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Towards an analytical framework of organizational innovation in the service industry

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This paper discusses the analytical typology of organizational innovation in service industry. After outlining empirical approaches, this paper offers a new measurement model for empirical and theoretical researches. With the construction of the organizational innovation model, the empirical study concludes that the weights of important dimensions in measuring organizational innovation measurement are: technical innovation (0.416), administrative innovation (0.584), external relational innovation (0.318), internal organizational innovation (0.266), product/service innovation (0.262), and process innovation (0.154). This paper proposes a typology and tests for the validity of a multidimensional measure of organizational innovation.

Key words: Service industry, innovation, organizational innovation (OI), analytical framework, analytic hierarchy process (AHP).

INTRODUCTION

Research background and rationale

Taiwan was an agricultural society in the 1950s, becoming an industrial society after the 1960s. Since then, the contribution of Taiwan's service industry to GNP has been on the rise and employment in this sector has steadily made gains. Taiwan's service industry accounted for 46.39% of GDP, employing 17% of the labor force in 1951. By 1988, the industry's share in GDP had exceeded 50%. In 2005, the service industry's GDP share reached 77.52% while employment rose to more than 58% of the labor market. The service industry has become Taiwan's largest industry and a key to Taiwan's economic progress.

The term innovation frequently appears in the literature, with technology improvements or breakthroughs being the main subject of investigation in related studies. Innovation and technical innovation used to refer to the same thing in most cases. A large number of studies address innovations in technological research and development. Relatively fewer studies consider an

organization as a whole and investigate organizational innovation. It is important to further explore the context of organizational innovation (OI) and contribute more theoretical supplements. Most previous studies on organizational theories are concerned with performance improvement, addressing how to achieve targets through better technological abilities but rarely proposing organizational innovation concepts or ways of coordinating related factors for the improvement of organization performance.

The dimensions of organizational innovation are extremely complex. In order to formulate the innovativeness of an organization, some scholars extended the dimensions of their studies to technological capability measurement indicators, incorporated management capabilities and the concept of learning organization (Evan, 1967; Downs and Mohr, 1976; Knight, 1967; Damanpour, 1984, 1991; Tang, 1999). They defined innovativeness as the overall capability expressed by an individual or group, and the output and structure of an organization during the process of knowledge renewal. The breadth of innovation includes equipment, systems, policies, processes, products and services. The depth of innovation includes importance, degree of influence and effects on long-term profitability. The present study is focused on service industry that requires extensive cultivation of their innovativeness (Djellal and Gallouj,

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2001; Van der Aa and Elfring, 2002; Tidd, 2003; Hipp and Grupp, 2005). It attempts to propose a typology and construct a multidimensional organizational innovation measurement model. By adopting a rigorous study methodology, the organization innovation measurement model was developed and used to establish the foundation of a more complete theory of organizational innovation. This article deals critically with existing measurement concepts derived from services, and introduces a new typology with a view to obtaining a better understanding of organizational innovation in service industry.

Purpose of the research

An in-depth study of OI is important for both theoretical exploration and business practice. The main objectives of this research are: (1) Construct an analytical typology of organizational innovation in service industry; (2) Employ a rigorous research process using qualitative and quantitative methods in order to produce an in-depth study into the nature and meaning of OI in Taiwan's service industry and into the dimensions involved and the context of its measurement model; (3) Establish an OI measurement model for service industry in Taiwan; (4) Based on the above-mentioned indicator establishing process and results, make suggestions for future researchers and recommend useful strategies for enterprises.

LITERATURE REVIEW

Different areas of research are developing their own approaches to try and understand the complex phenomenon of organizational innovation. A first literature strand focuses on the identification of the structural characteristics of an innovative organization and its effects on product and technical process innovations. A second literature strand aims to analyze and understand how organizations change. A third strand of literature focuses on how organizational innovations emerge, develop and grow at the microlevel within the organization (Armbruster, Bikfalvi, Kinkel and Lay, 2008). The growth innovation literature provides many alternative conceptualizations and models for the interpretation of observed data. An innovation can be a new product or service, a new production process technology, a new structure or administrative system, or a new plan or program pertaining to organizational members. Therefore, organizational innovation, or innovativeness, is typically measured by the rate of the adoption of innovations, although a few studies have used other measures (Damanpour, 1991; Liao and Wu, 2010).

