanko et al., 2006). Pavitt et al. (1989) further noted that diversification may

reflect technical interdependencies with suppliers, customers and partners, and therefore result in an insignificant relationship with innovation intensity. However, Hughes (1988) revealed that in the UK, there is a significantly negative relationship across industries between R&D intensity and diversification.

Accordingly, four hypotheses related to the effects of four organizational characteristics on innovation intensity are proposed in the following.

H2: Firm size is positively correlated to innovation intensity.

H3: Market position is positively correlated to innovation intensity.

H4: Past performance is positively correlated to innovation intensity.

H5: The level of diversification is positively correlated to innovation intensity.

#### The Effect of Innovation Intensity on Firm Performance

Research evidence reveals a strong correlation between innovation activities and firm performance in service sectors (Vermeulen et al., 2005; Cainelli et al., 2004; Jong et al., 2003; Hoffman and Bateson, 1997). In the empirical study of Netherlands services, Vermeulen et al. (2005) revealed that innovative service firms grow (by sales and employees) significantly faster than those firms that do not innovate. Furthermore, Cainelli et al. (2004) confirmed in their study of Italian services that innovative activities are positively related to firm performance, and that the introduction of new

or improved service/process helps firms to increase their sales in quantitative terms or via a price increase of the service delivered. Jong et al. (2003) summarized in their work exploring service innovations that service innovation tends to result in three different types of output, namely, financial benefits, increased customer value and strategic success, no matter in the form of tangible or intangible benefits. Innovation in service industries generally leads to better company performances in most of empirical studies. Hoffman and Bateson (1997) suggested that “firm’s ability to master technological change” be one of the key to success. They further revealed that firms that view technology as a source of innovation are particularly successful. Continuous improvements in technology enable successful firms to open new avenues of communication between firms and customers. Thus, we might posit that:

H6: Innovation intensity is positively correlated to firm performance.

#### The Effects of Organizational Characteristics on Firm Performance

In this study, four organizational characteristics of service firms are reviewed to propose their effects on performance, including firm size, past performance, market position, and diversification. Service firms that are of larger-scale, of higher market position and of better past performance tend to achieve better firm performance in general as a result of: (1) possessing more amounts of resources, whether in terms of financial or organizational resources, (2) being better able to allocate resources to generate economic profits, and (3) having a lower risk of

failure for the company as a whole (Cainelli et al., 2003, 2004, 2006; Mat-ear et al., 2004; Chen, 2003; Jong et al., 2003; Hipp et al., 2000). Therefore, they may well result in better firm performance. Accordingly, our hypotheses are:

H7: Firm size is positively correlated to firm’s performance.

H8: Market position is positively correlated to firm’s performance.

H9: Past performance is positively correlated to firm’s performance

However, the effect of diversification on a firm’s firm performance is rather mixed on the other hand. While Bettis and Mahajan (1985) suggest diversified firms outperform non-diversified firms in general, Pandya and Rao (1998) reveal a negative relationship on diversification and performance, and that a dominant undiversified firm may perform better than a highly-diversified firm in terms of return but its riskiness will be much greater, and vice versa. Furthermore, Besanko et al. (2006) found that highly diversified firms may lead to consequences of spreading their specialized resources too thin or increasing bureaucratic costs and finally result in worse performance compared to undiversified firms. Therefore, this study hypothesizes that:

H10: The level of diversification is negatively correlated to firm performance.

#### Organizational Characteristics, Innovation and Performance Relationship: The Mediating Effect of Innovation Intensity

Prior empirical evidences have demonstrated that a relationship exists between organizational characteristics (such as firm size, market position, past performance, and diversification) and innovation intensity (Hipp et al., 2000; Chen, 2003; Cainelli et al., 2004; Vermeulen et al., 2005). Results suggest that organizational characteristics have an impact on innovation intensity. Innovative service firms in turn are more successful, grow faster and generate more economic returns (Hoffman and Bateson, 1997; Camacho and Rodriguez, 2005; Vermeulen et al., 2005; Evangelista, 2006). Cainelli et al. (2003, 2004, 2006) confirmed in their study of Italian services that firm size, types of service sectors and innovation intensity are positively related to firm performance. They also indicated that the introduction of new or improved services/processes help firms to increase their sales.

Based on prior research results, we explore whether the relationship of between organizational characteristics and firm performance is mediated by innovation intensity; thus, this study proposes that:

H11: Organizational characteristics are correlated to innovation intensity and further have an impact on firm performance.

H11a: Firm size is correlated to innovation intensity and further has an impact on firm performance.

H11b: Market position is correlated to innovation intensity and further has an impact on firm performance.

H11c: Past performance is correlated to innovation intensity and further has impact on firm performance.

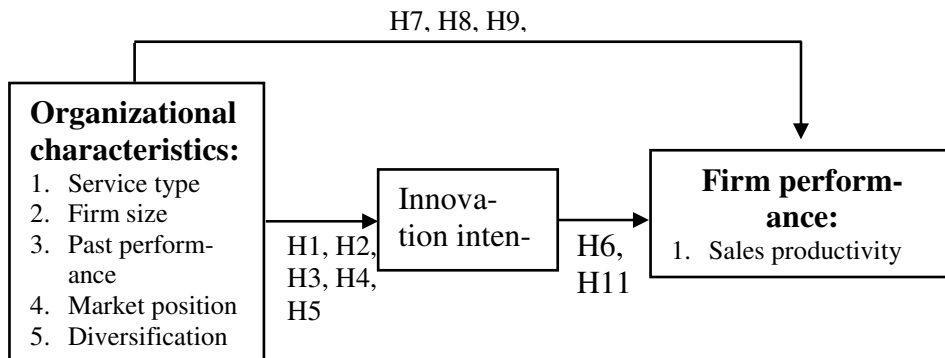
H11d: The level of diversification is correlated to innovation intensity and further has an impact on firm performance.

## Methodology

The empirical analysis carried out in this paper was based on data from Standard & Poor's COMPUSTAT database, during the period 1997 to 2006. The sample was selected using the first two digits of NAICS Code from 42 to 81 (NAICS, 2008). The resulting sample of this statistical process consisted of 606 service firms in the US.

As shown in Table 1, the variables used in this theoretical framework, along with their definitions and references, have a basis in previous empirical literature. In line with the research goal of comparing results among various service sectors, this paper classified the sample firms into three groups, literally, supplier-dominated services (195 firms), production-intensive services (204 firms), and science-based and specialized and specialized services (207 firms) (Miozzo and Soete, 2001). Supplier-dominated services can mainly be found in personal services, i.e. restaurants and hotels, laundry, repair services, barber, and beauty services, and in public or collective services like healthcare and public administration. Production-intensive services consist of firms involved in large scale back-office administrative tasks or dependent on physical or information

**Figure 1: Theoretical Framework of the Study**



**Table 1. List of Variables**

VARIABLE NAME	VARIABLE CODE	PROXY/CLASSIFICATION	REFERENCE
Types of service sectors	SS	<ul style="list-style-type: none"> <li>• The supplier-dominated sector (SD)</li> <li>• The production-intensive sector (PI)</li> <li>• The science-based and specialized sector (SB)</li> </ul>	Miozzo and Soete (2001)
Innovation intensity	INNO	Expenditures per employee on R&D, machines and equipment during the period of 2001-2003	Cainelli et al., 2003, 2004, 2006; Gallaher and Petrusa, 2006; Camacho and Rodriguez, 2005; Evangelista, 2000
Organizational characteristics			
• Firm size	FS	The logarithm of the number of employees in 2000	Evangelista, 2000; Pavitt et al., 1989
• Market position	MS	The percentage of market share in 2000	Oerlemans et al., 2005; Pearce and Robinson, 1996
• Diversification	DIV	The number of business segments operated under a single firm in 2000	Besanko et al., 2006; Pavitt et al., 1989; Hughes, 1988
• Past performance	PP	<i>The average return on assets (ROA) during the period of 1997-2000</i>	Cainelli et al., 2003, 2004, 2006; Chen, 2003
Firm performance			
• Sales productivity	SP	The average annual growth rate of sales during the period of 2004-2006	Elche and Gonzalez, 2008; Mansury and Love, 2008; Cainelli et al., 2004, 2006; Vermeulen et al., 2005
• Gross profit margin	GP	The average gross profit margin during the period of 2004-2006	

networks, such as transport and travel services, wholesale trade and distribution, banks, insurance and telecommunication services. Science-based and specialized services are business services closely related to laboratory, software, design services, and the development and application of information technologies.

Innovation intensity was measured in terms of expenditures per employee on R&D, machines and equipment during the period of 2001-2003. Firm size was measured by the *logarithm* of the *number of employees* in 2000 (a year prior to innovation measured year). Market position was measured by the percentage of market shares in 2000 comparing to the industry groups. The level of diversification was measured as the numbers of business segments operated under a single firm based on year 2000. Past performance was measured by *average return on assets (ROA)* during 1997-2000 (four years prior to innovation measured year). Firm performance was assessed in terms of sales productivity and gross profit margin during the period of 2004-2006, following the innovation year measured.

ANOVA, multiple regression, and path analysis on the basis of Baron and Kenny's (1986) analytical procedures for testing mediator effects were applied to examine the proposed relationships between organizational characteristics, innovation intensity and firm performance among the three types of service firms.

## Empirical Results and Discussion

### *Descriptive Statistics*

Table 2 presents the frequency statistics of our sample. The sample service firms are averagely distributed among categories of different service types, firm size, and market position. In diversification section, firms operating under 6 business segments consist of 90 cumulative percent of total sample firms, indicating most sample firms are undiversified, first and foremost, account for 43.6 percent, or moderately diversified. With regard to innovation intensity, sample firms invested in at least one innovation expenditure account for 87.5 percent.

Table 3 shows that a correlation generally exists among organizational characteristics, innovation and firm performance variables within three service groups. Moreover, a slight linear dependence can be detected among market position and firm size variables in all three service types.

### Sectoral Differences

From Table 4, research results of the Scheffe test reveal that firms in different service sectors tend to perform differently in terms of separate organizational characteristic variables. Among these three groups, supplier-dominated firms are the biggest, with best past performance and have the highest market position; yet they have the lowest mean in terms of diversification and sales productivity. Production-intensive firms are the smallest and out-perform those in the other two sectors in terms of sales productivity; still, their level of innovation intensity is the lowest. Science-based and specialized firms have the highest level of diversification and innovation intensity

Table 2. Frequency of Research Variables

Service Types		# of Samples	%	Cumulative %
Service types	Supplier-dominated (SD)	194	32.0	32.0
	Production-intensive (PI)	205	33.8	65.8
	Science-based and specialized sector (SB)	207	34.2	100.0
	Total	606	100.0	
Firm Size (FS)	1-250	159	26.2	26.2
	251-1000	134	22.1	48.3
	1001-5000	142	23.4	71.8
	5001 and above	171	28.2	100.0
	Total	606	100.0	
Level of diversification (DIV)	Undiversified firms	264	43.6	43.6
	2 business segments	64	10.6	54.1
	3 business segments	81	13.4	67.5
	4 business segments	73	12.0	79.5
	5 business segments	41	6.8	86.3
	6 business segments	25	4.1	90.4
	7 business segments	25	4.1	94.6
	8 business segments	10	1.7	96.2
	9 business segments	8	1.3	97.5
	10 business segments	6	1.0	98.5
	11 business segments	3	.5	99.0
	12 business segments	6	1.0	100.0
	Total	606	100.0	
Innovating firms	Non-innovative firms	76	12.5	12.5
	Innovative firms	530	87.5	100.0
	Total	606	100.0	

Table 3. Mean, Standard Deviations and Pearson Correlation Matrix

Type	Mean	SDEV	FS	PP	MS	DIV	INNO	SP	GP
SD	3.7799	.83987	1						
PP	2.3055	.02985	.346**	1					
MS	.0752	.11699	.403**	.137*	1				
DIV	2.2865	1.90511	.009	-.022	.046	1			
INNO	.7360	.39489	-.118	-.043	.060	-.024	1		
SP	2.0782	.34825	-.126*	.014	.210**	.072	.349**	1	
GP	2.7274	.01244	-.140*	-.005	-.078	-.091	-.020	.052	1



PI	FS	2.4978	1.19091	1						
	PP	2.3021	.03061	.050	1					
	MS	.0475	.09483	.538**	.021	1				
	DIV	3.0909	2.42068	.115	.033	.035	1			
	INNO	.5922	.63715	.056	-.226**	.140*	.114	1		
	SP	2.6154	.52913	-.370**	.113	-.179**	.031	-.070	1	
	GP	2.7276	.02120	-.199**	-.054	-.173**	-.032	.103	.166**	1
SB	FS	2.7721	.82761	1						
	PP	2.2678	.07451	.426**	1	.				
	MS	.0165	.04883	.427**	.184**	1				
	DIV	3.5226	2.72071	.231**	.096	.104	1			
	INNO	1.5446	.41971	.021	-.136*	-.074	-	1		
							.148*			
							*			
	SP	2.3051	.24569	.403**	.124*	.129*	.063	.272**	1	
	GP	2.7459	.02059	.052	.123*	-.135*	-.083	.182**	.107	1

\*\*\*p<.01; \*\* p<.5; \*p<.1

Table 4. A Comparison of ANOVA Statistics of the Three Types of Service Sectors

Variables	Types	Mean	Std. De- viation	ANOVA		Scheffe Com- parison
				Between Groups	90.217	
FS	SD	3.7799	.83987	Within Groups	.940	SD > SB > PI
	PI	2.4978	1.19091	F	96.019***	
	SB	2.7721	.82761			
	Total	3.0019	1.11117			
PP	SD	2.3055	.02985	Between Groups	.087	SD > PI SD > SB
	PI	2.3021	.03061	Within Groups	.002	
	SB	2.2678	.07451	F	35.172***	
	Total	.9698	.65002			
MS	SD	.0752	.11699	Between Groups	.169	S D> PI > SB
	PI	.0475	.09483	Within Groups	.008	

	SB	.0165	.04883	F	20.619***	
	Total	.0457	.09363			
<b>DIV</b>	SD	2.2865	1.90511	Between Groups	75.000	SB > SD PI > SD
	PI	3.0909	2.42068	Within Groups	5.678	
	SB	3.5226	2.72071	F	13.208***	
	Total	2.9828	2.43251			
<b>INNO</b>	SD	.7360	.39489	Between Groups	52.594	SB > SD > PI
	PI	.5922	.63715	Within Groups	.244	
	SB	1.5446	.41971	F	215.408***	
	Total	.9698	.65002			
<b>SP</b>	SD	2.0782	.34825	Between Groups	13.798	PI > SB > SD
	PI	2.6154	.52913	Within Groups	.150	
	SB	2.3051	.24569	F	91.782***	
	Total	2.3293	.44375			
<b>GP</b>	SD	2.7274	.01244	Between Groups	.023	SB > SD SB > PI
	PI	2.7276	.02120	Within Groups	.000	
	SB	2.7459	.02059	F	66.397***	
	Total	2.7338	.02053			
SD means the supplier-dominated sector; PI means the production-intensive sector; SB means the science-based and specialized sector. ***p<.01; ** p<.5; *p<.1						

Consequently, sectoral differences in services can be detected. This study thus divided the firms that constituted the sample into three distinct service sectors, namely the supplier-dominated sector, the production-intensive sector, and the science-based and specialized sector (Miles, 2008; Miozzo and Soete, 2001), and thereafter explored how the relationships among organizational characteristics, innovation intensity and performance relationship differ within sectors accordingly.

#### *Causal Relationships*

Table 5 displays the results of the effects of organizational characteristics and innovation intensity on firm performance. Likewise, the variance inflation factors (VIF) for the four organizational characteristic variables are all less than 1.7 in three types of service

sectors, implying that multicollinearity may not cause a problem in making inferences in this study.

#### *The Impact of Organizational Characteristics on Innovation Intensity*

As shown in Table 5, the effects of organizational characteristics on innovation intensity vary across the three types of service sectors. While the effects of organizational characteristic variables on innovation intensity are not statistically supported in the supplier-dominated sector (the F value is 1.480), the effects are partially supported in both the production-intensive sector and the science-based and specialized sector. In the production-intensive sector, while past performance has a negative effect on innovation intensity, both market position and diversification have positive effects on innovation intensity. In the science-

based and specialized sector, past performance, market position and diversification have negative effects on innovation intensity. Additionally, a U-shaped relationship between firm size and innovation intensity was not statistically supported in this study.

As a result, when types of service sectors are considered, the research results are in contradiction to previous studies, suggesting that the organizational characteristic variables considered in this paper may have a positive, a negative or a U-shaped relationship with innovation intensity (Mansury and Love, 2008; Vermeulen et al., 2005; Hipp et al., 2000; Tidd et al., 1997).

*The Impact of Innovation Intensity on Firm performance*

Table 5 reports that the effects of innovation intensity on firm performance in terms of sales productivity and gross profit margin are generally positive. Both supplier-dominated and science-based and specialized service firms show positive effects of innovation intensity on sales productivity.

Only science-based and specialized service firms reveal positive effects of innovation intensity on gross profit margin. In the production-intensive sector, the effects of innovation intensity on both sales productivity and gross profit margin are not statistically supported. The statistical results are partly in accordance with findings from previous (Elche and Gonzalez, 2008; Mansury and Love, 2008; Arundel et al., 2007; Cainelli et al., 2003, 2004, 2006; Vermeulen et al., 2005; Jong et al., 2003).

*Organizational Characteristics, Innovation Intensity and Firm Performance Relationship: The Mediating Effect of Innovation Intensity*

As shown in Table 5, the causal effects of organizational characteristics on firm performance as mediated by innovation intensity is not supported for all the service sectors.

In the supplier-dominated sector, the mediating effect of innovation intensity does not exist because the direct effects of four organizational

Table 5. The Effects of Organizational Characteristics and Innovation Intensity on Firm Performance

	Dependent Variable and Service Sector		
	INNO		
Explanatory Variable	SD	PI	SB
<i>Regression of Innovation Intensity on Organizational Characteristics</i>			
FS	-.179**	-.064	.214**
PP	-.001	-.268***	-.188**
MS	.146*	.178**	-.166**
DIV	-.030	.124*	-.130*
R <sup>2</sup>	.033	.107	.067

Adjusted R <sup>2</sup>	.011		.086		.047	
F	1.480		5.161***		3.287**	
Sig.	.210		.001		.012	
Explanatory Variable	SP			GP		
	SD	PI	SB	SD	PI	SB
<b>Regression of Firm performance on Innovation Intensity</b>						
INNO	.349***	-.070	.272***	-.020	.103	.182**
R <sup>2</sup>	.122	.005	.074	.000	.011	.033
Adjusted R <sup>2</sup>	.117	-.001	.069	-.005	.005	.028
F	26.319***	.882	16.128***	.076	1.993	6.850**
Sig.	.000	.349	.000	.785	.160	.010
<b>Regression of Firm performance on Organizational Characteristics</b>						
FS	-.217**	-.442***	.429***	-.081	-.147*	.144
PP	.017	.139*	-.042	.030	-.040	.128*
MS	.291***	.068	-.078	-.021	-.092	-.227**
DIV	.057	.062	-.025	-.088	-.011	-.114
R <sup>2</sup>	.085	.176	.141	.016	.048	.071
Adjusted R <sup>2</sup>	.064	.156	.123	-.007	.027	.051
F	4.049**	9.027***	7.639***	.694	2.303*	3.549**
Sig.	.004	.000	.000	.597	.060	.008
<b>Regression of Firm performance on Organizational Characteristics and Innovation Intensity</b>						
FS	-.152*	-.448***	.375***	-.112	-.112	.101
PP	.016	.121	-.009	.033	-.011	.185**
MS	.243**	.089	-.036	.000	-.119	-.189**
DIV	.070	.072	.017	-.097	-.001	-.099
INNO	.302***	-.067	.256***	-.077	.143*	.228**
R <sup>2</sup>	.169	.175	.200	.024	.059	.128
Adjusted R <sup>2</sup>	.145	.149	.178	-.004	.031	.104
F	7.043***	6.892***	9.116***	.869	2.102*	5.302***
Sig.	.000	.000	.000	.503	.068	.000
***p<.01; ** p<.5;*p<.1						

characteristic variables on innovation intensity are not statistically supported. In the production-intensive sector, the mediating effect of innovation intensity does not exist because the direct effect of innovation intensity on firm performance is not statistically supported.

Comparing to other two types of service sectors, the science-based and specialized service sector displays varied results of the mediating effect of innovation intensity. The positive effect of firm size on sales productivity

is mediated by innovation intensity. The positive effect of past performance on gross profit margin is mediated by innovation intensity. The negative effect of market position on gross profit margin is mediated by innovation intensity.

#### Summary of Hypotheses Analysis

Most of our research hypotheses are partially supported, in different terms of service sectors. The research hypotheses results are summarized in Table 6.

## Conclusions and Suggestions

This study has tried to look into the heterogeneous nature of services, exploring its organizational characteristics, innovation intensities and whether innovations contribute to performance of service firms within the United States. Shedding light on this issue is of much importance not only for improving our understanding of this emerging economy but also for managerial purposes. Along with assessing the impacts of organizational characteristics and innovation intensity have respectively on firm performance, this study also attempts to look into the mediating effect of innovation intensity on the relationship between organizational characteristics and firm performance. Empirical results of data from the COMPUSTAT database show the proposed relationships between organizational characteristics, innovation intensity and firm performance differ among the three types of service sectors in the US. This result discourages any simple generalization of service innovation but supports the adjustment innovation management theory and practices to the kind of service sector for which they are intended.

Among all service sectors, the science-based and specialized sector is the most active in terms of engaging in innovations, drawing special attention to a growing role of knowledge-intensive innovation. This result is in accordance with the theory of Miozzo and Soete (2001) and Miles (2008).

For the different service sectors, this paper provides empirical support on the increasing importance of organizational characteristics and innovation intensity as enhancing factors for firm

performance in terms of sales productivity and gross profit margin. A service firm may well out-perform competitors if it carefully reflects on its organizational characteristics to adjust its innovation intensity.

Services in the supplier-dominated sector are firms mainly in personal or public services. This empirical study reveals that as smaller firms in this group increase their level of innovation intensity, a positive correlation with sales productivity may be expected does not have a significant relation towards performance.

Moreover, by introducing innovative activities, services with higher market position may enhance their sales productivity. Further, less or moderately diversified services may enhance their sales productivity by engaging in more innovation activities rather than simply rely on suppliers; yet if firms overly diversified, it might change to a contrary result to a negative impact of overly scattering of resources on performance. On the other hand, rather through pursuing innovative activities, bigger firms in this group are less prone to innovate as other determinants may exert greater importance like maintaining closer relationships with suppliers. The result is in contradiction to the study of Miozzo and Soete (2001), suggesting that rather merely depend on suppliers as source of innovation, firms in this group may engage moderately in innovation might increase performance. In the production-intensive sector, sample service firms show that innovation intensity.

Table 6. Summary of Hypotheses Analysis Results

<i>Hypotheses Analysis Results</i>		<b>Sector Type</b>		
<b>Organizational Characteristics to Innovation Intensity</b>		SD	PI	SB
<i>H1</i>	<i>Service types have impact on firm's innovation intensity.</i>	S	S	S
<i>H2</i>	<i>Firm size is positively correlated to innovation intensity.</i>	R	R	S
<i>H3</i>	<i>Market position is positively correlated to innovation intensity.</i>	S	S	R
<i>H4</i>	<i>Past performance is positively correlated to innovation intensity.</i>	R	R	R
<i>H5</i>	<i>The level of diversification is positively correlated to innovation intensity.</i>	R	S	R
<b>Innovation Intensity to Firm Performance</b>				
<i>H6</i>	<i>Innovation intensity is positively correlated to firm's performance.</i>	PS	R	S
<b>Organizational Characteristics to Performance</b>				
<i>H7</i>	<i>Firm size is positively correlated to firm performance.</i>	R	R	PS
<i>H8</i>	<i>Market position is positively correlated to firm performance.</i>	PS	R	R
<i>H9</i>	<i>Past performance is positively correlated to firm performance</i>	R	PS	PS
<i>H10</i>	<i>The level of diversification is negatively correlated to firm performance.</i>	R	PS	R
<b>Organizational Characteristics, Innovation Intensity and Firm Performance Relationship</b>				
<i>H11</i>	<i>Organizational characteristics of services are correlated to innovation intensity, and further have an impact on firm performance.</i>	PS	PS	S
<i>H11a</i>	<i>Firm size is correlated to innovation intensity, and further has an impact on firm performance.</i>	PS	R	S
<i>H11b</i>	<i>Market position is correlated to innovation intensity, and further has an impact on firm performance.</i>	PS	PS	S
<i>H11c</i>	<i>Past performance is correlated to innovation intensity, and further has an impact on firm performance.</i>	R	PS	S
<i>H11d</i>	<i>The level of diversification is correlated to innovation intensity, and further has an impact on firm performance.</i>	R	PS	S

\* *S* means supported; *PS* means partially supported; *R* means rejected

Services in these sectors may consider increasing their level of innovation intensity when they are of higher market positions, highly diversified, or performed less well in the past; yet firm size is not a positive factor in innovation intensity and firm perform-

ance relationships. As firms with higher market position and higher level of diversification engage more actively in innovation activities, due to an advantage of economies of scale, they may expect an increase in performance. Nevertheless, firms that per-

formed well in the past, while having a positive return from current strategies, are not encouraged to increase their innovation intensity for an intention to achieve better performances. Alternatively, production-intensive service firms may increase firm performance by applying other approaches, such as increasing market share, enhancing employee productivity, or cost control. For the third sector group, firms in the science-based and specialized sector reveal the highest intensity of innovation expenditures within three sectoral groups. In addition, the increase of innovation intensity would in fact help to raise performance. Furthermore, firm size plays a significant role in enhancing innovation and performance relationships. Bigger services engaging actively in innovations are associated with better sales productivity, which may be explained by their advantages over professionals with special talents and abilities. Still, other organizational determinants such as past performance, market position or the level of diversification reveal a negative relationship towards innovation and performance, suggesting firms with lower market position, lower level of diversification and worse past performance, rather than enhancing performance in term of gross profit margin through introducing innovative activities, should focus on other issues, for example, business repositioning or employee's abilities reinforcements. The result is in accordance with Miles (2008); indicating services in this service sector may value talents the most and generally have high level of expenditures on innovation.

In all, this study provides empirical supports on the increasing importance of innovation as enhancing factor

for firm performance within different service sectors. With the growing share of service sectors within most advanced countries, service firms are no longer technological laggards as depicted in many of prior literatures; instead, a service firm may well outperform competitors if it carefully combines organizational advantages and actively participates in innovating activities. Further, sectoral differences should better be taken into account while studying innovations in service context for reflecting more factual outcomes. Moreover, service firms in other countries may well benefit from the empirical results from U.S. services; by carefully reflecting internal capability and adjusting innovation intensity, Taiwanese services may enhance their performance through similar experiences in the United States. As a result of exploring relatively uncharted territory, this study raises several limitations for future studies.

Firstly, while this study has found an association among organizational characteristics, innovation intensity and firm performance, it has not explicitly investigated the mechanisms by which innovation activities are carried out as far as different organizational characteristics are concerned. Therefore, future research could examine the relationship between organizational characteristics, innovation intensity and firm performance by considering innovation type differences (e.g. product innovation versus process innovation).

Secondly, it is suggested running the data using other typologies to divide the firms to find more meaningful results. The typology of service firms used in this study does not appear to be

helpful to interpret the results and place them in a context. The cause of this is most likely the fact that the guidelines used in this study to type firms in this were too broad within the categories. For example, Miozzo and Soete's (2001) study grouped together scale-intensive network sectors and information sectors into one sector (production-intensive). However, these two are disparate in nature, which may lead to a potential confound in the results. Moreover, most service firms may adopt more than one of the typology. For example, a tertiary referral hospital can be classified into either the supplier-dominated or the science-based and specialized service sector. Therefore, it worth a further research in the validity of service firm typologies and in whether the differences matter for innovation intensity and firm performance.

Finally, because most of the hypotheses are partially supported and the  $R^2$  numbers are low, more discussion should be devoted to limitations of the indicators used in this study as proxies of organizational characteristics, innovation intensity and firm performance. There are still other organizational determinants of service innovation such as links with public science, the use of business networks, inter-firm cooperation or non-technological features, which are not available from COMPUSTAT dataset; thus a more comprehensive picture of the variegated nature of service innovation may be revealed when such organizational features are amenable to statistical investigation. Furthermore, innovation intensity is measured by R&D activities and expenditures on machines and equipment, which is a mere indicator of investment in fixed capital. Fu-

ture research could add indicators of human capital investment, such as retaining well-trained and knowledgeable personnel or containing a high share of university-educated employees, to measure innovation intensity of service firms. Likewise, the meaning and the rationale behind the use of the firm performance indicators should be further clarified in relation to the interpretation of the contribution of innovation intensity.

