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此證

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A DISSERTATION FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

GRADUATE INSTITUTE OF MANAGEMENT SCIENCES

TAMKANG UNIVERSITY

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服務模組化模式之建構

CONSTRUCTING THE MODULARIZED SERVICE MODELS

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論文提要內容：

台灣服務業的產值，於 2006 年已達 GDP 的 72%，服務業就業人口超過就業總人口之 60%（行政院主計處，2007）。鑑於服務業之日趨重要，本研究對服務之內涵作了深入的研究，以發展一套能夠完整涵蓋傳統、高科技及知識密集之「整合性服務模式」，作為現代服務業訂定各項經營策略之有效工具，以期增加其競爭優勢，並產生最佳之營運績效。

本研究先從分類作起，以服務遞送流程（service delivery process）為一種開放系統之概念，及以Greig (2003)之分類三項要件（criteria）：內容（Content）、過程（process）與環境（Context）為基礎，將服務分成四個構面，並經由文獻探討，找出每個構面各包含三個屬性，即服務提供者（人員(P)、設備(E)、知識(K)）、服務過程（客製化(C)、標準化(S)、權變化(G)）、服務對象（人類(H)、物品(T)、資訊(I)）及服務場所（前場(F)、後場(B)、虛擬空間(V)）等；另外，第五構面回饋（feedback）更提供動態機制，使業主能於外部環境不斷變化下，訂定動態的策略。將四個構面之屬性加以組合後，即可產生 81 種（$=3^4$）組合，以代表所有之服務，而每種組合代表一種服務型態，稱之為「服務模組」。對同一種服務業務，其服務模組會因從服務業者觀點或顧客觀點而有所不同，因此一服務業只要將其所推出之服務，將此二觀點下之服務模組，按營業比例作為權重，加總後即可得到整合之服務屬性，並以 80/20 及大數原則，萃取出比重較大之「顯要屬性」，再以其與Kotler之行銷架構結合，訂定該服務業之行銷策略。

本研究除了如上述將服務屬性直接組合成服務模組，以作策略分析外，亦將各構面之屬性施以權重，將分類構面轉化成作業構面，即勞力密集度、客製化程度、顧客互動程度及空間導向，再將各作業構面整合，加上績效權重後，利用現有之行銷架構及服務流程矩陣，擬訂服務業之行銷策略。本研

究將上述「直接」及「轉化」方式，各推導出其數學模式，作為擬訂服務業行銷策略之平台。由於已將其公式化，易於電腦作業，使用者只要輸入有關數據，很快就可算出所要答案。本研究並以商業銀行、航空公司及大學為例，說明數學模式之應用，找出其顯要屬性，訂定其行銷策略。

關鍵字：服務業、行銷策略、整合模式、顯要屬性、服務遞送流程。

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Abstract：

The output of the service sector in Taiwan accounted for 72% of the GDP and the employment of the service sector exceeded 60% of the total employment in 2006 (Executive Yuang, 2007). Due to the increasing importance of the service sector, this paper is trying to develop a generalized “Integrative Service Model” so that the service firms can formulate marketing strategies based on it.

Through extensive literature reviews, this paper uses Greig’s (2003) three classifying criteria (content, process and context) to classify the service into 4 dimensions and each of which contains 3 attributes. They are Provider, Process, Customer and Place dimensions. The initials of the 4 dimensions include 3 Ps and 1 C. therefore, we call the model “3P+C model”.

Attributes of the 4 dimensions can be combined into 81 combinations to represent the entire service. Each combination is a type of service and is called a “service module”. For the same service, the service module can be different viewed from customer or provider perspectives. Based on such concepts, a mathematical model is constructed to calculate the attributes of the integrated service modules of the service firm. Then the salient attributes can be identified after optimizing them with 80/20 and large number principles. Business strategies can thus be formulated based on the resulted salient attributes.

Classifying dimensions can also be transformed into the “operational dimensions” by weighing the attributes. The operational dimensions are labor intensity, customization degree, customer interaction degree and place orientation.

A core service is formed by combining the 4 operational dimensions. A service firm can integrate all the core services and find the combined attributes of each dimension. Together with the existing framework, the marketing strategies can then be formulated. This paper uses retail bank, airline and college as the examples to explain how to use the developed “direct” and “transformed” mathematical models to formulate the marketing strategies with the existing well-established frameworks.

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List of Key Mathematical Symbols

1. Direct Model

w: Represents provider attribute (w_1 = P, w_2 = E, w_3 = K)

x: Represents process attribute (x_1 = C, x_2 = S, x_3 = G)

y: Represents customer attribute (y_1 = H, y_2 = T, y_3 = I)

z : Represents place attribute (z_1 = F, z_2 = B, z_3 = V)

$w_i+x_j+y_k+z_l$: Represents one of 81service modules

Φ_P: Integrated services viewed from provider's perspective

Φ_C: Integrated services viewed from customer's perspective

Φ_T: Integrated services viewed from both provider's and customer's perspectives

α_{ijkl}: Performance Weight (PW) of service module from provider perspective

β_{ijkl}: PW of service module from customer perspective

H: Importance Weight (IW) of Φ_C , i.e. the IW for customer perspective

A_{ijkl}: Dummy parameter

B_{ijkl}: Dummy parameter

γ = The final relative importance of the attribute of the summed core services

2. Transformed Model

A_j , B_j , C_j , D_j: IW of operational dimensions

α_i: PW of a Complete Single Service，i = 1,2,…, n

A_{ij}: IW of P, E, K attributes of the i-th (i =1, 2,…, n) single service

B_{ij}: IW of C, S, G attributes of the i-th (i =1, 2,…, n) single service

C_{ij}: IW of H, T, I attributes of the i-th (i =1, 2,…, n) single service

D_{ij}: IW of F, B, V attributes of the i-th (i =1, 2,…, n) single service

Chapter 1 Introduction

1.1 General

Similar to many other researches, this study starts from classification. For the purpose of constructing modularized service models, Greig's (2003) three classification criteria, i.e. content, context and process are adopted for classifying service. Four service classifying dimensions, i.e. provider, customer, process and place, are identified from service delivery process (SDP). Therefore, content criteria includes provider and customer dimensions, process criteria corresponds to process dimensions, and context criteria corresponds to place dimensions. Among the four dimensions, three of them have initials "P" and one has "C", therefore, the classification model is called "3P+C" model. Through literature reviews, three main attributes are identified for each dimension: provider dimension includes people (P), equipment (E) and knowledge (K) attributes; customer dimension consists of human (H), thing (T) and information (I) attributes; process dimension are composed of customization (C), standardization (S) and contingency (G) attributes; and place dimension contains front-office (F), back-office (B) and virtual space (V).

The three attributes of four dimensions form eighty-one (81) combinations, which are used for classifying entire service. Each one of 81 combinations is called "service module" which represents a type of service. Any service launched by service business can be the combination of some of the service modules. For the

same service, service module viewed from customer perspective and provider perspective will be different. This is because customer normally focuses on the satisfaction of service experience and provider emphasizes on the efficiency of resources utilization. For a service business that offers multiple core-services, summing the weighted service modules of the offered services from theses two perspectives will obtain the customer-oriented integrative service modules. Then, salient attributes and their associated relative importance can be identified by optimizing the integrative service modules. The salient attributes stand for the most important elements of the offered services under the considerations of both customer satisfaction and resource efficiency. The associated relative importance means the ratio of resource that provider can invest on this particular salient attribute. Therefore, based on the obtained salient attributes and their relative importance, marketing strategies of service business can be formulated.

In addition, attributes of classifying dimension can also be weighted to transform the classifying dimension into operational dimension. Hence, every service offered by service provider is constructed by the four transformed dimensions. For a service business offering multiple core-services, customer satisfaction weights can be added to obtain another integrative service model. Then service business can formulate its marketing strategy based on the integrative service model. The former of the above two approaches is called “direct model”, and the latter called “transformed model”. Both models are modularized that can migrate to generalized mathematical models.

The characteristics of the three criteria for service classification, i.e. content,

context and process, are mainly static. The marketing strategies formulated based on these static criteria will also be static in nature. The formulated strategies will be out of date and become no longer valid under the current fast changing environment, especially customer preference. So, the models have to be equipped with dynamic mechanism by adding another criterion which is temporal criterion. Temporal criterion is used for providing dynamic mechanism but not for classification.

The development of 3P+C model is based on open system concept. In addition to the above three service classifying dimensions, there is another dimension called “feedback” dimension. Feedback dimension sends back customer complaints and suggestions of different time to service provider so that provider can continuously improve his internal service process based on them to meet customer need. Service provider can also carry out periodical customer surveys or based on the secondary data such as ROI (return of investment) to identify customer’s actual needs and improve service. These two kinds of feedback are called active feedback and passive feedback, respectively, viewed from customer side (Sampson, 1999). Both kinds of feedbacks provide the opportunities to readjust dynamically the originally formulated strategy, and maintain high level of service quality which consequently brings customer satisfaction to maintain his loyalty to provider, and thus provider can keep good relationship with customer.

The integration of service modules and operational dimensions are based on resource-based view (RBV) that emphasizes the use of processes to exploit resources effectively to generate competitive advantages. The processes can be

classified based on system level into service delivery process (SDP), transformation process, improvement process and upgrade process. From their relationships, any kind of process improvement will finally reflected in the improvement of SDP. All the process integration will be covered by the integration of SDP.

Based on the above description, this paper develops a service classification model (3P+C model), two mathematical models of integrative services (direct and transformed model), and feedback dimension that provides dynamic capability. Marketing strategies are formulated through these models. Finally, to obtain objective weights from surveyed data in order to generate more accurate 3P+C model for the formulation of marketing strategies, formulas of weights are developed using Analytic Hierarchy Process (AHP) method.

1.2 Research Background, Problems and Objectives

1.2.1 Background

Fisher (1935) and Clark (1940) categorized service as the tertiary sector. In U.S.A. of 1940, the employment of tertiary sector accounted for 50% of total work population. In 2006, this ratio arose to 85%, and the output of service also accounted for 75% of GDP (gross domestic production) in U.S. (U.S. Department of Commerce, 2007). In OECD (Organization for Economic Cooperation and Development) countries, ratio of service employment over total employment was 71% and ratio of service output over GDP is 73% on average (Wolfl, 2005). In

Taiwan, the former was 60% and the latter was 72% in 2006 (Executive Yuan, 2007), but in China they were 30% and 41%, respectively (National Bureau of Statistics of China, 2007). It shows that the development of service sector in China lags behind most of countries and there is a large space to develop.

Table 1.1 is the historical records of ratios of employment over total work population for U.S. agriculture, manufacturing and service sectors from 1860 to 2005. From the table, we can see the trend of increasing importance of service sector in a world leading country. Table 1.2 is a comparison of service indicators (Ratio of Employment over Total Population, Ratio of Output over GDP).

Table 1.1: 1860 to 2005 Ratios of Employment over Total Population for U.S. Agriculture, Manufacturing and Service sectors

Year Sector	**1860**	**1880**	**1900**	**1920**	**1940**	**1960**	**1980**	**2000**	**2005**
Agriculture	60	50	41	30	20	8	4	3	2
Manufacturing	20	25	29	34	30	38	28	17	13
Service	20	25	30	36	50	54	68	80	85

Source： U.S. Department of Commerce, Bureau of Census, Statistical Abstract, U.S., 2007

In Table 1.2, Parts of OECD data are also included for comparison. The large space to be developed in service sector in China means there are great opportunities for Taiwanese as well as worldwide businessmen to develop service business in China.

Locally, Taiwan Executive Yuan held in 2006 a “Conference of Sustainable Taiwan Economic Growth” to plan an economic vision of growing GDP from US$ 15,000 per capita in 2006 to a targeted US$ 30,000 per capita in 2015. It was an extremely ambitious plan. On November 29 of the same year, a workshop of

"Vision of Economic Growth" was chaired by the President Wu of National Chen-Chi University to emphasize that Taiwan needs to pursue another leap of economic growth. To achieve such vision, Executive Yuan planned a 3-phase, 3-year per phased 9-year blue print. The first phase is from 2007 to 2009 to carry out five programs: Industrial development, Financial market development, Human resource development, Public construction and Social welfare (Council for Economic Planning and Development, 2006). Among the five programs, except the first one, they are mainly service business development programs. Therefore, service development is the main theme of the 9-year plan.

Table 1.2: Comparison of Service Indicators between Taiwan, China and OECD

Aera	Indicators	1980	1989	1990	1991	1993	2000	2001	2002	2004	2005
Taiwan[1]	Over GDP%	51*	55	58	59	61	71	74	73	74	75
	Over Population%	38	45	46	48	49	55	57	57.3	58	58
China[2,3]	OverGDP%	22	32	32	34*	34	39	40	41	40	40
	Over Population%	13.1	18.3	18.5	18.9	21.2	27.5	27.7	28.6	30.4	30.6
OECDCountries[4] (Average)	Over GDP%						70			73	
	Over Population%								70	71	

Source：1. Executive Yuan, 2007； 2. United Nations Statistics Division, 2007；3. National Bureau of Statistics of China, 2007；4. Wolfl, 2005。

Note：*means that service output exceed manufacturing in that year.

1.2.2 Research Problems

Due to the increasingly importance of service sector in economic system mentioned above, more and more firms jump into service business and it makes the competitions in the service market tougher and tougher. Under such circumtance, service firms must have good strategies in order to win out of ficerce competitions. In service business, to have good strategy means that the actions taken by the firm

based on this strategy shall be able to bring highest satisfaction to its customers. To have customer satisfaction does not mean to unconditionally please customer due to limited resources in the firm. The firm has to identify the prioritized main elements that can gain customer satisfaction. Then the firm can formulate marketing strategies based on these prioritized elements and invest the resources according to the strategies. In so doing, the launched service will bring the highest satisfaction to customer. To identify these key elements, there must be service models to be utilized. Through this service model, the firm can input its current situations into it and identify the prioritied elements. To build these service models, a sound service classification must be developed first.

Bailey (1994) contended that classification is the important staring step to development theory (e.g. the service models developed in this study). The objective of classification is for the development of theories (Kitay and Marchington, 1996). One of main functions of service classification is to formulate service marketing strategy (Lovelock, 1983; Bowen, 1990). Therefore, to build the needed service models, we will have to classify service first. But the current service classifications still have many drawbacks that might lead to formulate the wrong service strategies. These weakness and disadvantages are discussed in the literature reviews.

1.2.3 Resaerch Objectives

Under the trend that service sector is increasingly important globally and locally, it

is worthwhile to construct new service models based on the service classification to be developed in this study, the new service concepts such as Vargo and Lusch's (2004a; 2004b) sevice-centric economy and customer co-creation of service (Edvardson et al., 2005; Normann, 1991; Remirez, 1999) and Resource-based view are employed during the construction of the service models. With these generalized new integrative service models, global service business can use them to formulate marketing strategy. The objectives of this study are summarized as follows:

1. To build a new service classification model that can overcome the weakness and disadvantages of the previous service classification methods. The new service classification model shall be compatible with nowadays knowledge-economic society and fast advancement of information and communication technologies.
2. To build such new service classification model, the concept to see service delivery process as an open system is adopted to identify four classifying dimensions. Through extensive literature reviews, a total of twelve attributes of these four dimensions are identified.
3. To construct the service models, these attributes are artificially synthesized into eighty-one service modules and four operational dimensions. Mathematical models are developed to represent core services of the service firm with these service modules and operational dimensions.
4. Key elements are identified and prioritized by inputting the current situations of the service firm into these service models. Marketing strategies are formulated using these prioritized elements with existing well-established

marketing framework. Examples of different service businesses are used to illustrate the applications of these service models in formulating their marketing strategies.

1.3 Research Process

The research process of this paper is shown in Figure 1.1. This study introduces the background of global and local situation of service sector. It is found the service sector is increasingly important from the statistical figures in employment and GDP ratios. Under such environment, the competition in service business market becomes tougher and tougher. Service firms need good strategies to survive and win. To formulate good strategies, frims need good service models to identify key elements to invest resources into. Service classification is the first step to build such service model. The problem is that the previous service classifications have many drawbacks that may lead to make wrong strategies. Therefore, the research objective is to build a sound service classification model so that the key elements can be correctly identified and thus formulate correct strategies.

To build the service classification model, literatures of previous service classifications are reviewed. Open system literatures are reviewed to identify the four service classifying dimensions and twelve attributes to form the 3P+C service classifying model. Resource-based view is also reviewed to integrate attributes to form the mathematical service models. The mathematical model is divided into direct model and transformed. Finally, examples in banks, airlines and college are used to explain the use of the service models in marketing strategy formulation. In

the conclusion, research contributions of this study are listed, several issues related to this study are discussed and clarified. Research limitations in this study are also idenfied and are suggest to be overcomed in the future researches.