The present study takes service industry in Taiwan as

subject, with in-depth investigations of OI and related issues. Since Schumpeter proposed the effects of innovation and the spreading of knowledge on industry, the concept of innovation had been a crucial topic in the study of organization. Researchers have been most concerned about how to augment organization performance through the introduction of innovation. Although different studies were made on the characteristics of OI, vastly different conclusions were obtained, making it difficult to formulate innovation theories. Wolfe (1994) concluded that existing literature on OI showed that nearly all research results were dissimilar. Therefore, the present study attempts to review and explore the literature on OI in order to clarify its context.

Theories on OI

Researches on OI can be divided into several types according to different viewpoints: product-basis view, process-basis view, product-and-process-basis view, and multiple views. Those who took product-basis view defined OI according to new products which were produced or designed by the organization (Burgess, 1989), which were subsequently marketed successfully or obtained merits (Blau and McKinley, 1979). For those who took process-basis view, such as Amabile (1988), OI was regarded as a process. Product-and-process-basis view defined OI as the creation of new product or process in any organization.

Dougherty and Bowman (1995) described OI as a complex process in problem solving, and it involved activities like product design, coordination among product innovation departments, and the integration of company resources, structure and strategies. Those who defined OI with multiple viewpoints suggested that most of the people with a unitary viewpoint emphasized only the technical innovation (TI) of an enterprise, whilst administrative innovation (AI) like management policies and practices were neglected. Thus, both TI and AI are possible expressions of OI. The following discussion on OI theory is mainly based on the analysis of literature collated by Damanpour (1991).

Mechanistic and organic organization

Studies by Burns and Stalker (1962) pointed out that TI was more beneficial to an organic organization than a mechanistic organization. Some researchers attempted to incorporate an ideal type at the intermediate of a continuum (Hull and Hage, 1982; Kimberly, 1986). Therefore, Damanpour and Evan (1990) believed that organic organizations continuously innovated, mechanistic organizations did not, whereas an intermediate type was somewhere between these two extremes in terms of innovativeness.

Dual-core model

This model divided OI in terms of AI and TI (Evan and Black, 1967; Daft, 1978). Under this model, mechanistic organizations are suitable for AI and organic organizations are suitable for TI (Daft, 1989). The dual-core model proposition is supported by organizational variables such as specialisation, functional differentiation, centralisation and vertical differentiation. Damanpour (1991) discovered that the specialisation of members of an organization would have an equal influence on AI and TI.

Ambidextrous model

This model is based on the separation of the initiation stage and implementation stage when innovation is employed (Duncan, 1976). Duncan also suggested that an organic organization was helpful for the implementation of innovation. Beyer and Trice (1978) noticed that the higher the degree of formality and centralisation was, the greater the hindrance to innovation implementation would be. The study of Zmud (1984) reported that the formality and centralisation proposition by this model was valid for TI, but invalid for AI. Damanpour (1991) believed organizations with specialisation characteristics will not follow the prediction of this model. In addition, negative correlations exist between centralisation and innovation initiation together with centralisation and innovation implementation. Furthermore, for specialisation and functional differentiation, their correlation with innovation implementation is higher than that with innovation initiation. Therefore, comparison of this model with the dual-core model will help to explain the differences of different study results.

Dual-core and ambidextrous model

In this model, differences are made between the initiation stage of TI and the implementation stage of AI. Damanpour suggested that an organic organization was conducive at the initiation stage of TI, while a mechanistic organization promoted the implementation of AI (Damanpour, 1988). Better understanding on the relationship between organization factors and innovation can be made if the moderator effects of innovation initiation, innovation implementation, AI and OI are studied. Damanpour (1991) further discovered that organic organization is beneficial to TI implementation but not for AI initiation.