## References

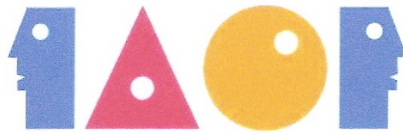
- Aas, T.H., & Pedersen, P.E. (2011). The impact of service innovation on firm-level financial performance. *The Service Industries Journal*, 31(13), 2071–2090.
- Acs, Z.J., & Audretsch, D.B. (1988). Innovation in large and small firms: An empirical analysis, *American Economic Review*, 78(4), 678–690.
- Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal*, 31, 306-33.
- Arundel, A., Kanerva, M., van Cruysen, A., & Hollanders, H. (2007). Innovation statistics for the European service sector, Pro *Inno Europe INNO Metrics 2007* report. Brussels: European Commission.
- Baron, R.M., & Kenny, D.A. (1986). The moderator- mediator variable distinction in social psychological



- research: Conceptual, strategic, and statistical consideration. *Journal of Personality and Social Psychology*, 51(6), 1173-1182.
- Besanko, D., Dranove, D., Shanley, M., & Schaefer, S. (2006). *Economics of Strategy* (fourth ed.). New York: Wiley.
- Bettis, R.A., & Mahajan, V. (1985). Risk / return performance of diversified firms. *Management Science*, 31, 785-799.
- Blomkvist, K., & Drogendijk, R. (2013). The impact of psychic distance on Chinese outward foreign direct investments. *Management International Review*, 53(5), 659–686.
- Cainelli, G., Evangelista, R., & Savona, M. (2003, December). The impact of innovation on firm's growth and productivity in Italian services. Paper presented at the International Workshop: Empirical Studies on Innovation in Europe, Urbino, Italy.
- Cainelli, G., Evangelista, R., & Savona, M. (2004). The impact of innovation on performance in services. *The Service Industries Journal*, 24(1), 116-130.
- Cainelli, G., Evangelista, R., & Savona, M. (2006). Innovation and firm performance in services: A firm-level analysis. *Cambridge Journal of Economics*, 30(3), 435-458.
- Camacho, J.A., & Rodriguez, M. (2005). How innovative are services? An empirical analysis for Spain. *The Service Industries Journal*, 25(2), 253-271.
- Chen, W. (2003, August). Determinants of technological search behavior of the firm. Paper presented at the *Annual Conference of the Academy of Management*. Seattle, WA.
- Davide, C. (2007). Services and systemic innovation: A cross-sectoral analysis. *Journal of Institutional Economics*, 3(1), 71-89.
- E Fang, RW Palmatier & R Grewal (2011). Effects of customer and innovation asset configuration Strategies on Firm Performance. *Journal of Marketing Research*, Vol. XLVIII (June 2011), 587-602.
- E Fang, RW Palmatier & JBEM Steenkamp (2008) Effect of Service Transition Strategies on Firm Value. *Journal of Marketing*, Vol. 72 (September 2008), 1–14
- Elche, D.M., & Gonzalez, A. (2008). Influence of innovation on performance: analysis of Spanish service firms. *The Service Industries Journal*, 28(10), 1483-1499.
- Evangelista, R. (2000). Sectoral patterns of technological change in services. *Economics of Innovation & New Technology*, 9(3), 183-221.
- Evangelista, R. (2006). Innovation in the European service industries. *Science and Public Policy*, 33(9), 653-668.
- Foss, N. J., Lyngsie, J., & Zahra, S. A. (2013). The role of external knowledge sources and organiza-

- tional design in the process of opportunity exploitation. *Strategic Management Journal*, 34(12), 1453–1471.
- Gallaher, M.P., & Petrusa, J.E. (2006). Innovation in the U.S. service sector. *Journal of Technology Transfer*, 31, 611-628.
- Garriga, H., von Krogh, G., & Spaeth, S. (2013). How constraints and knowledge impact open innovation. *Strategic Management Journal*, 34(9), 1134–1144.
- Hipp, C., Tether, B.S., & Miles, I. (2000). The incidence and effects of innovation in services: Evidence from Germany. *International Journal of Innovation Management*, 4(4), 417-453.
- Hoffman, K.D. & Bateson, J.E.G. (1997). *Essentials of services marketing*. Orlando: Dryden.
- Hughes, K. (1988). The interpretation and measurement of R&D intensity - A note. *Research Policy*, 17, 301-388.
- Jong, J. P. J., Bruins, A., Dolfsma, W., & Meijaard, J. (2003). *Innovation in service firms explored: What, how and why?* Zoetermeer: EIM Business & Policy Research.
- Leiponen, A., & Helfat, C. E. (2010). Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal*, 31(2), 224–236.
- Mansury, M.A. & Love, J.H. (2008). Innovation, productivity and growth in US business services: A firm-level analysis. *Technovation*, 28, 52-62.
- Miles, I. (2008). Patterns of innovation in service industries. *IBM Systems Journal* 47(1), 115-128.
- Miozzo, M. & Soete, L. (2001). Internationalization of services: A technological perspective. *Technological Forecasting and Social Change*, 67, 159-185.
- Naics. (2008). *The principles of NAICS development*. New Jersey: NAICS Association.
- N Rosenbusch, J Brinckmann, A Bausch (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of business Venturing*, 26,441-457.
- Oerlemans, L., Rooks, G., & Pretorius, T. (2005). Does technology and innovation management improve market position? Empirical evidence from innovating firms in South Africa. *Knowledge, Technology, and Policy*, 18(3), 38-56.
- Pandya, A.M., & Rao, N.V. (1998). Diversification and firm performance: An empirical evaluation. *Journal of Financial and Strategic Decisions*, 11(2), 67-81.
- Pavitt, K., Robson, M., & Townsend, J. (1989). Technological accumulation, diversification and organization in UK companies, 1945-1983. *Management Science*, 35(1), 81-99.

- Pearce, J.A., & Robinson, R.B. (1996). *Strategic management: Formulation, implementation and control*. New York: Irwin Professional Publishing.
- Schumpeter, J. A. (1942). *Capitalism, socialism, and democracy*. New York: Harper and Brothers.
- Tidd, J., Bessant, J., & Pavitt, K. (1997). *Managing innovation: Integrating technological, market and organizational change*. England: John Wiley.
- van Ark, B., Broersma, L., & den Hertog, P. (2003). Services innovation, performance and policy: A review. Hague: Ministry of Economic Affairs.
- Vermeulen, P.A.M., Jong, J.P.J., & O'Shaughnessy, K.C. (2005). Identifying key determinants for new product introductions and firm performance in small service firms. *The Service Industries Journal*, 25(5), 625-640.
- Vossen, R.W., & B. Nootboom (1996). Firm size and participation in R&D. In A.H. Kleinknecht (Ed.), *Determinants of innovation: The message from new indicators* (pp. 155-168). London: Macmillan Press.
- Zhou, K. Z., & Wu, F. (2010). Technological capability, strategic flexibility, and product innovation. *Strategic Management Journal*, 31(5), 547–561.
- Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: knowledge base, market knowledge acquisition, and inter-
- nal knowledge sharing. *Strategic Management Journal*, 33(9), 1090–1102



ORGANIZATIONAL INNOVATION OF FUNCTIONAL  
ORIENTATION MECHANISM FOR CROSS-REGIONAL  
GOVERNANCE: CASE STUDY OF THE REGIONAL  
EMERGENCY OPERATION CENTERS  
(REOCS) IN TAIWAN

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Abstract

Geo-political entities are now meeting multiple challenges and the traditional political organizations have been faced a transition. It is expected more trans-regional forums, platforms or organizations for “problem-solving” will emerge to guarantee and strengthen states’ competitive advantage. In 2004, the organizational innovation of six “Regional Emergency Operation Centers” (REOCs) were established in Taiwan for the object to integrate of emergency medical and ambulance resources, and strengthening emergency response mechanism. REOCs’ concept are to follow logic of the current regional planning in Taiwan, for setting up medical emergency response centers with government financial assistance, as well as leading role of regional disaster relief network. This research is adopting the neo-functional concept for analyzing the REOC mode to discuss: first, will governments according to “functional” way to establish various forms of coordination, operation, or governance platforms, to reach “problem-solving” goal? Second, how do inter-governmental or cross-sectors interactions reach efficiency for using and integrating resources through the functional mechanism? Third, can such governance platform or mode help to bring about “spillover effect,” then pursuing political cooperation or extend its experience to other levels? This paper is analyzing of concept and operation of the cases for exploring theoretical and practical inspiration.

Keywords: regional governance, governing across boundaries, neo-functionalism, organizational innovation, REOCs, spillover effect

## Introduction

Regionalization and localization, became complex public issues that impact and penetrate borders of public governance constantly in the era of globalization, accordingly bring about the expected or unexpected changes and displacements. Therefore, governments bear the growing roles on the account of democratic accountability and policy effectiveness, especially under the constraint of limited resources and bureaucratic system, to have renewed their thinking and finding new mechanisms for governance in response to the coming global competition. As Scott (2006: 371-73) has argued, there will be more interregional forums or organizations for “problem-solving” appear.

In practice, there are several measures that governments around the world have tried to adapt to respond to the rapidly changing environment, for instant, they brought about series of movements or reforms of strategic-oriented, citizen-oriented, customer oriented, privatization and innovative financial methods, which make governance modes changed. At the same time, the devolution of central authority or power has become an inevitable trend mostly because of the central and local governments have shared challenges of fiscal stress and economic crisis, such management and control structures apparently have gone beyond the traditional “government” towards a multiple level of “governance” or “network” mode (Beckett-Camarata, 2002). Meanwhile, modern countries have also embarked on encouraging citizen participation to improve the capacities and quality of governments. At present, regional, or regional governance has some strong local charac-

teristics of shape, but still has its common feature. From the perspective of “problem-solving” focus, some arrangements breaking old nature of the market, looking for more capable, flexible, and competitive of the structure, regardless of these specific mechanism is the local level of “executive agency,” public-private partnership, civic group or various forms of regional alliances and agreements. However, it may be better initiatives for the current stage if they consider civil rights, governance effectiveness and local conditions.

This study is mainly based on the concept of the neo-functionalism, which is discussed through the REOCs model for exploring: first, can government establish coordination, operational or governance platform on functional basis to achieve the goal of “problem solving”? Second, how does this functional governance mechanism enhance efficiency of resources or manpower and help integration on intergovernmental or inter-departmental level? Third, can such governance platform or model help to ignite the “spill-over effect,” and promote its experience to other level of cooperation? The study will analyze operation of the cases through the relevant literature and interview data and, hopefully offer its contribution to the theory and practice. However, this paper is only the preliminary stage of research that focusing on regionalism, functionalism and cross-boundary governance related literature and similar research in the past, then exploring their relationship to each other, hopefully, to identify some core concepts, as basis in the next phase of interviews and empirical study.

## Reforms of Taiwan's Local Governance: Organizational Evolution and Innovation

### 1. Cases at-a-glance

Since Taiwan has brought into practice local autonomy in 1950, the cross-boundaries cooperation between local governments has not been enough attention, the reasons apart from the laws and regulations were inadequate, heads of local governments or their representatives may have concerned their own political interests or partisan conflict, resulting in cooperation is fraught with difficulties. However, Taiwanese administrative jurisdiction division is too small and the current governance model has made it unable to effectively respond to international competition and challenges in the era of globalization. Particularly in industrial planning, transportation construction, land and water management and the metro development also facing a lot of difficulties (National Development Council, 2012). So, how to achieve and integrate domestic resources to enhance the competitiveness of the country are being the main efforts in recent years.

In fact, Taiwan has had some of experience in regional governance and cooperation. Though limited, but it can be used as reference for regional governance in Taiwan. These tools of regional governance can be categorized as six types: informal cooperation, committee, administrative contract or authorized public body, quasi-governmental organization or regional federation, and regional government. The magnitude of its management strength is orderly by weak turned strong. Of which by place led established organization, including

Taichung County and City Liaison Council in 1993, Kao-Kao-Ping 3 County/City Heads and Directors Council in 1999, the Northern Taiwan Regional Development Promoted Committee in 2006, the Chung-Chung-Chang-Tou Heads Breakfast Meeting in 2008, and Yun-Chia-Nan Regional Construction Implementation Committee in 2010, these organizations are types of informal cooperation.

Other organizations which set up by the central government are: The Southern Taiwan Joint Services Center, Executive Yuan in 1998, Central Taiwan Joint Services Center, Executive Yuan in 2003, Eastern Taiwan Joint Services Center, Executive Yuan, and the Kao-Ping River Basin Management Committee in 2001, the former three organizations for the commission, the last is the first specific river management institutions, and the nature of the organization is regional federation.

After the deactivated of Taiwan Province in 1998, there have no functional similar organization or mechanism substituted for it. While lacking the buffer of Provincial Government, the Central Government needed to face 23 Counties/Cities directly, such as the Taichung Scientific Industrial Park Fourth Section Development Plans, and also in the Miaoli Dapu agricultural land controversy, was managed by the Premier in person to solve the problems. Although the Central regularly meet Counties/Cities heads, and the Executive Yuan continually established the Southern, Central and the Eastern Joint Services Centers in 1998, 2003 and 2007, in order to meet and coordinate regional needs regularly. Yet, often local and cross-boundaries

affairs seemed no comprehensive planning and discussion, the existing mechanism mainly to resolve problems simply as garbage cleaning, community security and disaster relief, platform itself planning function is weak, seldom proposed regional development strategic plan to guide public construction or industry of investment.

According to the Executive Yuan for approval of 'National Spatial Development Strategy Plan' in 2009, Taiwan's spatial structure in the Western region towards the 3 largest city areas for development, and the North, Central and South metro areas have their core city respectively. Except to promote three metro cities for across boundaries cooperation, also divided land space for '7 Developmental Areas' as: pei-pe-kee-yi, tao-chu-miao, chung-chang-tou, yun-chia-nan, kao-kao-ping, hua-tung and peng-kim-ma. It applies from the concept of 'economic district' (or 'basin district') to promote regional cooperation. Also, it developed the so-called '3 Living Circles' to integrate the partnership relations among local governments. Government jointly participates in the regional cooperation organization, assist coordination resources distribution, and to balance regional development. Meanwhile, the counties and cities were merged and completed in 2010, this, opening the new era of Taiwan administrative area reform. The 'National Spatial Development Strategy Plan' has led local governments through the establishment of regional cooperation platforms to strengthen mutual dialogue, exchanges, and cooperation across boundaries. Through application and implements of national-development plans, the ad

hoc planning agency - the National Development Council (NDC) - joined forces across regions value-added ideas into planning of public works, financial innovation, etc. As well as the financial incentives provided by the central government (Executive Yuan), helps public works to meet local development needs then to achieve their maximum benefits (Chang, et al., 2014).

## 2. Positive and skeptics views

The construction of regional governance mechanism or cross-boundary cooperation platform in Taiwan has become significant issues for a long time. The people who in favored considers it can bring the views and needs of each region into governance then enhance regional cooperation in substantive functions. However, the establishment of regional governance mechanism may subject to principles of organizational reforms or government restructuring<sup>1</sup>, particularly the budget allocation and staffing problems will face many difficulties. At present, the views of the construction of regional governance platform, either in the theoretical or practical aspect, can be described as

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<sup>1</sup> The original Taiwan provincial government was revoked on December 21, 1998, and the administrative organizations were largely streamlined and its function was shrinking dramatically. In principle, Taiwan's administrative organization became a 'central-city/county' two-level system. Recently, the new organizational structure of the Executive Yuan of ROC began in 2012, and gradually reached a government organization to transform the 'lean, flexible and effective' targets. The original government hall 37 departments will be reduced to 29 ministries and departments to improve the problems of unclear and lack of flexibility in original government organizations. (Chang, et al., 2014)

positive and negative stand. (Chang, et al., 2014) The views of the support and opponents are analyzed as below. The positive points of view think the functional regional governance platform has its significant value.

Because of:

- (1) The construction of a 'decentralized intermediate level of governance platform (between central and locals)' can be expected, in which it is considered a better way to use the so-called "living circle" concept as a division standard.
- (2) Some experts believe that regional governance and cross-border governance are important matter in the future, but now that rights and responsibilities are unclear, it is proposed to set up a competent authority to promote cross-border affairs, which is more feasible and constructive.
- (3) It is not only the central dominant, the views from various regions should be covered; that is, local governance should think from the nature of services and obtain some substantive functions. The central government may have more understanding of local ideas through consultation or trading actions via such mechanism.

The people who hold skeptic views have doubted the possibility for establishing a regional governance authority mainly from the point of view of "right" and "money" restriction. They argue:

- (1) The establishment of 'regional government' should be under the facts of history and national development,

not only change for change. And, it is not necessarily in accordance with the concept of 'living circle.' To establish a regional level of governance organization is a dynamic process, it is not suitable for division if relevant resources are not in place.

- (2) These changes within members of the organization form a sense of insecurity, the implementation will have a lot of bounce. Moreover, the new stage of government organizations after transformation, the human resource system or new governmental structure do not meet the goal of overall government planning of current stage, but also contrary to public services delivery type in the future.

- (3) In the past, similar regional governance platforms had shown that political parties had greater impact than concerns to regional issues. Therefore, this defect should be overcome. Because the result of integration, too often affected by the political reality and party ecology. It may be viable to pick some certain important issues but not subject to spatial, political, or other factors can limit the function of cross boundary cooperation.

3. The REOCs may be practical alternative?

The Department of Health<sup>2</sup> revised the *Disaster Prevention and Protection Act* in response to the need for mutual support from regional disaster and medical care in 2002. The second paragraph of Article 5 of the Act clarifies that the central health

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<sup>2</sup> In 2013, the "Department of Health" was renamed as the "Ministry of Health and Welfare" through government reengineering.



authority (DOH) is responsible for integrating emergency medical rescue resources, strengthen the emergency response mechanism and, should establish a regional coordination and command system for local emergency medical care and rescue. The amendment of section 9 provides that the central competent authority shall, in accordance with provisions that mentioned above, entrust certain

medical institution to form a regional emergency medical response center in each area to carry out immediate monitoring of medical emergencies in the area and to immediately grasp the information of situation and resource, and help to establish the disaster medical and resources database in the region.

Table 1. Status and distribution of the REOCs in Taiwan

	<b>Area/District</b>	<b>Member city/country</b>	<b>Leading local government</b>	<b>Leading hospital</b>
1	Taipei District	Taipei City, New Taipei City, Keelung City, Yilan County, Lianjiang County, Kinmen County	Taipei City	National Taiwan University Hospital
2	North District	Taoyuan City, Hsinchu City, Hsinchu County, Miaoli County	Taoyuan City	Linkou Chang Gung Memorial Hospital
3	Central District	Taichung City, Changhua County, Nantou County	Taichung City	Taichung Veterans General Hospital
4	Southern District	Yunlin County, Chiayi City, Chiayi County, Tainan City	Tainan City	National Cheng Kung University Hospital
5	Gao-Ping District	Kaohsiung City, Pingtung County, Penghu County	Kaohsiung City	Kaohsiung Veterans General Hospital
6	Eastern District	Hualian County, Taitung County	Hualian County	Hualien Tzu Chi Hospital

Source: Author

Taiwan has established six emergency operation centers (EOCs or

REOCs) since 2004. Although the design originally based on the division concept of National Health Insurance

in Taiwan, but also in line with current national spatial planning logic of Taiwan. As mentioned above, the REOCs are subsidized by the central government, and led to the regional disaster relief network, with local governments, which have more resources in area to lead other counties and cities. As Table 1 has shown, the current division are: the Taipei District, from Taipei City to lead; the North District from Taoyuan City to lead; Taichung City leads the Central District; the Southern District, from Tainan City to lead; Gao-Ping District, from Kaohsiung City to lead; Eastern District, from Hualien County to lead. The principle is the central government funding to each REOCs, then let them allocate depending on the situation respectively. According to the recent operational review, this mode could be a successful network, and is considered an appropriate example in the disaster prevention mechanism. In fact, the REOCs have played a great effect in severe medical care, disaster relief and recovery work in recent years. According to the Table 1, deep blue color is Taipei District. Orange color is North District. Purple color is Central District. Light blue color is Southern District. Tree color is Gao-Ping District. Light yellow is Eastern District. Those six REOCs are shown as Figure 1.

### Literature Review

#### 1. Governance under Public Managerialism

‘Public Management’ is often used in describing the important concepts of contemporary government

management. It is an integrated architecture that complements or strengthens traditional public administration and governmental administration while meeting both the institutional structure emphasized by traditional public administration theory and the organizational management techniques of the New Public Managerialism, also add to the macro-level of political network and policy processes. With problems of the current world become more complex, dynamic, and diversified, how to find more effective and efficient governance model, become an important issue for governments. In the era of governance, both politicians and political scholars are faced with several problems: first, the national level of public administration, its characteristics gradually become more comprehensive, and even global governance; the second is the level of administrative system gradually became a more complex governance network; and thirdly, the ‘ungovernable’ situation faced by the governments was deteriorating (Huang, 2013: 9).

At the practical level, the term ‘governance’ is often used to refer to the rapidly growing international communications network, multi-level governance, transnational nature of mechanisms, or newly transnational civil society and democracy. And the establishment of these management models or mechanisms, the most important purpose is to jointly deal with the increasingly serious problems of various types of emerging. This type of management or control structure is clearly beyond the traditional

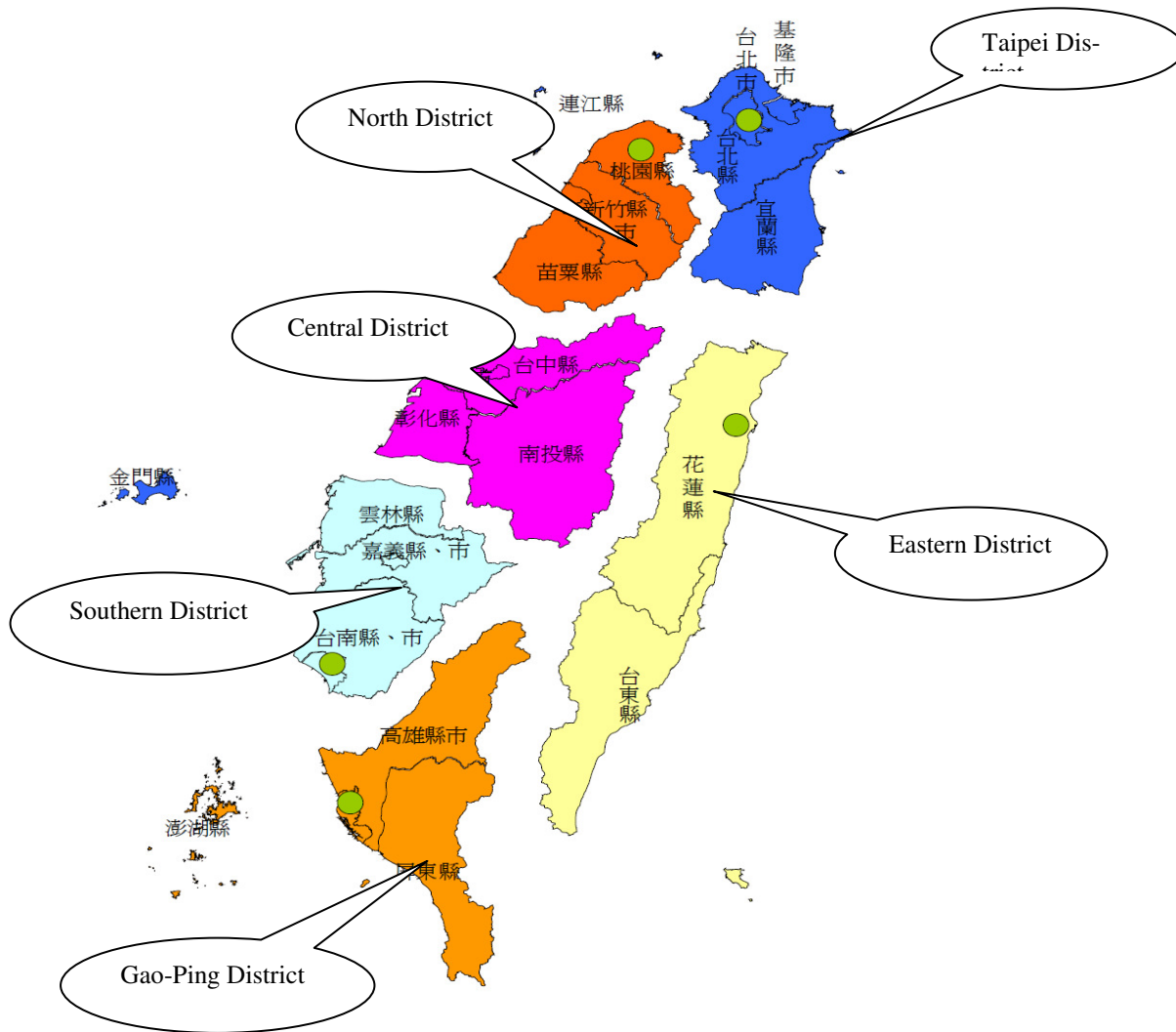


Figure 1. Six REOCs Status and Distribution of Taiwan Map

Source: Author

‘government,’ and towards a global, market orientation and multi-level ‘network’ governance relationship (Keating, 1995). The World Trade Organization (WTO), the North American Free Trade Area (NAFTA) and the Asian Free Trade Area (ASEAN) are such example of developments.

## 2. Regionalism and regional governance.

Regionalism can be defined in terms of both socio-cultural factors internal and political factors external to the region. Russett (1967:11; 1968) identifies five criteria: social and cul-

tural homogeneity, political attitudes or external behavior, political institutions, economic interdependence, and geographical proximity, also illustrate the ambiguity of region as an organizing concept. Based on the work of 22 scholars, Thompson’s (1973) composite definition lists 21 commonly cited attributes, which he condenses to a list of three necessary and sufficient conditions for defining a regional subsystem: general geographic proximity, regularity and intensity of interactions, and shared perceptions of the regional subsystem as a distinctive theater of operations.

However, traditional views of regionalism concerning the state-centric regional system are being challenged by the concentration of political and military power at the top as well as by transnational or interregional networks built around economic ties and cultural identities (Väyrynen, 2003: 25). In the study of regions, the key dimensions center on the division of the world by levels of analysis and by the physical–functional distinction. Physical regions refer to territorial, military, and economic spaces controlled primarily by states, but functional regions are defined by non-territorial factors such as culture and the market that are often the purview of non-state actors. Scholars, for example, Newman (1999) have tried to link the physical and functional conceptions of regions by focusing on the boundary-eroding consequences of globalization and identity formation and the extraterritorial challenges to sovereignty that these forces unleash. He suggests that physical and functional definitions of regions may be viewed as a sequence in which territory gradually gives way to space (Newman, 1999).

In fact, regional and global factors are closely intertwined during these years. The increasing globalization and deregulation of markets describes an erosion of national economic control that industrial states in the North seek to compensate for through regional integration schemes. But these differ in form. As Katzenstein (1996) has argued, regional integration can occur in *de jure* (as in Europe) or *de facto* (as in Asia). It occurs also in sub-regional groupings between or within states, as for example in Southeast Asia and along the South China coast. Similarly, Scott (2006: 371-73) argues that the

globalization process resulting in a geo-political entity began disintegrating, many significant transformations occurred in the old-world order. To find a capable governance structure to safeguard and strengthen its competitive advantage, so many large ‘City-region’ has emerged. Meanwhile, Scott (2006: 373) predicted there will be increasingly cross-regional or interregional forums or organizations appear for ‘problem-solving’ purpose. Lee (2011) has argued that ‘City-region’ on the governance model of meaning beyond the traditional concept of local governance, and added strategic spatial planning of towns with a goal-oriented governance.

Under double stress of time and space, the metropolitan has usually risen because of globalization effects (Hsia, 2002); regardless of the concepts of ‘city-region’ or ‘metropolitan,’ a most important proposition assumed is their core position of regional development, and they provide a quite number of elements of regional development (Lee, 2011; Sun and Lin, 2011). Sun and Lin (2011) continuing observation of the globalization impact on the competence of state organs, and argue resources and information should be considered gathered in many important nodes of the network society, and thus constitutes the development of metro area. Due to industrialization and rapid economic development, people are likely moved to industrial and commercial center of the city. Consequently, constant development of urban centers and their surrounding increasing changes in the environment and growth pressures. As cities continue to expand, local governments inevitably face throughout how to adapt themselves to such

changing phenomenon? How the metropolitan area should be 'effective development' or 'smart growth'? (Sun and Lin, 2011).

This development allows local authority has clear development objectives in the region, therefore easily to achieve regional governance functions. Lee (2011) points out the case of UK local governance as example, concludes that if the regional unit size is too large, it cannot be a proper link of network, and resources also cannot to achieve efficiency; but the scale is too small, they are not effectively integrated resources across areas, also is not conducive to dealing with major policy and strategic planning. Sun et al (2011) also points out that the metropolitan area is a functional area, they cause more problems than a single local government jurisdiction, direct and primary responsibility for solutions to local problems shall be jointly by the relevant local governments. Therefore, the '(cross- or inter-) regional governance' model or platform, which is building on the existing system of governance reform, under the operation of these mechanisms, both status and functions of local governments has not been much of an impact, and even could play a more active role in the new model (Wilson and Game, 2011).

### 3. From the centric style to cross-boundary governance

The words 'across boundaries' literally mean cross-fields or cross-regions. Lamont and Molnar (2002: 169-181) argue that 'borders' in sociological research have four meanings, namely, social identity, class or racial identity, professional or academic identity, and community, national or spatial identity. In short, the so-called

cross-border refers to the phenomenon of 'across multiple domains.' Comprehensive administrative scholars' view, cross-boundary governance of the simplest meaning should include: across areas, across organizational barriers, across different business and function of integrated governance as (Wu, et al., 2007: 326; Sun, 2013: 194).

In the American Public Administration textbook, the command or management of intergovernmental matters are generally used the terms of 'intergovernmental relations' (IGR) or 'intergovernmental management' (IGM). Both of which relate to the interaction or co-operation of government affairs between/among different jurisdictions, or between/among the central and local governments (Shafritz et al., 2007: 131-170; Starling, 2008: 109-143). According to Wright (1983: 431), IGM has three distinct characteristics: problem solving, intergovernmental rivalry and cyber relations. Therefore, the concept of cross-boundary management is considered as intergovernmental coordination and cooperation to solve public problems. More specifically, cross-boundary governance can take advantage of public and private sector resources and capabilities across different regions or areas to integrate them into better public services (Morse, 2010: 434-436). Thus, cross-boundary concepts are not only concerned with the static relationship between government power and responsibility, but also the dynamic relationship between all participants in the policy implementation process (Witesman, 2010: 362-363).

Based on this view, this study argues that the functions and interactions between the central and local govern-

ments should seek to transcend traditional government or organ standards and restrictions, then hope to consider the impact of different types of resources and powers, with more macro and flexible perspective to understand the interaction between governments and civil society. In short, the study uses of cross-boundary concept of government activities to identify the restrictions in central governance model, and to explore local requirements of autonomy, hopefully will have a better understanding to substance of regional governance and co-operation. (Abramson and Balutis, 2008: 53-54; Barnes, 2010: 141).

#### 4. New Functionalism and cross-boundary governance mechanism design

Organizational Innovation of Functionalism emphasizes supranational, cross-sectoral organizations or mechanisms that can be established on a given basis to carry out certain functions (Deutsch, 1968: 222). Haas (1964: 6) points out that functionalists are keen to explore the existence of human needs and desires outside those areas of politics, especially in the context of specific 'technical' and 'non-controversial' issues, the government will try to weave or create organization of network relationships to meet the needs or solving problem of the above. They may initially focus on some of the non-controversial areas of common expectations, and then from the functional issues, gradually expanded to the political level; these pragmatic cooperation, in functionalist view, as the sum of intergovernmental relations (Haas, 1964). Through functional integration, the government or organization will gradually integrate into a sin-

gle society, therefore conflict and contradiction becomes less possible.