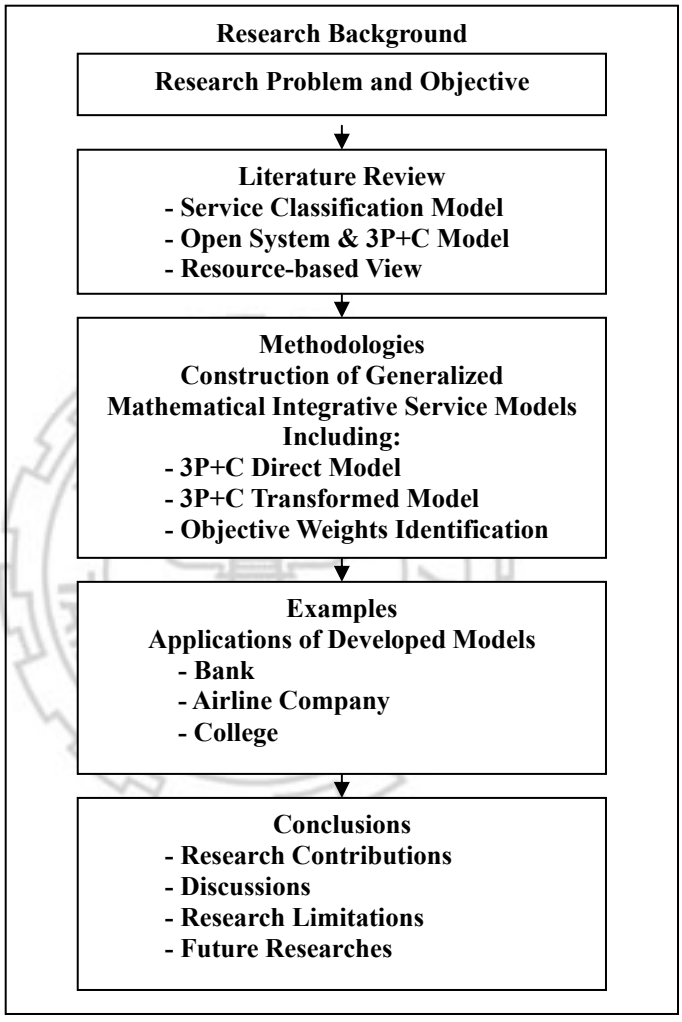


Figure 1.1: Research Process Framework

Chapter 2 Literature Review

2.1 Evolvement of Service Paradigm

Judd (1964) redefined the services that had been defined by the classical economic school represented by Adam Smith (〔1776〕1991). Judd classified service in three areas, i.e. rent goods services, owned goods services, and non-goods services. Rathmell (1966) proposed a Goods-Services continuum and introduced the concepts of perishability and intangibility for service. Shostack (1977) postulated the tangible dominant-intangible dominant continuum and explained the services with a molecular model that the service is combined by the differently weighted tangible and intangible components. Sasser et al. (1978) was the first one to summarize the four distinct characteristics, i.e. inseparability, heterogeneity, intangibility, and perishability (IHIP) to distinguish services from goods. Then, most researchers such as Kotler et al. (1999), Soloman and Stuart (2000), and Fitzsimmons and Fitzsimmons (2003), etc. used IHIP in their textbooks as the basic concept of service. Zeithaml et al., (1985) had reviewed 46 service-related publications of 33 authors from 1975 to 1983 and found the most frequently cited characteristics of service were IHIP.

In 2000's, owing to the rapid progress of information and communication technology (ICT), the percentage of worker's employment of the tertiary sector in many OECD (Organization for Economic Cooperation and Development) countries including U.S. exceeded 80% (OECD, 2005) of the total work forces.

Vargo and Lusch (2004a; 2004b) developed the service-centered paradigm treating service as the basic economical exchange unit, and dispelled the IHIP myth was too limiting to represent services. Under such paradigm, service was seen as the value co-created with customer (de Bandt & Gadrey, 1994; Edvardsson et al., 2005; Normann, 1984; Remirez, 1999). The degree that a firm allowed the customer co-creation during service process let the firm differentiate itself from competitors (Mills, 1986; Skaggs & Youndt, 2003; Upah, 1980). To construct the model of integrative services in this paper, we follow the concept of the service-centered paradigm.

Lovelock and Gummesson (2004) developed the 'ownership' paradigm and contended that services could be rented. Customer could get services without buying the products that were owned by the service provider through the usable lifetime. A new trend called 'servitiation' (Vandermerwe & Rada 1988) to transfer industrial product manufacturing from product-centered service that follows IHIP paradigm to process-centered service which follows such ownership paradigm.

2.2 Service Classification

Since Judd's (1964) first services classification article was published, successively there have been many other research papers focused on classifying service organizations from different perspectives. Basically, the structures of the previous classifications of services are based on several different scheme concepts.

2.2.1 Classified by Discrete Item Scheme

The taxonomy in early days intends to classify services into few different absolutely independent categories. Judd (1964) has classified the services based on the relationship between goods and the service activities into rented goods services, owned goods services and non-goods services. Part of Kotler's (1980) classification is done by need of customer's presence, and type of technology used. The advantage of such taxonomy is the clearness in the classification types, the easiness of classifying, and the strong exclusivity between the classified clusters. The weakness is that it only considers one dimension of service and neglects the other important dimensions. It focuses mainly on the properties of the serviced objects but nothing on the traits of the service providers and the characteristics of the service delivery process. It lacks exhaustiveness or completeness in the strategic implication.

2.2.2 Classified by Continuum Scheme

Continuum type consists of a dichotomy of independent attributes at the two ends of the horizontal line. Few referenced points are selected as the basis of the classification items. For example, Shostack (1977) has used the physical goods and intangible services, and Thomas (1978) has used people-oriented provider and machine-oriented provider as the two ends of the continuum. The weakness of such classification is the same as item scheme that other important dimensions of services are not considered. Researches of continuum scheme are summarized in Table 2.1.

Table 2.1: Services Classifications in Continuum Scheme

Researchers	Classification Dimensions
Rathmell (1974)	Type of buyer/seller, Buying practice and motives, Degree of specifying
Hill (1977)	Service affecting people vs. affecting goods, Permanent effect vs. temporary effect, Physical effect vs. mental effect, Individual service vs. collective service
Shostack (1977) Sasser *et al* (1978)	Weights of tangible goods and intangible services
Thomas (1978)	People-based vs. equipment-based
Chase(1978)	Extent of customer contact in the delivery of service
Parts of Kotler's (1980)	People vs. equipment based service, Satisfaction of personal needs vs. business needs
Maister and Lovelock (1982)	Degree of customer contact, Degree of customization
Coulter and Ligas (2004)	Customer and provider relationship (from professional relationship, causality, personally acquainted, to personal friend)
Cunningham *et al*. (2004)	Level of product component, Level of customer-employee contact, Service consumption and production is separable or inseparable, Risk of choosing provider, Switching of provider is easy or difficult, Service objects, Relationship between provider and customer, Service delivery is continuous or discrete, Customization degree, Level of employee discretion, Convenience level to obtain service

2.2.3 Classified by 2-Dimensional Matrix Scheme

The basic concept is to combine two item schemes or two continuum schemes to form a two dimensional matrix. For example, Maister and Lovelock (1982) have classified the services into service factory, service shop, mass service and professional service by using degree of customization and degree of customer contact. Such scheme more or less improves the weakness of the above two schemes, but still have the problems of insufficiency of exhaustiveness. For example, Lovelock (1983) proposed five independent classification matrix structures. It provides a more complete coverage for the service classifications, but without having them been integrated. Some problems in service classification still exist because of lack of integration. If the marketing strategies are formulated by an un-integrated classification, the strategies may lead to the incorrect direction.

The researches of classification in matrix scheme are summarized in Table 2.2.

As shown in Table 2.2, Maister and Lovelock (1982) have suggested two dimensions, Extent of client contact and Extent of customization, to form a matrix to classify the service into Factory, Mass service, Job shop and Professional service and explained the alternative directions for facilitator services. Lovelock (1983) has used six different types of matrices to classify service organizations. The drawback of the classifications is that it is difficult to formulate an integrated marketing strategy from these separate classifications. The classifying dimensions are so diversified that no systematic logic can be found in why the service should be classified with those dimensions. The dimensions of the five matrices are as follows:

1. Nature of the act (Tangible, Intangible) vs. Receipt of service (People, Things);
2. Type of customer relationship (Membership, Informal) vs. Type of service delivery (Continuous, Discrete);
3. Availability of service outlets (Single site, Multiple sites) vs. Nature of the interactions between the customer and the service provider's employees (Customer travels, Service provider travels, Transactions is at arms length of customer);
4. Demand fluctuations (Wide, Narrow) vs. Supply constraints (Peak demand without delay, Peak demand exceeds capacity);
5. Extent of customization (High, Low) vs. Importance of service employee's judgment (High, Low).

Table 2.2: Service Classification in Matrix Scheme

Researchers	Classification Dimensions
Davis et al. (1979)	Two dimensions of degree of consumer internal search
Mills & Margulies (1980)	Personal interface between the customer (interactive of maintenance, task, personal) vs. Information, Decision, Time, Problem awareness, Transferability, Power, Attachment, for the 3 types of service organizations
Kotler (1980)	Public or private vs. Profit or non-profit organization
Maister and Lovelock (1982)	Extent of client contact vs. Extent of customization (for managing facilitator services)
Fitzsimmons and Sullivan (1982)	People changing, People-processing, Facilitating service
Lovelock (1983)	Nature of service, Serviced objects, Relationship between service provider and customer, Potential for customization and employee discretion, Nature of service supply and demand, Method of service delivery
Schmenner (1986)	Degree of labor intensity, Degree of interaction and customization
Shostack (1987)	Divergence, Complexity
Haywood-Farmer (1988)	Degree of labor intensity, Degree of contact/ interaction, Degree of customization (three dimensional)
Kelly (1989)	Nature of service act, Customization during service process and judgment
Wemmerlov (1990)	Nature of customer/service system interaction, Degree of routinization of the service process, Serviced objects in service process
Haynes (1990)	Level of technology complexity vs. Interface type (mechanistic or organic)
Mersha (1990)	Passive contact vs. Active contact
Hsieh and Chu (1992)	Time or space utility creation, service object is people or thing
Bitner (1992)	Service participants' physical environment
Silvestro et al. (1992)	Number of customer processed by a typical unit per day vs. Service objects (people, equipment or mix), Level of contact time/customization/discretion, front or back office or mix, process or product or mix
Tinnila and Vepsalainen (1995)	Type of service (mass transaction, standard contracts, customized delivery, contingent relationship) vs. Type of channel access to the service (market network, service personnel, agent alliance, internal hierarchy)
Kellogg and Nie (1995)	Service process structure (expert service, service shop, service factory) vs. Service package structure (unique, selective, restricted, generic)
Stell and Donoho (1996)	Product type (convenience, preference, shopping, specialty) vs. Risk, Involvement and purchase effort
Collier and Meyer (1998)	Number of pathways built into service system designed by management vs. Customer's service encounter activity sequence in repeatability
Mayer et al. (2003)	A 2-dimensional model using Personal of service assembly and Process of delivery
Schmenner (2004)	Degree of variation of customization and interaction, Relative throughput time

Following service process-related dimensions from Maister and Lovelock (1982) such as Extent of client contact and Extent of customization, and from Lovelock (1983) such as Receipt of service (People, Things) and Extent of customization (High, Low) , many other researchers have also used the same or

other service process-related dimensions as the classifying dimensions (Haywood-Farmer, 1988; Kelly, 1989; Mayer et al., 2003; Schmenner, 1986; Schmenner, 2004; Silvestro et al., 1992; Tinnila and Vepsalainen, 1995; Wemmerlov, 1990), which are shown in Table 2.2. Among them, Schmenner (1986) has proposed a two-dimensional classification matrix, and Haywood-Farmer (1988) a three-dimensional matrix. From these researches, we can see that dimensions in service process have played important roles in the classification of services. It seems that they know to use them by experience but still have not told us why they should be selected and used.

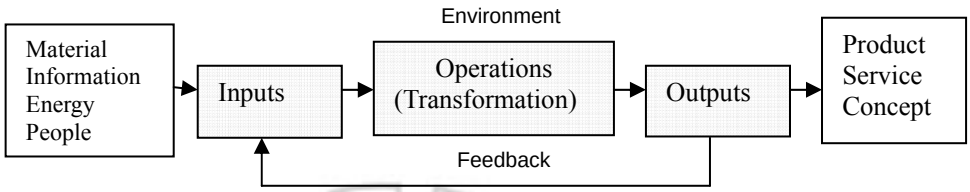
2.3 Open System and 3P+C Model

2.3.1 Open System

A system refers to an organized and integrated entity that includes two or more coordinated components or subsystems with a clear boundary to its external environment (Kast & Rosenzweig, 1979). An open system includes inputs, operations, outputs, feedback, and boundary (Huse, 1980) to equip the system with capability of self-reproduction (Boulding, 1956). The open system is illustrated in Figure 2.1.

Huse (1980) did not further elaborate the open system in terms of the outputs, especially the service. For this purpose, we redraw the diagrams of open systems for service in Figure 2.2. In the diagrams, environment is further divided into four layers, i.e. local environment, firm environment, industrial environment and

sector/national/global environment. For the open system, all the system elements such as resources, operations and outputs are considered as internal to the open system, i.e. local environment. The other elements such as supplier and support in and above the firm environment are external to the open system, i.e. outside the boundary of the open system.

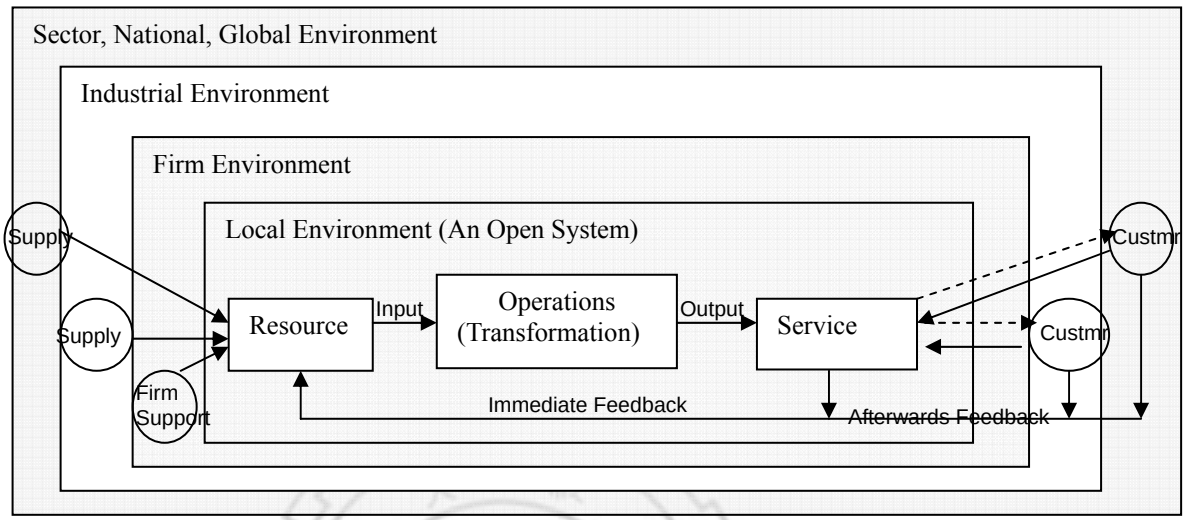


Source: Revised from Huse, 1980.

Figure 2.1: Diagram of Open System

For service open system shown in Figure 2.2, the resources and the firm supports are coming from the places outside the boundary of the local environment of open system. Service is seen as the value co-created with customer (de Bandt & Gadrey, 1994; Edvardsson et al., 2005; Normann, 1991; Remirez, 1999; Sampson & Froehle, 2006). The degree that a firm allowed the customer co-creation during service process let the firm differentiate itself from competitors (Mills, 1986; Skaggs & Youndt, 2003; Upah, 1980). Service delivery can only be completed with customer's participation and co-creation in the same environment. Therefore, customer is one of the key elements of the service open system. As shown in Figure 2.2, customers coming from the outside environments or external systems to the local system go to the output of the open system to co-create service with provider. The whole service delivery is the customer-provider co-creation processes that occur in the same open system. After the service delivery process is

finished, the customers get serviced and go back to the external environment with different degree of satisfaction or dissatisfaction.



Note: Custmr = Customer

Figure 2.2: An Open System for Service

2.3.2 Wang-Hsu Model of Integrative Service Business Classification

Wang and Hsu (1994) developed an integrative type of service business classification system based on the concept treating service business as a production system. The production system includes input, transformation process, output and environment. Input means provider that can be divided into people (P) and equipment (E). Output refers to patron that can be divided into human (H) and thing (T). Transformation process is abbreviated as process that can be divided into customization (C) and standardized (S). Environment is changed to place that is divided into front field (F) and back field (B). Therefore, there are 16 combinations to classify service business, i.e. PSHF, PSHB, PSTF, PSTB, PCHF, PCHB, PCTF, PCTB, ESHF, ESHB, ESTF, ESTB, ECHF, ECHB, ECTF and ECTB.