Radical model

This model was proposed by Hage (1980) whose main

assumption was that if an organization can make positive attitude changes on the alliance that controls the organization's scope, and unite the elitists to exert their effects, radical innovation will be promoted. Damanpour (1991) verified Hage's assumption, and showed that the attitude of managers who faced the changes bore a stronger positive relationship with progressiveness innovation than radical innovation. This is contrary to Hage's assumption. Therefore, the communication between department members and the influence of leaders on progressive or radical form of innovation is an issue worth studying.

Damanpour (1991) reviewed the supports for different theoretical models mentioned above and summarized that most research results supported the theory of mechanistic organization, organic organization and dual-core models, while some studies favored the radical model, and fewer studies supported the ambidextrous model; the dual-core and ambidextrous models explained not only the overlapping of TI and OI, but also that of initiation stage and implementation stage. The present study adopts the approach of the dual-core model and divided OI into TI and AI. Such assumption has gained general consensus among researchers and is the major contribution of the dual-core model.

Research orientation of OI

Wolfe (1994) suggested that there were three orientations of OI, and each orientation had its own core issue, model and data collection method. A review of the views of Wolfe (1994) on research orientation of OI shows:

Orientation towards diffusion of innovation

The diffusion of innovation refers to the spreading of an innovative new product through a group of potential users. The research emphasises the innovative spreading pattern of users, employing the logistic growth model to investigate the fitness between the proposed model of innovation diffusion and actual diffusion results. The data collection methods mainly include cross-sectional surveys of large samples, expert judgments and secondary information filing methods, etc.

Orientation towards organizational innovativeness

Organizational innovativeness is determined by the number of innovations employed. The determinants of OI were the main subject of study and an analysis is based on individual organizations. The variance/regression model is used to investigate related affecting factors that can best resolve organizational innovativeness. Information for this part of the study is mainly collected

through cross-sectional surveys.

Orientation towards process theory research

The orientation of process theory research is focused on studying the characteristics of innovation process, with attempts to understand how and why innovation occurs, develops, grows and ends. The stage/process model is used to investigate OI process and factors that affect the process. Information is obtained chiefly through retrospective cross-sectional surveys and in-depth field studies. What was mentioned above indicates that research on OI is not complete yet. Though Wolfe (1994) suggested that each of the three research orientations made some contributions to OI, each orientation still has some major limitations. The present study divides OI into two main dimensions of TI and AI on the basis of dual-core model in order to establish a hierarchical structure and indicators for service industry in Taiwan. In addition, dimensions and measurement indicators are established and classified in accordance with relevant literature references.

Key typologies of OI on service industry

Service industry organizational innovation is a relatively new term in Taiwan, and few Taiwanese scholars have proposed a clear definition of the term. Currently, related literature is scarce (Van der Aa and Elfring, 2002). Djellal and Gallouj (2001) have investigated organizational innovation models of service industry. Innovative products and services, broadly defined, include tangible and intangible products and can be divided into several forms: process innovation; technical systems (even more abstract processes); internal and organizational innovation; different process innovations composed of organization activities and processes; external relationship innovation; companies that create special partnership with customers, a chain of suppliers, government, or competitors. On the other hand, Van der Aa and Elfring (2002) divided industry innovation into four models: multi-unit organizations, new combinations of services, customers as co-producers, and technological innovations. Obviously current researchers do not have the same definition of service industry organizational innovation.

ESTABLISHMENT OF OI MEASUREMENT MODELS

The typologies of organizational innovation have resulted from rather arbitrary combinations of various dimensions of organizational innovation. Thus, this article attempts to develop an empirically-based typology of organizational innovation which would reflect the actual innovation

dimensions and their indicators. Through related OI literature review and analysis, it is found that continuous innovation activities undertaken by managers of the service industry are critical to gaining a competitive edge. Researchers have also extended studies by focusing on organizational innovation typology. Organizational innovation is broadly classified as technical (new technologies, products and services) and administrative (new procedures, policies and organizational forms) (Ravichandran, 1999).