However, this expectation seems to have considerable uncertainty, since these functional organizations do not necessarily have legislation, taxation and effective sanctions, and there is considerable difficulty in governance. Haas therefore assumes that consideration of integration of the members depends on the sum of their expectations on benefits or losses that brought about by the cooperation. The government is pragmatic in nature and, if supported by a leading elite or a personal stake group, integration becomes feasible. Haas (1961: 372) further suggests the concept of 'spillover' as an 'expansive logic of sector integration' to explain the increased momentum of cross-domain collaboration and integration activities. In short, both functionalism and neo-functionalism, they emphasize the need for more highly institutionalized solutions, both of which share some common features: first, emphasizing the common well; second, neither emphasizes symbols and signs of recognition of the role, while the importance of social composition of the utilitarian factors. Thirdly, both sides believe that individuals and groups are free to transfer their actions and loyalty in a pluralistic society. Fourth, both emphasize functional technical bureaucrats, but neo-functionalism places greater emphasis on the close combination of technical bureaucrats and political powers.

However, the functionalist approach still has its shortcomings. For example, it was criticized as its 'Europe-centered' feature and could be faced with great difficulties and failures if applied to other third world

countries. Moreover, it is difficult to judge how many successful integrations is completed? Or, how to check whether there are some common values, or some degree of common identity and loyalty? Even the presume of integration process may be achieved by the common community consciousness is difficult to fully verify. When politicians make decisions, they often go beyond the integration logic of functionalism, especially when stress comes from regional or political considerations (Nye, 1971: 57). However, functionalism emphasizes the business, technical, and problem-solving approach, and indeed we are thinking about cross-domain cooperation and cross-boundary governance strategies on the viable direction, namely: cross-boundary governance can be expected from the specific functional policy issue areas of cooperation, and then look forward to spillover effects, to promote further cooperation in other areas.

#### Organizational Innovation: Establishment Of The Reocs And Related Discussions

Because of the change of social form, the current disaster and emergency accidents continue to increase, emergency medical system assistance<sup>3</sup> is more important. At present, Taiwan's emergency medical care system includes: The Ministry of Health and Welfare, the Ministry of Ministry of the Interior, the city/county government and health bureaus, the Disaster Relief Command Center and first aid

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<sup>3</sup> They are including the emergency medical care system operation of the good, the relationship between the wounded whether the survival of patients and their medical prognosis quality, and patients' cross-district medical treatment if a major disaster or acute illness happened.

responsibility hospitals which to provide ambulance and emergency medical care services. Hope to be able to protect safe, healthy and the lives of people with a variety of disaster emergency response measures (Ministry of Health and Welfare, 2015: 32). To integrate emergency medical rescue resources and strengthen the emergency response mechanism, Taiwan has established its emergency medical rescue area coordination and command system according to the *Emergency Medical Rescue Act*. The central authorities of the Ministry of Health and Welfare in accordance with the law commissioned by the medical institutions in all regions of Taiwan to form a regional emergency medical response center, which responsible for tasks including real-time monitoring of disaster-related emergency medical events in the region, immediately grasp the region emergency medical information and resource situation, etc.

The construction of the emergency medical care system is expected to meet the needs of regional disaster medical support. Since 2004, the emergency medical rescue system has been established in the Taipei District, North District, Central District, Southern District, Gao-Ping District, and Eastern District. The tasks of REOCs include: to monitor the information and resource situation of emergency medical events in the area and to assist in planning of rehabilitation work, to build a database of disaster medical resources in the region, to assist the central health authority dispatches the emergency medical resources in the area when the disaster occurs across the county or city, to direct the emergency first-aid hospital in the area to assist in handling a large number of

emergency patients, and regularly carry out emergency medical emergency training.

The operation of the emergency medical care system involves a wide range of related business areas, including fire, police, and medical and other social security units, which contains various types of human facilities, communication, transportation, patient referral, public health, and system assessment mechanism and so on. Due to the differences in emergency medical care resources and abilities in various districts, patients should be immediately sent to other medical institution that has recently been able to dispose of illness in the event of a major disaster or emergency if they are unable to receive proper medical care locally. Therefore, cross-regional coordination and cooperation in medical resources consumption is a very important subject. It may strengthen emergency medical quality, in addition to the promotion of emergency ambulance quality before and after arriving the hospital, but also help to integrate the resources to build a regional-based capacity of emergency response model. Wu et al. (2008) have conducted a study on the construction and operation of trans-regional emergency medical system in Taiwan. According to the questionnaire survey to understand the situation of domestic cross-regional emergency medical care, and its problems. Wu's study focuses on executive director, disaster relief, ambulance command center, training and education to staff, and the hospital emergency room management, the problems have found mainly includes: regional emergency medical response center and the units linked to pre-hospitalization, emergency medical inter-regional

operations, database construction, education, and training issues, and so on. Some of the topics covered are related to medical professional or on-site operation, but it is also worthy to be reference in many cross-regional and cross-disciplinary cooperation matters. The results show that the current six regional emergency response centers generally face the hospital ambulance manpower training and continuing education as the biggest challenge; overall, emergency medical management system has several functions, but the quality of the national emergency information integration can be further strengthened (Wu et al., 2008).

In the part of the contingency of the disaster, the authorities and responsibilities among the central and local governments should be more clearly defined. By setting up the regional emergency medical disaster response center, the central government will enhance its response ability to disaster and help the local governments to strengthen the disaster prevention system. The fault of any one of the links in this system may lead to the failure of the whole operation. This study is a preliminary exploration that based on the planning and operation of the emergency medical care system in Taiwan in purpose to find out if the construction of such functional regional governance platform could be the feasible mode of cross-regional cooperation.

#### The Organizational Innovation Functions of the REOCs and Cross-regional Integration

In design, the REOC is mainly responsible for monitoring the information and resource status of emer-



gency medical events in real-time monitoring and assisting in the planning of rehabilitation work. In addition, it also helps for constructing database of disaster medical resources in the area, and assisting the central health authorities for dispatching emergency medical resources in the area at the time while a major disaster-related emergency medical exercise. The spirit of the planning and operation of the ROEC is a typical functional regional governance case, since the operation of the emergency medical care system involves a wide range of stages, which can be divided into pre-hospital ambulance and hospital medical care. The relevant professions include fire, police, medical and other social security units, while involves various types of human facilities, communication, transportation, patient referral, public health education and system evaluation mechanism. The most important factor for the success of its operation is necessarily to have a good cross-regional mechanism that can integrate matters in the emergency after the incident, even if the central unit of the command system has not yet formed, the mechanism can immediately start a systematic operation.

There exists difference in emergency medical care resources and abilities in various districts. When a major disaster or emergency happened and massive illness cannot be properly received and treated locally, it should be immediately sent to a medical institution which has recently been able to dispose, so that can reduce the consumption of medical resources. Thus, better cross-regional coordination and cooperation is a very important part. The quality of the emergency medical response mechanism, not only to en-

hance the capacity of 'emergency ambulance,' but also requires the integration of neighboring resources to construct a useful regional emergency response model.

#### The Evaluation of the REOCs Organizational Innovation Practices

Based on the information provided by the Ministry of Health and Welfare as above, this paper summarizes current situations of Taiwan's REOCs mechanism and its derivatives in recent years (Wu, et al., 2008; Ministry of Health and Welfare, 2015).1. REOCs provides 24-hour duty monitoring At present, the number of attendants is about 5 to 8, and the main channels find out the incident in the area were 'self-monitoring news' and 'monitoring the fire service agency,' followed by 'notification by the health bureau'; after the disaster incident, The CEO made decision or follow the start standard to determine the operational level, and the decision is mainly based on their own standards.2. The linkage of the REOCs with various unit Up to the third level of start (green level), the REOCs will be associated with the District Health Bureau, Disaster Relief Command Center, and First Aid Responsible Hospital, only a few will be associated with other REOCs and the Department of Health and Welfare. When the secondary level start (yellow level), the REOC will be associated with other REOCs and the Department of Health and Welfare, most of which will be associated with the District Health Bureau, Disaster Relief Command Center, and First Aid Responsible Hospital. Start level first (red level), every REOC will be associated with the District Health Bureau, Disaster Relief Command Center, and First

Aid Responsible Hospital, other REOCs and the Department of Health and Welfare. Among them, the North REOC in the chemistry disaster or nuclear disaster and other special disasters, it will also be associated with the District Health Bureau, Disaster Relief Command Center, and First Aid Responsible Hospital, other REOCs and the Ministry of Health and Welfare. The Center for Disease Control and Response, Environmental Protection Agency and Drug Administration Center will be contacted by other organizations whose responsibilities are linked. In the connection tools, within the area, the Health Bureau, Disaster Relief Command Center, and First Aid Responsible Hospital, the other REOCs and the Ministry of Health and Welfare are mainly use of telephone, and use of internet and satellite phone to associate with other REOCs. Telephone, radio, and internet communication are offered that will improve the quality of services of REOCs.

### 3. The establishment of the REOCs database varies from region to region

Each REOCs has a database of disaster medical professionals, emergency medical and rescue resource, and most of them have a database of disaster medicine and major disaster events at home and abroad. Among them, the North District establish all the databases, and the Central District's data of disaster medical professionals, emergency medical rescue resources and major disaster events at home and abroad, and the Southern District's emergency medical rescue resource database, are both part of open nationally to inquiry.

### 4. The education and training organized by REOCs

Training courses and topics include: Disaster Medical Rescue Team (DMAT) training and retraining courses, hospital emergency medical contingency courses, tourism area first line ambulance training courses, large number of injuries and evacuation of the desktop simulation and exercise, poisoning and chemical education and training courses.

### 5. The problems that REOCs to be resolved

Including the shortage of human resources and inadequate training, the emergency medical management system of the Department of Health and Welfare cannot cross-site registration and the lack of capacity to mobilize resources, inconsistent timing and initiative of contacts across units within the emergency medical system, the division of powers to be clarified, and six Districts' resources have not integrated properly.

### 6. The coordination of disaster relief and ambulance command center with other units

The fire units are mainly using of telephone to associate with other units while the case is happening, then followed by the internet; and to contacted with ambulance personnel mainly use the radio; with the disaster relief command center outside the county is mainly use of telephone; and contact to the evacuative hospital is mainly used radio, followed by the telephone. And, the main contact for the dispatcher, followed by the medical care division; and the contact with the Health Bureaus mainly use the phone, a few use the green phone, and the main contact for the medical care division, followed by dispatcher, a few by responsible person. The timing of

the notification to the Health Bureau is mainly when the case is identified or is expected to be many injuries, followed by the capability of local fire units are not enough to cope with the occurrence of cross-county disaster; a few command centers will also inform the Health Bureau in the case of special injuries, such as suicide or psychiatric cases, or with the different views with delivery of the hospital in send medicine timing or unit.

7. The use of the Central Emergency Medical Management System by the Disaster Relief Ambulance Command Center

Only two counties did not use this system, one county and city use their own development of computer system. 70% of the command center are required to use the emergency medical management system in services, four counties using the system after in the Health Bureau or the Department of Health and Welfare have established a 'disaster incident,' in addition to a county only uses the system as a query.

8. Disaster Relief and Rescue Center to send medical situation across areas (counties)

In addition to Kaohsiung City, Yilan County and Lianjiang County, the wounded patients were not sent to the other county for medical treatment, the remaining counties, and cities to send medical treatment across the region of ratio about 0.05 to 30%, of which Lianjiang County's cross-district medical delivery is handled by the local hospital, the command center is only responsible for sending injury to the area responsible hospital and health clinic. The main reason for cross-district delivery of medical care for the county outside that hospital

responsible for the distance, followed by family requirements. The situation of the vacant bed in the county is mainly by the command center to contact, a few through the Health Bureau contact. Overall, cross-regional medical delivery situation is not serious.

9. The problems that Disaster Relief Command Center to be resolved Including the lack of human resources, inadequate training, poor radio reception, the interface of the Central Emergency Medical Management System is inconvenient, the Health Bureau without a 24-hour one-stop of link, and cannot get the hospitals empty bed information quickly.

10. The Central Emergency Medical Management System uses the hospital emergency room only after the authority establishment of a disaster incident

98% of first-aid responsible hospitals have used emergency medical management systems, 60% of which are used by the Health Bureau or the Ministry of Health and Welfare to establish all the injuries under the "Disaster," 5% do not know the timing of use, and 25% do not answer. The number of empty beds in each hospital intensive care unit, burns units and emergency room can receive emergency medical conditions patients, and most of them are daily update, there is a hospital in every five minutes, a hospital using the computer system automatically implemented. Among them, the intensive care unit is the best in update empty number. If one wants to understand the responsibility of the hospital in each section of the intensive care unit, burn scald wards and emergency empty bed and the

emergency can receive emergency injuries, most of the hospital through their own links.

11. The hospital emergency room and the pre-hospital ambulance system  
The emergency room and the ambulance technician, whether it is a major condition (such as: heart arrest, stroke, etc.), will notice the hospital before arrived, and fill the 'ambulance record' or oral explain injury cases, are 'always' (more than 7 times in 10 times) have implemented. 94% of the hospital will store ambulance records in the medical records of the injured patients. Overall, the connection is good.

12. The contact situation before arrived of injuries from the hospital to the other hospital

Most of the patients who are affected by emergency hospitals are clinically referred by hospitals or clinics outside the county. However, most of them only 'sometimes' (1 to 3 times in 10 times) will inform hospitals that are affected. And the time to reach the hospital most of required 45 to 60 minutes, the main hospital for the disease will decide whether to give priority to such patients. According to the research results, the contact situation remains to be strengthened. The aforementioned mentioned is the organizational innovation, which is very helpful for emergency care system and emergency medical network. Especially Taiwan is a multi-earthquake, and densely populated countries, such an organization innovation is quite useful.

### Summary and Suggestions

Emergency medical care system and emergency medical network in Taiwan has been pushing for more than a decade, from the September 21 earthquake, Peach Typhoon, Nali Typhoon, SARS and other major health crisis challenges, highlighting the medical system must strengthen disaster prevention measures and crisis when the emergency response.<sup>4</sup> The operation of the emergency medical care system involves a wide range of relevant areas, so inter-regional coordination and cooperation is a very important part. How to integrate existing medical resources and professional manpower, integrate and crisis-related departments, the disaster hit the health impact to a minimum, become one of the most important issues. Through this operation, it has strengthened the crisis management ability of the health care system, reduced the impact of health and human life, accelerated the recovery of health, and finally established a comprehensive disaster prevention society. In summary, this model has the following inspirations:

(1) With reference to the same mode of operation, the Governments may establish a coordination, operational or governance platform for each district according to specific 'function.'

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<sup>4</sup> In 1999, the September 21 earthquake also called Jiji earthquake which occurred in Jiji of Nantou County in Taiwan. In this earthquake, a total of 2,415 people were killed, 11,305 injured, and US\$10 billion worth of damage was done. In 2001, Peach Typhoon caused serious economic losses and casualties in Taiwan. In 2001, Nali Typhoon hit Taiwan and made a huge damage. In 2002, Severe Acute Respiratory Syndrome (SARS) is a viral respiratory disease of zoonotic origin caused by the SARS coronavirus. SARS caused a great crisis in Taiwan.

(2) Base on the consideration of operational efficiency, resources, manpower utilization and integration, it may be led by the department, and the district command or operation center may be set up.

(3) The governance platform, center, or agency (organization), assist the central ministries to grasp local needs and provide immediate information for decision-making; also use coordinated contact centers to effectively transmit decision-making orders and monitor follow-up effectiveness and implementation of the situation.

(4) To provide the legal basis for the construction, functions, powers, and responsibilities of the relevant platforms to strengthen its substantive functions and legitimacy.

Based on the four-point discussion, the Taiwan emergency medical system has been quite complete. Furthermore, the construction and organizational innovation of the health care system has been ongoing.

#### Conclusion: Organizational Innovation of REOCs in Taiwan

The rapid flow of current global economy, led to a series of political boundaries adjustment, the emergence of newly style of mode or mechanism, in extent, could be the final puzzle of government's strategy for reducing the impact of globalization. Despite governments' strategies are vary, but the direction is the same, that is, *increasing the coordination function among different level of governments*, as well as *construction of flexible new governance mechanisms*. Therefore, the relevant recommendations for Taiwan administrative regions should be more flexible, such as the merger of the

Southern District and Gao-Ping District. Because the culture and geography of these two Districts are the closest, in other words, medical treatment in neighboring Districts can support each other. Most of these two Districts have also been ruled by the DPP for a long time and their cooperation would also be easier. This is the current political ecology in two Districts of local democratic governments.

Taiwan has long been discussing the construction of regional governance mechanism or cross-boundary governance platform. However, it is difficult to discuss the principle of organizational change and innovation or the adjustment of governance structure and the formation of budget and manpower configuration. Some believe the concept of 'regional government' that usually considered as a new government level or the expansion of formal operational method, is not easy to reach at this stage, nor should the new wave of administrative reorganization of the public service. In fact, similar regional governance platforms in the past have been influenced by political parties, integration practices, and it is often influenced by the so-called 'political ecology.' Therefore, it is recommended to try out several important but not subject to political factors for governing. Therefore, based on their functional characteristics and needs, to establish a dynamic regional governance network or mechanism, is worth to think it over.

The challenges of the major health crises such as the September 21 Earthquake, the Tao-tzi typhoon, the Nali storm, and the SARS epidemic have highlighted the need to strengthen

disaster prevention measures and emergency response in times of crisis. Emergency medical care system and network in Taiwan for more than a decade, the current six REOCs effective integration of existing medical resources and professional manpower, integrating the crisis-related departments to reduce disasters and the public health impacts to a minimum. There is no doubt that the importance of the command system in emergency response. The centers of the six regions are equipped with 24-hour staffs and the CEOs who are responsible for the day-to-day operations, and to encourage experts and scholars from different professions to consult various advisors and advisory groups to establish a variety of emergency response processes, to provide relevant education and training, and at any time to monitor the occurrence of health crisis.

In case of emergency happened, the response process normally in accordance with the provisions of the emergency. Importantly, the integration of various emergency-related medical contingency mechanisms, such as emergency medical network, many injuries and disaster medical system, poisoning and radiation injury medical system, to help the decision-makers assigned by the Ministry of Health and Welfare for decision-making. They include: providing up-to-date information on the collection, analysis related resource situation for decision-making, and use coordinated focal points to effectively disseminate decision-making orders, then, monitor subsequent process and implementation of the policy.

Despite the skeptics have questioned political interference with REOCs, the six already operating REOCs have achieved initial results. In other words, the function of REOCs has been recognized positively than those skeptics. With reference to the similar mode of operation, the Government may establish a coordinative or governance platform for each district according to 'function.' Based on operational efficiency, resources and manpower utilization, and integration considerations, can be led by the Ministry of Health and Welfare, set the district command or operational center. Such governance platform, center or agency can assist the central ministries to master local needs and provide immediate information for decision-making; can also use coordinated contact centers to effectively send decision orders and monitor follow-up effectiveness and implementation. At the same time, though legislation to provide relevant legal basis and guide for the construction, as to whether the governance network or mechanism can help to form the 'spillover' effect as functionalists' expect, to promote their experience to other levels or political cooperation, it should be validated from more empirical experience, but similar attempts should be encouraging.

#### References

- Abramson, M. A., & A. P. Balutis (2008). The Challenge of Managing across Boundaries. *The Public Manager*, 37(1): 52-54.
- Barnes, W. R. (2010). Governing Cities in the Coming Decade: The Democratic and Regional Disconnect. *Public*

- Administration Review*, 70 (Special Issue):137-144.
- Beckett-Camarata, J. (2002). "The Relationship between Municipal Strategic Planning and Financial Performance," *Journal of Public Budgeting, Accounting and Financial Management*, spring 2003: 33-40.
- Bozeman, B. (1993). *Public Management: The State of the Art*. San Francisco: Jossey-Bass.
- Chang, S. M., R.Y. Huang, Y. C. Lu, and Y. H. Chen (2014). *The Comparative Study of Central and Local Administration Organizations Function Alignments and Responses*. National Development Council commissioned research program (NDC-DSD-103-004). Taipei: NDC, ROC. (In Chinese)
- Cantori, L. J. and Spiegel, S. L. (1970). *The International Politics of Regions: A Comparative Approach*. Englewood Cliffs, N.J.: Prentice-Hall.
- Deutsch, K. (1968). *The Analysis of International Relations*. Englewood Cliffs, N. J. : Prentice-Hall.
- Haas, E. (1958). *The Uniting of Europe*. C. A.: Stanford University Press, 1958.
- Haas, E. (1961). "International Integration: The European and Universal Process," *International Organization*, autumn, 1961.
- Haas, E. (1964). *Beyond the Nation State: Functionalism and International Organization*. CA: Stanford University Press.
- Hsia, C. J. (2002). "Facing the Urban Reality of Taipei in the Process of Globalization." *Feng-Chia-Ren Monthly*, 122. In: <http://www.fcu.edu.tw/then/alwww/htm1/122fm/122index.htm> (2002) (In Chinese)
- Huang, R. Y. (2013). "The Construction and Transformation of Public Governance System in the European Union," in Ju Jing-peng (Eds.) *The Public Governance of the European Union: Policy and Case Studies* (pp. 3-59). Taipei: National Taiwan University Publishing Center. (In Chinese)
- Keating, M. (1995). "Europeanism and Regionalism" In B. Jones and M. Keating (eds.) *The European Union and the Region* (pp. 1-45). Oxford: Clarendon Press.
- Katzenstein, P. Jr. (1996). *Regionalism in a Comparative Perspective*. *ARENA Working Papers* WP 96/1. Retrieved Mar 22, 2012. In: [http://www.sv.uio.no/arena//working-papers1996/wp96\\_1.htm](http://www.sv.uio.no/arena//working-papers1996/wp96_1.htm)
- Lamont, M., & Molnar, V. (2002). The Study of Boundaries in the Social Science. *Annual Review of Sociology*, 28: 167-195.
- Lee, C. Y. (2011). "Institutional Change and Development of System of Regional Governance Bodies in the United Kingdom - A Case Study of Metropolitan

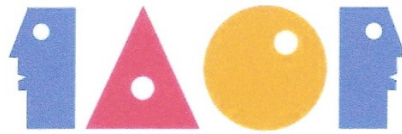
- Government.” Paper presented at the fifth Local Autonomy and Democratic Development Conference, December 15, 2011. Taichung: Tunghai University. (In Chinese)
- Ministry of Health and Welfare (2015). *Wei-Fu Quarterly Journal*, No.6 (2015 November). Taipei: MoHW, ROC. (In Chinese)
- Morse, R. S. (2010). Bill Gibson and the Art of Leading across Boundaries. *Public Administration Review*, 70(3): 434-442.
- National Development Council (2012). *The Medium-Range Plan of Comprehensive Assessment for Nation Development*. Taipei: NDC, ROC. (In Chinese)
- Newman, D. (1999). *Boundaries, Territory, and Postmodernity*. London: Frank Cass.
- Nye, J. (1971). *Peace in Parts*. Boston: Little, Brown.
- Robertson, R. (1992). *Globalization: Social Theory and Global Culture*. London: Sage Publications.
- Russett, B. M. (1967). *International Regions and the International System*. Chicago: Rand & McNally Company.
- Scott, A. (2006). "Globalization and the Rise of City-Regions." In Neil Brenner & Roger Keil (eds.). *The Global Cities Reader* (pp. 370-376). New York: Routledge.
- Shafritz, J. M., Russell, E. W. & Borick, C. (2007). *Introducing Public Administration* (5th eds.) New York: Pearson Education.
- Starling, G. (2008). *Managing the Public Sector* (8<sup>th</sup> eds.) M. A.: Thomson Higher Education.
- Sun, T. W. and Y. W. Lin (2011). The Study on Metropolitan Governance in the US.” Paper presented at the fifth Local Autonomy and Democratic Development Conference, December 15, 2011. Taichung: Tunghai University. (In Chinese)
- Sun, B. T. (2013). *New Public Management* (5<sup>th</sup> eds). Taipei: Yi-ping Culture. (In Chinese)
- Thompson, W. (1973). “The Regional Subsystem: A Conceptual Explication and a Propositional Inventory.” *International Studies Quarterly*, 17: 89-117.
- Väyrynen, R. (2003). ‘Regionalism: Old and New.’ *International Studies Review*, 5: 25–51.
- Weimer, D. L. and Vining, A. R. (2010). *Policy Analysis: Concepts and Practice* (5<sup>th</sup> eds.). Upper Saddle River, NJ: Pearson Prentice Hall.
- Wilson, D. & Game, C. (2011). *Local Government in the United Kingdom*. New York: Palgrave Macmillan.
- Witesman, E. M. (2010). Order beyond Crisis: Organizing Considerations across the Public Service Configuration Life Cycle. *Public*



*Administration Review*, 70(3):  
361-366.

Wright, D. S. (1983). Managing the Intergovernmental Scene: The Changing Drama of Federalism, Intergovernmental Relations, and Intergovernmental Management. In W. P. Eddy, ed. *Handbook of Organizational Management*. NY: Marcel Dekker, 417-454.

Wu, S. C. et al. (2008). *Study on the Built and Plan of Trans-Regional Emergency Medical System: Questionnaire Survey Report*. Taipei: Department of Health, Executive Yuan, ROC. (In Chinese)



## A MEASUREMENT MODEL FOR CONSTRUCTION COMPANIES' ORGANIZATIONAL EFFICIENCY

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### Abstract

In an age valuing competitiveness, artificial neural network is widely used to construct measurement model of organizational efficiency in every industry or trade. The researcher uses artificial neural network as measurement model of construction companies' organizational efficiency. After summarizing references and interviews with construction executives of five listed or OTC listed companies of more than ten years old, the researcher concludes that organizational efficiency of construction companies is classified into five categories and 17 variables and develops 17 measurement items. For this research, 200 questionnaires have been handed out and 195 questionnaires have been collected. The 135 effective samples include 105 learning samples and 30 prediction samples. Through traditional back propagation artificial neural network simulation and that of variable learning efficiency, it is found that organizational efficiency of construction companies should be classified into four categories, namely, background of organizational structure; flexibility, rules and regulations of organizations; adaptation process of personnel; and methods and objectives of organizational strategy. It is also found that back propagation artificial neural network of variable learning speed is an excellent prediction tool for organizational efficiency construction applied in this research if over fitness can be avoided.

Key Words: artificial intelligence, organizational efficiency, construction executives, traditional back propagation artificial neural network

Background and Motives Of Research

The 21st century is an age with  
fierce industrial and commercial competition. Low cost, high quality and high

efficiency are always valued in every industry or trade. As for products, quality control, total quality management and conformance to requirements of ISO all aim at the so called “competitiveness”. Market demand and supply will also change as external environment changes. Technologies and knowledge provided by the former products or services inside enterprises will be tested by trend. According to development trace theory of S curve, it is found that enterprises formerly devoted to product improvement may undergo aggressive technological change so that the former products are fully replaced and the ability and endowment the former products rely upon for existence will weaken. Consequently, leaders in an industry may become losers but startup new enterprises may quickly become leaders of an industry (Afuah, 1997; Foster, 1986; Khalil, 2000).

Speed, efficiency and performance are basic conditions for survival of enterprises. Besides, diversification of the society requires workers engaged in every industry or trade to value quality and competitiveness. Namely, properly working is no longer sufficient for survival of enterprises. On the contrary, only enterprises with excellent operation can survive in the environment with increasingly fierce global market competition. With many consumption choices, consumers will obviously first consider and seek products or services, which can satisfy their demand. In order to obtain desirable profitability, enterprises must deeply know about and satisfy demands of the target customers and work better than their competitors. By observing growth and decline of domestic construction industry, the researcher finds this industry is the mostly influenced by busi-

ness cycle factors and related overall environment factors.

The recent worldwide financial storm has swept across the globe and caused negative growth pressure to economy and will inevitably greatly impact the construction industry of Taiwan. With economic decline, the government has carried out multiple economic revitalization plans. However, economy hasn't showed signs of improvement. The main reason is that not only has private investment in industries sharply declined but also many factories are shut down and operation scale is commonly reduced so that unemployed people constantly increase. Traditional construction industry is the first to bear the brunt and it is difficult for it to take a favorable turn within a short period.

For a long term period, the whole construction industry will still be mired in the difficulty of bleak business if efficient reform is not carried out. Vicious 40 cycle will form and recession will follow in case of irrational fierce horizontal competition. Affected by worldwide financial storm, the construction industry must comprehensively enhance its competitiveness in order to operate perpetually. It is no longer enough to only pay attention to technical aspects of new technologies and tools. It is necessary to carry out thorough reform and analysis with respect to organizational efficiency in administrative and technological management aspects. All operation plans of construction companies have short term and Long term objectives.

Thus many factors will influence organizational efficiency. The researcher will collect information from references and interviews with five listed or OTC listed construction companies of more

than ten years old. After summarizing such information, the researcher uses artificial neural network to construct measurement model of organizational efficiency. This research aims at carrying out self evaluation of construction companies and enhancing their competitiveness. (Objectives may be further described).

#### Discussion of Literature

Whether construction companies are competitive and whether their organization is efficient will be very important indexes. Main considerations for perpetual operation of enterprises include proposals of many scholars and experts, such as total quality management, organization reengineering and conformance to ISO standards, and also include other management strategies. They are no longer technology based. Therefore, Robbins (Robbins, 1990) defines organizational efficiency as the extent to which an organization realizes its short term and long term objectives, response of selection strategy supporters, evaluators' own interests and organizational life steps. The so called organization plan proposed by Nadler et al. in 1992 is an obvious management tool. They propose that two important patterns emphasized by organizational efficiency are appropriate interior and exterior.

According to traditional response method of Miller and Fresien (1984), it is found that organizations must change their internal attribute structure, strategy and process in order to respond to environmental transformation. Hitt (1988) believes measurement of organizational efficiency and its importance lie in creation and design. Organizational efficiency of constructions is mainly determined by organizational structure, strat-

egy and culture (Adas, 1996). These factors greatly influence adaptability of construction industry environment.

Four modes of competition value:

- (1) Reasonable objective mode emphasizes control and organization focuses, methods set by plan and objectives as well as advantage efficiency value with such considerations as productivity and efficiency;
- (2) open system mode emphasizes flexibility and organization focuses as well as advantage efficiency value with such considerations as readiness, flexible method application, internal growth and external support;
- (3) internal process mode emphasizes control and internal focuses as well as advantage value efficiency with such considerations as method and control of communication process; and
- (4) inter personal relationship mode emphasizes flexibility and internal focuses and advantage value efficiency with such considerations as cohesiveness and the method of boosting employees' morale.

Principle of all the four modes emphasizes organizational efficiency and uses organizational efficiency for defining variables and application of network input. Quinn and Rhorbaugh (1983) suggest selecting this method for defining effective mode of organizational efficiency standards of construction companies. The reasons are as follows. First, its four modes have been taken as the representative combining most efficiency criteria by researchers and managers. Secondly, Maloney and Federle (1993) have proved competition value is applicable to construction companies. Sunil K. Sinhal and Robert A. McKim (2000) classify organizational efficiency of construction companies into four categories, namely,

1. background of organizational structure;
2. flexibility, rules and regulations of organizations;
3. adaptation process of personnel; and 4. methods and objectives of organizational strategy.