2.3.3 3P+C Model of Integrative Service Classification

2.3.3.1 Why and What Is 3P+C Model?

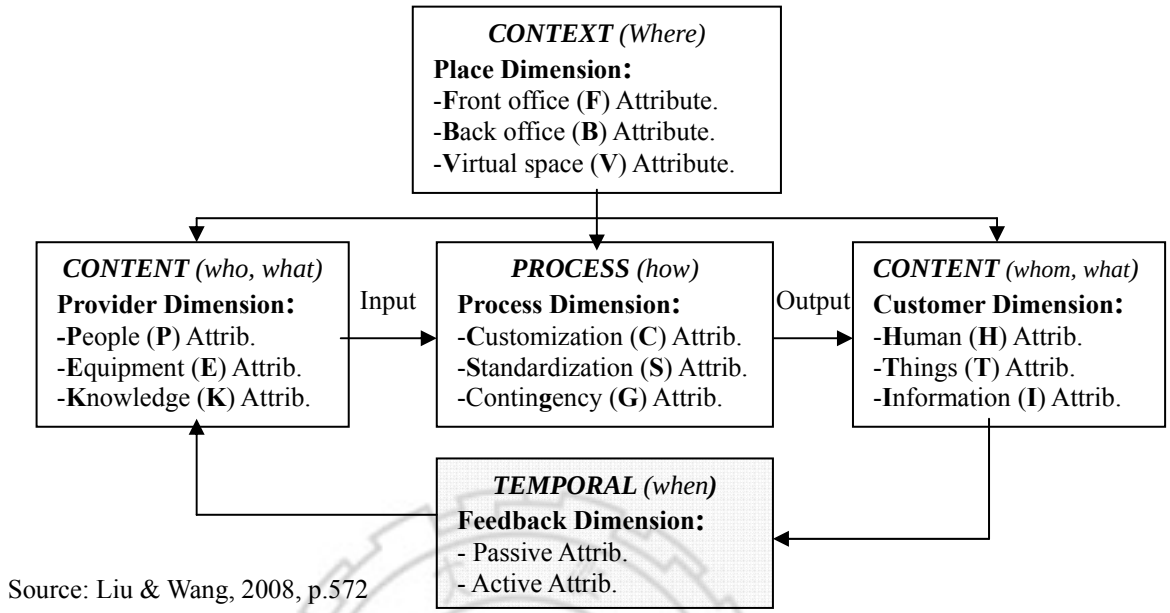
Liu and Wang (2008) constructed an integrative service classification by combining concepts of open system and Wang-Hsu Model (Wang & Hsu, 1994) as shown in Figure 2.3. The reasons to construct a new classification model are as follows:

(1) Due to business environment change, a service provider always offers multiple service business in one firm. It is difficult to classify the type of service business that a firm is operating. Therefore, the classifying object should be changed to service itself but not service business.

(2) Owing to the fast advancement of IT (information technology), so many services have utilized IT to enhance performance. Wang-Hsu model that did not consider IT and knowledge-economic environment has to be revised.

Liu and Wang's (2008) generic service model that can be used to describe the generic service process is shown in Figure 2.3. It is done by mapping "Provider" onto "Resources" of the open system since the service provider has to consolidate all the needed resources to service customer, mapping "Process" onto "Operations" since it transforms the input resources to a new form that can be used to serve customer, mapping "Customer" onto "Customer" since the services are delivered to recipients here, and mapping "Place" onto "Environment" since it's the place where the services are produced and delivered. The four classification dimensions

include three initials of P and one C. Therefore, it is named as "3P+C model".



Source: Liu & Wang, 2008, p.572

Figure 2.3: A Generic Service Classification Model (3P+C Model)

The model uses Greig's (2003) classification criteria, i.e. content, process and context, to classify the service into four dimensions which are provider, process, customer and place. Provider means the service provider who gathers all the necessary resources that are needed to serve customer. Process means the methods and steps that the resources are converted into the form that can be used to serve customer. Customer is the object to be served. Place is the location where the provider and customer encounter. Another dimension i.e. feedback, means the complaints or suggestions coming from customers during or after service (active), or the customer surveys conducted by provider (passive). Attributes of the four dimensions are explained below.

2.3.3.2 Attributes of Dimensions

2.3.3.2.1 Provider Dimension

Provider is the short name of the service provider. Three attributes, People (**P**), Equipment (**E**) and Knowledge (**K**) are selected to represent provider dimension. Thomas (1975) and Kotler (1980) have used people-based and equipment-based dimensions as the classification base. In OECD (2000, p.7) publication, the first thing is to clarify the characteristics of service industries. It says:

"*Services are a diverse group of economic activities that include high-technology, knowledge-intensive sub-sectors, as well as labor-intensive, low-skill areas"*

Knowledge has become one of very important factors in service provision. Knowledge attribute is the enabler of the "professional service" classified by Maister and Lovelock (1982). In the application here, knowledge stands for skills, technologies, or professional know-how. Kotler (1980) has used "type of technology" as one classification dimension for service. Knowledge attribute is becoming increasingly important due to the booming of ICT in 2000's. Professional consultancy for a complex project such as legal service, complex financial service, and designing of semiconductor chips, etc., belongs to such knowledge-serviced category.

2.3.3.2.2 Process Dimension

This dimension is represented by three attributes, i.e. Customization (**C**), Standardization (**S**) and Contingency (G). Maister and Lovelock (1982), Schmenner (1986) and Haywood-Farmer (1988) have used "extent of customization" as one of the dimensions to classify service. The other side of

customization is standardization, which is the “degree of routinization” used by Wemmerlov (1990). The contingency is firstly used by Tinnila and Vepsalainen (1995) to divide service into two types, i.e. mass transaction and contingency relationship.

2.3.3.2.3 Customer Dimension

Customer means the serviced object and is represented by Human (**H**), Thing (**T**), and Information (**I**). Human is actually the same as people. But to avoid duplication with the “People” attribute in Provider dimension, Human is used to replace people. The objective of service is mainly for the processing of goods, people, or information/image (Perrow, 1967). Lovelock and Yip (1996) divided core services into three categories, i.e. People-processing services which refer to tangible actions to customer in person, Possessing-processing services which refer to tangible actions to physical objects, and Information-based services. Today, the ICT progresses more rapidly and is more advanced than that of 1996. The position of the attribute of “Information” is more important than ever. It normally relates to more knowledge-based services such as analysis of an anamnesis, financial reports, marketing survey, customer database and engineering problems. Other services like credit check, or credit card billing, or consultancy, etc. also belong to such category. Information normally deals with complex document, image and database.

2.3.3.2.4 Place Dimension

This dimension includes Front office (**F**), Back office (**B**), and Virtual Space (**V**) as its attributes. Place is referred to as the space where the services encounters occur. Service providers contact customers in here. Bitner (1992) has called it

"servicescape". Silvestro et al. (1992) used the term Front office and Back office developed by Maister (1983) as the value-added source. Customer can see provider in front office but cannot see provider in back office.

Virtual marketplace has been used by Shih (1998), Gronroos et al. (2000), Bishop (2001), and Voss (2003). Thanks to the ICT development, especially the application software and the broadband Internet technologies, many real-time services with images and videos can be done remotely via network. The traditional telephone, or fax cannot achieve these performances. Very often, the customer can be serviced without the participation of provider. The service encounter is neither in front office nor in the back office, for example, the pier-to-pier music or movie downloading. The service is done between customer and other customer. The service provider is only a facilitator who provides the platform but without actually participating the process of the service. On-line auction and on-line game are also the cases that customers serve or entertain one another. These services are delivered, encountered and consumed on-line without the necessity to know who and where the counterparts are. The on-line servicescapes are not real physical space and thus are called virtual space.

2.3.3.2.5 Feedback dimension

The feedback dimension could be divided into two attributes, i.e. active (customer-initiated) and passive (provider-initiated) according to Sampson's (1999) classification of customer feedback. Active attribute refers to the customer's suggestions and complaints. The firm has to tactically decide how to improve the

current operation processes based on it. To improve the current operation processes, the complaint-receiving people have to coordinate with the actual operational personnel for the improvement.

Passive attribute means that the provider takes initiatives to survey customer's opinions for the upgrade of the SDP in system and dimension levels. The customers being surveyed are passive respondents in such case. It is more strategic and sometimes can be used as the source of service innovation. Feedback dimension is the source of dynamism that helps the firm face the changing environment. It contributes substantially in maintaining good customer relationships.

2.3.3.3 Eighty-one (81) Service Modules that Classify the Entire Service

In the 3P+C service classification model, there are four (4) dimensions and each dimension has three (3) attribute. There are eight-one combinations ($3^4 = 81$) of attributes to form service. One combination of attributes is called a service module. Therefore, there are totally eighty-one service modules to classify the whole service as shown in Table 2.3.

For example, for a simple haircut, the service module is ESTF, which means that cutter (equipment) serves hair (thing) in a standardized way at the front office. This is a perspective of a low priced barbershop owner toward his haircut service. Under such perspective, what the owner focuses will be the efficiency of haircutting, e.g. the sharpness of the cutter. Then he hires better skilled and friendly barbers to attract more customers, and his service module becomes PSTF. If he wants to increase the price per haircut, he then hires a hair designer to customize

the hairstyle for customers and the service module then becomes PCTF. But for some special customers who want their haircut process to be an enjoyable experience and do not care much about the price. If the owner can sense such change and define the haircut service module from customer perspective as PCHF, he will re-decorate the shop and add new facilities such as Hi-Fi (high fidelity audio) to provide a home-like relaxation atmosphere and dignified ambient.

Table 2.3: 3P+C Service Module Matrix to Classify the Entire Service

Attributes		**Human, H (Y_1)**			**Thing, T (Y_2)**			**Information, I (Y_3)**		
		F (Z_1)	B (Z_2)	V (Z_3)	F (Z_1)	B (Z_2)	V (Z_3)	F (Z_1)	B (Z_2)	V (Z_3)
People P,(W_1)	C, (X_1)	$W_1X_1Y_1Z_1$	$W_1X_1Y_1Z_2$	$W_1X_1Y_1Z_3$	$W_1X_1Y_2Z_1$	$W_1X_1Y_2Z_2$	$W_1X_1Y_2Z_3$	$W_1X_1Y_3Z_1$	$W_1X_1Y_3Z_2$	$W_1X_1Y_3Z_3$
	S, (X_2)	$W_1X_2Y_1Z_1$	$W_1X_2Y_1Z_2$	$W_1X_2Y_1Z_3$	$W_1X_2Y_2Z_1$	$W_1X_2Y_2Z_2$	$W_1X_2Y_2Z_3$	$W_1X_2Y_3Z_1$	$W_1X_2Y_3Z_2$	$W_1X_2Y_3Z_3$
	G, (X_3)	$W_1X_3Y_1Z_1$	$W_1X_3Y_1Z_2$	$W_1X_3Y_1Z_3$	$W_1X_3Y_2Z_1$	$W_1X_3Y_2Z_2$	$W_1X_3Y_2Z_3$	$W_1X_3Y_3Z_1$	$W_1X_3Y_3Z_2$	$W_1X_3Y_3Z_3$
Equip-ment E,(W_2)	C, (X_1)	$W_2X_1Y_1Z_1$	$W_2X_1Y_1Z_2$	$W_2X_1Y_1Z_3$	$W_2X_1Y_2Z_1$	$W_2X_1Y_2Z_2$	$W_2X_1Y_2Z_3$	$W_2X_1Y_3Z_1$	$W_2X_1Y_3Z_2$	$W_2X_1Y_3Z_3$
	S, (X_2)	$W_2X_2Y_1Z_1$	$W_2X_2Y_1Z_2$	$W_2X_2Y_1Z_3$	$W_2X_2Y_2Z_1$	$W_2X_2Y_2Z_2$	$W_2X_2Y_2Z_3$	$W_2X_2Y_3Z_1$	$W_2X_2Y_3Z_2$	$W_2X_2Y_3Z_3$
	G, (X_3)	$W_2X_3Y_1Z_1$	$W_2X_3Y_1Z_2$	$W_2X_3Y_1Z_3$	$W_2X_3Y_2Z_1$	$W_2X_3Y_2Z_2$	$W_2X_3Y_2Z_3$	$W_2X_3Y_3Z_1$	$W_2X_3Y_3Z_2$	$W_2X_3Y_3Z_3$
Know-ledge K,(W_3)	C, (X_1)	$W_3X_1Y_1Z_1$	$W_3X_1Y_1Z_2$	$W_3X_1Y_1Z_3$	$W_3X_1Y_2Z_1$	$W_3X_1Y_2Z_2$	$W_3X_1Y_2Z_3$	$W_3X_1Y_3Z_1$	$W_3X_1Y_3Z_2$	$W_3X_1Y_3Z_3$
	S, (X_2)	$W_3X_2Y_1Z_1$	$W_3X_2Y_1Z_2$	$W_3X_2Y_1Z_3$	$W_3X_2Y_2Z_1$	$W_3X_2Y_2Z_2$	$W_3X_2Y_2Z_3$	$W_3X_2Y_3Z_1$	$W_3X_2Y_3Z_2$	$W_3X_2Y_3Z_3$
	G, (X_3)	$W_3X_3Y_1Z_1$	$W_3X_3Y_1Z_2$	$W_3X_3Y_1Z_3$	$W_3X_3Y_2Z_1$	$W_3X_3Y_2Z_2$	$W_3X_3Y_2Z_3$	$W_3X_3Y_3Z_1$	$W_3X_3Y_3Z_2$	$W_3X_3Y_3Z_3$

Note: $w_ix_jy_kz_l = w_i+x_j+y_k+z_l$ for i,j,k,l = 1, 2, 3

2.4 Resource-Based View

The business process is the firm's internal operational process. RBV emphasized the critical resources identification and acquiring, and the business processes exploiting them. Porter (1985) suggested that service processes that produced and delivered services to customer by exploiting the firm's resources was one kind of business processes.

2.4.1 Resources of the Firm

Resources and capabilities were referred to as the firm's tangible and intangible assets that the firm used to develop and implement their strategies (Ray et al., 2004). Penrose (1959) argued that a firm must have possessed resources in order to maintain a competitive position. Rubin (1973) suggested that a firm had to process raw resources to make them useful. Wernerfelt (1984) proposed that a firm should obtain the resources that were critical to the development of the products requested by the market. Prahalad and Hamel (1990) contended that manger's critical work was to exploit the firm's core competence to develop radical new products. Barney (1991) argued that the valuable, rare, inimitable and non-substitutable resources could provide the firm sustainable competitive advantages. Business process stood for the competence to exploit the resources.

2.4.2 Business Process

Business processes were actions that firms engaged to accomplish some business purpose or objective (Ray et al., 2004). Business process is the link between resource possession and resources exploitation (Newbert, 2005). Mahoney and Pandain (1992) suggested that a firm could have profit not because it had better resources, but rather the firm's distinctive competence in making better uses of resources. Resources must have been exploited through business processes to do something in order to become the source of competitive advantage. Porter (1991) argued that resources could only be valuable if they allowed firms to perform

activities, and the business processes were the sources of competitive advantages.

Building on the Mahoney and Pandain's (1992) argument, Barney (1997) developed VRIO (value, rarity, inimitability, and organization) framework to argue that a firm needed a strategy to organize a general and unified approach to fully exploit the available resources to attain a competitive advantage. Teece et al. (1997) proposed a dynamic capabilities framework to explain how combinations of competences and resources could be developed, deployed and protected in changing environment. Eisenhardt and Martin (2000) contended that resources were of no real value to the firm unless their latent value could be made available via its idiosyncratic dynamic capability. Our dynamic mechanism provided by the feedback dimension shown in Figure 2.3 reflects this point.

Porter (1985) explained that the business process could be the process for acquiring supplies and raw materials, of producing products or services, of delivering products or services, and of providing after sales services. Therefore business process is a generic name for a firm's operational processes.

2.4.3 Multiple Business Processes

For a multiple business firm, the overall performance depended on the net effect of these business processes on a firm's position in the market place (Ray et al., 2004). Porter (1996) argued that the distinctiveness and sustainability of a corporate strategy depended not only on doing many individual activities well but also integrating among them. Goold and Luchs (1993) suggested that the overall value of a multiple business firm exceeded the sum of individual values of its businesses

when there were synergies among the businesses. Davis and Thomas (1993) argued that the source of synergy was the resource relatedness of business, and they illustrated the effect as: Value (a, b) > Value (a) + Value (b). Tanriverdi and Venkatraman (2005) building on the RBV of diversification postulated that synergies arising from the complementary knowledge relatedness significantly improved the performance of multiple-business firm. This paper adopts the RBV concept of synergy generation to formulate the mathematical model by integrating business processes of a multiple business firm.

2.4.4 Processes of a Service Firm Viewed from 3P+C Perspective

The most basic service process of system level is the service delivery process (SDP) shown Figure 2.3, which stems from open system shown in Figures 2.1 and 2.2. Below system level, it can be further drilled down to dimensional, attributive, and operational levels from the perspective of 3P+C model. Table 2.4 shows the hierarchical architecture of 3P+C model from mode of dynamism, 3 classifying criteria, 4 dimensions, 12 attributes, corresponding internal operational processes and the owners of the operational processes in the firm. For every improvement or upgrade of internal process, the owner is responsible for it. From the hierarchy, it indicates any improvement of internal process will lead to the improvement of SDP. Table 2.5 shows the main processes of different levels in the firm. It classifies their hierarchical levels, strategic levels and mode of dynamism.