In the past, organizational innovation was usually measured by perceived questionnaires, evaluated by subjective indicators or some simple weighted indicators such as the number of patents or the amount of research and development expenditure. However, results from such an approach varied greatly because of the subjective perception of the questionnaire respondents. Besides, the weighted relative importance of different dimensions was not considered. The foundation of the OI measurement model developed in the present study is mainly based on OI structure factors proposed by Daft (1978), Kimberely and Evanisko (1981, Amabile (1988), Damanpour and Even (1984), Damanpour (1987, 1991), Schumann et al. (1994), Wolfe (1994), Tang (1999), Djellal and Gallouj (2001), Van der Aa and Elfring (2002), Tidd (2003), Hipp and Grupp (2005). The preliminary measurement model was established through a study of in-depth literature interviews with experts, assessors and subjects, together with focus group techniques (FGT) to compile the views and opinions on the dimensions and measurement indicators for the OI of service industry. In addition to subjective indicators, objective indicators were also included. The preliminary measurement model was first designed in the form of a questionnaire and sent to middle to higher managers in the service industry. A total of 800 questionnaires were sent out, and 541 (68%) valid returns were collected. Based on the results of factors analysis, different dimensions were identified and named accordingly. A total of two system dimensions, four major dimensions and eight secondary dimensions were obtained; the construction of a preliminary measurement model was completed. The dimensions and indicators of the measurement model are shown in Figure 2. On completion of the hierarchical structure for the present study, 12 experts who were familiar with OI studies were consulted to compare the pairing of the dimensions and indicators through an analytical hierarchy process (AHP) questionnaire. The objective of this study is to obtain the relative weights of the hierarchy and indicators for subsequent development of equations to evaluate OI. The details of the whole construction process are given below:

Research process

The flow chart of the present study process is depicted in

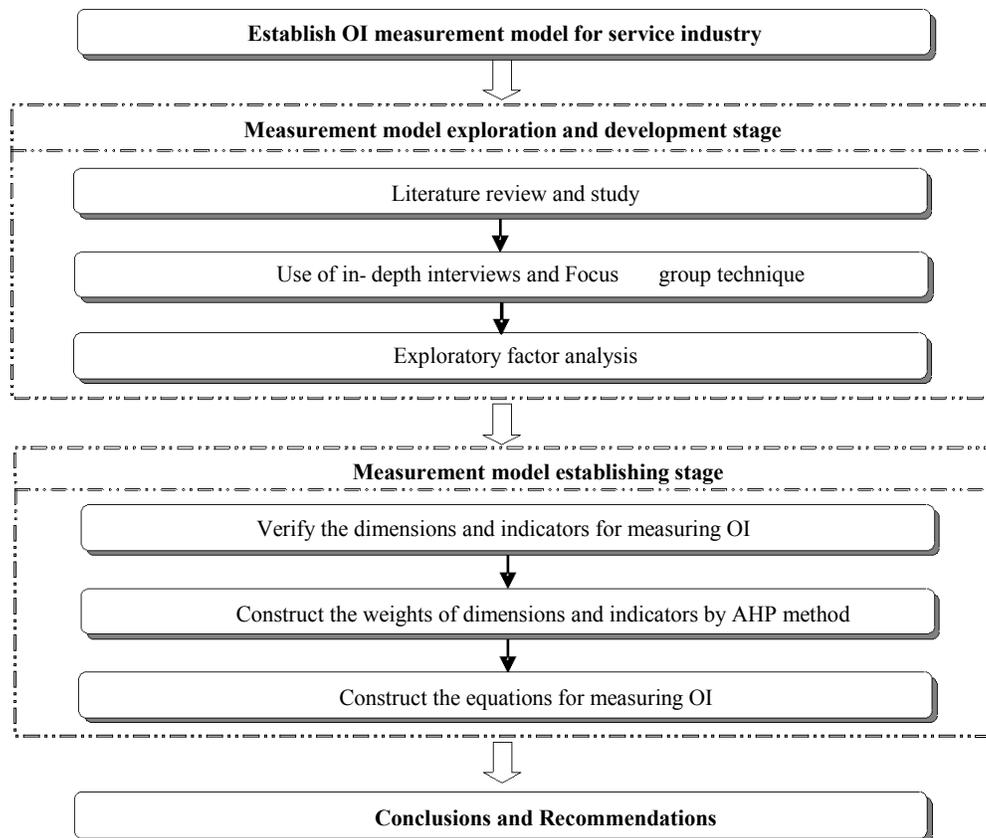


Figure 1. Flow chart for constructing OI measurement model.