Fourteen independent variables and dependent variables are developed from the four modes, namely, 1. harmonization of employees; 2. joint responsibility; 3. subcontracting; 4. diversified project management; 5. coordination; 6. information communication; 7. attitude towards reform; 8. familiarity with rules and regulations; 9. compliance with rules; 10. process control; 11. cultural advantage; 12. workers' participation in decision making; 13. planning; and 14. setting of objectives.

In the 1950s, artificial neural network proved all continuous functions could be expressed by a three layer feedback artificial neural network (Kolmogorov, 1957). Therefore, artificial neural network can be called a common solution to all learning problems. The principle of general artificial neural network lies in using the method minimizing energy function to seek optimum weight distribution with gradient steepest descent method.

The reason is that networks of this kind have hidden layer structure and can process nonlinear data (Zeng Xianxiong, Huo Guozhen, 2005). Artificial neural network is precisely defined as follows: artificial neural network is a kind of computer system including hardware and software and it can use many connected artificial neurons to simulate biological neural network. Artificial neurons are simple simulation of biological neurons. They collect information from external

environment or other artificial neural networks, perform very simple operation and then output the results to external environment or other artificial neural networks (Ye Yicheng, 1994). In civil engineering, artificial neural network has been successfully used as the method of improving construction companies' efficiency. For example, Karunanithi et al. (1994) successfully used artificial neural network (ANN) to predict flow characteristics of complex river system; Adeli and Wu (1998) used neural network to predict construction cost; Sinha and McKim (1997) used artificial neural network to predict rise of construction cost; Flood and Katim (1994) used implementation structure of artificial neural network basic mode to analyze problems; Moselhi et al. (1991) pointed out that artificial neural network could be used for soil analysis, optimization, solution to project disputes and facts of implementation.

Artificial neural network is a structure simulating human brain. Its advantage mainly lies in that it can carry out beforehand training and constantly adjusts connected weight until predictive value is very close to actual value (Hegazy et al., 1994). An artificial neural network is multiple nodes or units connected by links. Every link has a corresponding digital weight. Weight is an important method for artificial neural network to carry out long term storage. Learning is usually carried out by updating weight (Stuart Russell, Peter Norvig, 2002). Prediction model of artificial neural network development is feed forward training method calculated by back propagation. Namely, gradient descent is utilized to adjust ANN weight (Rumelhart et al., 1986). Design of artificial neural network model includes two main items, namely, analysis and construction

of problems. Analysis of problems is an independent factor confirming problems.

Construction of problems requires sorting out and identification of independent factors and responds to variables. Training quality of artificial neural network is the quantity depending on training data and the way of inputting data into network. 34

#### Methods of Measuring Organizational Efficiency

Prediction model of artificial neural network is developed in three steps. First, define categories and related variables of construction companies' organizational efficiency so as to test efficiency. Secondly, research field covers design and implementation; in the construction industry, variables measure organizational efficiency and structure is also a measurement scale; it is also required to collect representative data acquired by construction companies by using self management questionnaire samples. Thirdly, carry out training and collect correct data about use of artificial neural network, such as principal component analysis (PCA), linear regression and correlation of main factors in data group, which are obtained by statistical means. It is found in references that organizational efficiency is classified into four categories.

According to results of interviewing construction executives of five listed or OTC listed construction companies, it is found that they not only have the same perception and opinion but also play an important role in enhancing organizational performance and efficiency. Therefore, organizational efficiency of construction companies is summarized and classified into five categories. Namely,

(1) background of organizational structure including variables 1. harmonization of employees, 2. joint responsibility, 3. subcontracting, 4. diversified project management, 5. coordination and 6. information communication; (2) flexibility, rules and regulations of organizations including variables 1. attitude to wards reform, 2. familiarity with rules and regulations, 3. Compliance with rules and 4. process control; (3) adaptation process of personnel including variables 1. cultural advantage, 2. workers' participation in decision making; (4) methods and objectives of organizational strategy including variables 1. planning and 2. setting of objectives; (5) improvement of organizational performance including variables 1. construction period control, 2. cost control and 3. quality improvement.

The researcher collects correct data by means of research field design. After all variables undergo operation and measurement, the researcher constructs different items to score their degree. Except cultural advantage, all variables are scored by Likert 5 point scale, namely, the highest score is five points and the lowest score is one point (Furnham and Gunter, 1993). As for measurement of organization culture, constant method of Maloney and Federle (1993) is used to measure six main aspects of culture and the measurement results can be converted into Likert 5point scale and are compatible with scoring of other variables. Efficiency index of the construction industry is determined by three factors, i.e., construction period, cost and quality. Efficiency is calculated by average percentage of whether construction scheduling is brought for ward or completion is delayed, whether budget cost is increased or decreased, whether any compensation is made and customers' acceptance of specifications, etc. The calculated value

falls between “1” and “0”. “0” represents no efficiency and “1” represents 100% efficiency. (Tabulate this discovery) Sources of data mainly include interview, observation, investigation and archives but they must meet two basic requirements, namely, data must be reliable and effective.

As for statistical analysis of data, artificial neural network can reach new state through sample learning and knowledge summary. For example, preprocessed data successfully reduces complexity of network architecture. Correlation analysis is mainly used to deal with linear correlation between two groups of measurement data. When variables researched only include one X variable and one Y variable, linear correlation between them is simple correlation (e.g., Pearson product moment correlation). When variables researched include only one Y variable but p X variables, the linear correlation between the p variables and Y variable is multiple correlation. When variables researched include p X variables and q Y variables, the linear correlation between the p X variables and q Y variables is typical correlation (Cheng Binglin, 2005).

Pearson correlation is used to control construction data group and is main predictor observing the six variables as correlation analysis output. Regression analysis is mainly used for explanation and prediction. Its explanation function mainly lies in predicting variables as well as correlation intensity and correlation direction. Prediction function lies in applying regression equation and using known independent variables to predict unknown dependent variables (Cheng Zheng Chang, 2005). The researcher conducts linear regression analysis over the 17 independent variables and depend-

ent variables. Stepwise regression analysis starts with all variables selected. Remove unimportant variables step by step until all variables kept are important ones. It is main predictor observing the eight variables as output of stepwise regression analysis. Combining networks is intended to develop accurate prediction model of construction organizational efficiency. Five continuous networks are combined. Each network represents a stage of completing mode evolution.

Different statistical methods are used to obtain multiple combinations of important prediction and evaluate implementation ability. Test data of network is unknown so error will occur. Such error is called root mean square error (RMSE). Its calculation formula is:

$$RMSE = \sqrt{\sum_{i=1}^N \{Y - Y^*\}^2 / N}$$

Y = actual output; Y \* = predicted output; N = observed value. It is also required to calculate total time for network weight and implementation. Total time necessary for implementing one training cycle is (Skapura, 1996):

W = total weight within network;  
Tf = forward propagation time;  
Tb = back propagation time; Tt = conversion function time; Nt = training sample size; Ne = number of repetitions; M = machine operation time.

Data input by it consists of 17 dependent variables. Accordingly, the researcher constructs prediction efficiency of construction organizations and uses five different networks to construct prediction structure of construction companies' efficiency. The first 17 processing elements (PEs) are constructed in input two hidden layer network. Network output is single neuron. This is general network mode (GEN). The second network

mode is based on principal component analysis (PCA), including the eight input processing elements, the first hidden layer and four processing elements at the second hidden layer. As for the third mode, network is constructed through regression analysis. Input and output respectively need two hidden layers made up of eight neurons. The third mode is called regression analysis mode (REGR). The fourth mode is correlation analysis mode (CORR) based on correlation analysis results. This mode is made up of six output processing elements and two hidden layers. The fifth mode is constructed by using GEN and PCA. Appropriate number of neurons is selected at hidden layers according to PCA information of construction data.

Therefore, for network construction, 17 processing elements are at hidden layers, with eight processing elements at the first hidden layer and four at the second hidden layer. This mode is called principal component analysis artificial neural network (PCAANN).

## Research Methods

### (1) Sample questionnaire design

Measurement of this questionnaire originates from the second aspect. The first source is collection and summary of related literature. The second source is in depth interview with construction executives of five listed or OTC listed construction companies. After making summary, referring to the references and making other efforts, the researcher finally concludes organizational efficiency of construction companies is classified into five categories and 17 variables. The researcher then discusses with construction operators the important points valued at each construction level and has altogether developed 17 measurement items.

For background of organizational structure, six items are designed; for flexibility, rules and regulations of organizations, four items are designed; for adaptation process of personnel, two items are designed; for other matters related to improvement of organizational performance, three items are designed. Altogether 17 items are designed.

### (2) Sampling process

For this research, samples are collected for questionnaires of construction operators in the north, the mid, the south and the east of Taiwan. It is intended to predict the results according to answers filled in by the construction operators. Therefore, when artificial neural network is constructed through MATLAB 2007a, effective samples are classified into learning samples and prediction samples. For this research, altogether 200 questionnaires have been handed out and 195 questionnaires have been collected in total.

(3) Sampling results, analysis and discussion (It is suggested to make supplement with respect to this subject because it is not sufficient to discuss artificial neural model.)

This research adopts prediction model. Therefore, questionnaires not completely answered are ineffective samples. Altogether, there are 60 ineffective samples and 135 effective samples. The researcher regards 105 of the effective samples as learning samples and 30 of them as prediction samples. Conditions of ceasing model learning include learning times and MSE. For stabilizing the results, steadily set the upper limit at 10,000 times and MSE at zero. Cease the model when it satisfies either condition. Set the initial weight as random weight. As for variable conversion mode, the



researcher adopts the answers originally filled in as output value. It is intended to reduce degree of freedom and increase prediction error when 0 + 1 S function is used to convert output value. It is inappropriate for learning speed to be too high or too low. Besides, back propagation artificial neural network can now provide variable learning speed. When MSE changes greatly, increase learning speed; when MSE changes slightly, reduce learning speed to increase learning efficiency. For the purpose of determining optimum prediction model, the researcher compares which of the two learning methods will produce better learning effect. There is no fixed formula for calculating the number of neurons. In addition, learning effect and efficiency will be influenced if the neurons are too many or too few.

Therefore, for the purpose of avoiding influences caused by the number of neurons, the researcher sets the number of neurons between 1 and 21 and respectively builds models to compare the results. This research is intended to build a reliable prediction model. Although prediction objectives are answers filled in the questionnaires, the prediction is essentially quantitative prediction. Therefore, the researcher compares the predicted numeric value with actual data and uses GOAL, MSE, mean absolute percentage error (MAPE) to measure error for the purposes of determining accuracy of predictive value and finding out better structure of artificial neural network. As for prediction of possible answers of a single questionnaire informant, the research defines prediction error by difference between predicted value and actual value. Its calculation formula is as follows:  

$$eit = Fit - Oit$$

Where:  $e_{it}$  = prediction error of question  $t$  in sample  $i$ ;  $Fit$  = predictive value of question  $t$  in sample  $i$ ;  $Oit$  = actual value of question  $t$  in sample  $i$ . Deviation of predictive value from actual value in this research can be used for reference. Therefore, the researcher uses percentage to show degree of error.

The common indexes include Mean Absolute Percentage Error (MAPE). Its calculation formula is as follows:

$$MAPE_i = \frac{\sum_{i=1}^n \frac{|e_{it}|}{O_{it}}}{n}$$

Lewis (1982) believes that MAPE is the most effective evaluation index and formulates related evaluation standards, as shown in Table 1. In addition, the researcher also uses GOAL as one of the comparison standards. This research is intended to predict answers of questionnaire. Using back propagation artificial neural network to predict results doesn't necessarily produce integer solution but produces status of continuous integer solution. Therefore, the research defines as follows: prediction is correct if the difference between predictive value and actual value is within  $\pm 0.5$ ; prediction is correct if predictive value is 3.1 and questionnaire value is 3 and prediction is wrong if predictive value is 3.6. Simulation results of back propagation artificial neural network in this research are shown in the following figures.

In Figure 1, Figure 2 and Figure 3, GOAL, MAPE and MSE can be found when traditional back propagation neural network algorithm is applied. When the number of neurons is set between 4 and 18, performance is desirable within the range of Q1 Q4 (MAPE is lower than 0.15 and GOAL is higher than 0.5).

When the number of neurons is set at 6, performance is optimum. Its MPAAE is lower than 0.1. Performance is not desirable at Q5 but it is within the range of reasonable prediction. In Figure 4, Figure 5 and Figure 6, it can be found that prediction results of back propagation artificial neural network perform better than those of traditional back propagation artificial neural network algorithm when variable learning speed algorithm is applied. Its optimum performance only requires four neurons. When efficiency is pursued, variable learning speed will perform better. The maximum difference between the two algorithms lies in that extreme results may occur when the number of neurons is set at 19. In such event, neither variable learning speed algorithm performs correctly and the performance even falls beyond prediction. On the contrary, MSE increases by more than 50. The researcher concludes over fitness may occur during learning prediction process. If such circumstance is avoided, variable learning speed back propagation arti-

cial neural network can be deemed as an excellent prediction tool applied in this research.

### Conclusion

Through artificial neural network calculus, the research finds that Q5 doesn't perform desirably. Namely, three variables of organizational efficiency improvement status are within reasonable prediction scope but are obviously unimportant. Therefore, organizational efficiency of construction companies is classified into four categories, i.e., flexibility, rules and regulations of organizations; adaptation process of personnel; methods and objectives of organizational strategy. The researcher also finds that variable learning speed back propagation artificial neural network is an excellent prediction tool applied in this research if over fitness can be avoided. (This part is analysis results and conclusion should put forward with regard to the overall discovery).

Table 1. Evaluation Standards of MAPE

MAPE (%)	Description
<10	Highly accurate prediction
10-20	Excellent prediction
20-50	Reasonable prediction
>50	Inaccurate prediction

Figure 1. MAPE of GDA Algorithm

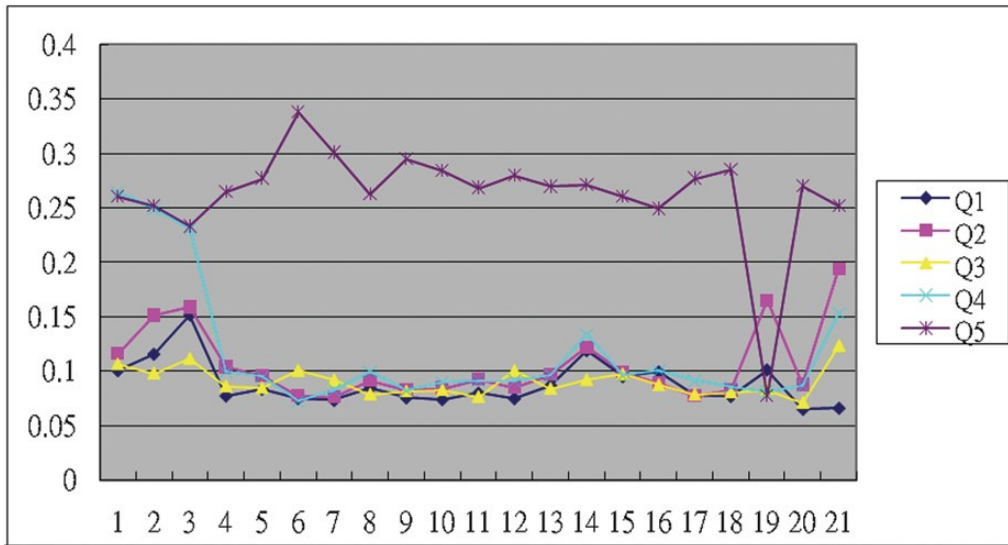


Figure 2. MSE of GDA Algorithm

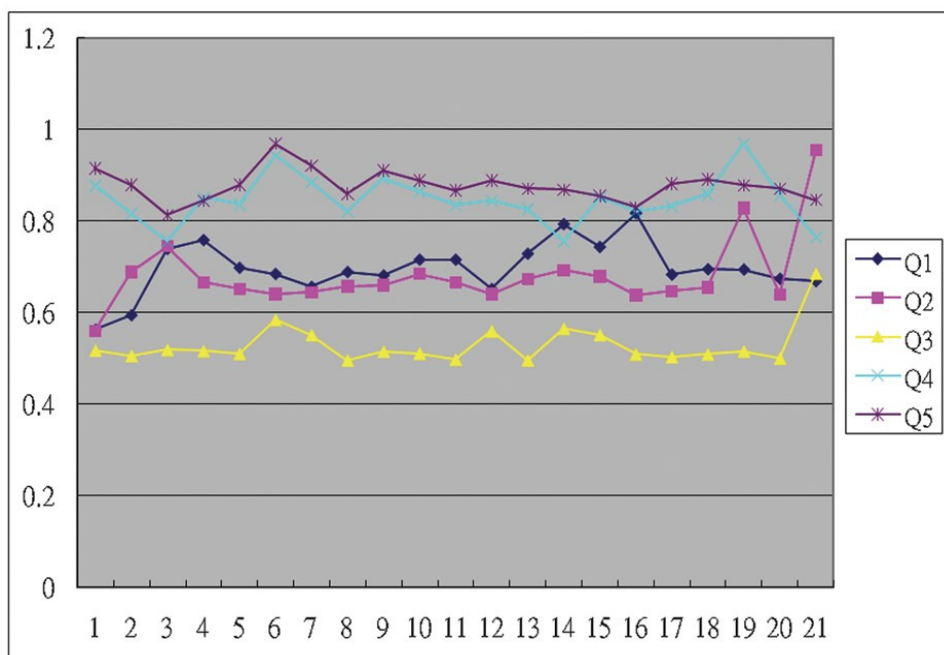


Figure 3. GOAL of GDA

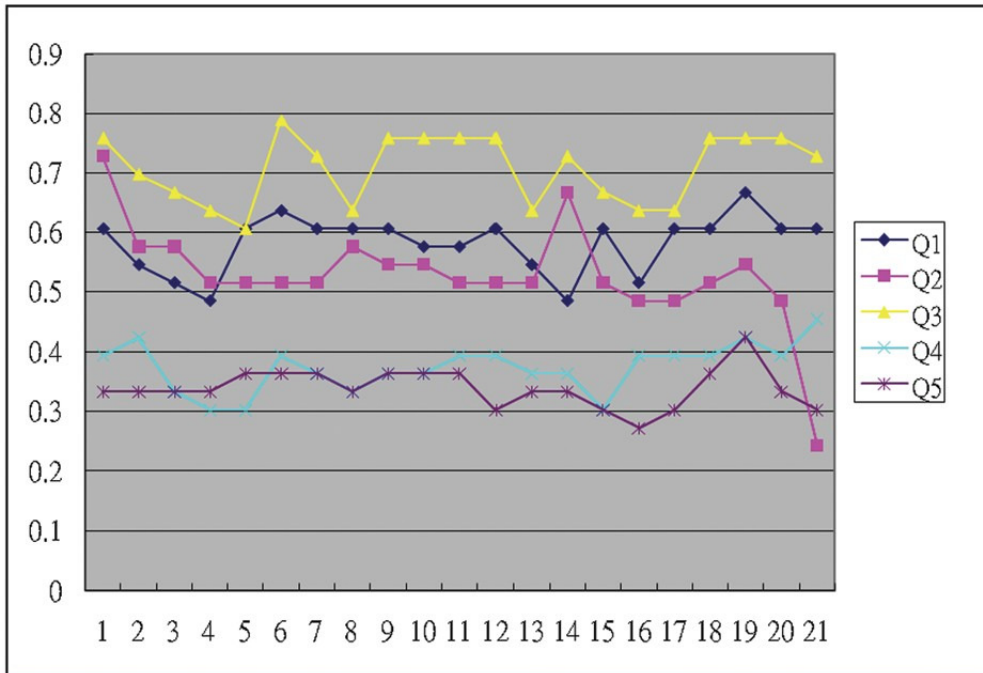


Figure 4. MAPE of GDX

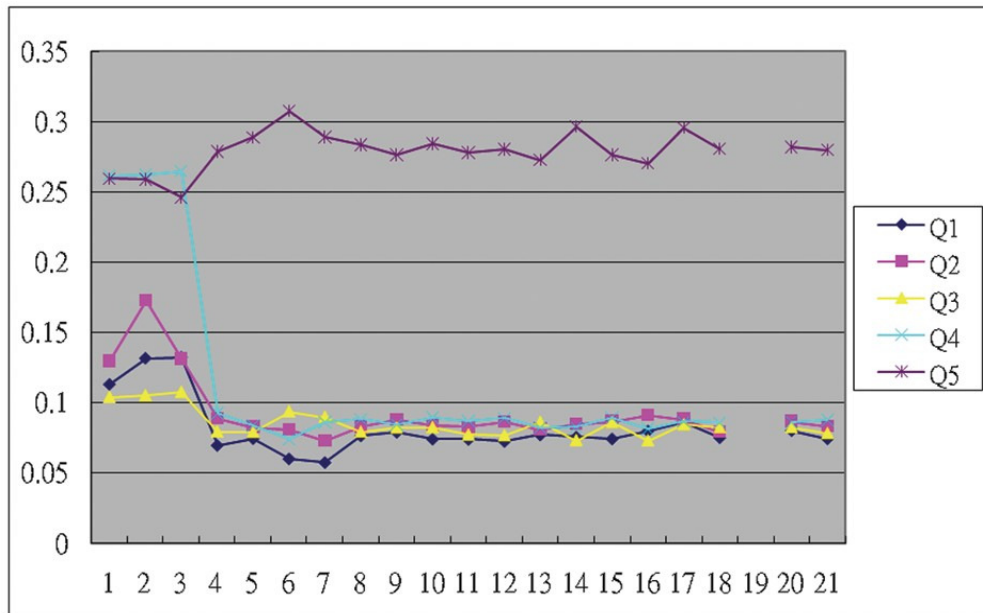


Figure 5. MSE of GDX

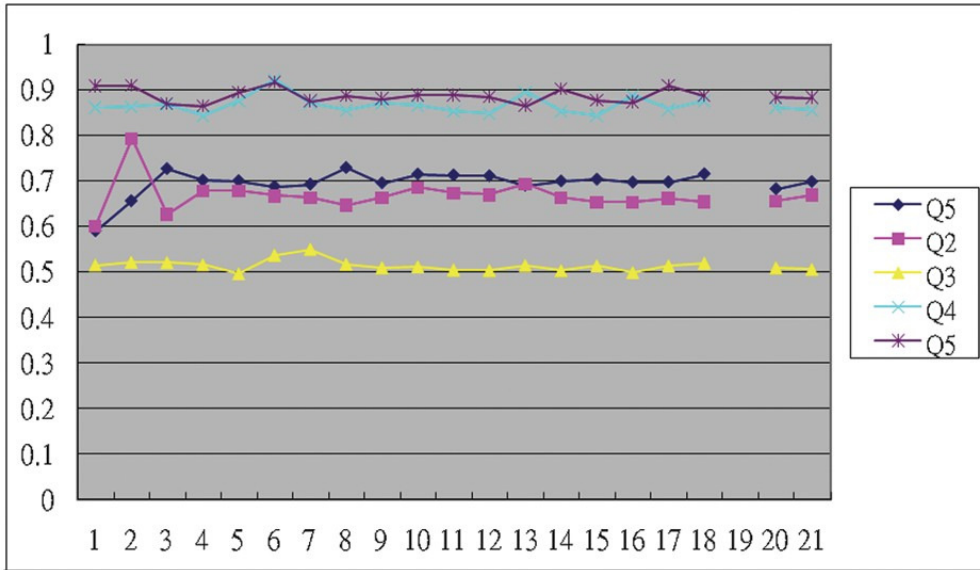
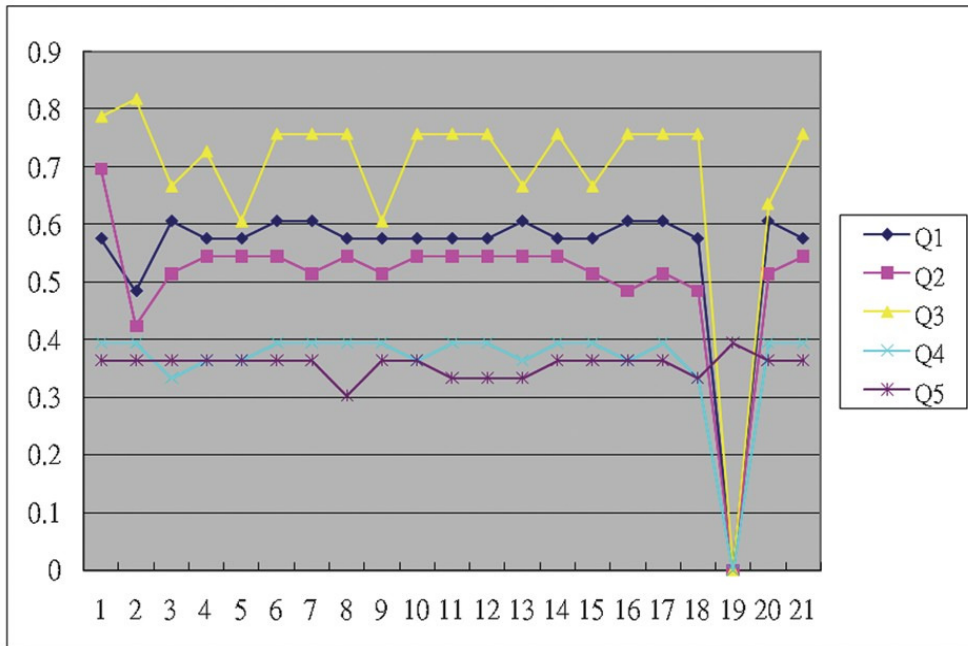


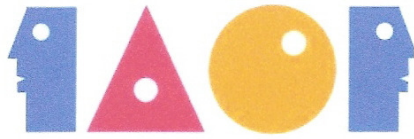
Figure 6. GOAL of GDX



## References

- Adas, A. A. "The level of organizational efficiency of the construction firm: A multivariate model based prediction methodology," PhD Thesis, University of Waterloo, Ont. Canada. 1996. 5
- Adeli, H. and Hung, S. L. "An adaptive conjugate gradient learning algorithm for efficient training of neural networks." *Appl. Math.*, 8Vol. 62(1), 1994, pp. 81–102
- Adeli, H., and Wu, M. "Regularization neural network for construction cost estimation." *J. Constr. Engrg. And Mgmt.*, ASCE, Vol. 124(1), 111998, pp. 18–23.
- Flood, I., and Kartam, N. "Neural networks in civil engineering .II: Systems and application. " *J. Comp. inciv. engrg.*, ASCE, Vol. 8(2),1994, pp. 14149–165.
- Cheng Zheng Chang, Chen Xinfeng, Cheng Binglin, Liu Zijian *Multiple variable Analysis Method*, p1, 43, Taipei, Wunan Book Publishing Co., Ltd. 2005. 18
- Furnham, A., and Gunter, B., *Corporate assessment: Auditing company's personality*. Routledge, London. 1993
- Hegazy, T., Moselhi, O., and Fazio, P., "A neural network approach for representing Implicit knowledge in construction." *Int. J. Constr. Inf. Technol.*, Vol. 1(3), 1994, pp. 73–86.
- Haykin, S. *Neural Networks: A comprehensive foundation*. Macmillan, New York. 1994.
- Hitt, A. M. "The measuring of organizational efficiency: Macmillan, New York. 1988. 28
- Karunanithe, N., Grenney, W. J., Whitley, D., and Bove, K. "Neural networks for river flow prediction." *J. Comp. Civ. Engrg.*, ASCE, Vol. 318(2), 1994, pp. 201–220.
- Khalil, Tarek, "Management of Technology: The Key to Competitiveness and Wealth Creation," McGraw Hill, 2000.
- Lewis, C. D. *Industrial and Business Forecasting Methods: A practical Guide to Exponential Smoothing and Curve Fitting*. London: Butterworth Scientific. 1982.
- Maloney, W. F., and Federle, M. O. "Practical model for organizational assessment." *J. Mgmt. in Engrg.*, ASCE, Vol. 9(1), 1993, pp. 64–81.
- Miller, D., and Friesen, H. P. *Organizations: A quantum view*. Prentice Hall, Englewood Cliffs, N.J. 1984.
- Moselhi, O., Hegazy, T., and Fazio, P. "Neural Networks as tools in construction." *J. Constr. Engrg. And Mgmt.*, ASCE, Vol. 117(4), 1991, 3pp. 606–625.
- Nadler, D. A., Gerstien, M. S., and Shaw, R. B. *Organizational architecture: Designs for changing organizations*. Jossey-Bass Publishers, San Francisco. 1992.

- Quinn, R. E., and Rhorbaugh, J. "A spatial model of effectiveness: Criteria towards a competing values approach." *J. Mgmt. Sci.*, Vol. 29, 91983, pp. 363–377.
- Robbins, P. S. *Organization theory: Structure, design and applications*. Prentice Hall, Englewood Cliffs, N.J. 1990.
- Robel, A. "Dynamic pattern selection: Effectively training back propagation neural networks." *Proc., Int. Conf. on Artificial Neural Networks*, Springer, New York, Vol. 1, 1994, pp. 643–646.
- Rumelhore, D., Hinton, G., and Williams, R. "Parallel distributed processing." *Foundations*, MIT Press, Cambridge, Mass, Vol. 1, 1986.
- Sinha, S. K., and McKim, R. A. "Forecasting construction cost escalation using artificial neural networks." *Proc., IEEE Artificial Neural Network in Engrg. Conf.*, Vol. 1, 1997, pp. 829–836. 21
- Stuart Russell, Peter Norvig "Artificial Intelligence A Modern 23 Approach" 2002, pp. 196–197.
- Sunil K. Sinha and Robert A. McKim "Artificial Neural Network for Measuring Organizational efficiency" *Journal of Computing in Civil Engineering*, ASCE, ISSN, Vol. 14(1), 2000, pp. 9–14.
- Ye Yicheng. *Application and Implementation of Artificial Neural Network*, Taipei, Scholars Books Co., Ltd. 1994.
- Zeng Xianxiong, Huang Guozhen. *Artificial Intelligence and Expert System*, Taipei, Flag Publishing Co., Ltd. 2005, pp. 4–8.