Table 2.4: A Firm's Processes Architecture Viewed from 3P+C Perspective

Classifying Criteria		Service Dimensions (***Service Delivery Processes, SDP***)	Service Attributes	Related Firm's ***Internal Processes*** (Examples)	Internal Process Ownership
Static Mode	Content (What, who, whom)	Provider	People	Personnel recruiting Customer contact, Training	HR Marketing + Operation
			Equipment	Purchasing Deployment Operating	Procurement Operation Operation
			Knowledge	KM Knowledge usage	CKO Operation
		Customer	Human	Marketing, Sales Customer contact	Marketing Operation
			Thing	Repair, Production	Operation
			Information	Scrutinizing documents	Legal, Finance
	Process (How)	***Process of Transformation***	Customization	Technology acquisition	Operation
			Standardization	Daily operations	Operation
	Context (Where)	Place	Front Office	Customer facing	Marketing
			Back Office	Planning	R&D
			Virtual Space	Network-related implementation	R&D + Operation
Dynamic	Temporal (When)	Feedback	Customer-initiated Active)	Monitoring ***Improvement Processes***	Operation
			Provider-initiated (Passive)	Surveying ***Upgrade Processes***	Marketing

It also shows the focused requirements of their works, e.g. SDP needs to integrate all the dimensional processes, Transformation process (one of dimensional processes) needs to aggregate customization, standardization and contingency processes, and internal process function as the basic independent unit. For the improvement process stemmed from feedback, it needs to coordinate

several internal processes to achieve. For upgrade process needed to do after customer survey, the process changed is a whole SDP of system level. Integration among dimensional processes is required.

Table 2.5: Characteristics and Relationships of Processes in a Firm

Process Type	Service Delivery Process	Transformation Process	Internal Process	Improvement Process
Hierarchy Level	System	Dimension	Attribute	Attribute
Strategic Level	Strategic	Strategic	Operational	Tactical
Work Requirement	Integration	Aggregation	Independent	coordination
Process Type	Service Delivery Process	Transformation Process	Internal Process	Improvement Process
Mode of Dynamism	*Static oriented* (except Feedback Dimension). Can be described by the 3P+C mathematical models for any given time point (cross-sectional).			*Dynamic oriented.* Improvement & upgrade are continuously made over time (longitudinal).

2.5 Comparison between 3P+C Model and Other Market-Oriented Numerical Service Models

Pullman and Moore (1999) suggested that due to service characteristics of inseparability, the researches in service needed tighter coupling between marketing and service operations aspects. In a ski resort case, they use the similar DCA (discrete choice analysis) and conjoint method to obtain the customer preference. Then based on these preference-weighted variables, a maximum profit mathematical objective function is built. Capacity and demand management strategies are formulated by solving the functions with heuristics and emulation. Based on such concept, Verma and Thompson (1999), in a dine-in pizza restaurant case, used DCA numerical model and conjoint methods to identify the

customer-preferred variables and verify that the actual customer choices were different with what viewed from manager's perspective.

Verma et al. (2001), in a pizza delivery case, used the similar method to get the variables of operating difficulty levels to build the maximum profit objective function. Microsoft Excel is used to solve the function to show the relationships between difficulty level and profit, market share, cost and product profile. Goodale et al. (2003) summarized the above methods, in the fast food restaurant case, to employ the above mentioned method to identify the customer preference parameters and based on which they formulated a maximum profit objective function. Table 2.6 is their comparison with 3P+C model.

They classify the service first to identify the customer-preferred variables. Linear programming method is used to get the optimal combination of variables to generate a Market Utility-based planning and scheduling strategy for Mass Service (MUMS). The above researches all deals with market utility-based operation optimization for mass service and hence are the members of MUMS family. Both of our model and the MUMS-related models classify service into attribute level to develop mathematical models with customer-oriented approach. But we adopt the generic service-process based approach to make our model be able to generalize across the service industry. Their models focus on customer contact and thus are more restricted in mass service applications. Their mathematical model use DCA to identify customer preferences, and stochastic mathematics (e.g. Markovian queuing system) to optimize the maximum profit functions.

Table 2.6: A Comparison between MUMS Model Family and 3P+C Model

Literatures (Year) / Items of Comparison	MUMS Model Family	3P+C Model
	1. Verma &Thompson (1999), 2. Pullman & Moore (1999), 3. Verma, Thompson, Moore, & Louviere (2001), 4. Pullman & Thompson (2003), 5. Goodale, Verma, and Pullman (2003)	**Liu & Wang (2008)**
Type of Service Attributes Dealt	"Hard" service attributes such as waiting time or customer arrival time (demand), and service rate (capacity) that are clear defined so that impact on customer can be measured, and the cost can be directly calculated. Hard attributes are necessary for building the maximum profit objective function and related constraint equations which are the heart of MUMS.	"Soft" attributes are hard to measure directly, such as attributes of 3P+C model.
Focused Customer or Marketing Components	Customer-preferred variables and their weights are identified by a customer survey, and the data are analyzed by DCA and MML conjoint method. Then objective functions of maximizing profit and the related constraint equations are built based on the results.	Customer survey or reported profit to get the customer-based weights on core services. Use Customer-input dimensions such as customization and interaction.
Difficulty Level of Mathematical Model	The heart is the objective function of maximizing profit and the related constraint equations. The process to derive this function is complicated. To solve the problem of optimization, complicated mathematical methods needs to use, such as LP, computer emulation and heuristics, and Excel computation.	Straightforward arithmetic method is used, which is simple to understand and use.
Assumption	NUMS model focuses on "Mass Service", and assumes high labor intensity, front office operation with single-phase queue, and market share ties to manager's decision. In addition, Stochastic model are assumed for waiting time and service rate, which is an approximation. To solve the optimization problem, some constraints are basically assumptions. Emulation with heuristics to solve non-linear equations also involves some assumptions. Generalizability is limited.	Managers who are in charge of service business shall know the weights of elements of service dimensions of his business.
Case of Application	1. Dine-in Pizza, to prove manager's view are not the same with the actual customer preference. 2. Ski-resort, to formulate demand and capacity management strategy. 3. Pizza delivery firms, to get better operation strategy by knowing relationship of difficulty level with profit, market share, and cost. 4. Ski resort, to obtain the optimal operational strategy for different session and customer mix. 5. Fast food industry, to get the optimal shift scheduling with maximum profit.	Airline, bank, and college, to find the relative importance of the current service attributes, and identify where to enhance to achieve maximum profit.
Comments	More specific on mass service categories. More quantitative than qualitative. High level of difficulty in mathematics. Not easy for managers to understand and use. Limited generalization.	Fit for all service types. More qualitative. Simple to use.

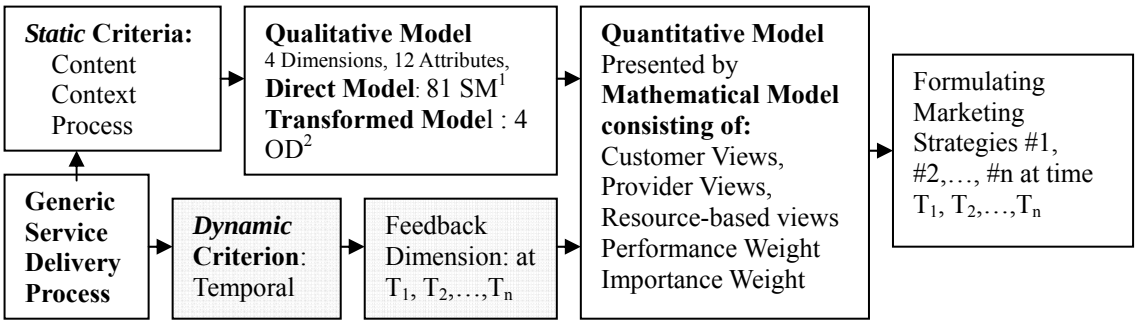
Notes: DCA means discrete choice analysis, LP means linear programming, MML means multi-nominal LOGIT, MUMS means market-utility based mass service, 3P+C means provider, process, place, and customer.

Chapter 3 Methodologies

3.1 Conceptual Structure of the Entire Models

Based on the service module and operational dimension concepts developed in 3P+C service classifying model that includes four classifying dimensions and twelve attributes (Liu & Wang, 2008), the adoptions of customer co-creation concept of the service-centered paradigm, and process integration concept of resource-based view, the mathematical models that represents the integrative service models are constructed. For direct model, salient attributes are to be extracted from the result of optimization. Marketing strategies can then be formulated from the salient attributes along with the existing marketing frameworks. For transformed model, weighted attributes are transforming classifying dimension into operational dimensions to form mathematical model. Schmenner's matrix is used to optimize the weights of attributes of operational dimensions. Marketing strategies can be formulated by the new operational dimensions along with existing marketing framework. The conceptualization structure of this study is shown in Figure 3.1.

But 3P+C model formed by content, context and process criteria is a static model, so are mathematical models derived from it. To make the formulated strategies adaptive to changing environment, a temporal criterion is added to provide feedbacks at time T_1, T_2, … and T_n to adjust the strategies according to real customer needs at that time, and generate strategies #1, #2, … and #n, respectively.

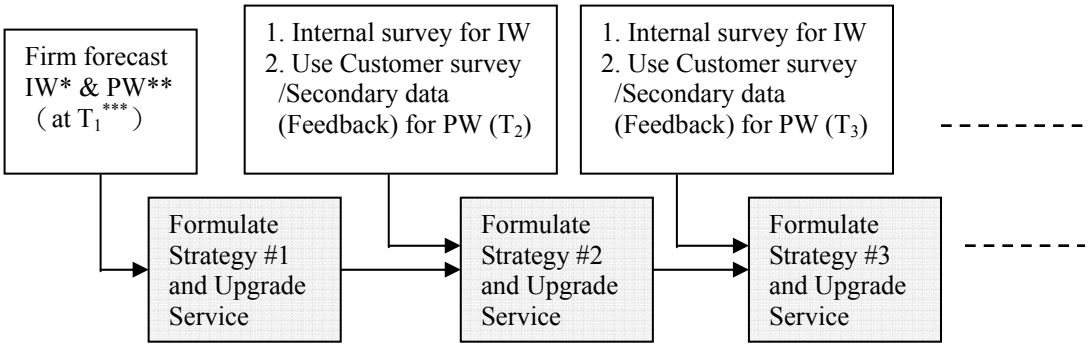


Notes: 1. SM = Service Module; 2. OD= Operational Dimension

Figure 3.1: Overall Conceptualization of This Study

3.2 Dynamics of Strategy Formulation

Figure 3.2 further elaborates the dynamic process of strategies formulation and service upgrade. It shows that if we feed the IW (importance weight) and PW (performance weight) data at time T_1 to the mathematical model and formulate the strategy, it is the strategy #1 at T_1. IW and PW will be explained in the chapter of mathematical model construction. As the external environment changes at time T_2, the strategy #1 at T_1 may no longer be effective. Then we need to conduct the provider-initiated feedback to make customer surveys for the new IW and PW data to get the new strategy #2 by adjusting last strategy according to environment conditions at T_2 stage. Similarly, there will be new strategies formulating for time T_3, T_4, …T_n, etc. as shown in Figure 3.2, which are an endless processes as long as the firm exists. Therefore, due to the feedback function, the continuous strategies formulations and thus the actions to upgrade service delivery processes become a series of dynamic processes.



Notes:*IW=Importance Weight, **PW=Performance Weight (explained in the forthcoming paragraph), *** T =Time.

Figure 3.2: Dynamic Processes of Strategies Formulating and Service Upgrading

3.3 Feedback, Service Quality and Customer Relationship

The improvement processes are similarly dynamic. The service provider receives the suggestions and complaints from the customers after the service has been delivered. Based on the feedback information, the service provider keeps on improving the basic internal processes that have been poorly performed or complained. For customer complaints, Hamer et al. (1999) built a real-time updating (RTU) model suggesting that customer's expectations continuously changed during a service encounter and the customer's perceptions of service quality were heavily based on the updated expectations. Liu et al. (2000) argued that the customers' overall service quality perceptions and positive behavioral intentions were heavily influenced by the effective complaint management. Therefore, if the firm's feedback mechanism in customer complaint handlings could provide the real-time improvements in smart ways with reasonable costs, then its strengths could be significantly enforced. Figure 3.3 illustrates the dynamic

mechanism of feedback and how it helps maintaining good customer relationship.

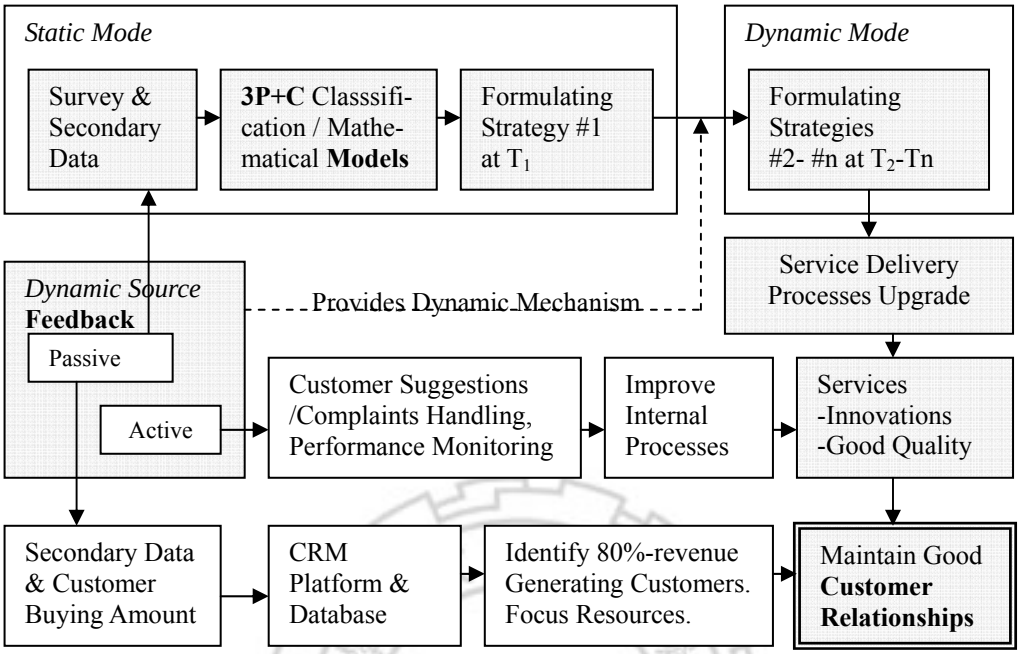


Figure 3.3: 3P+C Model, Feedback and Customer Relationships

Thus, feedback dimension is a very important component of criteria that makes the whole service delivery process of the firm dynamically evolve, always maintain at good quality levels and thus obtain high customer satisfactions. By doing so, the firm could consequently keep very good relationships with customers and thus gains their high loyalties through customer satisfactions (Kotler & Keller, 2006). Therefore, the firm is able to keep on growing.

For the customer relationship building, in addition to providing good quality of service, the interactions that occurred during surveying, suggestions taking, and complaints listening and afterward improving would definitely help significantly. Besides these, if the firm can implement an IT-based CRM (customer relationship

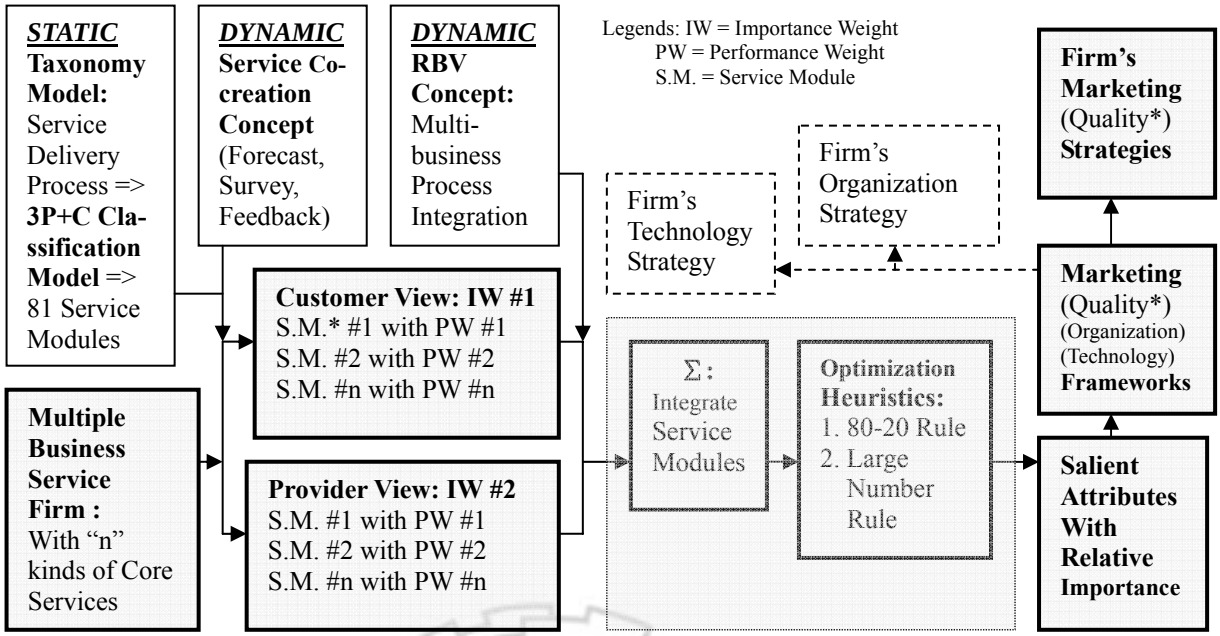
management) platform with database, those 20% of customers who contribute 80% of the revenues can be identified. Then the firm can focus most of its resources on these 20% of customers and thus CRM system would make the firm more profitable. This CRM system is actually a combination of performance monitoring and secondary data analysis, i.e. a kind of feedback functions.