Figure 1.

Measurement model exploration stage

Literature review and analysis

The first stage of OI hierarchy and indicators for service industry in Taiwan was constructed through collection, collation, and analysis. It was followed by appropriate induction and comparison of related literature results.

In-depth interview and focus group technique (FGT)

After the establishment of the first stage hierarchy and indicators, experts and scholars sought views and opinions concerning the OI hierarchical structure and measurement indicators of Taiwan's service industry in order to modify the initial model and set up a more rigorous analytical structure for subsequent studies. Ten experts from related areas in Taiwan were consulted - five of them were academics with innovation management as major research interests, whilst the remaining five were middle to higher managers in the service

industry. The consultation, carried out in Taipei and Kaohsiung, used in-depth interviews and focus group technique, each lasting between two and three hours.

Exploratory factor analysis (EFA)

Based on the statistics compiled by relevant government departments in 2005, Taiwan's service industry can be categorized into seven groups. Among them, "business," "financial insurance and the immobility industry," and "social service and individual servicing business" contributed to the highest value share of the total production income in Taiwan. Thus, this research focuses on these three fields, which played leading roles in Taiwan's service industry. Also, the selected companies for the case study are screened based on the recommendation list from World Magazine's 500 largest service and 100 largest finance industry rankings. A total of 14 companies were chosen from the three preceding groups as respondents. Since the respondents were limited to the three types of service industry and were contingent on the recommendations of experts and the companies' willingness to cooperate, this study uses a purposive sampling method to choose case analysis