APPLICATIONS OF NETWORK DATA ENVELOPMENT  
ANALYSIS TO EXPLORE THE OPERATIONAL EFFICIENCIES OF  
INTERNATIONAL FIVE-STAR HOTELS

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Abstract

Based on operating characteristics of the hotel industry, this study divided the service processes of international five-star hotels into room services and food & beverage service, and used network data envelopment analysis to analyze the service efficiencies of the distinctive stages of the hotel industry. Study results show that international five-star hotels that have distinctive customer sources and are located in distinctive areas, indicating significant differences in overall efficiencies. In addition, if the hotel is the international chain brand, the only significant difference is in room occupancy efficiency. Finally, based on room occupancy efficiency and catering efficiency, this study classified 46 DMU into four categories, and provided corresponding suggestions for operational management and marketing activities.

Keywords: International Five-Star Hotels, Network Data Envelopment Analysis,  
Room Service, Catering Service.

Introduction

Due to fast economic developments and increase in income, countries worldwide are gradually transforming from industrial society to service-oriented industrial structures. Peter F. Drucker, a

guru on management, once pointed out that “the new economy is service economy”. The service industry has become an industry accompanied with global economy development, which grows very fast in the 21st century (Fatma & Timothy, 2005). According to statistics from the United Nations World Tourism



Organization (UNWTO), in 2014, worldwide, there were over 1.1 billion trips taken abroad. Number of international tourists has increased for five consecutive years since the financial crisis. Tourism has now become a primary source of foreign exchange income for many countries. The World Economic Forum has just released a report on global travel and tourism competitiveness. The report says that global GDP created by travel and tourism has grown at an average rate of 3.4% per year in the past three years, showing that the contribution from travel and tourism to the economy of every country is increasing.

According to statistics from the Tourism Bureau, Ministry of Transportation, & Communications, in 2014, 83 out of 100 visitors to Taiwan stayed in hotels, with sightseeing visitors spending an average of 95 US dollars in hotels each day, approximately 40% of their total spending (Bureau of Tourism, Ministry of Transportation, & Communications, 2015). Consequently, in order to enhance tourism service qualities, the satisfaction of tourists, and to shape the tourism image of Taiwan, good operational management of tourist hotels is crucial in tourism. In June, 2015, there were 46 international five-star hotels in Taiwan. Considering such fierce market competition and in order to maintain sustainable operations, externally, hotels should have acute responses to the market, and internally, should properly use their limited resources to create maximum profit. In order to understand their advantages and weaknesses, and to strengthen any shortcomings in their operational capacity, hotel owners should conduct analyses of their competitors. Therefore, this study aims to establish a systematic efficiency evaluation model

that can be used to compare the operational efficiencies of distinctive tourist hotels.

The analysis methods used by previous studies on evaluations of hotel efficiency can be classified into three categories. The first category is ratio analysis, which was commonly adopted by earlier studies. This method calculates the ratio between a single output and a single input to measure the operational performance of a hotel (Wasenaar & Stafford, 1991). The second category is the parametric approach. This approach takes one output item as a dependent variable, and several input items as independent variables, and uses a linear production function to evaluate the efficiency of the evaluated object (Assaf & Magnini, 2012). The third category is the data envelopment analysis (DEA) which has been widely used in recent years. However, this method doesn't need to set a function in advance. Dividing multiple output items by multiple input items, this method obtains production frontiers using mathematical programming to evaluate the relative efficiencies of hotels. This analytical method is a kind of non-parametric approach (Manasakis, Apostolakis, & Datseris, 2013).

The traditional DEA model (Charnes, Cooper, & Rhodes, 1978; Banker, Charnes, & Cooper, 1984) can only present the overall operational efficiency, but cannot further present the transformation processes of middle-stage resources. However, in practical operation, the production activities of an organization consist of multiple sub-activities (Färe & Grosskopf, 2000; Tone & Tsutsui, 2009). Besides the final outputs, each sub-production system may produce outputs that are used as inputs of

other sub-production systems. Therefore, adopting a multistage network efficiency evaluation model can help to obtain more transformational efficiencies of middle resources, which can be used as important references for generating operational strategies. There have been studies adopting multistage DEA to measure operational efficiencies (Huang, Ho & Chiu, 2014; Hsieh & Lin, 2010; Yu & Lee, 2009).

Previous studies have generally divided hotel efficiency into efficiencies of room service and food & beverage service, but have failed to conduct further comparisons based on the characteristics of hotels, and also to understand the competitive positions of hotels. To summarize, this paper proposes the following three study aims.

1. Referring to the characteristics of the production activities of hotels, this study will adopt network data envelopment analysis to establish a multistage efficiency evaluation model that can evaluate the room service efficiencies, food & beverage service efficiencies, and operational efficiencies of hotels in Taiwan, and compare the evaluation results with those obtained by a traditional model to present the differences, strengths and weaknesses of the network efficiency evaluation model.
2. Evaluate whether room service efficiencies, food & beverage service efficiencies, and operational efficiencies of international five-star hotels in Taiwan are influenced by such factors as international chain brands, hotel location, and types of tourists, and provide deeper implications for operational management.

3. Establish a decision-making matrix based on the room service efficiencies and food & beverage service efficiencies of hotels. The evaluated hotels which are based on competitive positions will be divided into four categories: leading hotels, hotels with potential, followers, and hotels with little potential in order to present the competitive positions of the hotels.

#### Literature Adopting DEA to Evaluate Hotel Efficiencies

Reviewing the previous literature on hotel efficiency evaluation, evaluation models can be divided into either single-stage DEA or multistage DEA categories. Introductions to the two categories are as follows.

##### *Single-stage DEA*

Earlier literature mostly adopted static CCR and BCC models or SBM DEA to evaluate hotels' operational efficiencies for a specific year, or from a long-term perspective, adopted Malmquist Productivity Index (MPI) to discuss hotel efficiency changes over different periods.

For example, Anderson, Fok & Scott (2000) adopted CCR and BCC models to discuss the operational efficiencies of 48 hotels in the USA. The study results showed that poor performance of efficiency results from poor technical efficiency and allocation efficiency, and that efficient hotels allocate more resources to food & beverage management. Barros & Alves (2004) used MPI to evaluate the operational efficiencies of 42 hotels in Portugal. The study results showed that more than 60% of the hotels had space for improvement in gross productivity. Hwang

& Chang (2003) adopted DEA to discuss the operational efficiencies of 45 international hotels in 1998, and then adopted MPI to compare the evaluated hotels' efficiency changes from 1994 to 1998. Based on relative efficiencies and efficiency changes, the study divided the hotels into six groups, and proposed corresponding operational strategies for each group. Yang & Lu (2006) adopted DEA to evaluate the operational efficiencies in year 2002 of 56 international hotels in Taiwan, and further analyzed why some hotels failed to be efficient.

The study results show that 40% of the international hotels fail to take full advantage of their manpower, and fail to make the best of the floorage of the food & beverage department. Chiang, Tsai, & Wang (2004) adopted the BCC model to discuss operational efficiencies of 25 international hotels of different operating types in Taiwan in year 2000. The study results showed that the operational performance of hotels from international hotel chains is not necessarily higher than independent hotels.

Wang, Shang, & Hung (2006) added the perspective of quality element, and adopted MPI to measure service qualities and operational efficiencies of 29 international hotels in Taiwan. The studied period was the 11 years from 1992 to 2002. The study results showed that when employees felt that they were not respected, the operational efficiencies and service qualities of the hotels would decrease. Barros & Dieke (2008) used CCR and BCC models to discuss the operational efficiencies of 12 hotels in Rwanda during the seven year period from 2000 to 2006. The study results show that only one hotel demonstrated the scale effect. The study suggested that the government should establish an pro-

fessional association to gather together the cohesive forces of the hotel industry to enhance overall market efficiency. Manasakis, Apostolakis, & Datseris (2013) adopted DEA to compare the operational efficiencies in year 2008 of 25 brand hotels with 25 independently operating hotels in Crete, Greece, finding inefficient DMUs and proposing implications for operational management. The study results showed that domestic brand hotels were comparatively efficient, and that international brand hotels had the best efficiencies. However, the inefficiencies of inefficient hotels were mainly caused by the inequitable distribution factor of input and output resources, and had nothing to do with the capabilities of their management teams. Chen, Lu, & Chung (2010) adopted slacks-based measure (SBM) context-dependent to analyze the operational efficiencies of 34 international hotels in Taiwan. The analysis results can assist hotel operators to understand their competitive advantages, find benchmarking hotels to learn from, and from which the generation of operating strategies can be determined.

#### *Multistage DEA*

A single-stage DEA can only present overall operational efficiencies, but cannot present the transformation processes of middle resources. Consequently, Seiford & Zhu (1999) first proposed a two-stage DEA, using profitability and marketability to measure the operational efficiencies of banks, which can then present the sub-production activities of the organizations. As soon as the concept was proposed, it was applied by scholars to different fields. Two-stage DEA assumes that the inputs of the second stage are the outputs of the first stage, while in practice, production ac-

tivities have multiple stages, and inputs and outputs are not necessarily consistent. Consequently, Färe & Grosskopf (2000) proposed the model of network DEA to measure the efficiencies of healthcare organizations in Sweden, covering middle efficiencies inside the organizations and resource allocation conditions, which was close to practical production processes. Lewis & Sexton (2004) took Major League baseball teams as the study objects, using the status of team funds as an input item, and results of games as an output item, dividing the operational efficiencies of the teams into administrative efficiencies, immediate efficiencies, and overall efficiencies. The study compared the analysis results of the network DEA and the traditional DEA, and discovered that the network DEA could provide more detailed information. Yu & Lin (2008) adopted the model of network DEA, and took the number of trains, railway lines, and number of employees as input items, and transporting distance as an output item to evaluate the passenger and goods transportation efficiencies of 20 railway companies worldwide.

Certain studies applied multi-stage DEA model of the hotel efficiencies in the past, such as Huang, Ho, & Chiu (2014) adopted two-stage DEA to analyze the production efficiencies, room service efficiencies, and food & beverage service efficiencies of 58 international hotels in Taiwan. The study results show that multistage DEA can present the middle efficiencies of all DMUs. Hsieh & Lin (2010) divided the efficiencies of international hotels in Taiwan into service efficiencies and catering efficiencies, and combining them with differential variable analysis, provided suggestions on how to improve resource allocation to DMUs that failed to reach

the efficient level. Yu & Lee (2009) used network DEA to analyze the efficiencies of international hotels in Taiwan, and divided service into the two stages of production process and marketing process. The study results show that the service qualities of hotel industry have been receiving more and more attention in recent years, and the model for network DEA can clearly present the efficiencies of resource transformation processes, and how the self-positioning of a hotel can also influence its production efficiency or marketing efficiency.

To summarize, literature that adopted network DEA often divided the operational efficiencies of hotels into room service efficiencies and food & beverage service efficiencies when conducting a discussion. However, these literatures failed to consider the relationships between tourist guests and the food & beverage service. Tourist guests often prefer to eat at the hotel they are staying at. Therefore, the number of tourist guests will influence the quality of the food & beverage service. This study adds the number of tourist guests as a middle input item at the second stage.

## Research Methods

### *Analysis procedures*

This study took 46 international five-star hotels in Taiwan as the research objects, and established a network DEA efficiency evaluation model to analyze food & beverage service efficiencies, room service efficiencies, and the overall operational efficiencies of hotels. It also compared the efficiency values of DMUs to confirm whether there were significant differences due to the factors of international hotel chain brand, hotel

location, and target customer groups. Then, based on room service efficiency and food & beverage service efficiency, this study classified the competitive positions of the international five-star hotels into four categories. The analysis consisted of four steps, and the explanations are as follows.

1. The selection of input and output items: this study referred to evaluation indices used by previous studies, and considered the availability of the data. The input and output data on the tourist hotels comes from the *2013 Operation Analysis Report of International Hotels in Taiwan*.
2. The establishment of an efficiency evaluation model: based on the input and output items selected, this study firstly used correlation analysis to verify whether the indices conformed to the isotonicity hypothesis before establishing a network efficiency evaluation framework to evaluate the food & beverage service efficiencies, room service efficiencies, and operational efficiencies of tourist hotels.
3. Analysis of efficiency influencing factors: using the Kruskal-Wallis  $\chi^2$  of nonparametric statistics, this study took food & beverage service efficiency, room service efficiency, and operational efficiency as the dependent variables so as to find out factors that would significantly influence the efficiencies of international five-star hotels, including international hotel chain brand, location, and countries of major customer source, which can be used as important references for hotel operators when making decisions.
4. Efficiency analysis results and conclusions: based on the efficiency evaluation results of tourist hotels, this study took food & beverage ser-

vice efficiency and room service efficiency as the coordinate axes to ascertain the competitive positions of the tourist hotels, which could provide more detailed information for hotel operators, before concluding managerial implications.

#### *Evaluation framework*

DEA uses production frontiers established by the input and output data of all evaluated units to analyze the relative efficiency of each DMU. This study referred to related previous studies, considered practical production activities of tourist hotel industry, representativeness of indices, and the availability of data, before dividing the operational process of the evaluated units into food & beverage service efficiency, room services' efficiency, and operational efficiency, as shown in Figure 1. A total of nine indices were adopted, and detailed explanations are as follows.

- (1) The number of guest rooms  $I_1$  (room): the number of guest rooms provided by each hotel can not only reflect the operational conditions of the hotel industry, but also represent the flourishing conditions of the tourism industry. Consequently, the number of guest rooms belongs to the fixed costs of the production factor (Wang, Lee, & Wong, 2007; Sun & Lu, 2005; Wang, Hung, & Shang, 2004).
- (2) Guest room employee number  $I_2$  (persons): formal employees hired by a hotel to work in the rooms department. The hotel industry is a labor-intensive industry and depends heavily on manpower to provide services. If the employee turnover rate is high, it will influence the opera-

- tional management of the hotel. The number belongs to the variable cost of production factor (Sun & Lu, 2005; Wang, Hung, & Shang, 2004, Hwang & Chang, 2003).
- (3) Revenue expenditure  $I_3$  (thousand NTD): the total revenue expenditure includes salaries and related expenses, electricity and water and fuel costs, depreciation expenses, renovation and maintenance costs, and laundry costs. It is a necessary input for maintaining the normal operating activities of a hotel (Wang, Lee, & Wong, 2007; Sun & Lu, 2005; Hwang & Chang, 2003).
- (4) Floorage of the food & beverage department  $I_4$  (square meters): the floorage of the food & beverage space of a hotel represents the accommodation capacity in the hotel dining hall (Wang, Lee, & Wong, 2007; Sun & Lu, 2005; Wang, Hung, & Shang, 2004).
- (5) Food & beverage department employee number  $I_5$  (persons): formal employees hired by a hotel to work in the food & beverage department (Hsieh & Lin, 2010).
- (6) Food & beverage expenditure  $I_6$  (thousand NTD): direct raw material costs and transportation miscellaneous costs of the food & beverage service of each hotel (Anderson, Fork, & Scott, 2000).
- (7) Guest room income  $O_1$  (thousand NTD): practical income of guest rooms after deducting discounts. Guests include individual guests, group guests, contract guests and long-term guests. This revenue is the main income source of a hotel (Wang, Shang, & Huang, 2006; Wang, Hung, & Shang, 2004; Hwang & Chang, 2003).
- (8) Food & beverage income  $O_2$  (thousand NTD): practical income obtained from Chinese and western-style food, desserts, wines, and drinks provided by each hotel (Wang, Lee, & Wong, 2007; Wang, Hung, & Shang, 2004; Hwang & Chang, 2003).
- (9) Tourist guest number  $L$ : the number of tourist guests for each hotel, including domestic and foreign guests. international five-star hotels in Taiwan generally provide breakfast. Therefore, the number of guests will influence food & beverage service efficiency (Huang, Ho, & Chiu, 2014; Manasakis, Apostolakis, & Datseris, 2013; Wang, Shang, & Huang, 2006; Barros & Alves, 2004).

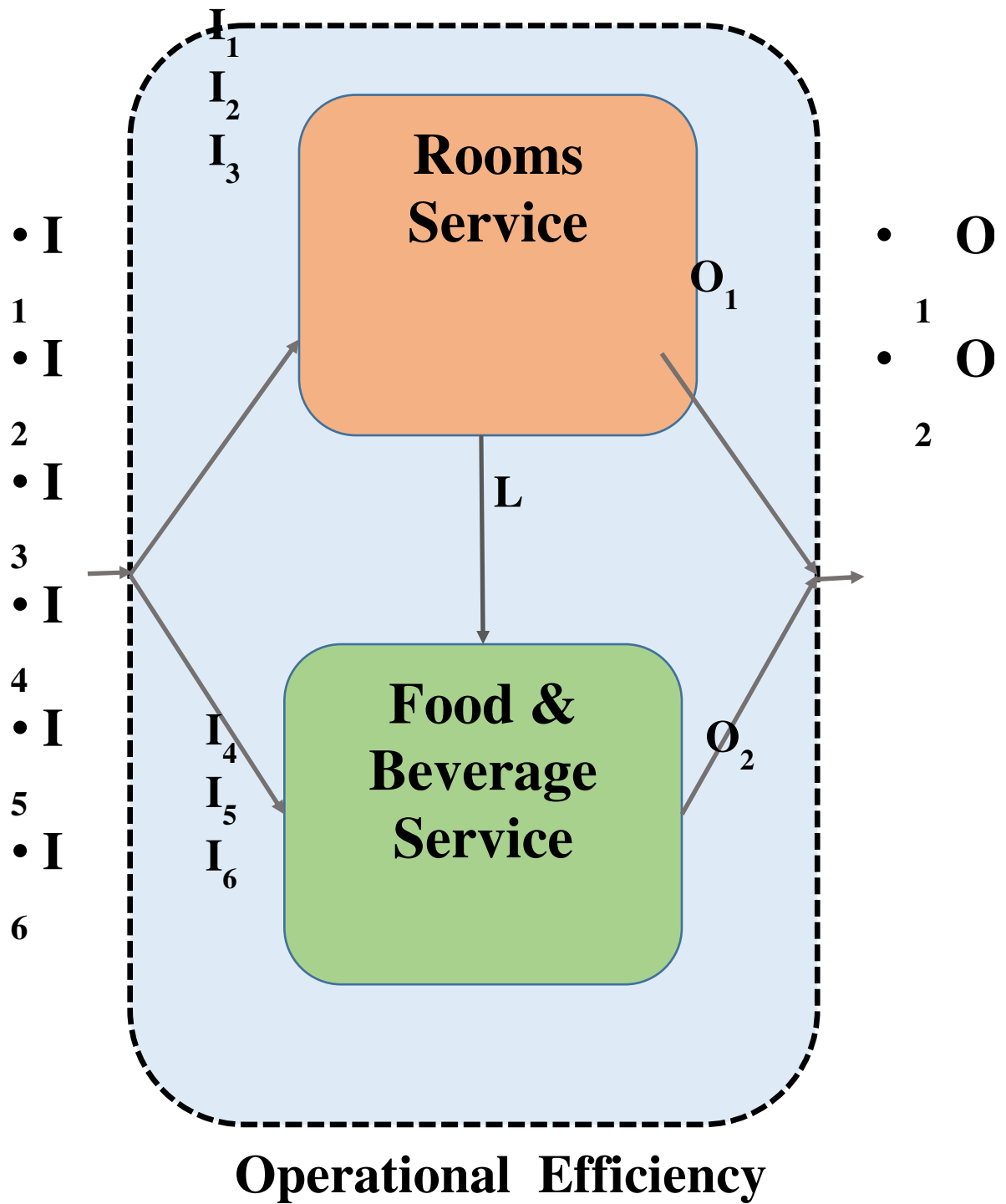


Figure 1. Evaluation Framework

*Editors Note: the following section is in single column format to facilitate easier reading of the formulas.)*

*Network data envelopment analysis*

Services of the tourist hotel industry contain the two aspects of rooms and food & beverage. In order to highlight the characteristics of the hotel industry, this study adopted the non-oriented model of SBM Network DEA which can simultaneously consider the input difference and output difference when inquiry food & beverage service efficiency, room service efficiency, and overall operational efficiency. As shown in formula (1), when  $E_k^* = 1$ , it indicates that the evaluated unit  $k$  reaches the efficient state, otherwise, when  $E_k^* < 1$ , it indicates that the evaluated unit  $k$  fails to reach the efficient state, and the closer the value is to 0, the poorer the efficiency.

$$\text{Min } E_k^* = \min \frac{\sum_{d=1}^D w^d \left[ 1 - \frac{1}{m_d} \left( \frac{\sum_{i=1}^{m_d} s_{ik}^{d-}}{x_{ik}^d} \right) \right]}{\sum_{d=1}^D w^d \left[ 1 + \frac{1}{r_d} \left( \frac{\sum_{i=1}^{r_d} s_{rk}^{d+}}{y_{rk}^d} \right) \right]} \quad (1)$$

$$\text{s.t. } x_k^d = X^d \lambda^d + s^{d-}$$

$$y_k^d = Y^d \lambda^d - s^{d+}$$

$$\lambda^d, s^{d-}, s^{d+} \geq 0, \quad d = 1, 2$$

$$\sum_{d=1}^D w^d = 1, \quad w^d \geq 0$$

Among:  $w_d$  is the weight of stage of  $d$ ,

$m_d$  is the number of input of stage of  $d$ .

$r_d$  is the number of output of stage of  $d$ .

$s_{ik}^{d-}$  is the amount of difference in the  $i^{th}$  input item of evaluated unit  $k$  in stage of  $d$ .

$s_{rk}^{d+}$  is the amount of difference in the  $r^{th}$  output item of evaluated unit  $k$  in stage of  $d$ .

$y_{rk}^d$  is the amount of output in the  $r^{th}$  output of evaluated unit  $k$  in stage of  $d$ .

$x_{ik}^d$  is the amount of output in the  $i^{th}$  input of evaluated unit  $k$  in stage of  $d$ .

$x_k^d$  is the amount of input of evaluated unit  $k$  in stage of  $d$ .

$y_k^d$  is the amount of output of evaluated unit  $k$  in stage of  $d$ .



is the overall difference amount of stage of  $d$ .

$s^{d+}$  is the overall of amount of excess of stage of  $d$ .

$X^d$  is the total input amount of stage of  $d$ .  $X^d = (x_1^d, \dots, x_n^d) \in R^{m_d \times n}$

$Y^d$  is the total output amount of stage of  $d$ .  $Y^d = (y_1^d, \dots, y_n^d) \in R^{r_d \times n}$

$\lambda^d$  is the nonnegative number of stage of  $d$  either efficiency values for food & beverage service and room service can be obtained through formula (2). When  $E_k^d = 1$ , it indicates that the evaluated unit  $k$  at stage  $d$  reaches an efficient state; when  $E_k^d < 1$ , it indicates that the evaluated unit  $k$  at stage  $d$  fails to reach an efficient state, and the closer the efficiency value is to 0, the poorer the efficiency indicated.

$$E_k^d = \frac{1 - \frac{1}{m_d} \left( \sum_{i=1}^{m_d} \frac{s_{ik}^{d-}}{x_{ik}^d} \right)}{1 + \frac{1}{r_d} \left( \sum_{i=1}^{r_d} \frac{s_{rk}^{d+}}{y_{rk}^d} \right)} \quad (2)$$

This study used the number of hotel guests as the inputs items of intermediate outputs. It is a variable value. Therefore, this study added a new limit type, shown in formula (3).

$$Z^{(k,h)} \lambda^h = Z^{(k,h)} \lambda^k (\forall (k, h)) \quad (3)$$

Among:  $Z^{(k,h)} = (z_1^{(k,h)}, \dots, z_n^{(k,h)}) \in R^{t(k,h) \times n}$

## Research Results

### *Efficiency evaluation results*

This study used Network SBM DEA proposed by Tone & Tsutsui (2009) as research method, and adopted nine input and output indices to analyze the performance of 46 international five-star hotels in Taiwan, including rooms divi-

sion performance, food & beverage performance, and operational performance. The descriptive statistics of the raw data is shown in Table 3.

*(Editor's Note: Please see all the rest of the Tables and the Appendix at the end of this article.)*

In general, due to the differences in location and scale, the 46 DMUs have large differences in resource inputs with regards to the rooms department and the food & beverage department, with the numbers of employees working in the rooms department varying from 46 to 257, and an average of 109. The Lalu Hotel has 96 rooms and is the smallest. The Grand Hyatt Taipei Hotel located in a flourishing area of Taipei has 865 rooms. The Le Meridien Taipei and Sheraton Grande Taipei Hotel with 692 rooms has the largest revenue expenditure, reaching NTD 2.13 billion, and the Hotel Royal Chihpen has the least revenue expenditure of NTD 196 million.

The average number of employees in food & beverage departments across the 46 five-star hotels is 181, with an average food & beverage floorage of 4780 square meters. The Westin Taipei has the largest food & beverage floorage, and the Hotel Royal Chiaohsi has the smallest, with the floorage difference between the two hotels reaching 30,000 square meters. The difference is also reflected by the food & beverage costs, with the standard deviation reaching NTD137 million.

Different DMUs have different market positions, and the benefits created are different. The Le Meridien Taipei and Sheraton Grande Taipei Hotel has the largest guest room income, while the Regent Taipei Hotel has the largest food & beverage income. However, on the whole, the average food & beverage income of the five-star hotels is 46 million NTD higher than the average guest room income. With respect to guest sources and differences of location and transportation, there are differences in guest demographics. For example, the Grand Hotel has comparatively more

guests from Mainland China, while the majority of the guests at the Caesar Park Hotel Taipei, also located in Taipei, come from Japan. The difference in the number of guests for all DMUs can reach 206,000.

This section presents the analysis results of the relative performance of the 46 DMUs, including rooms' division performance, food & beverage performance, and operating performance. Table 2 shows the performance evaluation results of international five-star hotels in Taiwan. A total of eight DMUs have an operational efficiency of 1, with their rooms' service and food & beverage service also reaching an efficient state. This group of DMUs can be divided into two categories. One can effectively refer to the scale economies effect, using more input resources than the industrial standard to create benefits that shareholders are satisfied with. This category contains H4, H7, and H8. The other category can use fewer resources than the industrial standard to create the maximum benefits. This category contains H12, H27, H29, H31, and H32. The three DMUs with the poorest performance are H17(0.5283), H37(0.5326), and H23(0.5517). When exploring the reasons for poor performance, it was discovered that these three international five-star hotels have comparatively poor rooms' efficiencies, although their food & beverage performance is just slightly under the average of the 46 DMUs. Therefore, in order to enhance their overall operational efficiencies, they need to start by improving their room service.

With respect to rooms' efficiency, eight DMUs reached an efficient state. The average rooms' income (529 million NTD) of the DMUs of this group was higher than the average amount (333

million NTD) of all the other DMUs. Depending on input levels, this group can further be divided into two categories. The first category has a resource input lower than the average for the industry. This category contains H27, H29, H31, and H32. These international hotels can effectively use limited guest rooms, employees, and revenue expenditure for the rooms departments whilst creating maximum guest room income. The second category has higher output benefits than the average for the industry. This category contains H4, H7, H8, and H12. These international hotels aim to create the highest occupancy rates. Except for H12, the other three DMUs have invested more in guest room resources than the industrial standard, but in so doing they have created more benefits, even three times as many benefits when compared to the average for the industry. The minimal three DMUs for rooms division performance are H22 (0.3899), H37 (0.3906), and H17 (0.3978). As well as three international five-star hotels having fewer inputs in rooms' resources than the average industry standard, the output benefits created by them are also far lower than the industry standard. This might be related to limited rooms' resources, including manpower and the number of guest rooms. Among them, the number of guest visits for H60 is only half of the average industry standard. In order to improve rooms' division performance, hotels should adopt effective marketing and promotion methods to enhance guest numbers and guest room income.

With respect to food & beverage performance, the performance values for 15 DMUs were 1. The average food & beverage income (530 million NTD) of this group of DMUs is higher than the average income (379 million NTD) of

all DMUs. Depending on the input and output levels, this group can further be divided into two categories. The first category has a resource input smaller than the average for the industry. This category contains H27, H29, H31, H32, H26, H45, and H33. These international hotels can effectively use limited food & beverage resources to create high food & beverage incomes. The second category has higher food & beverage incomes than the average for the industry. This category contains H4, H7, H8, H12, H10, and H2. These international five-star hotels can create high food & beverage incomes. Although these hotels input more food & beverage resources than the average standard, the benefits they create are higher than the average standard of the industry. The minimal three DMUs in food & beverage performance are H41(0.5187), H44(0.6005), and H6(0.6281). Of these, the food & beverage service resources input by H16 are more than the average industry standard. However, H16 fails to effectively respond to the effects of scale economy. The other two DMUs input fewer resources than the average standard for the industry, but the output benefits they have created are far lower than the average industry standard. They have limited food & beverage resources, including manpower and food & beverage floor-age. In order to enhance food & beverage performance, hotels need to provide special food to increase the number of guests who receive the food & beverage service and improve the guest turnover rate.

#### *Comparison of the efficiency results*

This study used the method proposed by Tone & Tsutsui (2009) to discuss whether the efficiencies of room service and food & beverage service

have a linking effect. It divides the original values of the middle input and output items by the targeted improvement value. If the result is 1, it means the middle input and output items have reached the optimal allocation. The larger the value, the higher the improvement margin. The results are shown in Figure 2.

The middle input and output items for this study are the number of guests. The results show that the top three for the linking effect are H37(2.305), H35(2), and H9(1.786). It means that these three international five-star hotels need to further explore the position of insufficient guests. They can consider enhancing the attractions of the hotels by aligning themselves with other industries or combining with local cultural activities, thus increasing the number of guests. This study used the method proposed by Tone & Tsutsui (2009), to compare the overall efficiency values obtained by single-stage SBM DEA to those obtained by SBM Network DEA. The analysis results were compared for rooms' division performance, food & beverage performance, and operational performance to confirm whether these performance values experience the network effect, before their differences were compared. Single-stage SBM DEA has six input items, namely the number of employees in the rooms department, the number of guest rooms, operating costs, the number of employees in the food & beverage department, food & beverage costs, and food & beverage floorage. The output items were food & beverage income, guest room income, and the number of guests. Figure 3 shows the comparison results of the performance values obtained by SBM DEA and by SBM Network DEA. It shows that by means of SBM DEA, up to 22

DMUs have a performance efficiency of 1. Using a single performance value cannot fully explore the competitive strengths and weaknesses of a DMU. Efficiency information obtained by original SBM DEA has poor discrimination power. Therefore, it is necessary to use the network structure to discuss the performance of middle efficiencies.

Figure 4. shows the comparisons between rooms' division performance, food & beverage performance, and operational performance. The results show that dividing the overall performance of the 46 DMUs into three aspects can help to highlight the competitive strengths and weaknesses of each international five-star hotels, and obtain more information on resource allocation and operational management. For example, H22 has good resource applying abilities in the food & beverage department, and serves special meals. Therefore, its food & beverage performance is the best. However, its occupancy rate is comparatively low. The hotel could consider launching a guest room and food & beverage package to increase occupancy rates and guest room income. The benefit for H6 mainly comes from guest rooms because the hotel has a good location and high-quality guest rooms and facilities. Its average annual occupancy rate is higher than 70%. However, the hotel still has space for improvement in its food & beverage service.