3.4 Development Process of Direct Model

The direct mathematical models are derived from generic service delivery process. They are generalized model that can be used across the whole service industry. If organizational, technological and service quality dimensions and their related frameworks are provided, this model can also formulate organizational and technological strategies for the service firms based on the resulted salient attributes. We do not illustrate the development of these three strategies since they can be done in a similar way as we do to the marketing strategy. They are shown in the dotted boxes of Figure 3.4, which mean they are not included in this paper. To make the whole processes of strategies development clearer, Figure 3.4 is also a compact summary that shows the linkages of all the main concepts and processes in this paper.

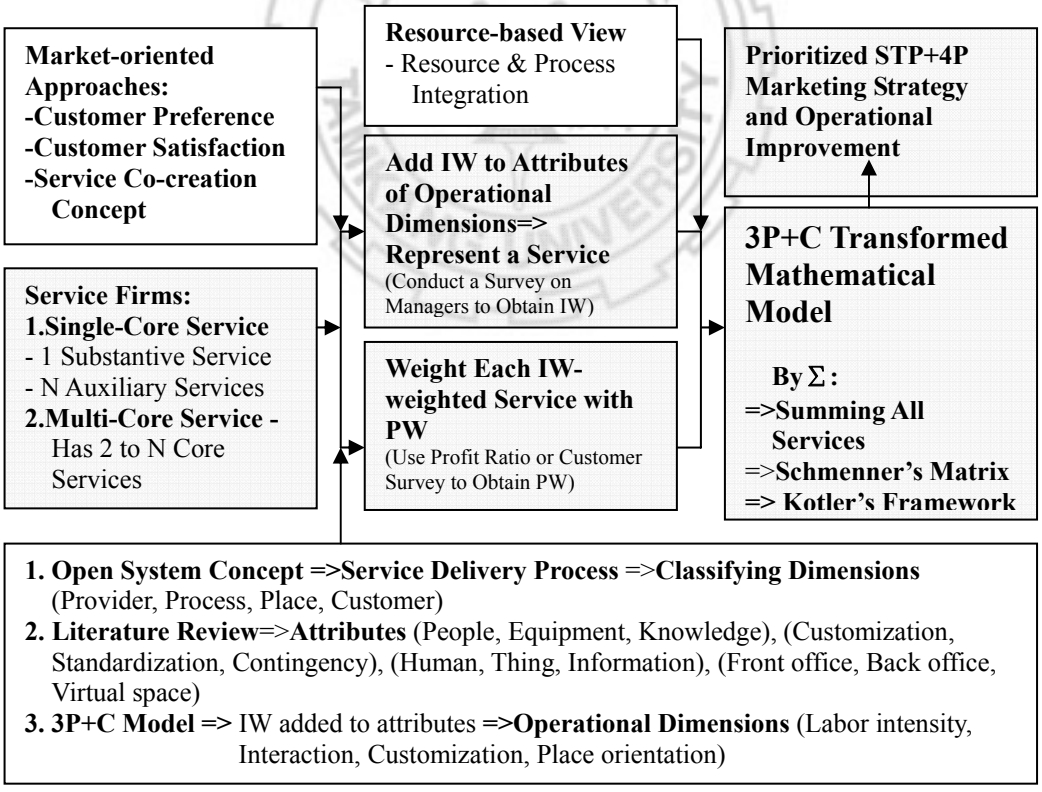
3.5 Development Process of Transformed Model

Developing Process of transformed model is shown in Figure 3.5.



Notes: Contents included in dotted boxes and with asterisk are not studied in this paper.

Figure 3.4: Direct Model Developing Process



Legends: 1. IW: Importance Weight; 2. PW: Performance Weight; 3. STP+4P: Segmentation, Targeting, Positioning, and Product, Price, Promotion, and Place.

Figure 3.5: Developing Process of Transformed Model

The transformed mathematical models are also derived from generic service delivery process. They use the attributes developed in the generalized classification model that can be used across the whole service industry.

Similar to direct model, customer co-created concept, resource-based view, importance weights and performance weights are used to construct such transformed mathematical model. To formulate marketing strategy, the integrative services are optimized by Schmenner's (1986) matrix first to get the new attribute weights. To put it clearer, Figure 3.5 is also a compact summary that shows the linkages of all the main concepts and processes in this paper.

Chapter 4 Constructinos of Generalized Mathematical Models

4.1 3P+C Direct Model

4.1.1 Review of Concepts of Service Modules

In Table 2.3 of Chapter 2, eighty-one service modules are developed to represent the entire service. Liu and Wang (2008) argued that the service modules had the following characteristics.

1. Since the 81 service modules represented the entire possible services, any service offered by a firm could be a combination of some service modules among these 81 modules.
2. For the same service, different perspective corresponded to different service module, which implied different resources investment.
3. The service modules could be quite different between those from provider perspective and those from customer perspective. Provider normally focused on resources utilization efficiency while customer focused on experiential satisfaction.
4. A service was a summation of the service modules viewed from the mentioned two perspectives.
5. For a service firm offering several core services, the service processes should be integrated to generate synergies and thus gained competitive advantages by RBV theory.

6. The integrated service would be the sum of the individual core service module weighted by a performance weight (PW). PW was the relative importance ratio of ROI (return on investment), revenue, profit or other performance indicators of that individual core service.
7. From the customer co-creation point of view of service-centered paradigm, a core service module was the sum of a service module from customer perspective and a service module from provider perspective weighted by the respective importance weight (IW). IW would be decided by the firm depending on how important the customer was assessed.

4.1.2 Construction of 3P+C Direct Mathematical Model

The main purpose of the mathematical model is to integrate the service modules of the services firms, and then extract the salient attributes out of it. With the extracted salient attributes, the firm can formulate the strategies that focus the resources on these key attributes, i.e. to use the already-limited resources on the most important elements. The mathematical model is actually simple and straightforward. It involves only addition and multiplication operation methods of arithmetic. The main purpose of developing such a generalized mathematical model is to make it be applicable to any kind of service firm that offers any numbers of services. In the future, if more attributes are added to make finer analysis of service business, it can also easily fit. In addition, due to the formulization, it becomes very easy to computerize the process. User just needs to enter the related parameters to computer and the results of the salient attributes come out quickly. Then he can start the qualitative analysis based on the results. He

actually does not need to worry about the process of the calculation. The whole process of the construction of the mathematical model is described below.

4.1.2.1 Notations

Provider: w_1 = P, w_2 = E, w_3 = K; Process: x_1 = C, x_2 = S, x_3 = G; Customer: y_1 = H, y_2 = T, y_3 = I; Place: z_1 = F, z_2 = B, z_3 = V

Φ_P = Integrated services viewed from provider's perspective; Φ_C = Integrated services viewed from customer's perspective; Φ_T = Integrated services viewed from both provider's perspective and customer's perspective; $w_i+x_j+y_k+z_l$ = one of 81service modules.

α_{ijkl} = Performance Weight (PW) of service module $w_i+x_j+y_k+z_l$ (e.g. the ratio of revenue of $w_i+x_j+y_k+z_l$ to total service revenue) from provider perspective

β_{ijkl} = PW of service module $w_i+x_j+y_k+z_l$ (e.g. the ratio of revenue of $w_i+x_j+y_k+z_l$ to total service revenue) from customer perspective

H = Importance Weight (IW) of Φ_C , i.e. the IW for customer perspective (the value of H is determined by service provider)

1 – H = IW of Φ_P, i.e. the IW for provider perspective (the value of H is determined by service provider)

A_{ijkl} = 1, if $w_i+x_j+y_k+z_l$ service module exists for provider

= 0, otherwise

B_{ijkl} = 1, if $w_i+x_j+y_k+z_l$ service module exists for customer

= 0, otherwise

γ = The final relative importance of the attribute of the summed core services

The H (IW for customer perspective) is the provider's interpretation of the relative importance of the service modules that viewed from the customer perspective. The provider's resource will determine directly the service quality. The customer satisfaction will decide customer's repeated purchase. It is actually quite provider-subjective and service-specific. It depends on the needed amount of the resources to deliver the service, and the complexity of the service process. It has to be judged by the service provider. With H, the service provider can use different ratios to make simulation tests to see how the final salient attributes would change by using different IWs. γ's are the final relative importance of the resulted attribute after the service modules are integrated weighing by IW and PW.

4.1.2.2 Model building

$$\Phi_P = \left[\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} (w_i+x_j+y_k+z_l)\, A_{ijkl}\, \alpha_{ijkl} \right] (1-H)$$

(Implication: This step integrates service modules from provider perspective)

$$\Phi_C = \left[\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} (w_i+x_j+y_k+z_l)\, B_{ijkl}\, \beta_{ijkl} \right] H$$

(Implication: This step Integrates service modules from customer perspective)

$\Phi_T = \Phi_P + \Phi_C$ = Integrated service modules from (provider + customer) perspectives

$$= \left[\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} (w_i+x_j+y_k+z_l)\, A_{ijkl}\, \alpha_{ijkl} \right] (1-H) + \left[\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} (w_i+x_j+y_k+z_l)\, B_{ijkl}\, \beta_{ijkl} \right] H$$

$$= \sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} w_i \left[A_{ijkl}\, \alpha_{ijkl} + H\,(B_{ijkl}\, \beta_{ijkl} - A_{ijkl}\, \alpha_{ijkl}) \right] + x_i \left[A_{ijkl}\, \alpha_{ijkl} + H\,(B_{ijkl}\, \beta_{ijkl} - A_{ijkl}\, \alpha_{ijkl}) \right] + y_i \left[A_{ijkl}\, \alpha_{ijkl} + H\,(B_{ijkl}\, \beta_{ijkl} - A_{ijkl}\, \alpha_{ijkl}) \right] + z_i \left[A_{ijkl} \right.$$

α_{ijkl} +H ($B_{ijkl}\beta_{ijkl}$ - $A_{ijkl}\alpha_{ijkl}$) 〕 (1)

(Implication: This step Integrates service modules from the above two perspectives)

Where $\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} \alpha_{ijkl} = 1$; $\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3} \beta_{ijkl} = 1$; $0 < H < 100\%$

(Implication: These two steps show the total sum of the weights, PW or IW, is 100%)

From equation (1), we can get the coefficients for w_i, x_j, y_k, z_l. Then we calculate their ratios to the sum of total coefficients.

Ratio of w_i coefficient to the sum of total coefficients γ_{wi} for i = 1,2,3.

$$\gamma_{wi} = \frac{\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]}{\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]} \quad (2)$$

(Implication: This step shows the relative importance of the Provider's attributes)

Similarly, for x_j, y_k, z_l,

$$\gamma_{xj} = \frac{\sum_{i=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]}{\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]} \quad (3)$$

(Implication: This step shows the relative importance of the Process' attributes)

$$\gamma_{yk} = \frac{\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]}{\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]} \quad (4)$$

(Implication: This step shows the relative importance of the Customer's attributes)

$$\gamma_{zl} = \frac{\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]}{\sum_{i=1}^{3}\sum_{j=1}^{3}\sum_{k=1}^{3}\sum_{l=1}^{3}[A_{ijkl}\alpha_{ijkl} + H(B_{ijkl}\beta_{ijkl} - A_{ijkl}\alpha_{ijkl})]} \quad (5)$$

(Implication: This step shows the relative importance of the Place's attributes)

4.1.3 Bank Example: from Service Modules Integrating to Strategy Formulating

A retail bank offers five core services and the respective profit ratios are: (1) Front counter cash deposit and withdraw, 20%; (2) ATM service, 10%; (3) Consumer loan, 50%; (4) Credit card service, 15%; and (5) On-line bank 5%.

4.1.3.1 Identification of Service Modules

Table 4.1 identifies all the service modules of the corresponding five services offered by the retail bank from both customer and provider perspectives. The rationales how the service modules are selected are explained on the left side of the table.

4.1.3.2 Identification of Integrative Services

Table 4.2 shows the step-by-step procedures to identify the integrative service attributes. Profit ratios are used as PW since customer satisfaction is positively correlated to the profit (Anderson et al., 1994). For IW, 50% is used under the customer co-creation service paradigm, which means that the customer and the provider perspective are equally treated. As shown in the last item of Table 4.2, we obtain the integrative service attributes as (22P+3E +0K)+(13C +8S +4G) +(14H+4T +6I)+(6F+18B +2V). The coefficients of the attributes of the integrative service equals to $\gamma_{w1}, \gamma_{w2}, \gamma_{w3}, \gamma_{x1}, \gamma_{x2}, \gamma_{x3}, \gamma_{y1}, \gamma_{y2}, \gamma_{y3}, \gamma_{z1}, \gamma_{z2}, \gamma_{z3}$ of Equation (2) to Equation (5). Or we can also directly use the Equation (2) to Equation (5) to calculate $\gamma_{w1}, \gamma_{w2}, \gamma_{w3}, \gamma_{x1}, \gamma_{x2}, \gamma_{x3}, \gamma_{y1}, \gamma_{y2}, \gamma_{y3}, \gamma_{z1}, \gamma_{z2},$ and γ_{z3}. The coefficient of the attribute of the integrative service is the combined weight of that attribute.

Table 4.1: Identification of Service Modules

Bank Service (Profit Ratio)	**Perspective**	**Service Module**	**Rationales**
Front Counter (20%)	Provider	PSHF	Personnel serve customers with standard process at the front counter.
	Customer	PSHF	Bank officer serve me with standard process at the front counter.
ATM (10%)	Provider	ESHB	Equipment serve customer with standard process with supporting from the back office.
	Customer	ESHF	Machine in front of me serves me with standard process.
Loan (50%)	Provider	PCIB	Financial specialist scrutinize customer's document at the back office.
	Customer	PCHB	Bank officer check my personal credit at the back office.
Credit Card (15%)	Provider	PGTB	Personnel handle credit cards in a way of mass customization at the back office.
	Customer	PGTB	Bank people handle thousands of cards including mine at the back office.
On-line Banking (5%)	Provider	KGHV (50%)	Specially designed web contents serve mass customer in the virtual network.
		ESTV (50%)	Computer servers deal with customers laptop computers with standard process via virtual networks.
	Customer	PCHV (50%)	I deal with the bank officers via personalized web pages in virtual network.
		PCTV (50%)	My computer interacts via personalized web pages with the bank officers in virtual network.

4.1.3.3 Identification of Salient Attributes

Identification of the salient attributes is shown in the Table 4.3. The same procedures used in the generalized mathematical model are adopted.

To identify the salient attributes, we follow the steps below:

1. Re-rank the attribute of the integrative service, (22P+3E+0K)+(13C+8S+4G) +(14H+ 4T+6I)+(6F+18B+2V), from large to small in terms of the coefficients of attributes to become 22P+18B+14H+13C+8S+6F+6I+4T+ 4G+ 3E+2V+0K.
2. Calculate cumulative percentage, the integrative service can be re-written as: 22P+40B+54H+67C+75S+81F+87I+91T+95G+98E+100V+100K.

Table 4.2: Identification of Integrative Service Attributes

Service of Bank (Core Services)	PW, Performance Weight (Profit) α or β	**Service Module,** WXYZ*	
		Provider Weight (IW=1-H= 50%), (Provider Perspective)	Customer Weight (IW=H= 50%), (Customer Perspective)
Front Counter	20%	PSHF	PSHF
ATM	10%	ESHB	ESHF
Loan	50%	PCIB	PCHB
Credit Card	15%	PGTB	PGTB
On-line Banking	5%	KGHV (50%) ESTV (50%)	PCHV (50%) PCTV (50%)
Sum of weighted service modules Φ_P and Φ_C	100%	Φ_P = (PSHF x 0.2)+(ESHB x 0.1)+ (PCIB x 0.5 〕+ (PGTB x 0.15) +(KGHV x 0.5+ESTV x 0.5) x 0.05	Φ_C = (PSHF x 0.2) +(ESHF x 0.1)+ (PCHB x 0.5)+ (PGTB x 0.15)+(PCHV x 0.5+PCTV x 0.5)x 0.05
Calculation of the Integrated ServiceΦ_T	$\Phi_T = \Phi_P + \Phi_C$ = (PSHF x 0.2) +〔(ESHB x *0.5*+ESHF x *0.5*) x 0.1 〕+〔(PCIB x *0.5*+ PCHB x *0.5*) x 0.5 〕+ (PGTB x 0.15) +{〔(KGHV x 0.5+ESTV x 0.5) x *0.5* 〕+〔(PCHV x 0.5+PCTV x 0.5) x *0.5* 〕}x 0.05 , Note: underlined figures are PWs		
Integrated Service Attributes	The sum of the weighted service modules from customer and provider perspectives= 22P+18B+14H+13C+8S+6F+6I+4T+4G+3E+2V+0K (The coefficients of the attributes are γ's.)		

Note: *service module WXYX means W+X+Y+X, e.g. PSHF = P+S+H+F in the calculation.

3. Discard the attributes whose cumulative percentages are larger than 80% (80/20 rule) and get the result: 22P+40B+ 54H+67C+75S+81F (i.e. only P, B, H, C, S, and F are selected as the surviving attributes at this stage)
4. Recalculate the coefficients of the remaining attributes on 100% basis (i.e. standardize) and the result is: 27P+22B+ 17H+16C+10S+8F.
5. The attributes whose coefficients are smaller than 10% (large number principle) are discarded again to get the preliminary salient attributes 27P+22B+ 17H+16C+10S.
6. Standardize the coefficients, the final salient attributes are 29P + 24B +19H +17C + 11S.