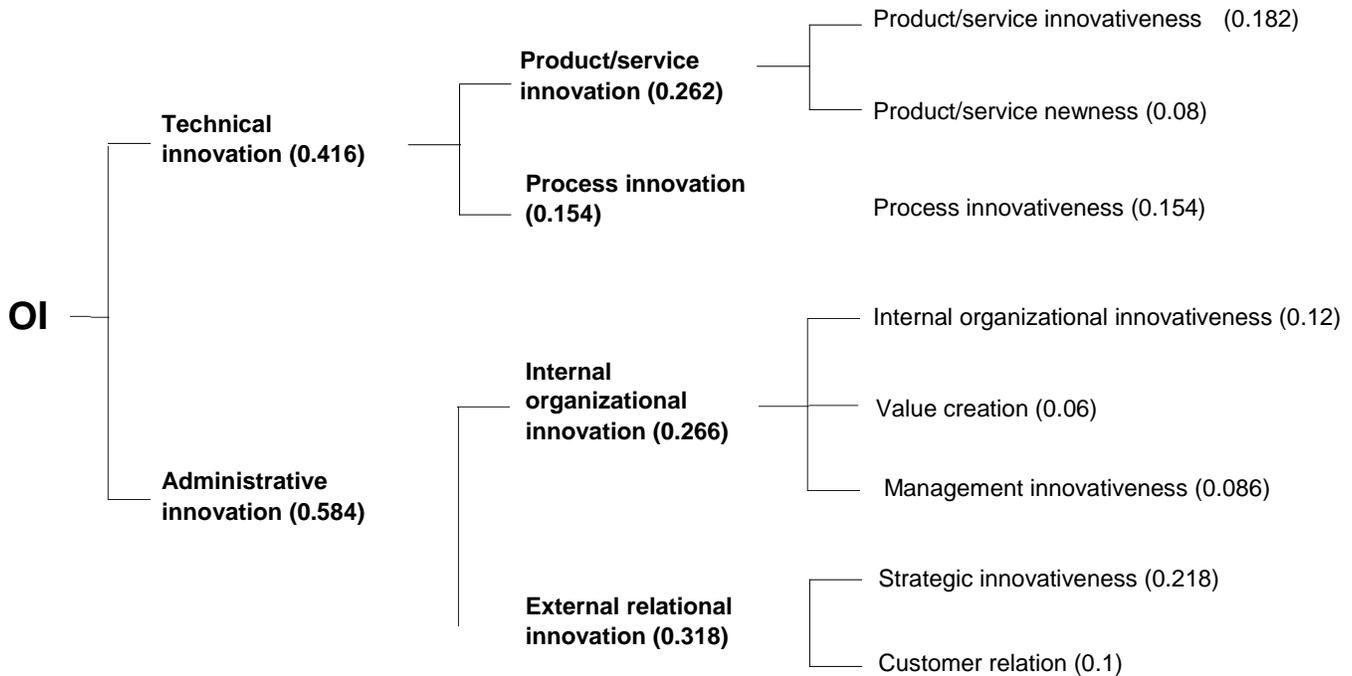


Figure 2. Hierarchical structure and dimensions being studied.

businesses. All of the 14 companies were ranked among the top 500 in service industry by World Magazine in 2005. These companies have performed well and have demonstrated high-quality organizational innovation. To verify the dimensionality and reliability of the research constructs, a purification process was conducted, including factor analysis, item to total correlation analysis, and Cronbach's alpha analysis. The results of factor analyses are shown in Table 1. With the principal component analysis method and an Eigen value greater than 1.0 for the selection criteria, common factors were extracted from the returned questionnaires.

Then the common factors were subjected to orthogonal rotation treatment using the varimax solution method, so that the following rotation, the greatest difference between the maximum and minimum factor loading of the same factor in each question, could be obtained to identify and name common factors. A pre-measurement table that contained 49 questions was prepared according to measurement dimensions and indicators. The hierarchy and naming of the final measurement structure obtained after factor analysis is shown in Figure 2. With an Eigen value greater than 1.0 and the absolute value of factor loading greater than 0.5 in the factor analysis, there appear to be multiple distinctive factors to characterize the construct of organizational innovation. Further evaluation was made in terms of the item to total correlation coefficient (ranging from 0.5116 - 0.8168) and Cronbach's alpha (ranging from 0.8283 - 0.9438) for each of the organizational innovation factors and indicators.

Measurement model construction stage

Dimensions and indicator weight establishment

After compiling experts' opinions and undertaking exploratory factor analysis, the research's hierarchical structure was established to contain four levels: TI and AI as system dimensions at the first level; product/service innovation, process innovation, internal organizational innovation, external relational innovation as four major dimensions at the second level; eight secondary dimensions were at the third level; the remaining level contained 49 indicators (details in Table 1). In order to verify whether the analytical hierarchy process method was congruous with the assumptions, the consistence ratio (C.R.) was used according to the suggestion by Saaty (1980). The result, $C.R. \leq 0.1$, indicates that the consistency is at an acceptable level.

According to the ten experts who were consulted, Taiwan's service enterprise OI system dimensions in the order of importance were AI (0.584) and then TI (0.416); the ranking of major dimensions was: external relational innovation (0.318), internal organizational innovation (0.266), product/service innovation (0.262), and process innovation (0.154); the ranking of secondary dimensions was: strategic innovativeness (0.218), product/service innovativeness (0.182), process innovativeness (0.154), internal organizational innovativeness (0.12), customer relations (0.1), management innovativeness (0.086), product/service newness (0.08), and value creation (0.06). A C.R. value of 0.02 was obtained, indicating that

Table 1. Factor analysis and reliability test of research constructs.