This study further compared the efficiency evaluation results of the 46 international five-star hotels depending on whether a hotel chain brand, the location, and the nationalities of the guests. The results are shown in Table 3. The results of the non-parametric statistics test show that international five-star

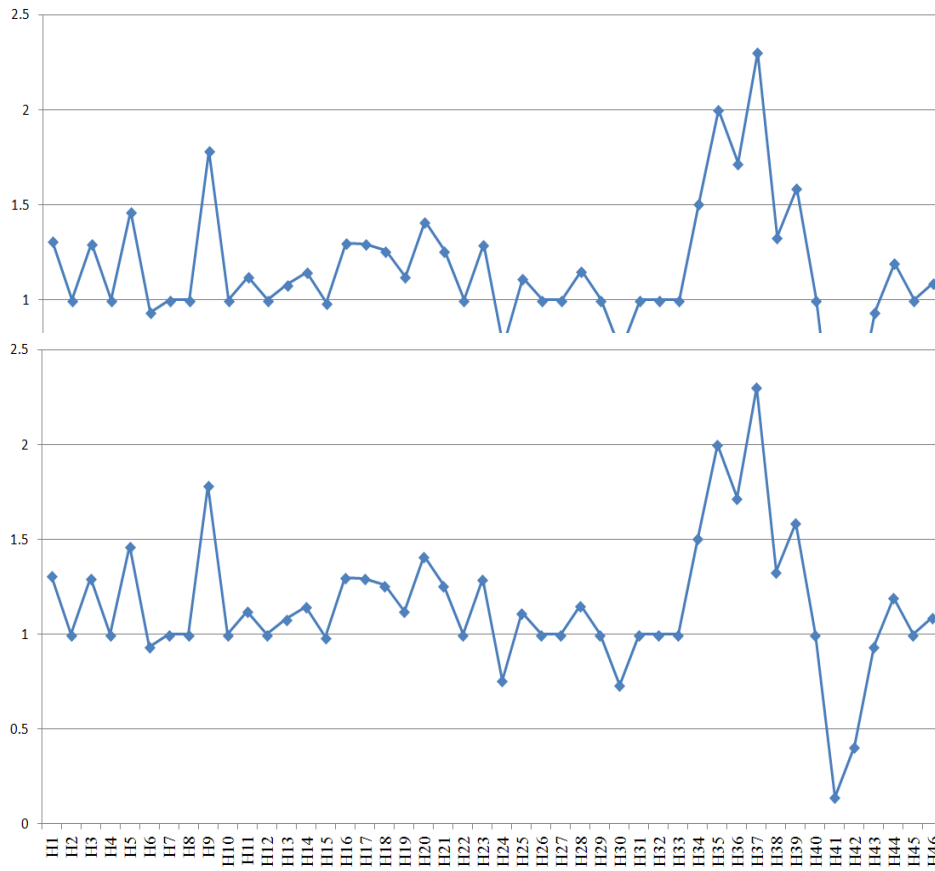


Figure 2. Comparison of the Linking Effect

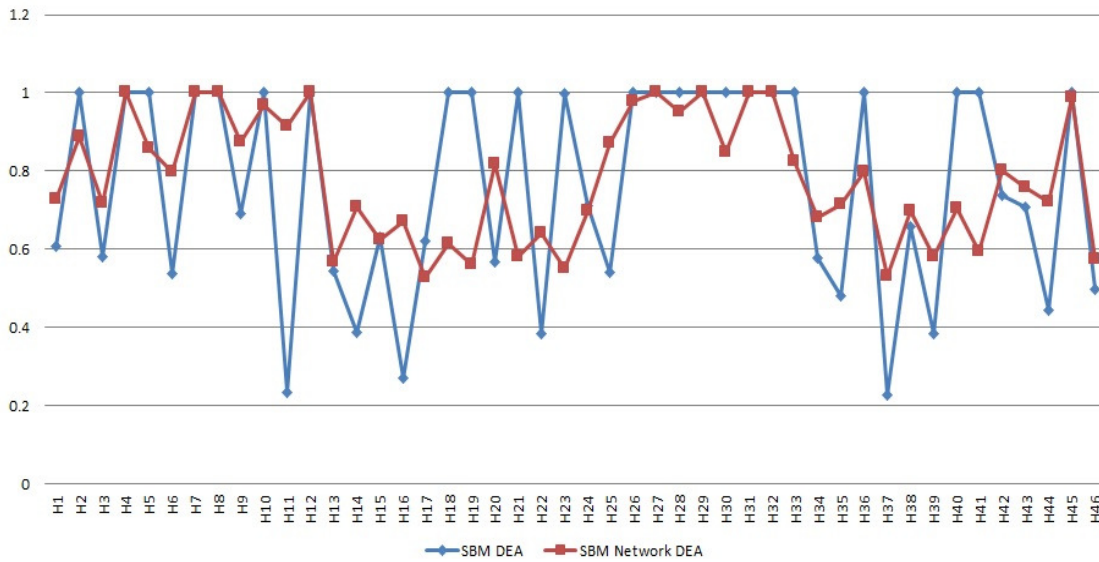


Figure 3. Comparisons between SBM DEA and SBM Network DEA

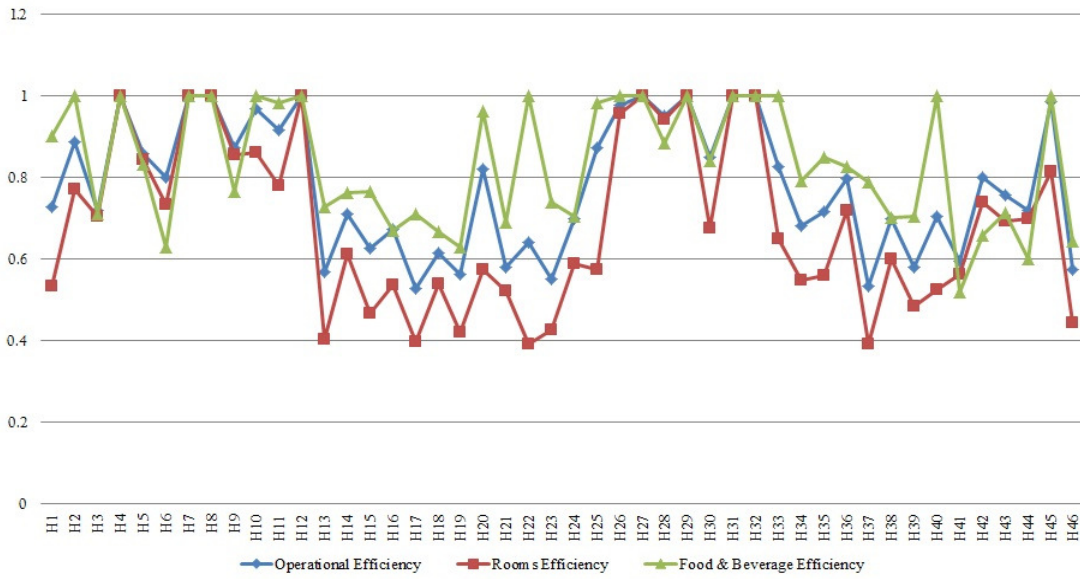


Figure 4. Comparisons of Three Performance Values

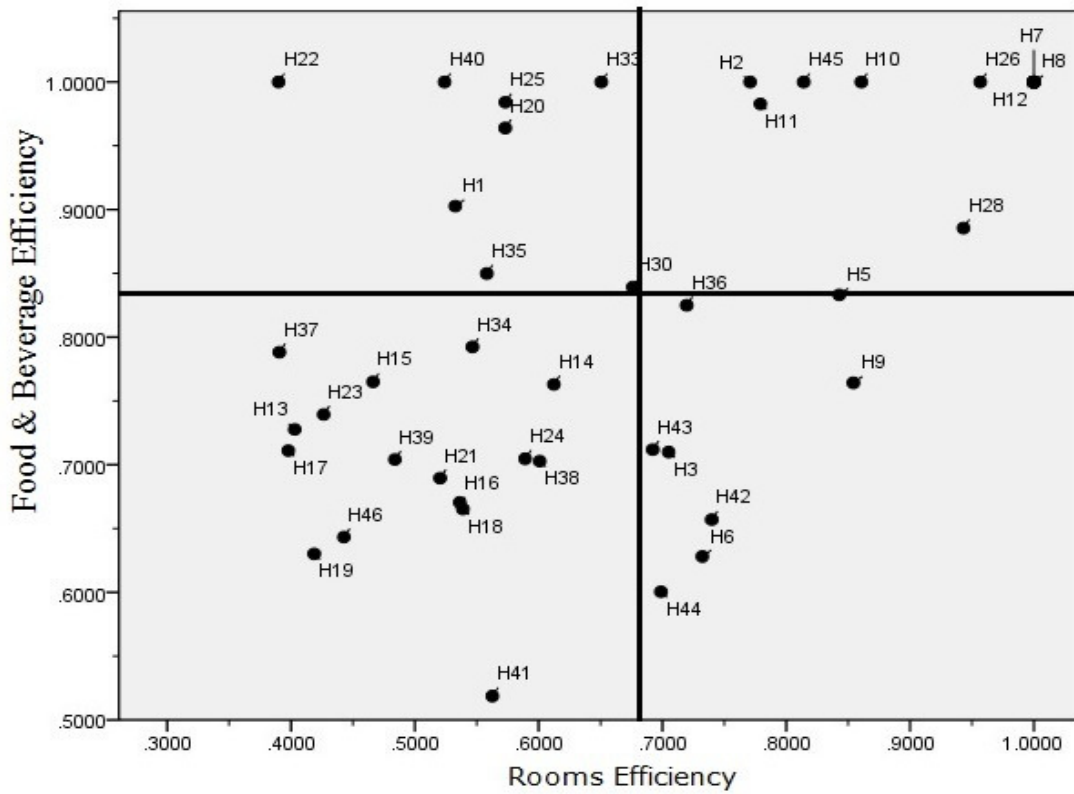


Figure 5. The Decision-making Matrix of the 46 International Five-star Hotels

hotels belonging to international hotel chain brands demonstrate better performance in three kinds of efficiencies than those hotels that are not part of an international chain brand. The differences in occupancy rates are especially significant. The operational efficiencies, rooms efficiencies, and food & beverage efficiencies in seven areas all show significant differences. On the whole, international five-star hotels located at scenic area have the best efficiencies. With respect to guest sources, the performance of the three efficiencies all show significant differences. International five-star hotels with the main guest source from North America have the best efficiencies.

#### *The decision-making matrix*

1. High rooms' efficiency and high food & beverage efficiency: DMUs in this area include H2, H4, H7, H8, H10, H11, H12, H26, H27, H28, H29, H31, H32, and H45. The room service efficiencies and food & beverage service efficiencies of these 14 DMUs are higher than the industry standard. They are the leading hotels of Taiwan's five-star hotel industry. In order to maintain their competitive status, the DMUs of this group need to maintain their attention to service quality, stabilize their core competitiveness, and monitor environmental changes at all times in order to adjust their operating strategies corresponding to market trends.
2. High rooms' efficiency but low food & beverage efficiency: this group includes the eight DMUs of H3, H5, H6, H9, H36, H42, H43, and H44. They have outstanding room service capabilities, but their food & beverage services need to be improved. For example, they could use local

products to launch special foods, launch limited foods depending on different seasons, create a special dining environment, or hire famous chefs to improve the standards of their food & beverage. They are the followers of the five-star hotel industry.

3. Low rooms' efficiency but high food & beverage efficiency: this group includes the eight DMUs of H1, H20, H22, H25, H30, H33, H35, and H40. They have outstanding food & beverage service capabilities, but their guest room service capabilities need to be improved. They are hotels with potential in the five-star hotel industry. In order to increase rooms' efficiency, these DMUs could launch a guest room and food & beverage package, actively participate in national traveling exhibition, launch guest room discounts irregularly, cooperate with local businesses, and create local events to attract more guests.
4. Low rooms' efficiency and low food & beverage efficiency: a total of 16 DMUs fall into this group. Their overall service capacities need to be strengthened. They are the hotels with little potential in the five-star hotel industry. The DMUs of this group need to re-examine the allocation and usage conditions of their tangible resources, such as manpower, funds, and site, or invite an external consulting group to undertake an examination, and find the competitive weakness and operating problems of the hotels, thus enhancing their overall service ability.

#### Conclusions and Suggestions

This study took international five-star hotels in Taiwan as DMUs, adopted the SBM Network DEA proposed by Tone & Tsutsui (2009), and established a multistage efficiency evaluation model to enable evaluation of the rooms' efficiencies, food & beverage service efficiencies, and overall operational efficiencies of the DMUs. It also compared the efficiency value differences of the DMUs with regards to international hotel chain brand, location, and the nationalities of the main guests. Aims and implementation methods are explained as follows.

1. The network framework can highlight the transformation process of the middle resources.

During practical service procedures, from resource input to substantial output, there will be several sub-production activities. A traditional efficiency evaluation model can only present the performance of the overall operating efficiency, and the efficiencies of internal sub-production activities cannot be presented. Establishing an efficiency evaluation model for the network framework can not only present the resource transformation processes of a DMU at different stages, but also present the competitive strengths and weaknesses of each DMU. The model can enhance the discriminating power of the analysis results, and provide improvement directions as references for decision makers when making resource allocation decisions and generating management strategies.

2. There are significant differences in the efficiencies of the DMUs of different operating types.

This study has discovered that, due to the brand enchantment and abundant operating experience of an international team, international five-star hotels belonging to an international hotel chain brand demonstrate better performance in room service efficiency, food & beverage service efficiency, and overall operational efficiency than those DMUs that are not connected to an international hotel chain brand. International five-star hotels located at scenic spots utilize the sightseeing features of the locality when conducting their brand marketing. As these hotels have fewer rooms and higher prices, they can provide high-quality services to customers. In addition, international five-star hotels whose main guest source is from North America have more than 800 guest rooms, distinctive styles of dining environment, and special foods. They give full attention to the scale economy effect.

To summarize, this study proposes the following three suggestions for future studies.

- (1) The network efficiency evaluation framework is not limited to the hotel industry. Other industries can consider the processes behind their production activities and the characteristics of evaluated units to establish multistage efficiency evaluation models, and present the efficiency performances at multiple stages of the evaluated units.
- (2) This study collected official secondary data, and adopted a non-oriented efficiency evaluation framework that can simultaneously consider the input and output spread. This study suggests that fu-



ture studies should use questionnaire surveys to acquire satisfaction information that cannot be presented by the secondary data, and use it as an output item of the DMU.

- (3) This study aims to establish a multistage network efficiency evaluation model. This study used one-year static data as analysis examples. Further studies can use the Malmquist Productivity Index to analyze the long-term efficiency changes of the DMUs, and use them as important references for establishing operational targets and generating operating strategies.

#### References

- Anderson, R. I., Fork, R. & Scott, J. (2000). Hotel Industry Efficiency: an Advanced Linear Programming Examination. *American Business Review*, Vol.18, 40-48.
- Assaf, A. G. & Magnini, V. (2012). Accounting for Customer Satisfaction in Measuring Hotel Efficiency: Evidence from the US hotel industry. *International Journal of Hospitality Management*, Vol.31, 642-647.
- Banker, R. D., Charnes, A. & Cooper, W. W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science*, Vol.30, 1078-1092.
- Barros C. P., & Alves, C. A. (2004). An Empirical Analysis of Productivity in a Portuguese Retail Chain using the Malmquist Index. *Journal of Retailing and Consumer Services*, Vol.5, 269-278.
- Barros, C. P. & Dieke, P. U. C. (2008) Technical Efficiency of African Hotels. *International Journal of Hospitality Management*, Vol. 27, 438-447.
- Bureau of Tourism, Ministry of Transportation & Communications. (2015) Operation Analysis Report of International Hotels in Taiwan. Tourism Service Center, Bureau of Tourism, Ministry of Transportation and Communications.
- Charnes, A., Cooper, W. W. & Rhodes, E. (1978). Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research*, Vol.2, 429-444.
- Chen, H., Lu, Y. C. & Chung, J. T. (2010). Improved Slack-Based Context-Dependent DEA-A Study of International Tourist Hotels in Taiwan. *Expert Systems with Applications*, Vol.37, 6452-6458.
- Chiang, W. E., Tsai, M. H. & Wang, L. S. M. (2004). Research Note: A DEA Evaluation of Taipei Hotels. *Annals of Tourism Research*, Vol.31, 712-715.
- Färe, R. & Grosskopf, S. (2000). Network DEA. *Socio-Economic Planning Sciences*, Vol.34, 35-49.

- Fatma, P. & Timothy, H. (2005). Patient Satisfaction in a Preoperative Assessment Clinic: An Analysis Using SERVQUAL Dimensions. *Total Quality Management & Business Excellence*, Vol.16, 15-20.
- Hsieh, L. F. & Lin, L. H. (2010). A Performance Evaluation Model for International Tourist Hotels in Taiwan-An Application of the Relational Network DEA. *International Journal of Hospitality Management*, Vol.29, 14-24.
- Huang, C. W., Ho, F. N. & Chiu, Y. H. (2014) Measurement of Tourist Hotels' Productive Efficiency, Occupancy and Catering Service Effectiveness using a Modified Two-stage DEA Model in Taiwan. *OMEGA, The International Journal of Management Science*, Vol.48, 49-59.
- Hwang, S. N. & Chang, T. Y. (2003). Using Data Envelopment Analysis to Measurement Hotel Managerial Efficiency Change in Taiwan. *Tourism Management*, Vol.24, 357-369.
- Lewis, H. F. & Sexton, T. R. (2004). Network DEA: Efficiency Analysis of Organization with Complex Internal Structure. *Computers & Operations Research*, Vol.31, 1365-1410.
- Manasakis, C., Apostolakis, A. & Datseris, G. (2013). Using Data Envelopment Analysis to Measure Hotel Efficiency in Crete. *International Journal of Contemporary Hospitality Management*, Vol.25, 510-535.
- Seiford, L. M. & Zhu, J. (1999). Profitability and Marketability of the Top 55 US Commercial Banks. *Management Science*, Vol.45, 1270-1288.
- Sun, S. & Lu, W. M. (2005). Evaluating the Performance of the Taiwanese Hotel Industry using a Weight Slacks-based Measure. *Asia-Pacific Journal of Operational Research*, Vol.22, 487-512.
- Tone, K. & Tsutsui, M. (2009). Network DEA: A Slacks-based Measure Approach. *European Journal of Operational Research*, Vol.197, 243-252.
- Wang, F. C., Hung, W. T. & Shang, J. K. (2004). Measuring the Efficiency of China and Non-chain International Tourist Hotel in Taiwan. *Asia-Pacific Economic and Management Review*, Vol.7, 109-123.
- Wang, F. C., Shang J. K. & Hung, W. T. (2006). Productivity and Service Quality Changes in International Hotels in Taiwan. *Annals of Tourism Research*, Vol.33, 571-574.
- Wang, Y. H., Lee, W. F. & Wong, C. C. (2007). Productivity and Efficiency Analysis of International Tourist Hotels in Taiwan: an Application of the Stochastic Frontier Approach. *Taiwan Economic Review*, Vol.35, 55-86.
- Wassenaar, K. & Stafford, E. R. (1991). The Lodging Index: An Economic Indicator for the Hotel/Motel Industry. *Journal of Travel Research*, Vol.30, 18-21.

Yang, C. & Lu, W. M. (2006). Performance Benchmarking for Taiwan's International Tourist Hotels. *INFOR*, Vol.44, 229-245.

Yu, M. M. & Lee, B. C. (2009). Efficiency and Effectiveness of Service Business: Evidence from International Tourist Hotels in Taiwan. *Tourism Management*, Vol.30, 571-580.

Yu, M. M. & Lin, E. J. T. (2008). Efficiency and Effectiveness in Railway Performance Using a Multi-Activity Network DEA Model. *International Journal of Management Science*, Vol.36, 1005-1017.

Table 1. Description of Raw Data

Index	Max.	Min.	Avg.	SD
The Number of Guest Rooms I <sub>1</sub>	865	96	325	161
Guest Room Employee Number I <sub>2</sub>	257	46	109	55
Revenue Expenditure I <sub>3</sub>	2,130,638,474	195,688,361	611,154,667	426,069,641
Floorage of the Food & Beverage Department I <sub>4</sub>	32,045	586	4,780	5,011
Food & Beverage Department Employee number I <sub>5</sub>	516	32	181	118
Food & Beverage Expenditure I <sub>6</sub>	613,686,250	27,409,718	151,731,750	136,708,317
Guest Room Income O <sub>1</sub>	1,066,689,012	86,201,435	332,870,503	208,835,868
Food & Beverage Income O <sub>2</sub>	1,564,468,209	69,770,691	379,175,047	328,049,084
Tourist Guest Number L	1,471,149	56,928	171,123	205,941

Table 2. Performance Evaluation Results for International Hotels in Taiwan

DMU	Operation Efficiency	Rooms Efficiency	Food & Beverage Efficiency	DM U	Operation Efficiency	Rooms Efficiency	Food & Beverage Efficiency
H1	0.7275	0.5327	0.9027	H24	0.6979	0.5891	0.7047
H2	0.8881	0.7708	1	H25	0.8721	0.5731	0.9841
H3	0.7188	0.705	0.71	H26	0.9779	0.9567	1
H4	1	1	1	H27	1	1	1
H5	0.8572	0.8428	0.8332	H28	0.9506	0.9431	0.8855
H6	0.7995	0.7322	0.6281	H29	1	1	1
H7	1	1	1	H30	0.8489	0.6761	0.8393
H8	1	1	1	H31	1	1	1
H9	0.8732	0.8542	0.7642	H32	1	1	1
H10	0.968	0.8606	1	H33	0.8248	0.6506	1
H11	0.9149	0.7791	0.9828	H34	0.6799	0.5465	0.7924
H12	1	1	1	H35	0.7154	0.5581	0.8499
H13	0.5688	0.403	0.7277	H36	0.7975	0.7196	0.825
H14	0.7096	0.6123	0.763	H37	0.5326	0.3906	0.7882
H15	0.6258	0.4662	0.765	H38	0.6992	0.6009	0.7028
H16	0.6711	0.5363	0.6705	H39	0.5803	0.4839	0.7041
H17	0.5283	0.3978	0.7111	H40	0.7055	0.524	1
H18	0.6147	0.5388	0.6653	H41	0.5953	0.5626	0.5187
H19	0.5614	0.4187	0.6302	H42	0.8005	0.7398	0.657
H20	0.8192	0.573	0.9639	H43	0.7565	0.6922	0.7119
H21	0.5801	0.5204	0.6895	H44	0.7197	0.6988	0.6005
H22	0.6398	0.3899	1	H45	0.9872	0.8141	1
H23	0.5517	0.4264	0.7394	H46	0.5748	0.4427	0.6433

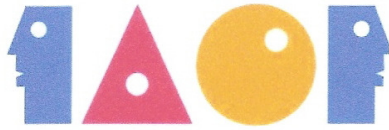
Table 3. Analysis of Performance Differences of International Hotels of Different Types

Type	Item	Avg. Operational Efficiency	Avg. Rooms Efficiency	Avg. Food & Beverage Efficiency
International Hotel Chain Brand	Yes	0.8383	0.7809	0.8534
	No	0.7587	0.6476	0.8260
Kruskal-Wallis $\chi^2$		2.489	4.171**	0.536
Location	Taipei	0.8956	0.8398	0.9018
	Taoyuan, Hsinchu, and Miaoli	0.7100	0.5731	0.8511
	Taichung	0.6501	0.4755	0.8209
	Kaohsiung	0.6197	0.4924	0.7171
	Hualien	0.7072	0.5295	0.8094
	Others	0.7132	0.6177	0.7265
	Scenic Spots	0.9682	0.9394	0.9607
Kruskal-Wallis $\chi^2$		28.138***	29.504***	16.211**
Main Guests	Japan	0.8948	0.8644	0.8816
	North America	1.0000	1.0000	1.0000
	Taiwan	0.7348	0.6314	0.7969
	Asia	0.9026	0.7634	0.9943
	Mainland China	0.8574	0.6734	0.9514
Kruskal-Wallis $\chi^2$		10.789**	10.927**	7.943*

Note: \*\*\* represents  $P < 0.01$ , \*\* represents  $P < 0.05$ , and \* represents  $P < 0.1$

Appendix

<b>DMU</b>	<b>Name</b>	<b>DMU</b>	<b>Name</b>
H1	The Grand Hotel	H24	Parkview Hotel
H2	Ambassador Hotel Taipei	H25	Hualien FarGlory Hotel
H3	The Landis Taipei Hotel	H26	Hotel Royal Chiaohsi
H4	Sheraton Grande Taipei Hotel	H27	The Lalu Hotel
H5	Hotel Royal-Nikko Taipei	H28	Fleur De Chine Hotel
H6	The Howard Plaza Hotel Taipei	H29	Caesar Park Hotel Taipei
H7	Grand Hyatt Taipei	H30	Howard Beach Resort Kenting
H8	Regent Taipei Hotel	H31	Hotel Royal Chihpen
H9	The Sherwood Taipei	H32	Silks Place Taroko Hotel
H10	Shangri-La's Far Eastern Plaza Hotel Taipei	H33	Monarch Skyline International Hotel
H11	The Westin Taipei	H34	Hotel Novotel Taipei Taoyuan International Airport
H12	Le Méridien Taipei	H35	Sheraton Hsinchu Hotel
H13	Ambassador Hotel Kaohsiung	H36	Hotel Royal Hsinchu
H14	The Grand Hi Lai Hotel)	H37	Ambassador Hotel Hsinchu
H15	The Howard Plaza Hotel Kaohsiung	H38	Fullon Hotel Tamsui Fishermen's Wharf
H16	85 Sky Tower Hotel	H39	Tayih Landis Hotel Tainan
H17	Han-Hsien International Hotel	H40	Evergreen Plaza Hotel Tainan
H18	The Lees Hotel	H41	Shangri-La's Far Eastern Plaza Hotel
H19	Hotel National	H42	E-Da Royal Hotel
H20	Evergreen Laurel Hotel Taichung	H43	Silks Place Yilan Hotel
H21	Howard Prince Hotel Taichung	H44	Evergreen Resort Hotel Jiaosi
H22	The Splendor Hotel Taichung	H45	Formosan Naruwan Hotel Taitung
H23	Chateau de Chine Hualien	H46	Nice Prince Hotel



## OPTIMAL SERVICE DESIGN: INTEGRATING DIGITAL SERVICE SYSTEM AND TAM THEORY

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### Abstract

Innovation is crucial for increasing competitiveness. Although innovation is highly valued in the service industry, it can still be extensively investigated. Service industries should improve performance by investing in additional innovation resources. Regarding user experience, the participants positively perceived the ease of use and usefulness of the novel service and exhibited positive attitudes towards using the service. Concerning participants' acceptance towards the novel service was consistent with that of the technology acceptance model, indicating that participants' attitudes when receiving services corresponded to that of the TAM theory.

**Keywords:** Service design, technology acceptance model, digital service system, service innovation.

### Introduction

Currently, the Digital signage service systems (DSSs) has been gradually adopted by several tourist hotels or hotel operators in the lobby or banquet hall as means of advertising or guiding events. Integrating DSSs into service processes not only involves technological issues, but also entails considering the acceptable level of tourists or users who receive the service (Dennis et al., 2013). The technology acceptance model proposed by Davis (1989) can effectively analyze and predict users' acceptance of information technology or services. Furthermore, user

acceptance of a new technology or service is related to user experience with the new technology or service (Choi & Chung, 2013; Lin, 2013; Lee et al., 2012; Ma & Liu, 2004; Wang et al., 2015). Therefore, based on an actual case of DSSs development by a tourist hotel, this study developed the service & design guide (SDG and subsequently used the technology acceptance model (TAM) to determine the difference in DSSs service acceptance between users who had and those who had not used the DSSs. Finally, we examined factors influencing DSSs user acceptance and verified the proposed SDG by examining the collected data and statistical results. The findings can



provide references for future tourist hotels in constructing, using, and evaluating service technology systems.

The primary objectives of this research were to (a) analyze the development approach and process of service innovation and construct a SDG suitable for the tourist hotel industry (b) execute the SDG based on DSSs implementation in a tourist hotel to explain the application process, and (c) analyze the differences in the acceptance of users who had and those who had not used the DSSs by employing the TAM and evaluating the effect of the SDG.

#### Literature Review

In response to the development trend of service economy, Edvardsson et al. (2000) proposed a development framework for service development and innovation comprising executive items at every stage, which included four stages (i.e., service idea generation, service strategy and culture gate, service design, and service policy deployment and implementation) and eight steps (i.e., identifying potential customers, defining customer needs, internal communications, understanding customer behavior, analysis of market potential, service development, service concept testing, and quality certification). Wilson (2008) applied the product innovation framework, integrating the initial stage of service planning and the final stage of implementation to plan nine execution steps (i.e., business strategy development or review, new service strategy development, idea generation, concept development and evaluation, business analysis, service development and testing, market testing, commercialisation, and

post introduction evaluation) based on the perspective of corporate strategy. From the perspective of product innovation, Johnson and Gustafsson (2003) proposed the service innovation development framework comprising six procedures: identify innovative directions, extensively understand customer needs, combine concepts, filter gates, design and produce prototypes, and conduct testing and implementation.

Deutsches Institut für Normung (DIN, 2008) proposed a service implementation stage model, which can serve as a reference procedure for service innovation implementation. The procedure includes five stages (i.e., idea management, requirement analysis, service conceptualisation, service implementation, and market launch) and 15 steps (i.e., creation collection, creation assessment, market needs, corporate needs, product model, process model, product production, process testing, resource allocation, marketing, service measurement, listing, and continual control) (DIN, 2008). Based on the findings of extant service innovation studies, we determined that although minor differences exist among the perspectives of previous studies, all the scholars have suggested that service providers strategically plan and design service operation and management based on operational objectives and characteristics. However, the planning and design must be integrated with appropriate design procedures to implement service innovation in product design applications.

#### Research Methods

This study evaluated the effectiveness of the new service by using the questionnaire developed according

to the objectives of this study, the TAM theory proposed by Davis (1989), relevant literature (Lee et al., 2012; Herrero & San Martín, 2012; Morosan & DeFranco, 2014; Morosan, 2011), and the Delphi method. Because interactive devices involving large digital panel are increasingly common, tourists might have already experienced the interactive information interface. Therefore, the questionnaire survey was conducted on tourists who had used a DSSs (experimental group) and tourists who had not used DSSs (control group) to compare the differences in new service acceptance between the two groups of participants. The questionnaire design included two sections: demographics and structured questions. The items in the demographic section included sex, age, education level, monthly income, and occupation.