Table 4.3: Identification of Salient Attributes

Attributes / Steps	P	B	H	C	S	F	I	T	G	E	V	K
1. Resulted γ in % (From Table 4.2)	22	18	14	13	8	6	6	4	4	3	2	0
2. Cumulative γ (Re-rank & Cumulate)	22	40	54	67	75	81	87	91	95	98	100	100
3. 80/20 Rule (Optimization)	27	22	17	16	10	8						
4. Large No. Principle (Re-optimization)	29	24	19	17	11							
5. Salient Attributes (Optimized Results)	**29P + 24B + 19H +17C + 11S.**											

4.1.3.4 Interpretation of the Salient Attributes: 29P + 24B + 19H +17C + 11S

From the bank's revenue ratio scheme of the existing five core services, we optimize the service modules of the core services. The final result is 29% servicing personnel (resources), 24% back office internal support, 19% serviced customer, 17% customized service and 11% standardized service. Amongst many possible services provided by a commercial bank, one of the services that can meet the resulted salient attribute weights seems to be the Personal Financing Service (PFS).

To facilitate PFS services, the bank will have to invest significantly to train some of the existing employees (P) who are already financially knowledgeable to be certified for financial consultancy. Instead of training own employee, the bank can also outsource the financial consultants if the time is urgent or more knowledgeable specialists are needed. The employees can then provide to customers (C) individually customized financing services by bundling (or customizing) different standardized financing products depending on customer's financial capability.

The back office's works (B) are very heavy in the provisions of supports such

as training employees, building a CRM platform to allow frontline employees maintaining good customer relationship, and providing VIP rooms where customer can discuss business with employees with dignity and privacy. The back office actually means that the firms capability to implement the integrated strategies.

4.1.4 Marketing Strategy for Personal Financial Services

Kotler et al. (1999) suggested a marketing strategy formulation framework based on MR+STP+4P framework. MR refers to market research. STP is segmentation, targeting, and positioning. 4P, the marketing mix, means product, price, promotion and place or distribution channel. Table 4.4 is using the key items proposed by Kotler et al. (1999) to formulate the strategy on PFS. The strategies are formulated mainly from the resource acquisition and utilization point of view.

The above 4P concept adopted by Kotler was initially developed by McCarthy (1975) for manufactured goods. Fifield and Gilligan (1996) expanded it to 7P by adding People, Process and Physical dimensions for the service business.

These lately added 3P are actually corresponding to those 3P in the 3P+C model adopted in this paper. Their people correspond to our the people attribute of the provider dimension and the human attribute of the customer dimension, process corresponds to customization attribute of our process dimension, and physical corresponds to the front-office attribute of the place dimension. Thus we can say that 3P+C model has high expert validity. The differences are that 3P+C model covers broader range of attributes to make the analysis finer, and the 3P+C mathematical model identifies the relative importance of the salient attributes. Thus the business strategies can be more exhaustively and accurately formulated.

Table 4.4: Retail Bank's Personal Financial Service (PFS) Marketing Strategies

ITEM	**Salient Attributes:** *P = People, H= Human, B= Back Office C= Customization, S = Standardization*						Business-specific Strategy for PFS *(1)Ratio of Customization and Standardization = 61:39. (2) Bundled product of medium price with medium degree of risk. (3) Need detailed planning and development from back office. (4) Well-trained frontline people are most critical.*
	Salient Attribute	P	H	B	C	S	
	Coefficient % (importance ratio)	29	19	24	17	11	
1	Target Market		v*				Customers with high-savings but do not have time to handle personal finance, or do not have enough financial knowledge, e.g. DINK, Hi-tech employees, just-retired people, etc.
2	Product Positioning				v	v	Ratio of Customization and Standardization (C/S) is 61:39 (17/28:11/28). Bundled product such as stocks, bonds, options, foreign exchange, and mutual funds, etc. It is a product with medium price and medium degree of risk.
3	Product Line				v	v	Personal Financial Service
4	Price	v	v	v	v	v	Medium priced to enlarge customer base
5	Distribution Channel	v		v			Use current nationwide branch office and newly equip them with good-ambient VIP rooms.
6	Sales Force	v					Sales forces is very important in salient element (29%). They must be experienced and knowledgeable in PFS, friendly, sensitive, fluent-speaking. Generic and business domain specific training is absolutely necessary.
7	Service Scope Breadth and Speed	v		v			Planners of back office make a through design of service scope to cover PFS, investment analysis as well as some warm and thoughtful service such as speedy and timely emergency loan to help valued customer overcome the temporary difficulty.
8	Advertisement			v			Planners of back office plan to launch high taste ads mainly on the high class publications such as magazine, newspaper. Letters to customers to recommend suitable financial products to them are to be sent to them periodically.
9	Promotion	v		v			Back office make complete plan of promotions such as providing membership of special clubs, or the discounted membership fees.
10	Research and Development			v			Back office has to develop and implement sufficient tools of financial analysis and practical operation processes for the frontline people to facilitate face to face presentation to customer. CRM and data mining platform common to the whole company needs to be built up for the analysis of customers' life-time value and associated suitable value propositions.
11	Marketing Research			v			Back office people help segment the market, position the launched financial products and group the customers to find potential prospects including existing customer friends and relatives based on the lifetime value concept.

4.2 3P+C Transformed Model

3P+C service classifying dimensions and the associated attributes are identified in Figure 2.3 and its related sections. It is necessary to convert them to operational dimensions before building up the mathematical model. For all of the operational dimensions, IW (i.e. A_j , B_j , C_j , D_j below) can be obtained by a survey to the managers of the firm.

4.2.1 Construction of Transformed Mathematical Model

4.2.1.1 Labor Intensity Dimension

The provider's resource of the offered service is a weighted combination of labor, goods and knowledge attributes. We define Labor Intensity as:

Let $W_1 = P$, $W_2 = E$, $W_3 = K$ for neater expression,

$$\text{Labor Intensity} = A_1P + A_2E + A_3K = \sum_{j=1}^{3} A_j W_j \quad (6)$$

Where $\sum_{j=1}^{3} A_j = 1$, A_j is the importance weight (IW) of attribute, j = 1, 2, 3.

4.2.1.2 Customization Dimension

The distinctive dimension of process to transform the resources is the degree of customization. We define Customization as follows:

Let $X_1 = C$，$X_2 = S$ ， $X_3 = G$

$$\text{Customization} = B_1C + B_2S + B_3G = \sum_{j=1}^{3} B_j X_j \quad (7)$$

Where $\sum_{j=1}^{3} B_j = 1$, B_j is the importance weight (IW) of attribute, j = 1, 2, 3.

4.2.1.3 Interaction Dimension

The degree of interaction means the degree of human contact. We define Interaction as follows:

Let Y_1 = H, Y_2 = T, Y_3= I

$$\text{Interaction} = C_1H + C_2T + C_3I = \sum_{j=1}^{3} C_j Y_j \quad (8)$$

Where $\sum_{j=1}^{3} C_j = 1$, C_j is the importance weight (IW) of attribute, j = 1, 2, 3.

4.2.1.4 Place Orientation Dimension

The place orientation of service process is the combination of front office, back office and virtual space. Each attribute has its weight depending on how much it contributes in the service process. The Place Orientation is defined as follows:

Let Z_1 = F, Z_2 = B, Z_3= V

$$\text{Place Orientation} = D_1F + D_2B + D_3V = \sum_{j=1}^{3} D_j Z_j \quad (9)$$

Where $\sum_{j=1}^{3} D_j = 1$, D_j is the importance weight (IW) of attribute, j = 1, 2, 3.

4.2.1.5 Integrative Service

4.2.1.5.1 A Complete Single Service

A Complete Single Service (or A Core-Service) = Labor Intensity Dimension + Customization Dimension + Interaction Dimension + Place Orientation Dimension

$$= \sum_{j=1}^{3} A_j W_j + \sum_{j=1}^{3} B_j X_j + \sum_{j=1}^{3} C_j Y_j + \sum_{j=1}^{3} D_j Z_j \text{ , j = 1, 2, 3.} \quad (10)$$

4.2.1.5.2 Multiple Core-Services

Integrative Services for Multiple Core-Services = Σ Weighted Complete Single

Service (or core-service)

$$= \sum_{i=1}^{n} \alpha_i \left(\sum_{j=1}^{3} A_{ij} W_j + \sum_{j=1}^{3} B_{ij} X_j + \sum_{j=1}^{3} C_{ij} Y_j + \sum_{j=1}^{3} D_{ij} Z_j \right) \quad (11)$$

$$= \sum_{k=1}^{3} A_k W_k + \sum_{k=1}^{3} B_k X_k + \sum_{k=1}^{3} C_k Y_k + \sum_{k=1}^{3} D_k Z_k \quad (12)$$

(1) In Equation (11):

α_i is the performance (PW) of a Complete Single Service，i = 1,2,…, n，$\sum_{i=1}^{n} \alpha_i = 1$

W_j = P, E, K, for j = 1, 2, 3, respectively. X_j = C, S, G for j = 1, 2, 3, respectively.

Y_j = H, T, I, for j = 1, 2, 3, respectively. Z_j = F, B, V, for j = 1, 2, 3, respectively.

A_{ij} = Importance Weights (IW) of P, E, K attributes of the i-th (i =1, 2,…, n)
Complete Single Service, for j = 1, 2, 3.

B_{ij} = Importance Weights (IW) of C, S, G attributes of the i-th (i =1, 2,…, n)
Complete Single Service, for j = 1, 2, 3.

C_{ij} = Importance Weights (IW) of H, T, I attributes of the i-th (i =1, 2,…, n)
Complete Single Service, for j = 1, 2, 3.

D_{ij} = Importance Weights (IW) of F, B, V attributes of the i-th (i =1, 2,…, n)
Complete Single Service, for j = 1, 2, 3.

$\sum_{j=1}^{3} A_{ij} = 1$, $\sum_{j=1}^{3} B_{ij} = 1$, $\sum_{j=1}^{3} C_{ij} = 1$, $\sum_{j=1}^{3} D_{ij} = 1$, for i = 1, 2,…, n

(2) In Equation (12):

W_k = P, E, K for k = 1, 2, 3, respectively. X_k = C, S, G for k = 1, 2, 3, respectively.

Y_k = H, T, I for k = 1, 2, 3, respectively. Z_k = F, B, V for k = 1, 2, 3, respectively.

A_k, B_k, C_k, D_k are the Consolidated Importance Weights (CIW)

A_k = P, E, K CIW for k = 1, 2, 3, respectively. B_k = C, S, G CIW for k = 1, 2, 3, respectively.

C_k = H, T, I CIW for k = 1, 2, 3, respectively. D_k = F, B, V CIW for k = 1, 2, 3, respectively.

$$\sum_{k=1}^{3} A_k = 1, \quad \sum_{k=1}^{3} B_k = 1, \quad \sum_{k=1}^{3} C_k = 1, \quad \sum_{k=1}^{3} D_k = 1$$

(3) Final Results:

Finally, we get the consolidated importance weight for each service attribute of equation (12), i.e $\sum_{k=1}^{3} A_k W_k + \sum_{k=1}^{3} B_k X_k + \sum_{k=1}^{3} C_k Y_k + \sum_{k=1}^{3} D_k Z_k$ (13)

For j = 1, 2, 3, $A_k = \sum_{i=1}^{n} \alpha_i A_{ij}$, $B_k = \sum_{i=1}^{n} \alpha_i B_{ij}$, $C_k = \sum_{i=1}^{n} \alpha_i C_{ij}$, $D_k = \sum_{i=1}^{n} \alpha_i D_{ij}$ (14)

4.2.2 Compare 3P+C Model with Other Service-Process based Matrices in Coverage of the Operational Dimensions

For a classification, the most ideal case is that the dimensions are mutually exclusive and collectively exhaustive (Bailey, 1994). 3P+C model includes more operational dimension coverage than the main previous researches as shown in Table 4.5 that compares it with those of Schmenner (1986; 2004), Haywood-Farmer (1988), and Wemmerlov (1990). 3P+C service model is comparatively more exhaustive than the other service classification approaches in addition to having all of its attributes mutually exclusive.

For Silvestro et al. (1992), the x-axis “Number of customer processed by a typical unit per day” has to do with the degree of intensity of labor and the degree of customization, which impact the productivity of service. It covers both Provider and Process dimensions. Another dimension on the y-axis “Level of contact time/ customization/ discretion” also covers both Process and Customer dimensions. It

means that there is some overlapping between classification dimensions to make the model lose some characteristics of mutual exclusivity in classifying dimensions.

Table 4.5: Comparison of Dimensions Coverage between 3P+C Service Model and Other Service-Process Based Model

Service Process Classifying Dimensions	Provider	Process	Customer	Place
Service Operational Dimensions	Labor Intensity	Customi-zation	Customer Interaction	Place Orientation
3P+C Model (this study) -Labor Intensity (v) -Customization (x) -Interaction (△) -Place Orientation (◇)	v	x	△	◇
Schmenner (1986) -Degree of labor intensity (v) -Degree of interaction and customization (x)	v	x	x	
Haywood-Farmer (1988) -Degree of labor intensity (v) -Degree of contact/interaction (x) -Degree of customization (△)	v	△	x	
Wemmerlov (1990) -Nature of customer/service system interaction (v) (no/direct/ indirect customer contact) - Degree of routinization of the service process (x) (rigid/fluid service process) - Serviced objects in service process (△) (processing of people/goods/information/image)		x	v △	v
Silvestro et al. (1992) x-axis: -Number of customer processed by a typical unit per day (v) y-axis: -Equipment /people –focus (x) -Level of contact time/customization/discretion (△) -Front or back office (◇) -Process or product (○)	v	v △	x △ ○	◇
Schmenner (2004) - Degree of variation of customization and interaction (v) - Relative throughput time (x)	x	v x	v	

For Schmenner (2004), the Degree of variation of customization and interaction straddles the Process and Customer dimensions. The Customization and

Relative throughput time that can be referred to as productivity straddles the Provider and Process dimensions. The overlapping means the losing of mutual exclusivity between classifying dimensions. In addition, the place dimension is not covered, and thus this fact makes it less exhaustive.

Wemmerlov (1990) uses a dimension of Nature of customer/service system interaction (no/direct/ indirect customer contact) for place orientation. The no/indirect contact actually means contact via fax or telephone. It is not ICT directly related. In 1990 or earlier, Internet had not come out. There was not yet virtual space concept. Although we include it in the dimension of place orientation, it includes less ICT-related attribute than 3P+C service model does.

4.2.3 Example: Single Core-Service Firm—an Airline Company

Gronroos (1978) divides a service into substantive service and auxiliary services. The auxiliary service is also called peripheral service by Norman (1984) or supplementary service in Lovelock and Yip's (1996) flower pattern. The core services are the integrated service of the substantive and the auxiliary services. The performance of the total service is the integrated sum of the performance of each individual service.

4.2.3.1 Survey on Executives for IW of Substantive and Auxiliary Services

After conducting interviews of ten executives of an airline company, we get the mean values of the IW shown under the attributes of service in Table 4.6 for different services. We ask them to give us the value in a multiple of 5, e.g. 5, 10, 15, and 20, etc.

Table 4.6: PW & IW of Airline Services and the Resulted Integrated Service

Airline Services	IW / PW	Labor Intensity			Customization			Interaction			Place Orientation		
		P	E	K	C	S	G	H	T	I	F	B	V
Transport	82%	20	60	20	90	10	0	95	5	0	80	20	0
Check-in	3%	80	10	10	80	10	10	80	15	5	70	20	10
Caring	6%	90	5	5	60	40	0	95	3	2	100	0	0
Catering	6%	70	30	0	90	10	0	100	0	0	60	40	0
Entertain	3%	70	30	0	90	10	0	100	0	0	90	10	0
Integration		28.7	54	17	88.1	11.6	0.3	95	4.7	0.3	80	19.7	0.3

We summarize our survey and get one substantive service that is passenger transporting, and four auxiliary services that are check-in service, on-flight caring, on-flight catering, and on-flight entertainment. The reason to have the firm decide service items is that customer may get confused on which services are provided by airline and which are provided by host airport, e.g. services like security check and waiting for baggage when checking out are provided by host airport.

4.2.3.2 Survey on Passengers for Performance Weights of Services

We prepare a circular cardboard plate with 360-degree scales on the edge, and five clock-hand-like moveable needles marked clearly with the names of services. The passenger-perceived importance ratios of the services can be obtained visually by asking passenger to move the needles. 200 passengers are surveyed by systematic random sampling at the airport. The resulted Performance Weights (mean value) are: Passenger Transport = 82%; Check-in Service = 3%; On-flight Caring = 6%; On-flight Catering = 6%; On-flight Entertainment = 3%. The results of the integrated services are shown in Table 4.6. The Integrated service equals to (29P+54E+17K)+(88S+11.7C+0.3G)+ (95H+ 4.7T +0.3I) + (80F + 20B).

Then we use Schmenner's (1986) Matrix to check if we can do any

improvement. In Figure 4.1, from point "a" (29P, 12C) to the diagonal, there are two paths, i.e. ab and ac. With path ab, it means that we need to decrease headcount for people attribute. With ac, it means to increase customization attribute by 17%, e.g. managing to provide more personalized manus for the economic passenger with the help of ICT technology. To decrease headcount, it may lower the quality of service. Therefore, to increase customization is more likely the better direction to make customer more satisfied and thus gain more profit.