Major dimensions	Secondary dimensions and indicators	Factor loading	Eigen value	Varlance explained (%)	Item to total correlation	α
Product/service innovation	Product/service innovativeness		3.286	41.077		0.8817
	1. Widely applications of new product/service (**)	0.789			0.6409	
	2. Profits of new product/service (3 years) (*)	0.711			0.7171	
	3. Product/service always lead the industry (**)	0.877			0.7452	
	4. Awards for product/service innovation (3 years) (*)	0.809			0.6875	
	5. Percentage of new products/service (3 years)(*)	0.625			0.7371	
	process organizational innovation		2.485	31.059		0.8283
	6. New ideas formation (*)	0.765			0.7391	
Process innovation	7. Diversity of products/services (**)	0.777			0.7286	
	8. Response to customer needs/wants (**)	0.865			0.5116	
	Process innovativeness		5.417	60.188		0.9163
	1. Mechanism of acquiring knowledge (**)	0.771			0.6991	
	2. Application of new knowledge (**)	0.814			0.7550	
	3. Integrated but independent operation procedure (**)	0.691			0.6170	
	4. Effective operation service process (**)	0.660			0.5818	
	5. Effective management process (**)	0.766			0.6975	
	6. Business process reengineering (BPR) (**)	0.825			0.7644	
7. Simplification of working process (**)	0.817			0.7545		
Internal organizational innovation	8. New technology (**)	0.843			0.7862	
	9. New operation process (**)	0.776			0.7041	
	Internal organizational innovativeness		5.538	27.688		0.9438
	1. Culture of breakthrough and innovation (**)	0.616			0.7465	
	2. Integration of knowledge (**)	0.797			0.7532	
	3. Creativity of employee (**)	0.693			0.7713	
	4. Flexibility of organizational structure (**)	0.725			0.8080	
	5. Innovative control system (**)	0.710			0.7703	
	6. Change of service patterns based on customers' needs/wants (**)	0.726			0.7687	
	7. Rewards for employees' creative ideas (*)	0.745			0.8083	
	8. Encouragement to employees for their innovative problem-solving skills (**)	0.667			0.7596	
	9. Encouragement to employees for their creative and innovative projects (**)	0.603			0.7304	
	Value creation		4.900	24.501		0.9311
	10. Rewards for new ideas (*)	0.739			0.7847	
	11. Opportunities for employees to explore their talent (**)	0.805			0.7676	
12. Respect for employers' ideas and professional (**)	0.763			0.8168		
13. Free operation style (**)	0.750			0.7426		
14. Participative working environment (**)	0.620			0.7197		
15. Innovative compensation system (**)	0.676	3.874	19.371	0.7945		

Table 1. Contd.

	Management innovativeness				0.8630
	16. Innovative welfare system (**)	0.757			0.6328
	17. Innovative policy (**)	0.681			0.6484
	18. Timely rearrangement of task assignment (**)	0.611			0.7069
	19. Slack resources (*)	0.726			0.6251
	20. Innovative organization culture (**)	0.759			0.5874
External relational innovation	Strategic innovativeness		4.249	35.412	0.8895
	1. Identification of valuable external knowledge (**)	0.734			0.6165
	2. Understanding of the contents and trends of external knowledge (**)	0.729			0.6769
	3. Channels to new knowledge (**)	0.781			0.6724
	4. Collecting external information from customers, suppliers, community or government (**)	0.692			0.6050
	5. Applications of information technology (**)	0.726			0.7582
	6. New and effective project on customers' complaint (**)	0.699			0.7636
	7. Appropriate policies responding to competitors (**)	0.675			0.6753
	Customer relation		3.631	30.259	0.8915
	8. Strategic alliance in response to external environment changes (**)	0.857			0.6300
	9. Regular surveys of customers' satisfaction (**)	0.851			0.7246
	10. Constant emphasis on employees' service attitude (**)	0.809			0.7147
	11. Emphasis on Customer Relationship Management (**)	0.674			0.7251
	12. Customer complaint reporting/response system(**)	0.623			0.6992

(Note: *represents "objective indicators"; ** represents" subjective indicators").
(Target) (System dimensions) (Major dimensions) (Secondary dimensions).

the consistency was acceptable. From these results, it can be concluded that the display of external relational innovation, internal organizational innovation and product/service innovation are the most important dimensions in evaluating the organizational innovative capability of an enterprise. The most important activities or criteria for these dimensions are strategic innovativeness, product/service innovativeness as well as internal organizational innovativeness.

Establishing equations for measuring the OI of Taiwan's service industry

For establishing dimension and indicator weightings for the OI of Taiwan's service industry, the 49 indicators were normalized to obtain a standardized value (Z). The main purpose of standardization is to eliminate the effects on each indicator due to different units used in the survey. The value of Z was set between 0 and 1. The

standardized value of individual secondary dimension is equal to the sum of the products between the standardized value of each indicator within its dimension and its weighting. Likewise, the sum of the products between the standardized value of the secondary dimensions and its weighting yields the standardized value of a main dimension, whereas the sum of the products between the standardized value of the main dimension and its weighting gives the

standardized value of the system. Finally, the sum of the products between the standardized value of each system dimension and its weighting gives the score for the organizational innovativeness of the enterprise.