The structured questions section contained service pleasure and system acceptance scales. To avoid disturbing the tourists during their stay in the hotel, we surveyed participants who were willing to participate in the research survey during the time when they had checked out of the hotel and were waiting for shuttle buses to travel to city stations. When developing the questionnaire, the Delphi method was employed to collect expert opinions and expert content validity was performed to ensure the integrity and reliability of the questionnaire content. We recruited 30 tourists to complete a draft questionnaire pretest and subsequently identified several unclear questions, which were revised forming the formal questionnaire. Overall, 250 questionnaires were distributed, recovering a total of 232 valid questionnaires (18 questionnaires were invalid because the tourists were unable to complete

the questionnaire in time). Among the obtained valid questionnaires, 103 were from the experimental group and 129 were from the control group, yielding a recovery rate of 92.8%.

### Data Analysis and Results

Analysis of variance (ANOVA) was adopted to compare the subjective perceptions of participants from the experimental and control groups and the differences in the TAM variables. In comparing the experiences with the original and new services between the two groups of participants, the new service provided significantly superior convenience ( $F = 51.43, p < .01$ ), satisfaction ( $F = 53.67, p < .001$ ), excitement ( $F = 11.45, p < .01$ ), and familiarity ( $F = 7.36, p < .01$ ), but no significant difference was observed in the trust and confidence aspects ( $F = 4.59; 6.67, n.s.$ ).

In addition, when comparing the satisfaction, convenience, and familiarity provided by the original and new services between the two groups of participants, we observed significant interactions. Regarding satisfaction, the control group expected that they would be more satisfied with the new service (new service: 4.46; existing service: 3.63); although the experimental group also believed that they would be more satisfied with the new service, the difference was minimal (new service 4.20; existing service: 3.97,  $F = 10.46, p < .01$ ), which indicated that the participants in the control group had a high expectation towards the new service.

Regarding convenience, participants from both the control and experimental groups scored higher in the

new service than in the existing service model (control group: 4.78 > 3.45; experimental group: 4.23 > 3.46). Compared to the experimental group's responses towards the existing and new services, the control group exhibited higher differential expectation for convenience ( $F = 13.49, p < .01$ ), which indicated that the participants perceived the new service to be convenient. Participants in the control and experimental groups scored higher in the new service than in the existing model (control group: 4.31 > 3.97; experimental group: 3.96 > 3.61), which indicated that the participants felt familiar with the new service. In addition, the acceptance exhibited by the control group was satisfactory as expected (Table 1). This indicated that participants in the experimental group regarded the new service as being superior in perceived ease of use compared with that of the original service model; in other words, the new service is perceived to be easy to use ( $F = 5.126, p <$

.05). Regarding perceived usefulness, Participants in the control group considered the new service to be highly useful compared with that of the existing service model, implying that the participants believed that the new service had service value ( $F = 4.159, p < .01$ ).

Table 2 shows that several variables of the control group had a direct effect. Among all the direct effects produced in the new service, the direct effect of attitude towards using on behavioural intention of use ranked the highest at 0.322 ( $\beta = 0.323, p < .05$ ), which indicated a high correlation. In addition, perceived ease of use positively influenced attitude towards using ( $\beta = 0.144, p < .05$ ); perceived usefulness positively influenced attitude towards using ( $\beta = 0.256, p < .01$ ) and behavioural intention of use ( $\beta = 0.138, p < .05$ ); the influence of perceived ease of use on perceived usefulness ( $r = 0.247, n.s.$ ) and on

Table 1. F test on the experience of using the new service

Factor	Exp. Group [N=103] M (SD)	Control Group [N=129] M (SD)	F test	
			F	p
Perceived Ease of Use	4.39 (1.34)	4.28 (0.83)	5.126	0.017*
Perceived Usefulness	3.87 (1.09)	4.59 (0.97)	4.158	0.009**
Attitude towards Using	4.46 (1.36)	4.27 (0.84)	0.677	0.414
Behavioral intention	4.11 (1.16)	3.81 (1.04)	1.462	0.011*

Note: \* $p < 0.05$ , \*\* $p < 0.01$

behavioural intention of use ( $r = 0.106, n.s.$ ) was non-significant. The total effect of perceived ease of use on behavioural intention of use was significant

at 0.207 ( $t = 2.68, p < .05$ ). The total effect of perceived usefulness on attitude towards using and behavioural intention of use was 0.256 ( $t = 3.92, p < .01$ ) and 0.221 ( $t = 4.15, p < .05$ ), respectively, which were significant.

The total effect of attitude towards using on behavioural intention of use was significant at 0.323 ( $t = 3.59, p < .05$ ). Among the results, attitude towards using had the greatest total effect on behavioural intention of use (0.323) and perceived usefulness had the lowest total effect on attitude towards using (0.207). Therefore, attitude towards using was crucial to behavioural intention of use and the overall model was approximately consistent with the TAM theory.

In addition, we compared the  $\beta$  coefficient between the experimental and control groups and found that the  $\beta$  coefficient of the experimental group was greater than that of the control group, which indicated that the experimental group had superior explanatory power for the variables. Therefore, based on the  $\beta$  coefficient comparison, we inferred that in contrast to the control group, the experimental group positively perceived the ease of use of the new service, which significantly influenced their perceived usefulness.

Overall, in the experimental group, participants' acceptance of the new service was the same as that exhibited in the TAM; except for the influence of ease of use on usefulness, the results for the control group were similar to that of the TAM. Therefore, the participants' attitudes when receiving services were in accordance with the TAM, and the SDG applied in this study can be used as a service innovation tool.

Subsequently, we compared the direct, indirect, and total effects of the experimental and control groups on behavioral intention of use. In this study, we focused on behavioral inten-

tion of use because it reflected the participants' level of expectation for the provided service.

The SEM results indicated that for the experimental group, the influences of perceived ease of use, perceived usefulness, attitude towards using, and behavioral intention of use were greater than those exhibited in the control group. In addition, for both groups, perceived usefulness and attitude towards using were crucial factors that influenced behavioral intention of use. This suggested that participants who were experienced in operating DSSs exhibited greater acceptance towards the new service than participants in the control group did.

## Conclusion

This study first investigated the development and procedure of service innovation, collected expert opinions using the Delphi method, and established the SDG and TAM questionnaire. The SDG can assist the tourist hotel industry in fulfilling service innovation requirements, and included three stages (i.e., demand evaluation, service development, and service execution) and eight steps (i.e., market overview, current status analysis, demand context analysis, concept generation, design planning, concept proposal, design implementation and revision, and service and product commercialization). Second, we developed the SDG, executed DSSs construction, and designed the product and content interface of a tourist hotel. The DSSs provided tourists with additional digital content service and assisted the service personnel in providing a comprehensive service model.

In the future, this study aims to empirically analyze other industries and products to revise the SDG, providing valuable results to operators in various industries for implementing service innovation.

## References

- Choi, G., & Chung, H. (2013). Applying the Technology Acceptance Model to Social Networking Sites (SNS): Impact of Subjective Norm and Social Capital on the Acceptance of SNS. *International Journal of Human - Computer Interaction*, 29(10), 619.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.
- Dennis, C., Josko Brakus, J., & Alamanos, E. (2013). The wallpaper matters: Digital signage as customer-experience provider at the Harrods (London, UK) department store. *Journal of Marketing Management*, 29(3-4), 338.
- DIN. (2008). DIN EN ISO 9001:2008: Deutsches Institut for Normung.
- Edvardsson, B., Gustafsson, A., Johnson, M. D., & Sandén, B. (2000). *New service development and innovation in the New Economy*: Student litteratur.
- Herrero, Á. & San Martín, H. (2012). Developing and testing a global model to explain the adoption of websites by users in rural tourism accommodations. *International Journal of Hospitality Management*, 31(4), 1178-1186.
- Johnson, M. D., & Gustafsson, A. (2003). *Competing in a Service Economy: How to Create a Competitive Advantage Through Service Development and Innovation*: Wiley.
- Lee, W., Xiong, L., & Hu, C. (2012). The effect of Facebook users' arousal and valence on intention to go to the festival: Applying an extension of the technology acceptance model. *International Journal of Hospitality Management*, 31(3), 819-827.
- Lin, C. C. (2013). Exploring the relationship between technology acceptance model and usability test. *Information Technology and Management*, 14(3), 243-255.
- Ma, Q., & Liu, L. (2004). The Technology Acceptance Model: A Meta-Analysis of Empirical Findings. *Journal of Organizational and End User Computing*, 16(1), 59-72.
- Morosan, C. (2011). Customers' adoption of biometric systems in restaurants: An extension of the technology acceptance model. *Journal of Hospitality Marketing & Management*, 20(6), 661-690.
- Morosan, C., & DeFranco, A. (2014). When tradition meets the new technology: An examination of the antecedents of attitudes and intentions to use mobile devices in private clubs. *International*

*Journal of Hospitality Management*, 42, 126-136.

Wang, L., Law, R., Guillet, B. D., Hung, K., & Fong, D. K. C. (2015). Impact of hotel website quality on online booking intentions: eTrust as a mediator. *International Journal of Hospitality Management*, 47, 108-115.

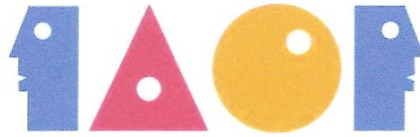
Wilson, A. (2008). *Services Marketing: Integrating Customer Focus Across the Firm*: McGraw-Hill Education.

Ulrich, K. T., & Eppinger, S. D. (2004). *Product design and development*: McGraw-Hill/Irwin.

Table 2. The Direct, Indirect, And Total Effects Of Behavioral Intention Of Use In The Control Group

Factor	Effect	Perceived Usefulness		Attitude towards Using		Behavioral intention to use	
		$\beta$ -value	t-value	$\beta$ -value	t-value	$\beta$ -value	t-value
Perceived Ease of Use	Direct effect	0.247	2.36	0.144	2.97*	0.039	2.65
	Indirect effect	--	--	0.063	2.73*	0.067	5.48
	Total effect	0.247	2.36	0.207	2.68*	0.106	5.21
Perceived Usefulness	Direct effect	--	--	0.256	3.92*	0.138	3.97*
	Indirect effect	--	--	--	--	0.083	4.29*
	Total effect	--	--	0.256	3.92*	0.221	4.15*
Attitude towards Using	Direct effect	--	--	--	--	0.323	3.59*
	Indirect effect	--	--	--	--	--	--
	Total effect	--	--	--	--	0.323	3.59*

Note: \*p<0.05, \*\*p<0.01



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WHY GREAT LEADERSHIP PRINCIPLES REMAIN LARGELY  
IRRELEVANT TO MODERN ENTERPRISES:  
A SPECIAL CASE STUDY OF A SMALL MOROCCAN COMPANY

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Abstract

Good leadership, generally believed, is important for success of business enterprises. Good leadership seems to be especially critical to small and medium sized business where small teams of employees determine the fate of the firm. In the case presented in

this paper, good leadership was nonexistent. That void left the team members demoralized, which in-turn led to the failure of the company. This paper, subsequently, explores why, in the 21<sup>st</sup> century, modern leadership principles still largely fail. This paper further questions if good leadership principles are truly necessary or even viable for organizations at all.

Key Words: Leadership, Leadership Principles, Entrepreneurship, Corporations, W. Edwards Deming, Elliott Jaques, Great Management Thinkers, Psychopathic Trends

### Introduction

After the financial crises that have rocked the world, companies and their leaders have faced many new challenges, including increased competitiveness. The response of each company and its leaders to these challenges to a large extent determined the success of the enterprise. The leader helps employees develop trust in the company and its leaders, a crucial factor for success (Ivanov, 2015). The leader's values, psychological profile, goals and inspirations are keys to impacting the employees' behavior, motivation, and productivity, as described by multiple leadership theorists and business thinkers.

Small private businesses in Morocco are used to being led in their own cultural way; in other words, the owner can manage the business and apply the leadership style and principles that he (i.e., he/she) wants. In-turn, these factors may have contributed to making the relationship between Moroccan employees and their companies possibly unique.

In some instances, it has led to a decrease of job security for its employees and a loss of trust that the employees have in the company. Therefore, many

employees do not feel attached to their companies anymore; and their main goal is their belonging to the company, but not necessarily being committed to its success.

In this paper, we will be analyzing the role of leadership in one Moroccan company and its impact on the employees and the company. The case is based on the personal experience of one of the coauthors who worked at CMICE, a Moroccan company, for eighteen months.

### CMICE and Zouth

CMICE, a Moroccan company, was established in 2012 with the focus to assist foreign investors in Morocco. It was owned by the person we are going to call Zouth in this paper.

Zouth did not give any importance to his team. For example, during business trips, he provided the lowest quality of services to his team, such as:

- he rented rooms that were in bad condition
- he did not provide any meals
- he did not provide any compensation to team members business trips



He hired mostly fresh graduates who desperately needed the job, and who would accept anything coming from him. He was taking the full advantage of their situation.

### Zouth's Personality

Zouth was a son of Moroccan immigrants in France, who decided to come back to Morocco and manage a family business. He had neither professional background nor experience in the field. He got the position because he was the son of the owner.

He did not know how to manage the company. He did not trust any member of the team. He did not take any suggestions or ideas on how to improve the company.

Zouth was ignorant and without any skills. The team saw it in lack of clarity of the tasks he assigned to employees. For example, he had no planning skills whatsoever. He did not have any vision for the long term, a required skill for any manager (Deming, 1992, 1993, Jaques, 1996, 2000, Ivanov, 2011, 2015), and did not think seriously about decisions. He refused to discuss anything with anyone. He acted like he was above everyone in the company, a prima-donna, and that he was the boss, which meant that his word was the only one that counted, also the final word.

### Discovering Con Artistry

By the end of February, the team was wondering why they had not re-

ceived their paychecks for that month. It was the second month the team did not get paid. During this time, however, Zouth paid himself a vacation, enjoying his time and privileges of being the leader. It was obvious he did not care about his employees' financial obligations, student loans, families; he only cared about himself, which is one of the traits of con artists and/or psychopaths.

In the Moroccan culture, even if one is not paid, he should not leave his job or it would be considered as if he gave up his job and unpaid salary. Thus, the employees kept on working because they hoped Zouth would come back and pay them.

Coming back from vacation, Zouth went on a three-month-sick-leave. He also claimed that he had no money. As months passed, the team kept on working on projects, as Moroccan traditions require.

Finally, On May 5<sup>th</sup>, Zouth showed up from his three months of vacation/sick leave. It was Zouth's custom to make announcements in one-on-one meetings instead of team meetings to allow him to manipulate individual team members. Zouth called each team member one by one to announce that each was being laid-off without pay. Soon after, the company went bankrupt.

### Leadership, Psychopathy, and Zouth

Good leadership is exemplified by one who looks out for the best interest of his employees. He believes in them and

helps encourage and motivate them in order to achieve the best outcome. A good leader is someone who has knowledge, competence, and has open and honest communication with his employees. In other words, he or she welcomes suggestions or ideas coming from his employees. Deming, Jaques, Machiavelli, Harvey, and others have described these qualities in great depth.

A good leader is responsible for creating an environment of mutual trust. However, to gain the employees' trust, a leader must consistently work hard at it. Once trust has been gained, the leader will have loyalty and collaboration within his company.

In the case of this company, employees did not trust Zouth nor the company. Surveying young graduates-employees, all of them distrusted the company, and especially its leader Zouth.

#### Deming, Jaques, and Great Management Thinkers

Over the past 100-200 years, many management thinkers have written how to create best companies, and build great organizations. Deming (1992, 1993) has written numerous papers and books describing best leadership practices. Jaques (1996, 2000) created a new management system that enables to build great companies. Machiavelli (1505) also explains how to build and lead teams and organizations in times of peace and stress. Most universities worldwide teach various leadership principles and require

leadership courses at undergraduate and graduate levels.

The question, though, has become if Zouth could have been helped. A psychopath, or a person with deep psychological disorders, according to experts, cannot be helped (Hare, 1993).

Most management thinkers, mistakenly, believe that applying certain "good" management principles, could help and change organizations.

Ivanov (2000, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018), Clement (2013, 2015), Deming (1992, 1992), Jaques (1996, 2002), Harvey (1988), Lee (2007), Kraines (2001), and many others believe in applying good leadership practices.

To apply any leadership practices, a person in the leadership role, must first value such practices than caring and focusing only on himself.

#### Conclusion

No psychopath has ever become a saint. Peck (1983) believed that psychopathy is a disease, and most scholars only disagree whether it is a birth-defect/genetic, or acquired at a particular age of development (Hare, 1993). Certainly, no business, ever, has been run by such a person, and likely, this small Moroccan case is unique and rare.

However, evaluating organizations and quasi-organizations/societies for over many centuries of war and crises

Dixon (1976), Ricks (2012), the question that largely arises is whether good leadership practices play any difference at all in organizations of business, or government.

Zouth's story ended that he urgently escaped Morocco to hide in France from police investigation, having robbed his clients and employees. He is still in hiding somewhere in Europe.

Perhaps, there is a need for a new approach that somehow addresses psy-

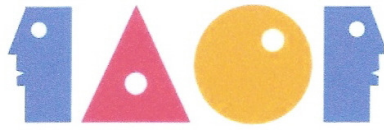
chopaths in power, and prevents them from messing other people's lives.

Good leadership principles are certainly necessary, but had no relevance to Zouth. The authors speculate that this particular case is likely unique, and no other Zouths operate other businesses worldwide. Recent destructions and troubles of many multinational corporations, such as Lehman Brothers, IBM, Bernie Madoff Enterprises, GE, GM, and lots of other companies are just rare coincidences.

#### References

- Clement, Stephen D. (2015). Time-span and Time Compression: New Challenges Facing Contemporary Leaders. Journal of Leadership and Management, 2(4), 35-40.
- Clement, Stephen D., Clement, Christopher R. (2013). It's All About Work: Organizing Your Company To Get Work Done. The Woodlands, TX: Organizational Design Inc.
- Deming, W. Edwards (1993). The New Economics: For Industry, Government, Education. Cambridge, MA: Massachusetts Institute of Technology.
- Deming, W. Edwards (1992). Out of the Crisis. Cambridge, MA: Massachusetts Institute of Technology.
- Dixon, Norman (1976). On the Psychology of Military Incompetence. London, UK: Jonathan Cape Ltd.
- Dixon, Norman F. (1987). Our Own Worst Enemy: The Controversial New Study of Human Behavior - And The Threat It Poses To Man Himself. London, U.K.: Jonathan Cape Ltd.
- Einstein, Albert & Freud, Sigmund (1933). Why War?. League of Nations: International Institute of Intellectual Cooperation.
- Fromm, Erich (1941). Escape from Freedom. New York, NY: Holt, Rinehart and Wilson, Inc.
- Fromm, Erich (1955). The Sane Society. Greenwich, CT: Fawcett Publications.
- Hare, Robert D. (1993). Without Conscience: The Disturbing World of the Psychopaths Among Us. New York, NY: The Guilford Press.
- Harvey, Jerry B. (1988). The Abilene Paradox and Other Meditations on Management. CA: Lexington Books.

- Ivanov, Sergey (2011). Why Organizations Fail: A Conversation About American Competitiveness. International Journal of Organizational Innovation, 4(1), 94-110.
- Ivanov, Sergey (2013). Defects in Modern Organizations: Field Findings and Discovery. International Journal of Innovation, Management and Technology, 4(2), 204-208.
- Ivanov, Sergey (2012). The Problem of Defects in Modern Organizations: Preliminary Research Findings. International Proceedings of Economics Development and Research: Management and Education Innovation, 37(1), 42-45.
- Ivanov, Sergey (2014). Feararchy and Organizations. Melbourne, Australia: Swinburne University of Technology.
- Ivanov, Sergey (2015). Exposing Myths of Modern Management: Innovation - Identifying the Problem. Journal of Leadership and Management, 1(3), 57-66.
- Ivanov, Sergey (2015). Exposing Myths of Modern Management: Innovation - Exploring a Solution. Journal of Leadership and Management, 2(4), 29-34.
- Ivanov, Sergey (2015). The Work of Associations: A Hidden Dimension of All Managerial Hierarchies (Bureaucracies). Journal of Leadership and Management, 2(4), 41-45.
- Ivanov, Sergey (2013). Defects in Modern Organizations: Field Findings and Discovery. International Journal of Innovation, Management and Technology, 4(2), 204-208.
- Ivanov, Sergey (2011). U.S. Analyst Predicts a Nationwide Russian Crisis in 2035-2040: It Is Not the U.S. but Russia that May Collapse... Again!. International Journal of Humanities and Social Science, 1(15), 215-216.
- Jaques, Elliott (1996). Requisite Organization. Arlington, Virginia: Cason Hall & Co.
- Jaques, Elliott (2002). Orders of Complexity of Information and of the Worlds We Construct: Unpublished Paper.
- Jaques, Elliott (2002). Social Power and the CEO. Westport, CT: Quorum Books.
- Jaques, Elliott (1998). On Leaving the Tavistock Institute. Human Relations, 51(3), 251-257.
- Jaques, Elliott (1976). A General Theory of Bureaucracy. London, UK: Heinemann Educational Books.
- Machiavelli, Niccolo (1505). The Prince. New York, NY: Airmont Publishing Company, Inc.
- Peck, M. Scott (1983). People of the Lie: The Hope for Healing Human Evil. New York, NY: Touchstone.
- Wilkinson, Richard G. (1996). Unhealthy Societies: The Afflictions of Inequality. New York, NY: Routledge.



STUDY ON THE RELATIONSHIP AMONG RECREATIONAL  
ENVIRONMENTAL FIT, SITUATIONAL INVOLVEMENT,  
RECREATIONAL SATISFACTION, AND REVISITING INTENTION  
OF PARTICIPANTS IN THE 2017 SUN MOON  
LAKE SWIMMING CARNIVAL

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Abstract

This study aims to conduct a survey concerning the relationship between recreational environmental fit, situational involvement, recreational satisfaction, and revisiting intention of the swimming participants in the 2017 Sun Moon Lake Swimming Carnival. Taking the swimmer participants in the 2017 Sun Moon Lake Swimming Carnival as the subjects, this study adopts the method of purposive sampling. A total of 1550 questionnaires were collected, and after removing 39 invalid questionnaires with incomplete or incorrect answers, the total number of valid questionnaires was 1511, for a recovery rate of 97.4%. In this study, SPSS 20.0 was first used to analyze the statistical analysis of demographic variables, then, AMOS 20.0 software was employed to analyze the relationship between variables and verify the rationality of the model. Research results show that (1) Demand-supply fit has significant impact on situational involvement; (2) Requirement-competence fit has significant impact on situational involvement; (3) Demand-supply fit has significant impact on recreational satisfaction; (4) Requirement-competence fit has significant impact on recreational satisfaction; (5) Situational involvement has significant impact on recreational satisfaction; (6) Recreational satisfaction has significant impact on revisiting intention. Finally, based on the research results, this paper proposes relevant recommendations as reference for follow-up research.

Keywords: Situational involvement, recreational satisfaction, revisiting intention

Introduction

With the gradual development of  
Taiwan's marine policy, venues for

water recreation activities tend to be-  
come more diversified. Surrounded by  
the sea and boasting multiple lakes,  
Taiwan has natural environments that

attract a large majority of Taiwanese for leisure and recreation. Sun Moon Lake has always been a popular tourist attraction, especially before and after the attractive activity of swimming across Sun Moon Lake. As Sun Moon Lake National Scenic Area Administration (2017) pointed out: the yearly activity of swimming across Sun Moon Lake has a long history and large scale. From 1983, before and after the Mid-Autumn Festival, swimmers from Taiwan and overseas have gathered on Chaowu Wharf of Sun Moon Lake to participate in the event. With a total 3000 meters, this event was formally included in the World Swimming Hall of Fame in 2002, as it attracts tens of thousands of swimmers from all over the world every year, hosts a carnival, and breaks the record of swimming across Sun Moon Lake, which shows the popularity of this event.

However, topics concerning software and hardware of this event draws the attention of the public due to its high profile, such as whether the water quality sampling is in line with drinking water resources and quality regarding effluent standards before, during, and after the activity (Chang, 2015); as well as the over-commercialization of such an event, the high registration fee (Huang, 2014), and missing swimmers (Lin, 2010). In other words, further research should be conducted on the compatibility between swimmer participants and the environment, as well as their competence to complete such an event. The concept of environmental fit can be used to discuss the above issues. Lu (2012) argued that environmental fit is the result of individual's interaction with the environment, which contains two points: 1. when resources, functions, ideas, and other conditions in the environment are

consistent with the expectations of the individual; 2. compatibility of personal knowledge, experience, and professional ability with the demands of the environment.

On the other hand, participants devote their time and money with the aim of experiencing freshness and pleasure, unlike those in land activities during the event, and become immersed in the activity. Houston and Rothschild raised the concept of situational involvement as early as 1978, pointing out that situational involvement means the temporary feeling of high involvement in an event. That is, motivated by special water situations, participants may fully engage into the event environment, which can improve their positive experience towards the activity of swimming across Sun Moon Lake. As their recreational satisfaction is raised, they are more likely to participate in the next event. In other words, if tourists are satisfied with the hardware and software qualities provided by the recreational attractions, their overall satisfaction will be positively enhanced; moreover, their revisit intentions are affected (Kozak, 2001).

It is clear from relevant literature that studies pertaining to Sun Moon Lake swimming activities focus on recreational activities (Tsai, Huang, and Hsieh, 2006; Kao, Wei, and Hsu, 2008; Yeh, Liu, 2011; Kao, Chen, and Chen, 2017). Chang, Lin, and Chen (2012) centered on the local residents of Sun Moon Lake, rather than the participants, in order to explore their attitude towards swimming activities, the impact of sport sightseeing, and event support. Chiu (2007) also explored the benefits of swimming activities for Sun Moon Lake sightseeing according to residents' perspective. However, the success or failure

of an activity is often a combination of both the hardware and software of the activity itself and participants' own experience. It can be seen that it is feasible to apply such theory to the Sun Moon Lake swimming activity. Hence, this study assumes that recreational environmental fit will help participants to enhance their degree of involvement in the situation, in order to improve their recreational satisfaction and revisit intention.

### Literature Review

The concept of environmental fit was previously applied to the organizational research areas of enterprise management (Adkins, Russell and Werbel, 1994; Saks and Ashforth, 1997). Kristof-Brown, Zimmerman, and Johnson (2005) pointed out that, the so-called environmental fit is widely defined as having good fit between individuals and work environments. In other words, when individuals are selecting a working environment, fitness between their values and the organization's values becomes one of the key considerations.

The process of taking individual-organization fit into account has also become the focus of emerging interactive psychology (Chiu, 2002), which focuses on individual-work fit (Edwards, 1991) and individual-organization fit (Kristof, 1996). The former refers to the fit between technology and the ability of individuals and specific conditions required by work; the latter explores the consistency between individuals' characteristics, beliefs, values, and organizational culture, strategic needs, norms, and values. As the concept of fit emphasizes the interaction between individuals and environment, that is, recreational activities occur under the situation that

individuals mutually cooperate with the activity environment, thus, studies concerning leisure and recreation gradually integrate the fit theory into relevant research. For example, Tsauro, Chang, Tsai, and Lin (2008) held that, in the field of leisure and recreation research, recreationists' recreational environment fit is a relatively new concept, which refers to the compatibility between recreationists and recreational environments. When these two have similar traits, their interaction may produce fit. Tsauro and Ku (2015) further concluded the fit between recreationists and recreational environment into three types, complementary fit, requirement-competence fit, and demand-supply fit; in which complementary fit means the compatibility when recreationists share similar values with the managers of recreational venues; requirement-competence fit means the knowledge, skills, and experience of recreationists required by the recreational environment; demand-supply fit are analyzed from two aspects: the interaction between recreationists and activities and recreationists' demand for recreational environments, including activity attributes, recreational benefits, and recreational experience; the interaction between recreationists, facilities, and recreationists' demands include natural resources, artificial facilities, and recreational benefits. This paper suggests that, if participants in the swimming activity held at Sun Moon Lake are equipped with certain swimming skills and waters knowledge, and if organizers provide sound hardware and software facilities or dynamic arrangements, the recreational environment fit will be improved under the condition that both sides have good interaction.

Situational involvement means that the certain behaviors of individuals are stimulated by particular situations (Houston and Rothschild, 1978), that is, after leaving a particular situation, people's behavior will return to their original mode due to a lack of special time and space. The concept of situational involvement was applied in the field of commercial consumption (Zaichkowsky, 1986) in the early years, and then, relevant research applied such concept to outdoor recreational studies. For instance, in the view of Havitz and Dimanche (1997), recreational involvement means that motives, incentives, and interests, which could not be observed from recreational activities or related products, may be awakened by special circumstances or stimuli, and have certain driving force. In other words, when people enter a particular situation or environment, they are interested in an activity for the time being. In this paper, the so-called scenario for participants of the swimming activity held at Sun Moon Lake is the hardware and software facilities of the venue and the environment cultivated by organizers to enhance participants' involvement. Tsauro and Ku (2015) also shared the same argument, meaning that environmental fit is positively related to situational involvement. On the other hand, by improving participants' involvement in recreational environmental fit, their recreational satisfaction may be further boosted. Relevant studies also prove the positive impact of situational involvement and satisfaction (Laverie and Arnett, 2000). Havitz and Mannell (2005) divided situational involvement into five indicators: 1. Interest - interest of participants in the activity; 2. Favor - favor of participants in the activity; 3. Correct - Participants' beliefs about activities; 4. Personalization - self-style of partici-

pants in the activity; 5. Time - time and value of participating in the activity. These five indicators suggest that the concept of situational involvement includes both individual and environmental dimensions.

Bigne, Sanchez, and Sanchez (2001) argued that the degree of satisfaction is the overall evaluation of visitors regarding their recreational experience. Thus, overall satisfaction is a holistic measure of consumers after using the products. In other words, recreational satisfaction is reached when visitors are expected to respond to questions about whether they are satisfied with the service or the product. However, recreational activities and environment are often inseparable. Hence, Baker and Crompton (2000) held that recreational satisfaction is a personal experience of visitors and a kind of feeling generated from interactions with the destination. It can be seen that satisfaction can be measured from multiple dimensions. For instance, Manning (1986) proposed that satisfaction is a multidimensional concept that considers the following three factors: 1. the substance and ecological characteristics of the recreational venue; 2. type and level of management; 3. visitors' personal social and cultural characteristics. From the above literature, it can be seen that recreational satisfaction stresses interactions with a recreational environment, and indicates the connection between satisfaction and environment (Zeithaml and Bitner, 2000). Pervin (1968) also considered that high fit between individuals and environments would have better results, higher satisfaction, and lower pressure. Therefore, the impact of environmental fit on recreational satisfaction becomes one of the focuses in this paper.