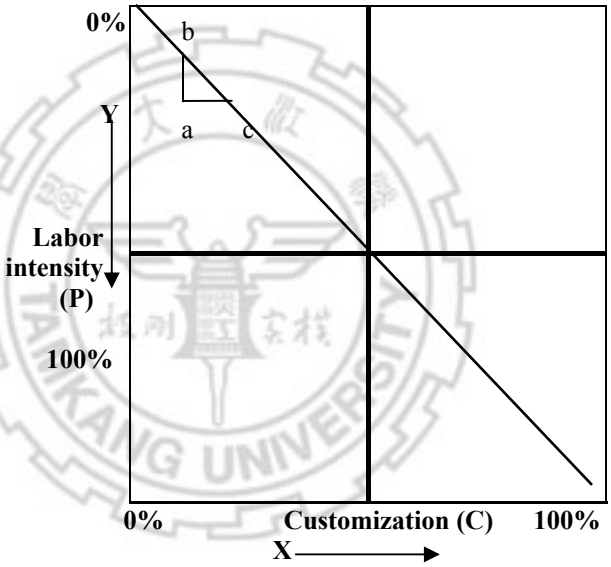


Figure 4.1: Check Service Improvement on Schmenner's Matrix for Airline

4.2.4 Example: Multiple Core-Service Firm-- Retail Bank

An interview meeting is conducted for 10 executive managers of a retail bank. From the results of the interviews, we identify four core services of the bank and their importance weights of service attributes as shown in the Table 4.7. From the financial report, we get the performance weights of the core services shown in the

same table. As mentioned, Anderson et al. (1994) argued that the customer satisfaction was positively corrected to the profit of the firm. Therefore, by using the profit ratio as the PW, it is equivalent to conducting the customer survey for the preference or importance of each core service in their minds. The integrated service is (33P+22E+ 45K)+(32C+64S+4G)+(15H+20T+65I)+(36F+59B+5V).

Table 4.7: Integrated Service of a Multiple Core-Services Retail Bank

Core Services		IW / PW	P	E	K	*C*	*S*	G	H	T	I	*F*	*B*	*V*
Regular Banking for Interest Earning	**Deposit**	28%	75	10	15	5	95	0	20	60	20	95	5	0
	Loan	28%	15	10	75	30	70	0	10	5	85	10	85	5
Stock/Security Trade		16%	10	10	80	90	10	0	0	5	95	0	85	15
Credit Card		20%	10	70	20	5	75	20	0	5	95	0	95	5
Wealth Management		8%	50	5	45	85	15	0	80	0	20	80	15	5
Integrated Service		100%	32.8	21.6	45.6	32	64	4	14.8	20	65.2	35.8	59	5.2
Integrated Service: After Wealth Management change to 20%, Deposit & Loan change to 22%			33.4	21	45.6	40.1	55.9	4	22.6	16.1	61.3	39.1	55.4	5.5
Change after PW Adjustment			0.6	-0.6	0	8.1	-8.1	0	7.8	-3.9	-3.9	3.3	-3.6	0.3

4.2.4.1 Direct Managerial Implication

From the result of integration, we can see that in general the current bank service is more knowledge intensive than labor intensive (33P+22E+45K). The major process and the product are quite standardized (32C+64S+4G). The customer of service is mainly information (15H+20T+65I). The back office support is crucial (36F+59B+5V).

Due to the fast advancement of Internet, the managers can consider

developing more network related service. It is because the bank is information intensive (65I) and network is very suitable to handle it. The network is not sufficiently utilized from the evidence of 8V in place orientation dimension. The bank has to strengthen his network capability including hardware such as computer servers and software such as friendly customer interfaces. Due to the trend that customers need personal wealth management more and more, the bank can consider investing more on this service. To the bank, it would be a more profitable service. Therefore, if the bank wants to increase the profit ratio of the "wealth management service" to higher percentage, e.g. 20%, what actions are needed to take? By doing so, it can lower the current heavy dependency on the regular banking service without lowering the original profit amount.

The managers can repeat the same methods as shown in Table 4.7 to calculate the relative importance of the integrative service by changing the PW to 20% for wealth management, 22% for deposit, 22% for loan, with the others remained the same. After calculation, the new result is (33P+22E+45K)+(40C+56S+4G) +(27H+16T+61I)+(39F +55B+6V). The total changes are (0.6P-0.6E+0K)+(8.1C-8.1S+0G)+(7.8H-3.9T-3.9I) +(3.3F-3.6B+0.3V).

It means that the manager has to consider investing slightly more headcounts (0.6P) and more VIP rooms (3.3F) to serve the increased numbers of customers (7.8H) to do more customized personal financial consultancy. The negative portion of the change is the decrease of the IW of some attributes due to the increase of the IW of the other attributes. In such way, the manager can set a target first and do the simulation to find out the changes of IW of attributes to do the business planning,

designing and forecasting. The manager can even collect some publicly available information of the competitors' and do the analysis mentioned above to forecast their possible strategies.

4.2.4.2 Using the Previous Researchers' Matrix and Frameworks

By using Schmenner's (1986) matrix, we can find one possible solution, i.e. to increase H by 18% from 15 to 33 for wealth management service that has less current profit share. It means that customer interaction has to be strengthened significantly, virtually or physically. We can also consider increasing "V" (virtual space) attribute to higher level, e.g. ICT facilities and software tools in risk-behavior analyzing. To combine these two actions together, it means that by utilizing ICT, we can provide more flexible way for customers to design their own investment portfolio on the web, i.e. to provide customer more sense of control before they come to talk with bank's personal financial specialist. Manager can also consider increasing front office weight, e.g. providing more VIP rooms for personal financial consultancy.

4.2.4.3 Summary of Single-core and Multiple-core Service Firm

A multiple-core service firm can be seen as if it were combined by many quasi single-core service firms but under the control of headquarters. Each core service consists of a substantive service and several auxiliary services. To formulate the strategies for a multiple-core service firm, the best way to do is to start from the quasi firms. The same procedures with the above airline case can be used to find the integrated service or core service of each quasi firm. Then the similar procedures to the above retail bank case can be followed to integrate the core

services of the quasi firms to obtain the integrated service attributes of this real firm for strategies formulation. Figure 4.2 illustrates these procedures.

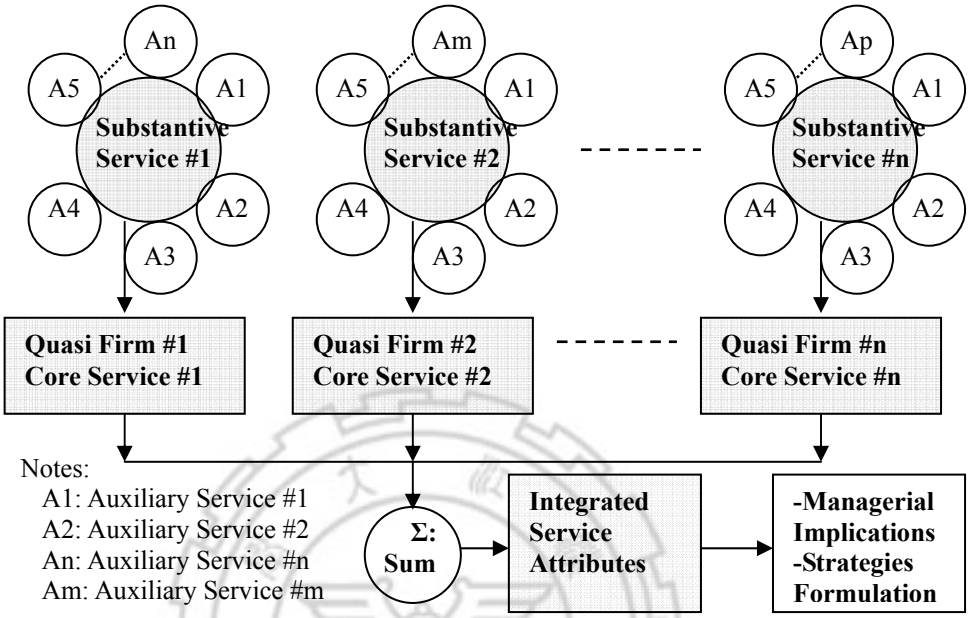


Figure 4.2: A multiple-Core Service Firm with "n" Quasi Single-Core Service Firms

4.2.5 Use College Example to Formulate a Marketing Strategy

A college offers core services as follows: (1) a regular program that students have to attend in the classroom in person; (2) a scheduled TV-broadcasting program; (3) a postal tuition program; and (4) 24 hours per day, 7 days a week's Internet on-line program. The performance of the college would be the net effect of the integration of these core services. As mentioned, Anderson et al. (1994) argued that customer satisfaction was positively correlated to the profit of the firm. Therefore, if profit contributions of the core services are used as the weight of the core services in 3P+C model, the resulted integrated attributes are of customer-preference based

result.

4.2.5.1 Identifying the Integrative Service

The ratio of profit contribution of each core service to the total profit can be seen as the performance weight (PW) of that service within the total services offered. Table 4.8 shows the four core services offered by a college, the ratio of profit of each core service as performance weight (PW), and the manager-perceived ratios of the attributes of service dimensions of each core service as importance weight (IW) of each attribute. As mentioned in the foregoing section, the manger will estimate the IW in the survey. The integrating of the core services is following the steps below:

(1) TV-Broadcasting Program Service = 15 x〔(60P+10E+30K) + (10C+90S+0G) + (95H+0T+5I) + (0F+90B+10V)〕

(2) The same procedures are done for the other services.

(3) A_1=42, A_2=28, A_3=30 means the Labor Intensity is about evenly distributed with a tendency being close to high labor intensity. The investment on people should be more.

B_1=16, B_2=84, B_3=0 means the college education is quite standardized service.

C_1=92, C_2=0, C_3=8 means the customer is mainly human (students) with small portion of information (students' data).

D_1=48, D_2= 38.5, D_3=13.5 means the Place Orientation is mainly in front office with quite heavy back office operation.

(4) Based on the results of the integrated service, the manager can go to

Schmenner's (1986) matrix for finding where the position of the service is, and use Kotler's (1997) marketing strategy framework for formulation college service-specific marketing strategy.

Table 4.8: Core Services of a College and the Weights

Core Services of College	IW / PW	Provider			Process			Customer			Place		
		P	E	K	C	S	G	H	T	I	F	B	V
Regular Program	60%	50	20	30	20	80	0	90	0	10	80	20	0
TV-Broadcasting Program	15%	60	20	30	10	90	0	95	0	5	0	90	10
Postal Tuition Program	10%	0	70	30	10	90	0	95	0	5	0	100	0
Internet On-line Program	15%	20	50	30	10	90	0	95	0	5	0	20	80
Consolidated Services		42	28	30	16	84	0	92	0	8	48	38.5	13.5

Legends: 1.IW = Importance Weight. 2. PW = Performance Weight. 3. S =1 –C. 4. All the figures are in percentage.

4.2.5.2. Using Schmenner's Matrix to Optimize the Integrative Service

Schmenner (1986) argues that the pressures for control and lower costs will drive the position of service toward the diagonal and /or up, should the company want to become the most profitable. Position of the college service in the matrix can be located by checking the result of the consolidated service, i.e. (42P+28E+30K) + (16C+84S) + (92H+0T+8I) + (48F+38.5B+13.5V).

By doing so, we actually check the relative importance of the attributes on the matrix. To be more profitable, the college has to decrease the IW of labor by 24% (from 42% to 16%) to reach the diagonal at (16, 16) from the current position (42, 16). Meantime, the IW of equipment will be increased to 54% (28%+26%) to become high automation service type. It can be achieved by gradually investing

more and more on ICT such as multi-media to facilitate the Internet or TV remote teachings. It means that in addition to keep the current customers, new investments will open the new huge continued-education market via Internet and TV teachings. For the Place dimension, the IW of front office will be decreased and that of virtual space service will increase significantly.

4.2.5.3 Using Kotler's framework to Formulate the Marketing Strategy

From the Schmenner's matrix, the business target and direction can be identified. To more specifically address the marketing operations that can lead to achieve the target, Kotler's framework (1997, p.100) is adopted as shown in Table 4.9.

4.2.6 Comparison of 3P+C Direct Model and Transformed Model

After 3P+C direct model and transformed models are constructed and respective examples illustrated, a comparison of common and different characteristics of these two models will further make people know more insights of them. Table 4.10 lists the comparisons. The common points of them are that they are derived from 3P+C service classification model that includes four classifying dimensions and twelve attributes; they all use performance weights (PW) to weigh different core-services, and the PW can be profit ratio or other secondary data; and they can be used for strategy formulation, prediction or simulation, etc. The different points are that the direct model adopts 81 service modules; the optimization methods use 80-20 rules and large number principle; strategy formulation is based on salient attributes and their relative importance; importance weights are used to weigh customer and provider perspectives; and the managerial implications can be directly interpreted

from salient attributes, which is on more strategic level. In contrast to direct model, transformed model uses four operational dimensions as the basic analysis unit; the optimization tool is Schmenner's (1986) matrix.

Table 4.9: Marketing Strategy Formulation by Adopting Kotler's Framework

Operational Dimension	*Labor Intensity*	Customization	*Customer Interaction*	Place Orientation
Current Service (Integrated)	42P+28E+30K	16C+84S	92H+0T+8I	48F+38.5B+13.5V
Targeted Service	**16P+54E+30K Hi Automation**	**Same (High enough)**	**Same (High enough)**	**Virtual Space Orientation**
Target Market	Target market is Internet and TV remote teaching with current regular education market kept. Target customers are the people who are working with ages 25-65 for continued life-time education.			
Product/Service Positioning	High quality multimedia teaching grounded on the high quality and reputable regular teaching. Regular teaching is kept on enhancing.			
Product Line	Regular teaching, Internet/TV multi-media teaching, Post-mail teaching			
Price	Regular teaching- high price. Internet/TV teaching- lower and attractive price.			
Distribution Channel	Regular teaching- in campus. Internet/TV teaching has no space and time restriction.			
Sales Force	The conventional sales forces are not needed. Instead, Back-office people implementing the contents and maintaining efficient ICT system are needed.			
Service Scope Breadth and Speed	Efficient and timely services have to be greatly enhanced by ICT system. Service scope includes everything having to do with education starting from registration to graduation certification award.			
Advertisement	Using newspaper and Internet. contents will be planned by back-office.			
Promotion	Use bundled packages. Students of outstanding performance will be awarded.			
Research and Development	Develop more diversified courses to attract customers with different needs. Promotion and ads will have to be innovative.			
Marketing Research	Periodically, market surveys have to be conducted to know the changes and the trends of customer wants.			

The different points also include that the strategy is formulated through checking the relative importance of attributes of the operational dimension; and importance weights (IW) are used to covert classifying dimension to operation; managerial implications are interpreted from the weighted attributes of operational dimensions, which is more on operational level.

Table 4.10: Comparison of 3P+C Direct and Transformed Models

	Comparing Items	3P+C Direct Model	3P+C Transformed Model
Common	**Derived from**	3P+C integrative service classifying model	
	Basic Elements	12 service attributes	
	PW, viewed from customer	Used as the weights of core-services. IW can be profit ratio or other secondary data.	
	Applications	Strategies formulation, business forecast, business simulation, planning, etc.	
Difference	**Basic Unit**	81 service modules	4 operational dimensions
	Optimization	80-20 rules, large number principle	Diagonal of Schmenner's matrix
	Strategy Formulation	Based on salient attributes and their relative importance	Based on the relative importance of attributes in operational dimensions
	IW, viewed from provider	Used to weigh customer perspective and provider perspective	Used to convert classifying dimension to operational dimensions
	Managerial Implication	Interpreted directly from salient attributes. More on strategic level.	Interpreted from structure of each operational dimension. More on operational level.

4.3 Obtaining Objective Weights for 3P+C Mathematical Model with Analytic Hierarchy Process Method

4.3.1 Why Objective Weights Are Necessary?

In the forgoing sections, 3P+C mathematical models, whether direct or transformed models, are adopted to formulate a service firm's marketing strategies. In the models, there are two kinds of crucial weights which are importance weight (IW) and performance weight (PW). Whether they are correct or not determines the correctness of the strategy that is formulated based on them. In our examples used for illustrating the applications of 3P+C mathematical models, when we decide the value of weights, we follow the following principle: (1) when surveyed data are

available, use surveyed data on the condition that the survey had been correctly conducted; (2) when there is no surveyed data, secondary data are used; (3) when the above data are not available, data from experts are used, and (4) when none of the above data can be obtained, equal weights are used first. Therefore, in the examples, some use surveyed data, e.g. IW in airline and bank examples for transformed model; some use secondary data, e.g. PW for all the examples. In the bank example, equal weights are used for IW (customer and provider perspectives). The above ways of obtaining weights are not very systematic.

For some special service that involves specific domain knowledge, subjective weights provided by few experts are always used. Experts are normally right. But they are also human beings who unavoidably sometimes make some mistakes. Therefore, to identify a systematic way to obtain the objective weights is very critical to 3P+C mathematical models. Through literature reviews and comparisons of many different approaches, Saaty's (1986) analytic hierarchy process (AHP) is found adequate to meet the need. Transformed model will be used to illustrate the identification of these objective weights. For direct model, same method can be used.