After individual indicators were weighted and dimensions of different hierarchical layers were obtained by AHP, the OI measurement model for Taiwan's service industry was constructed using a linear combination approach through the above mentioned simple additive weight (SAW) treatment. The detailed algorithm for establishing the model and score calculation is as follows:

$$A_{ijk} = \sum_{l=1}^n W_{ijkl} \cdot Z_{ijkl} \dots\dots\dots(1)$$

Where Z_{ijkl} : the ijk th secondary dimension, with the standardized value of the l th indicator.

W_{ijkl} : the ijk th secondary dimension, with the relative weight of the l th indicator.

A_{ijk} : score of the ijk th secondary dimension.

$$A_{ij} = \sum_{k=1}^m W_{ijk} \cdot A_{ijk} \dots\dots\dots(2)$$

Where A_{ijk} : the ij th major dimension, with standard value of the k th secondary dimension.

W_{ijk} : the ij th major dimension, with the relative weight of the k th secondary dimension.

A_{ij} : score of the ij th major dimension.

$$A_i = \sum_{j=1}^2 W_{ij} \cdot A_{ij} \dots\dots\dots(3)$$

Where A_{ij} : the i th major dimension, with standard value of the j th major dimension.

W_{ij} : the i th major dimension, with the relative weight of the j th major dimension.

A_i : score of the i th system dimension.

$$E = \sum_{i=1}^2 W_i \cdot A_i \dots\dots\dots(4)$$

Where A_i : the standard value of the i th system dimension.

W_i : the relative weight of the i th system dimension.

E : OI score of the service industry in Taiwan.

CONCLUSION

An OI evaluation model for service industry in Taiwan has been established by using a rigorous method. It is a challenging task and the model needs to be continuously

modified. The method employed orientation towards organizational innovativeness. The study employed multiple viewpoints to define OI, and the definition was in agreement with many contemporary researchers' views with an attempt to incorporate AI and TI into the definition of OI. Since the present model incorporates the views and opinions from numerous experts and literature, it displays general agreement with past studies. The major theoretical contribution of the present study is its being supplemental to existing OI theories. The present study proposes dimensions and indicators for evaluating service industry OI. They not only explain the context of OI, but also form a platform for studying OI measuring models and applications. In practical terms, results from the present study should be useful guidelines and reference for corporations seeking to improve organization innovation capabilities.

RECOMMENDATIONS

Though the present study has used various measures to make the model as comprehensive as possible, a number of difficulties remain unresolved. The following recommendations are made for future studies to facilitate improvements in the research model:

Construct a more complete measurement model by using other methods

This includes using completely different lines of thinking after consulting experts from different industries in order to take into account the nature of and differences among dissimilar industries. Also, we need to investigate the design of measurement indicators for different industrial sectors.

Supplement or extend the context and dimensions of the study model

As the present study is orientated toward the measurement of the two major dimensions within an enterprise, that is TI and AI; future studies can perhaps add other concepts such as industrial innovation, social innovation and national innovation. By investigating their interactions with or effects on OI, the context and dimensions of the study model can be supplemented and extended. This will result in a more refined and rigorous measurement model.

Enlarge sample size

Although the construction of the present study model has been verified and analyzed by incorporating a number of local service industry companies during the research, the

effectiveness and reliability of the results still need to be confirmed by a large sample of enterprises.

AI should be strengthened to improve corporate core capability

The above results showed that for an enterprise, the importance of TI appears to be greater than AI. However, it must be stressed that the activities of AI and TI can mutually enhance the adaptability of an enterprise to environmental changes. Namely, they have synergistic effects on the adaptability of an enterprise. Therefore, the present measurement model should be helpful for an enterprise in understanding its current OI status, providing strategic recommendations, and serving as guidelines when it aims at improving its OI activities and enhancing its competitiveness.

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