When consumers are satisfied with a product or service, they tend to spend again. In the field of leisure and recreation, such concept is named revisiting intention. Kozak and Rimmington (2000) argued that revisiting means that visitors are satisfied with the recreational destination and are willing to visit again. Bigne, Sanchez, and Sanchez (2001) further illustrated that revisit intention is an important measure of visitors' image of the recreational destination and their satisfaction. In other words, recreational participants use different recreational experiences to construct their own positive or negative images of a particular location; thereby, affecting their willingness to visit the site again. That is, when engaging in different activities, recreational participants may generate varied experiences and degrees of satisfaction towards the activity, which in turn affect participants' participation and revisit intentions. Relevant literature also points out that the degree of satisfaction of recreational participants will affect their revisit intention (Boulding, Kalra, Staelin and Zeithaml, 1993; Kim, Kim and Goh, 2011). Therefore, another focus of this paper is to explore the impact of recrea-

tional satisfaction of Sun Moon Lake participants.

## Research Methodology

### *Research Structure*

Based on the established theoretical structure and inference of the hypothesis relationship, the research structure is shown in Figure 1.

### *Research Hypotheses*

According to conclusions of related literature, the purpose of this study, and research structure, this paper proposes the following research hypothesis:

Hypothesis 1: Demand-supply fit will positively affect situational involvement.

Hypothesis 2: Requirement-competence fit will positively affect situational involvement.

Hypothesis 3: Demand-supply fit will positively affect recreational satisfaction.

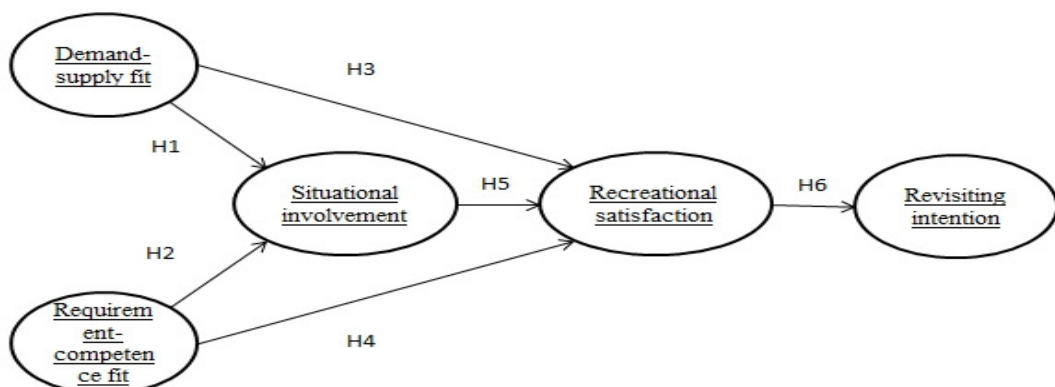


Figure 1. Research Architecture

Hypothesis 3: Demand-supply fit will positively affect recreational satisfaction.

Hypothesis 4: Requirement- competence fit will positively affect recreational satisfaction.

Hypothesis 5: Situational involvement will positively affect recreational satisfaction.

Hypothesis 6: Recreational satisfaction will positively affect revisiting intention.

#### *Research Subjects and Tools*

Research subjects.

Adopting the method of purposive sampling, this study aims to explore the relationship between the participants of the 2017 Sun Moon Lake Swimming Carnival and recreational environment fit, situational involvement, recreational satisfaction, and revisit intention. In this study a total of 1550 questionnaires are collected, and after removing 39 invalid questionnaires with incomplete or incorrect answers, the total number of valid questionnaires is 1511, for a recovery rate of 97.4%.

Research tools.

(1) Design of scale

The scale concerning the relationship between the participants of the 2017 Sun Moon Lake Swimming Carnival and recreational environment fit, situational involvement, recreational satisfaction, and revisit intention is produced by referencing the relevant literature of Tsaur et al. (2012), Tsaur and Lin (2012), Tsaur and Ku (2015), and Liu (2014).

(2) Scoring method of scale

In this study, the questionnaire is answered according to a Likert seven-point scale, with subjects filling in scores of 1, 2, 3, 4, 5, 6, and 7, which represents "Strongly disagree", "Disagree", "Somewhat disagree", "Fair", "Somewhat Agree", "Agree", and "Strongly agree", respectively.

#### *Data Processing and Analysis*

In this study, SPSS 20.0 statistical software is used to encode and reconstruct the valid questionnaires, and AMOS 20.0 statistical software is used to discuss the relationship between adaptability and the variables.

#### Research Results

##### *Characteristics of Samples*

Descriptive statistics is adopted to understand the basis distribution, while relevant data is summed up in Table 1. Among the 1511 of valid samples, in terms of gender, 952 are male, accounting for 63%; and 559 are female, accounting for 37%. In terms of age, subjects aged between 21 and 30 have the largest proportion of 45.9%, and above 41 has the lowest proportion of 1.8%. In terms of educational background, high school (occupation) students account for 92.5%, while institute (including) personnel accounts for 5%. In terms of occupation, students take up the largest proportion of 78.1%, while people working in agriculture, forestry, and animal husbandry only account for 0.3%. In terms of monthly salary, people with a salary lower than ten thousand accounts for the largest proportion of 47.3%, while people with a salary be-

tween fifty thousand to seventy thousand accounts for the lowest proportion of 0.3%. In terms of marital status, unmarried people account for 88.2%. In terms of living area, people living in the northern region (north of Hsinchu) account for the largest proportion of 72.3%, while the eastern region (Yilan, Hualien, Taitung) ranks the lowest, accounting for only 1.1%.

#### *Estimated Violation*

From Tables 2, 3, 4, and 5, error violation values in this study model are positive numbers between 0.01 and 0.03, and the normalization coefficients are between 0.66 and 0.92, which are less than 0.95. Hence, exploration of the relationship between the participants of the 2017 Sun Moon Lake Swimming Carnival and recreational environment fit, situational involvement, recreational satisfaction, and revisiting intention in the activity (Hair, Anderson, Tatham and Black, 1998) may further verify the fit of the overall mode.

#### *Measurement and Structural Model Analysis*

Validation of convergent validity.

In this study, CFA analysis is conducted on the environmental fit, situational involvement, recreational satisfaction, and revisiting intention of the model, and the results are shown in Tables 6, 7, 8, and 9. Standardized loads of all factors are between 0.66 and 0.97, composite reliability is between 0.85 and 0.91, and the average violation amount is between 0.61 and 0.72. This study is in accordance with the recommendations of Hair, Anderson, Tatham, and Black (1998), which

indicates that this study has good convergent validity.

#### *Verification of Discriminant Validity*

Table 10 shows the results of discriminant validity of environmental fit. In the table, the 95% correlation coefficient of Bootstrap does not include 1, indicates that environmental fit of this study has good discriminant validity (Wu, 2009).

#### *Structural Model Analysis*

SEM is for large sample analysis, and strongly recommends samples of 200 or more; however, it usually causes over-large chi-square value (Chang, 2011). Therefore, this study adopts Bollen and Stine (1992) Bootstrapping for modification, and sorts the results in Table 4, which shows that the p value of chi-square testing =00.

Bagozzi and Yi (1988) used a ratio between  $\chi^2$  and its degree of freedom to test the fit of the model. The smaller the better. In this research, the ratio between  $\chi^2$  and the degree of freedom is  $> 3$  (10.62).

Hair et al. (1988) pointed out that, the closer the value of GFI and AGFI to 1, the better the fit; however, there is no absolute criteria to determine the fit of a model. Baumgartner and Homburg (1996) indicated that GFI and AGFI  $> 0.90$ , while Chen and Shunyu (2007) argued that GFI  $> 0.90$  and AGFI  $> 0.80$  were acceptable. In the model of this study, GFI and AGFI are 0.90 and 0.87, respectively.

Browne and Cudeck (1993) pointed out that RMSEA should be between 0.05 to 0.08 to show a good model with reasonable fit. The present model RMSEA is 0.07, which indicates a good model with reasonable fit. The allowable standard of CFI is > 0.90, and CFI in this study is 0.93. The allowable standard is PCFI > 0.50, and PCFI in this study is 0.78.

Overall, it can be seen from Table 11 that, the fit indices in this study are within the standard range, indicating that the result of this study is an acceptable model.

Through empirical analysis, it can be seen that hypothesis H1 is established, which means demand-supply fit will positively affect situational involvement, and this result is the same as that of Tsaur and Ku (2015). Possibly, when the participants of the Sun Moon Lake swimming activity are satisfied with the hardware and software facilities provided by organizers, they may feel a sense of pleasure and identity, which further boosts their degree of involvement. Hypothesis H2 is established, which means the requirement-competence fit will positively affect situational involvement, and this result is the same as that of Tsaur (2013). Possibly, when the participants of the Sun Moon Lake swimming activity are willing to sign up for this event, their swimming skills or knowledge concerning swimming are sufficient, and they are likely to enjoy such an event. Hypothesis H3 is established, which means that the requirement-demand fit will positively affect recreational satisfaction, and this result is

the same as that of Zeithaml and Bitner (2000). Possibly, the organizers of the Sun Moon Lake swimming activity cultivate a well-equipped environment, which enables participants to enjoy the entire process and enhance their degree of recreation. Hypothesis H4 is established, which means the requirement-competence fit will positively affect recreational satisfaction, and this result is the same as that of Pervin (1968).

Possibly, the participants of the Sun Moon Lake swimming activity will carry out physical training before the event, in order to smoothly exert their strength and enjoy the entire event, thus, enhancing their recreational satisfaction. Hypothesis H5 is established, which means that situational involvement will positively affect the degree of recreational satisfaction, and this result is the same as that of Laverie and Arnett (2000). Possibly, under specific situations cultivated by organizers, the interest and enthusiasm of participants of the Sun Moon Lake swimming activity may be awoken through specific stimuli, thus, improving recreational satisfaction. Hypothesis H6 is established, which means recreational satisfaction will positively affect revisit intention, and this result is the same as that of Kim, Kim, and Goh (2011). Possibly, the participants of the Sun Moon Lake swimming activity may think highly of the services or relevant facilities of such event, and thus, are more likely to sign up again due to such a wonderful experience.

Table 1. Characteristics of the Sample

Variables	Category	Frequency	Percentage%	Cumulative percentage%
Gender	Male	952	63.0	63.0
	Female	559	37.0	100.0
Age	Below (including) 20 years old	672	44.5	44.5
	21-30(including) years old	694	45.9	90.4
	31-40(including) years old	118	7.8	98.2
	Above (including) 41	27	1.8	100.0
Educational level	junior high school	51	3.4	3.4
	Senior high school and vocational school	1397	92.5	95.8
	College and university	55	3.6	99.5
	Graduate school (including) or above	8	5	100.0
Occupation	Military, governmental employees and teachers	8	0.5	0.5
	Business and service	24	1.6	2.1
	Agriculture, Forestry, Fishery and Husbandry	4	0.3	2.4
	Student	1180	78.1	80.5
	Service industry	215	14.2	94.7
	Others	80	5.3	100.0
Average monthly income	Below ten thousand (including)	715	47.3	47.3
	Ten to thirty thousand	642	42.5	89.8
	Thirty to fifty thousand	142	9.4	99.2
	Fifty to seventy thousand	4	0.3	99.5
	More than seventy thousand (including)	8	0.5	100.0
Marital status	Unmarried	1333	88.2	88.2
	Married	178	11.8	100.0
Place of residence	Northern region (north of Hsinchu)	1092	72.3	72.3
	Central area (Miaoli to Yunlin, Nantou)	287	19.0	91.3
	Southern region (south of Chiayi)	116	7.7	98.9
	Eastern Region (Yilan, Hualien, Taitung)	16	1.1	100.0

Table 2. Estimated Violation Checklist of Environmental Fit

Code of items	Standardization Regression coefficients	Error Violations
Environmental resources 1	0.92	0.02
Environmental resources 2	0.80	0.02
Environmental resources 3	0.72	0.03
Social opportunity 1	0.86	0.02
Social opportunity 2	0.85	0.02
Social opportunity 3	0.80	0.02
Environmental function 1	0.82	0.02
Environmental function 2	0.82	0.02
Environmental function 3	0.83	0.02
Environmental equipment 1	0.79	0.02
Environmental equipment 2	0.77	0.01
Environmental equipment 3	0.85	0.02
Requirement-competence fit 1	0.91	0.01
Requirement-competence fit 2	0.79	0.02
Requirement-competence fit 3	0.86	0.01
Requirement-competence fit 4	0.82	0.02

Table 3. Estimated Violation Checklist of Situational Involvement

Code of items	Standardization Regression coefficients	Error Violations
Situational involvement 1	0.86	0.02
Situational involvement 2	0.81	0.01
Situational involvement 3	0.80	0.02
Situational involvement 4	0.77	0.02
Situational involvement 5	0.66	0.02

Table 4. Estimated Violation Checklist of Recreational Satisfaction

Code of items	Standardization Regression coefficients	Error Violations
Recreational satisfaction 1	0.83	0.02
Recreational satisfaction 2	0.82	0.02
Recreational satisfaction 3	0.79	0.02

Table 5. Estimated Violation Checklist of Revisiting Intention

Code of items	Standardization Re- gression coefficients	Error Violations
Revisiting intention 1	0.79	0.02
Revisiting intention 2	0.88	0.02
Revisiting intention 3	0.79	0.02

Table 6. Verification Analysis Table of Environmental Fit

Factors	Indicators	Stan- dardized load	Non- standard- ized load	S.E.	C.R. (t-value)	P	SMC	C.R.	AVE
Environmental resources	Environmental resources 1	0.92	1.00				0.84	0.86	0.67
	Environmental resources 2	0.80	0.83	0.02	35.86	***	0.63		
	Environmental resources 3	0.72	0.77	0.02	31.29	***	0.51		
Social oppor- tunity	Social oppor- tunity 1	0.86	1.00				0.74	0.88	0.70
	Social oppor- tunity 2	0.85	0.85	0.02	38.77	***	0.73		
	Social oppor- tunity 3	0.80	0.79	0.02	35.37	***	0.65		
Environmental function	Environmental function 1	0.82	1.00				0.67	0.86	0.68
	Environmental function 2	0.82	0.95	0.03	34.76	***	0.68		
	Environmental function 3	0.83	0.97	0.03	34.90	***	0.69		
Environmental equipment	Environmental equipment 1	0.79	1.00				0.63		
	Environmental equipment 2	0.77	0.82	0.03	32.77	***	0.60		
	Environmental equipment 3	0.85	1.10	0.03	36.09	***	0.72		
Requirement- competence fit	Requirement- competence fit 1	0.91	1.00				0.82	0.91	0.72
	Requirement- competence fit 2	0.79	0.81	0.02	40.73	***	0.63		
	Requirement- competence fit 3	0.86	0.95	0.02	47.76	***	0.74		

Requirement-competence fit 4	0.82	0.91	0.02	43.16	***	0.67
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Table 7. Verification Analysis Table of Situational Involvement

Factors	Indicators	Standardized load	Non-standardized load	S.E.	C.R. (t-value)	P	SMC	C.R.	AVE
Situational Involvement	Situational Involvement 1	0.86	1.00				0.74	0.89	0.61
	Situational Involvement 2	0.81	0.84	0.02	38.42	***	0.66		
	Situational Involvement 3	0.80	0.90	0.02	36.55	***	0.64		
	Situational Involvement 4	0.77	0.86	0.02	34.45	***	0.59		
	Situational Involvement 5	0.66	0.71	0.03	27.24	***	0.43		

Table 8. Verification Analysis Table of Recreational Satisfaction

Factors	Indicators	Standardized load	Non-standardized load	S.E.	C.R. (t-value)	P	SMC	C.R.	AVE
Recreational satisfaction	Recreational satisfaction 1	0.83	1.00				0.69	0.85	0.66
	Recreational satisfaction 2	0.82	0.98	0.03	31.57	***	0.67		
	Recreational satisfaction 3	0.79	0.85	0.03	30.85	***	0.62		

Table 9. Verification Analysis Table of Revisiting Intention

	Indicators	Standardized load	Non-standardized load	S.E.	C.R. (t-value)	P	SMC	C.R.	AVE
Revisiting intention	Revisiting intention 1	0.79	1.00				0.62	0.86	0.67
	Revisiting intention 2	0.88	1.21	0.04	32.08	***	0.77		
	Revisiting intention 3	0.79	1.08	0.03	30.99	***	0.63		



Table10. Fit Using Bootstrap

Parameters	Estimation	Bias-corrected		Percentile method	
		Lower bound	Upper Bound	Lower bound	Upper Bound
Requirement-competence fit <-> Demand-supply fit	0.87	0.84	0.89	0.84	0.89

Conclusion and Suggestions

*Conclusion*

Boasting a wealth of tourism resources, and in addition to high mountain resources, Taiwan governments spare no efforts in boosting marine development, with priority being attached to recreational activities concerning waters and seas. In the future, relevant government units should strive to develop a blueprint for recreational water facilities and build standards for watershed activities, as relevant water activities and events are strong driving forces. Hence, how to build a perfect environment for water activities is closely related to people’s evaluation and safety awareness for such activities. In this regard, recreational fit is one of primary concerns in relevant issues. This paper takes the 2017Sun Moon Lake swimming activity as an example, and explores the relationship among recreational environment fit, situational involvement, recreational satisfaction, and revisiting intention. Through empirical analysis, the conclusions are, as follows.

1. Demand-supply fit will positively affect situational involvement.
2. Requirement-competence fit will positively affect situational involvement.

3. Demand-supply fit will positively affect recreational satisfaction.
4. Requirement-competence fit will positively affect recreational satisfaction.
5. Situational involvement will positively affect recreational satisfaction.
6. Recreational satisfaction will positively affect revisiting intention.

*Suggestions*

Based on the results of this paper, the following suggestions are proposed for reference:

For the organizers of the Sun Moon Lake swimming activity.

According to the results of this study, demand-supply fit will positively affect situational involvement and recreational satisfaction. Situational involvement will positively affect recreational satisfaction, and recreational satisfaction will positively affect revisit intention. In this regard, it is recommended that the organizers of the Sun Moon Lake swimming activity should set up a complete set of operational activities during the event. For example, pre-exercise concerning the safety of swimmers should be carried out together with local fire departments, Sun Moon Lake National Sc-

nic Area Administration, and other relevant units, including the pushing and stampeding of participants before the swim, treatment of the loss of body temperature, wounded rescue, diving rescue for missing personnel, rescue for personnel falling off the floating platform, and simulation rescue of the collision of boats, in order to ensure safety measures in the case of emergency. In addition, it is important to keep all staff and rescue units on standby, and abreast of the situation, such as attention to senior participants, unmanned buoys, the occupation of the floating platform, and even inspection for impostors, in order to avoid any negative evaluations and perceptions regarding the event due to the negligence of the organizers. Regarding the end of the race, organizers should take water samples before and after the event to test the water quality, and detect whether any water quality changes are in line with the effluent standards. In other words, if organizers can establish a set of standardized operational procedures before, during, and after the event, they may maintain high quality throughout the entire event. Through the construction of a well-equipped activity environment, participants in such events will feel at ease, and be highly involved in the current situation, which in turn, enhances their recreational satisfaction.

For participants of the Sun Moon Lake swimming activity.

From the results of this study, it is known that the requirement- competence fit will have positive impact on situational involvement and recreational satisfaction. Therefore, it is recommended that, the participants of the Sun Moon Lake swimming activity should be able to develop their own

swimming ability and awareness during open water recreational activities.

In terms of swimming ability: most swimmers fail to have sufficient opportunities to practice in open waters, and some even think that it is dangerous to swim in open waters without waterway ropes, or feel flustered when they cannot see the end while in open waters. Thus, participants may simulate the situation of swimming in open waters in swimming pools. For example, practice treading water in open waters; as treading water when unable to touch the bottom is one of the better ways to rest and quell fears regarding the depth of waters during swimming. Moreover, treading water may help swimmers to locate the target. In addition, if participants get used to freestyle swimming in swimming pools, they may be unable to observe whether they have deviated from the route in open waters, as they tend to take breath from one side; thus, participants should develop their sense of direction when practicing taking a breath from one side. As the awareness required during open water activities is different from indoor swimming pools, it is recommended that participants get to know the number and locations of the balls floating on the surface. Moreover, they must keep their positioning point in mind; as participants start swimming, the change of sight-line may lead to a wrong direction, thus, it is of great importance to locate a positioning point. Enhancement of participants' awareness of swimming ability and open water recreation activities will enable them to be highly involved in the recreational environment and improve their fit, in order to understand their ability to participate in such event

and further enhance their situational involvement and recreational satisfaction.

(1) For future research

This study focuses on recreational fit during water activities, which has received less attention. In particular, spaces for land and water recreational activities are greatly diversified, and studies concerning how to explore the situations of different recreational spaces prove more meaningful.

Through the empirical results of this study, the application of the recreational fit theory can be extended to recreational water activities, and thus, enrich relevant discussions of the theory. Regarding the contribution to the practice, although water related research centers on various issues, such as satisfaction, revisiting intention, attraction of the destination, and participation behavior, the spatial environment of water activity are often important considerations. Therefore, starting from the argument of recreational fit will help to construct a better research argument. In future research, as recreational fit is rarely applied to water-related activities, it is suggested that future studies can conduct empirical research on more water activities, such as triathlon activities and recreational water facilities, such as jet skiing, etc., in order to enhance external validity through analysis of the samples.

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#### References

- Adkins, C.L., Russell, C. J., & Werbel, J. D. (1994). Judgments of fit in the selection process: The role of work-value congruence. *Personnel Psychology*, 47, 605-623.
- Bagozzi, R. P., & Yi Y. (1988). On the evaluation for structural equation models.
- Baker, D. A. & Crompton, J. L. (2000). Quality, satisfaction and behavioral intentions. *Annals of Tourism Research*, 27(3), 785-804.
- Baumgartner, H. & Homburg, C. (1996). Applications of structural equation modeling in marketing and consumer research: A review, *International Journal of Research in Marketing*, 13(2), 139-161.
- Bigne, J. E., Sanchez, M. I., & Sanchez, J. (2001). Tourism image evaluation variables and after purchase behavior: inter-relationship. *Tourism Management*, 22(6), 607-616.
- Bollen, K. A., & Stine, R. A. (1992). Bootstrapping goodness-of-fit measures in structural equation models. *Sociological Methods and Research*, 21, 205-229.

- Boulding, W., Kalra, A., Staelin, R., & Zeithaml, V. A. (1993). A dynamic process model of service quality: From expectations to behavioral intentions. *Journal of Marketing Research*, 30, 7-27.
- Browne, M. W., & Cudeck, R. (1993). *Alternative ways of assessing model fit*. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136- 162). Newbury Park, CA: Sage.
- Chang, W.C., Lin, D.X., Chen, P.J. (2012). Factors influencing local residents' attitude, tourism impact and activity support on 2010 Sun Moon Lake Travelers. *Journal of Sport and Recreation Management*, 9(1), 191-214.
- Chang, W.L. (2015). *EPA: Swimming water quality before and after Sun Moon Lake swimming activity is in line with standards*. Retrieved on October 1, 2017, from: <http://m.match.net.tw/pc/news/life/20151007/3185355>.
- Chiu, C.H. (2002). *A Study on correlation between employees - organization values and staff attitudes - a case study of six medical college centers*. Unpublished, master's thesis, Graduate Institute of Health Care Organization Administration, National Taiwan University, Taipei City.
- Chiu, F.B. (2007). *A Study of truism effects and influences of swimming carnival in Sun Moon Lake*. Unpublished, master's dissertation.
- Edwards, J. R. (1991). Person-job fit: A conceptual integration, literature review, and methodological critique. In C. L. Cooper, & I. T. Robertson (Eds.), *International Review of Industrial and Organizational Psychology* (Vol. 6, pp. 283-357). New York: Wiley
- Hair, J. F. Jr., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis* (5th ed.). Upper saddle River, NJ: Prentice Hall.
- Havitz, M. E. & Mannell, R.C. (2005). Enduring involvement, situational involvement, and flow in leisure and non-leisure activities. *Journal of Leisure Research*, 37(2), 152-177.
- Havitz, M. E., & Dimanche, F. (1997). Leisure involvement revisited: Conceptual conundrums and measurement advances. *Journal of Leisure Research*, 29(3), 245-278.
- Houston, M.J. & Rothschild, M. L. (1978). *Research frontiers in marketing: Dialogues and directions*. Illinois: American Marketing Association.
- Huang, M.S. (2014). *Commercial Sun Moon Lake swim activity boycotted by Members of Swimming Association*. Retrieved on October 1, 2017, from: <http://news.tvbs.com.tw/life/553148>
- Kao, W.Y., Wei, L., Hsu, S.M. (2008). The research of Sun Moon Lake cross-lake swimmers' sensation seeking motives and activity in-

- volvement. *Journal of Island Tourism Research*, 1(1), 30-43.
- Kim, Y. H., Kim, M. C., & Goh, B. K. (2011). An examination of food tourist's behavior: Using the modified theory of reasoned action. *Tourism Management*, 32(5), 1159-1165.
- Kozak, M., & Rimmington, M. (2000). Tourist satisfaction with Mallorca, Spain, as an off-season holiday destination. *Journal of Travel Research*, 38, 260-269.
- Kozak, M. (2001). Repeaters' behavior at two distinct destinations. *Annals of Tourism Research*, 28(3), 784-807.
- Kristof, A. L. (1996). Person-organization fit: An integrative review of its conceptualizations, measurement, and implications. *Personnel Psychology*, 49, 1-49.
- Kristof-Brown, A. L., Zimmerman, R. D., & Johnson, E. C. (2005). Consequences of individuals' fit at work: A meta-analysis of person-job, person-organization, person-group, and person-supervisor fit. *Personnel Psychology*, 58(2), 281-342.
- Kuo, Y.N., Chen, W.Y., Chen, A.N. (2017). A Study of the relationship between adventure recreation behavior and well-being on the sport tourists--A case study of Sun Moon Lake international swimming carnival. *Journal of Deming*, 40(2), 15-26.
- Laverie, D. A., & Arnett, D. B. (2000). Factors affecting fan attendance: The influence of identity salience and satisfaction. *Journal of Leisure Research*, 32(2), 225-246.
- Lin, H.L. (2010). *Sun Moon Lake swimming carnival, body of missing male found*. Retrieved on October 1, 2017, from: <http://www.cna.com.tw/news/firstnews/201009140036-1.aspx>
- Lu, Y.K. (2012). *A study on the influences of fitness of environmental education site to visitors' environment literacy - A case study of Chouchai Wetland Park in Kaohsiung*. Department of Landscape and Recreation, Feng Chia University. Taichung City.
- Manning, R. E. (1986). *Studies in outdoor recreation: A review and synthesis of social science literature in outdoor recreation*. Corvallis, OR: Oregon State University Press.
- Pervin, L. A. (1968). Performance and Satisfaction as a function of individual-environment fit. *Psychological Bulletin*, 69(1), 56-68.
- Saks, A. M., & Ashforth, B. E. (1997). A longitudinal investigation of the relationship between job information sources, applicant perceptions of fit, and work outcomes. *Personnel Psychology*, 50, 395-426.
- Sun Moon Lake National Scenic Area Administration (2017). *Sun Moon Lake swimming activity for thousands of people*. Retrieved on October 1, 2017, from: <http://www.sunmoonlake.gov.tw/DeepTour/Festivals/Festivals03.htm>
- Tsai, W.C., Huang, M.L., Hsieh, Y.C. (2006). A study on motivation of

- participation in Sun Moon Lake swimming activity. *Journal of Sport and Recreation Research*, 1(2), 24-43.
- Tsaur, S. H., Liang, Y. W., & Lin, W. R. (2012). Conceptualization and measurement of recreationist-environment fit. *Journal of Leisure Research*, 44(1), 108-128.
- Tsaur, S.H. (2013) Recreationists - study on Reasons and Consequences of recreational environmental fit. Report of Project of the National Science Council of the Executive Yuan. Project ID: NSC100-2410-H-415-039-MY2.
- Tsaur, S.H., Chang, D.I., Tsai, P.M., Lin, W.R. (2008). Recreational and recreational environment fit: conceptualization and measurement, the 10th leisure, recreation, sight-seeing seminar and international forum, outdoor recreation association of R.O.C.
- Tsaur, S.H., Ku, P.S. (2015). The relationship among r-e fit, situational involvement and flow. *Physical Education Journal*, 48(2), 205 -219.
- Tsaur, S.H., Lin, W.R. (2012). Antecedents and consequences of recreationist- environment fit: A study of Mt. Yushan climbers. *Journal of Outdoor Recreation Study*, 25(4), 79-98.
- Wu, M.L. (2009). *Structural equation pattern method and practical application*. Kaohsiung City: Liwen.
- Yeh, C.K., Liu, Z.Y. (2011). A study on the involvement of behavior and participating motivation for the seniors swimming across the Sun-Moon Lake. *Mingdao Journal*, 7(4), 29-55.
- Zaichkowsky, J. L. (1986). Conceptualizing involvement. *Journal of Advertising*, 15(2), 4-14.
- Zeithaml, V. A., & Binter, M. J. (2000). *Service marketing*. New York: McGraw Hill.

Table 11. Fit Analysis of the Overall Mode

Fit indices	Allowable range	Correction mode	Mode fix determination
$\chi^2$ (Chi-square)	The smaller the better	1359.95	
Ratio between $\chi^2$ and degree of freedom	<3	10.62	Unmatched
GFI	>0.90	0.90	Matched
AGFI	>0.80	0.87	Matched
RMSEA	<0.08	0.07	Matched
CFI	>0.90	0.93	Matched
PCFI	>0.50	0.78	Matched

Table 12. Empirical Results of Research Hypothesis

Hypothesis	Path relationship	Path value	Valid hypothesis
1	Demand-supply fit -> situational involvement	0.56*	Yes
2	Requirement-competence fit -> situational involvement	0.27*	Yes
3	Demand-supply fit -> Recreational satisfaction	0.24*	Yes
4	Requirement-competence fit -> Recreational satisfaction	0.12*	Yes
5	situational involvement -> Recreational satisfaction	0.56*	Yes
6	Recreational satisfaction -> Revisiting intention	0.87*	Yes