4.3.2 Review of Integrative Service of 3P+C Mathematical Model

Integrative Service = Service of customer perspective + service of provider perspective = W_1 [(A_{11}P + A_{12}E + A_{13}K)+ (B_{11}C + B_{12} S + B_{13}G) + (C_{11}H + C_{12}T + C_{13}I) + (D_{11}F + D_{12}B + D_{13}V)] + W_2 [(A_{21}P + A_{22}E + A_{23}K) + (B_{21}C + B_{22} S + B_{23}G) + (C_{21}H + C_{22}T + C_{23}I) + (D_{21}F + D_{22}B + D_{23}V)]

Where, (A_{1i}, B_{1i}, C_{1i}, and D_{1i}) and (A_{2i}, B_{2i}, C_{2i} and D_{2i}) for i = 1, 2, 3 are the weights of attributes of the operational dimensions, i.e. Labor Intensity Dimension (A_{1i} and A_{2i}), Customization Dimension (B_{1i} and B_{2i}), Interaction Dimension (C_{1i} and C_{2i}) and Place Orientation Dimension(D_{1i} and D_{2i}), respectively. W1 and W2 are the weights for Service of customer perspective and service of provider perspective, respectively. Restriction conditions are: $\sum_i A_{1i} = 1, \sum_i B_{1i} = 1, \sum_i C_{1i} = 1, \sum_i D_{1i} = 1, \sum_i A_{2i} = 1, \sum_i B_{2i} = 1, \sum_i C_{2i} = 1, \sum_i D_{2i} = 1$ and $W_1 + W_2 = 1$. The weights to be identified are: A_{1i}, B_{1i}, C_{1i}, D_{1i}, A_{2i}, B_{2i}, C_{2i} and D_{2i} for i = 1, 2, 3; and W_1 and W_2, from the survey data.

4.3.3 Converting 3P+C Model to AHP Analytic Model for Pair-wise Comparison

The 3P+C model in Figure 2.3, can be converted into four levels as exhibited in Figure 4.3.

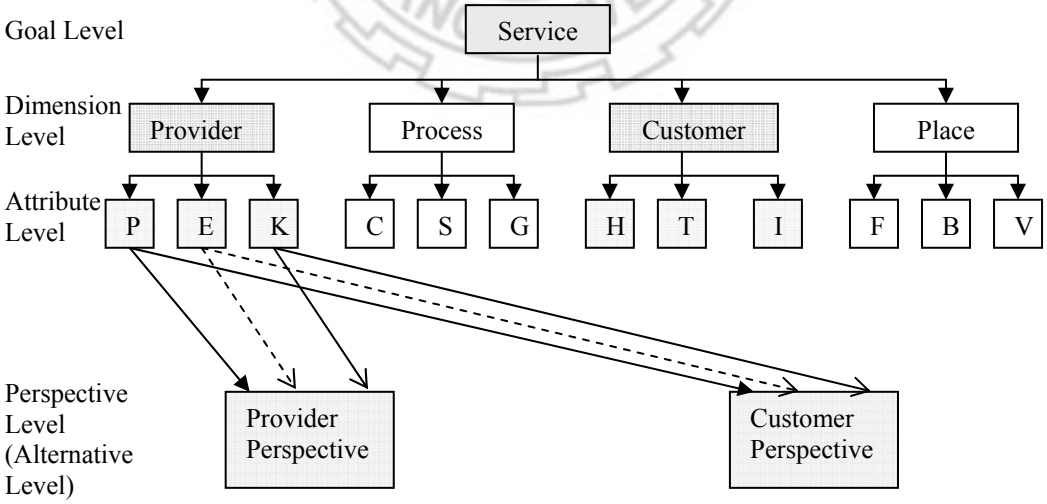


Figure 4.3: Service Hierarchy for Analysis

The hierarchy can be divided into four levels for easier analysis. The highest

level is service itself, which is goal level. The second level is the dimension level that includes four service dimensions, i.e. provider, process, customer and place. The third level is the attribute level that includes three attributes of each dimension, i.e. People (P), Equipment (E), Knowledge (K), Customization (C), Standardization (S), Contingency (G), Human (H), Thing (T), Information (I), Front office (F), Back office (B), and Virtual Space (V). The fourth level is the perspective level, which consists of provider perspective and customer perspective. In the dimension level, four dimensions will be compared in pair-wise manner. In attribute level, three attributes of each dimension will be compared in pair. In the perspective level, two perspectives for each attribute will be compared. Since there are twelve attributes, there will be twelve pairs of comparison in the perspective pair.

4.3.4 Identifying the Weights A_{1i}, B_{1i}, C_{1i}, D_{1i}, A_{2i}, B_{2i}, C_{2i} and D_{2i}

4.3.4.1 Data Collection

To collect the needed data, the Saaty (1986) scale of relative importance is employed to make the survey questionnaires for all dimensions and attributes of service. Then the same questionnaires are used in the survey conducted to about equal numbers of provider and customer respondents, respectively. A_{1i}, B_{1i}, C_{1i}, and D_{1i} are the weights of attributes viewed from customer, and A_{2i}, B_{2i}, C_{2i} and D_{2i} are the weights viewed from provider. Therefore to identify A_{1i}, B_{1i}, C_{1i}, and D_{1i}, we need to use the data obtained by the survey done to customer only. To identify

A_{2i}, B_{2i}, C_{2i} and D_{2i}, we will use the data collected from provider only. The steps of identifying the weights are described below.

4.3.4.2 Calculating Attribute Weights Viewed by Customer Based on the Surveyed Data

Attribute weights viewed from customer perspective can be calculated based on the surveyed data for customers in the following steps:

(1) Use the data collected from customer only to construct the pair-wise comparison matrix (PCM) of dimension, PCM_D. From PCM_D, We get the weight vector of dimension, $\Omega_D = [\omega_{D1}\ \omega_{D2}\ \omega_{D3}\ \omega_{D4}]^T$, and the related value of λ_{max} (maximum Eigen value), CI and CR. CI and CR are used to test degree of inconsistency. If CR > 0.1, then PCM_D has to be calibrated, but with weights remaining the same. Therefore, we use PCM_D to represent PCM of dimension whether it is calibrated or non-calibrated.

(2) Use the data collected from customer only to construct the pair-wise comparison matrix (PCM) of attributes, PCM_{A1}, PCM_{A2}, PCM_{A3}, and PCM_{A4} for provider, process, customer and place, respectively.

(2-1) From PCM_{A1}, we get $\Omega_{A1} = [\omega_{A11}\ \omega_{A12}\ \omega_{A13}]^T$ and the related value of λ_{max} (maximum Eigen value), CI and CR. CI and CR are used to test degree of inconsistency. If CR > 0.1, then PCM_{A1} has to be calibrated, but with weights remaining the same. Therefore, we use PCM_{A1} to represent PCM of attribute whether it is calibrated or non-calibrated.

(2-2) Similarly, from PCM_{A2}, we get $\Omega_{A2} = [\omega_{A21}\ \omega_{A22}\ \omega_{A23}]^T$.

(2-3) Similarly, from PCM_{A3}, we get $\Omega_{A3} = [\omega_{A31}\ \omega_{A32}\ \omega_{A33}]^T$.

(2-4) Similarly, from PCM_{A4}, we get $\Omega_{A4} = [\omega_{A41} \ \omega_{A42} \ \omega_{A43}]^T$.

(3) The Results of PCM and weight matrix of the above process are summarized in Table 4.11.

Table 4.11: PCM and Weight Matrix of Dimension and Attribute Viewed from Customer

Goal	**Service Viewed from Customer**											
Dimension	**Provider**			**Process**			**Customer**			**Place**		
PCM	PCM_D											
Dimension Weights Matrix	Ω_D											
Dimension Weights	ω_{D1}			ω_{D2}			ω_{D3}			ω_{D4}		
Attribute	**P**	**E**	**K**	**C**	**S**	**G**	**H**	**T**	**I**	**F**	**B**	**V**
PCM	PCM_{A1}			PCM_{A2}			PCM_{A3}			PCM_{A4}		
Attribute Weight Matrix	Ω_{A1}			Ω_{A2}			Ω_{A3}			Ω_{A4}		
Attribute Weights	ω_{A11}	ω_{A12}	ω_{A13}	ω_{A21}	ω_{A22}	ω_{A23}	ω_{A31}	ω_{A32}	ω_{A33}	ω_{A41}	ω_{A42}	ω_{A43}

(4) To calculate the attribute weights we need, we follow the process listed in Table 4.12 to get the result.

(5) For standardization, let

$\alpha_1 = \omega_{D1}\omega_{A11} + \omega_{D1}\omega_{A12} + \omega_{D1}\omega_{A13}$, $\beta_1 = \omega_{D2}\omega_{A21} + \omega_{D2}\omega_{A22} + \omega_{D2}\omega_{A23}$

$\gamma_1 = \omega_{D3}\omega_{A31} + \omega_{D3}\omega_{A32} + \omega_{D3}\omega_{A33}$, $\delta_1 = \omega_{D4}\omega_{A41} + \omega_{D4}\omega_{A42} + \omega_{D4}\omega_{A43}$

$A_{11} = \omega_{D1}\omega_{A11}/\alpha_1$, $A_{12} = \omega_{D1}\omega_{A12}/\alpha_1$, $A_{13} = \omega_{D1}\omega_{A13}/\alpha_1$

$B_{11} = \omega_{D2}\omega_{A21}/\beta_1$, $B_{12} = \omega_{D2}\omega_{A22}/\beta_1$, $B_{13} = \omega_{D2}\omega_{A23}/\beta_1$

$C_{11} = \omega_{D3}\omega_{A31}/\gamma_1$, $C_{12} = \omega_{D3}\omega_{A32}/\gamma_1$, $C_{13} = \omega_{D3}\omega_{A33}/\gamma_1$

$D_{11} = \omega_{D4}\omega_{A41}/\delta_1$, $D_{12} = \omega_{D4}\omega_{A42}/\delta_1$, $D_{13} = \omega_{D4}\omega_{A43}/\delta_1$

Where $\sum_i A_{1i} = 1$, $\sum_i B_{1i} = 1$, $\sum_i C_{1i} = 1$, $\sum_i D_{1i} = 1$, for i = 1, 2, 3.

Table 4.12: Calculation of Final Attribute Weights Viewed from Customer

Dimension Weights Matrix	$\Omega_D = [\omega_{D1}, \omega_{D2}, \omega_{D3}, \omega_{D4}]^T$			
Attribute Weight Matrix	$\Omega_{A1} = [\omega_{A11} \omega_{A12} \omega_{A13}]^T$	$\Omega_{A2} = [\omega_{A21} \omega_{A22} \omega_{A23}]^T$	$\Omega_{A3} = [\omega_{A31} \omega_{A32} \omega_{A33}]^T$	$\Omega_{A4} = [\omega_{A41} \omega_{A42} \omega_{A43}]^T$
Normalized Dimension-Attribute Weight Matrix	ω_{D1} x Ω_{A1}/α_1	ω_{D2} x Ω_{A2}/β_1	ω_{D3} x Ω_{A3}/γ_1	ω_{D4} x Ω_{A4}/δ_1
Equal to Final Attribute Weights	$[A_{11} A_{12} A_{13}]^T$	$[B_{11} B_{12} B_{13}]^T$	$[C_{11} C_{12} C_{13}]^T$	$[D_{11} D_{12} D_{13}]^T$

4.3.4.3 Calculating Attribute Weights Viewed by Provider Based on the Surveyed Data

Attribute weights viewed from provider perspective can be calculated based on the surveyed data for providers in the following steps:

(1) Use the data collected from provider only to construct the pair-wise comparison matrix (PCM) of dimension, PCM_d. From PCM_d, We get the weight vector of dimension, $\Omega_d = [\omega_{d1} \omega_{d2} \omega_{d3} \omega_{d4}]^T$, and the related value of λ_{max} (maximum Eigen value), CI and CR. CI and CR are used to test degree of inconsistency. If CR > 0.1, then PCM_d has to be calibrated, but with weights remaining the same. Therefore, we use PCM_d to represent PCM of dimension whether it is calibrated or non-calibrated.

(2) Use the data collected from provider to construct the pair-wise comparison matrix (PCM) of attributes, PCM_{a1}, PCM_{a2}, PCM_{a3}, and PCM_{a4} for provider, process, customer and place, respectively.

(2-1) From PCM_{a1}, we get $\Omega_{a1} = [\omega_{a11} \omega_{a12} \omega_{a13}]^T$ and the related value of λ_{max} (maximum Eigen value), CI and CR. CI and CR are used to test degree of inconsistency. If CR > 0.1, then PCM_{a1} has to be calibrated, but with weights remaining the same. Therefore, we use PCM_{a1} to represent PCM of

dimension whether it is calibrated or non-calibrated.

(2-2) Similarly, from PCM_{a2}, we get $\Omega_{a2} = [\omega_{a21} \ \omega_{a22} \ \omega_{a23}]^T$.

(2-3) Similarly, from PCM_{a3}, we get $\Omega_{a3} = [\omega_{a31} \ \omega_{a32} \ \omega_{a33}]^T$.

(2-4) Similarly, from PCM_{a4}, we get $\Omega_{a4} = [\omega_{a41} \ \omega_{a42} \ \omega_{a43}]^T$.

(3) The Results of PCM and weight matrix of the above process are summarized in Table 4.13.

(4) To calculate the attribute weights we need, we follow the process listed in Table 4.14 to get the result.

Table 4.13: PCM and Weight Matrix of Dimension and Attribute Viewed from Provider

Goal	**Service Viewed from Provider**											
Dimension	**Provider**			**Process**			**Customer**			**Place**		
PCM	PCM_d											
Dimension Weights Matrix	Ω_d											
Dimension Weights	ω_{d1}			ω_{d2}			ω_{d3}			ω_{d4}		
Attribute	**P**	**E**	**K**	**C**	**S**	**G**	**H**	**T**	**I**	**F**	**B**	**V**
PCM	PCM_{a1}			PCM_{a2}			PCM_{a3}			PCM_{a4}		
Attribute Weight Matrix	Ω_{a1}			Ω_{a2}			Ω_{a3}			Ω_{a4}		
Attribute Weights	ω_{a11}	ω_{a12}	ω_{a13}	ω_{a21}	ω_{a22}	ω_{a23}	ω_{a31}	ω_{a32}	ω_{a33}	ω_{a41}	ω_{a42}	ω_{a43}

Table 4.14: Calculation of Final Attribute Weights Viewed from Provider

Dimension Weights Matrix	$\Omega_d = [\omega_{d1} \ \omega_{d2} \ \omega_{d3} \ \omega_{d4}]^T$			
Attribute Weight Matrix	$\Omega_{a1} = [\omega_{a11} \ \omega_{a12} \ \omega_{a13}]^T$	$\Omega_{a2} = [\omega_{a21} \ \omega_{a22} \ \omega_{a23}]^T$	$\Omega_{a3} = [\omega_{a31} \ \omega_{a32} \ \omega_{a33}]^T$	$\Omega_{a4} = [\omega_{a41} \ \omega_{a42} \ \omega_{a43}]^T$
Normalized Dimension-Attribute Weight Matrix	$\omega_{d1} \times \Omega_{a1} / \alpha_2$	$\omega_{d2} \times \Omega_{a2} / \beta_2$	$\omega_{d3} \times \Omega_{a3} / \gamma_2$	$\omega_{d4} \times \Omega_{a4} / \delta_2$
Equal to Final Attribute Weights	$[A_{21} \ A_{22} \ A_{23}]^T$	$[B_{21} \ B_{22} \ B_{23}]^T$	$[C_{21} \ C_{22} \ C_{23}]^T$	$[D_{21} \ D_{22} \ D_{23}]^T$

(5) For standardization, let

$\alpha_2 = \omega_{d1}\omega_{a11} + \omega_{d1}\omega_{a12} + \omega_{d1}\omega_{a13}$, $\beta_2 = \omega_{d2}\omega_{a21} + \omega_{d2}\omega_{a22} + \omega_{d2}\omega_{a23}$

$\gamma_2 = \omega_{d3}\omega_{a31} + \omega_{d3}\omega_{a32} + \omega_{d3}\omega_{a33}$, $\delta_2 = \omega_{d4}\omega_{a41} + \omega_{d4}\omega_{a42} + \omega_{d4}\omega_{a43}$

$A_{21} = \omega_{d1}\omega_{a11}/\alpha_2$, $A_{22} = \omega_{d1}\omega_{a12}/\alpha_2$, $A_{23} = \omega_{d1}\omega_{a13}/\alpha_2$

$B_{21} = \omega_{d2}\omega_{a21}/\beta_2$, $B_{22} = \omega_{d2}\omega_{a22}/\beta_2$, $B_{23} = \omega_{d2}\omega_{a23}/\beta_2$

$C_{21} = \omega_{d3}\omega_{a31}/\gamma_2$, $C_{22} = \omega_{d3}\omega_{a32}/\gamma_2$, $C_{23} = \omega_{d3}\omega_{a33}/\gamma_2$

$D_{21} = \omega_{d4}\omega_{a41}/\delta_2$, $D_{22} = \omega_{d4}\omega_{a42}/\delta_2$, $D_{23} = \omega_{d4}\omega_{a43}/\delta_2$

$\sum_i A_{2i} = 1$, $\sum_i B_{2i} = 1$, $\sum_i C_{2i} = 1$, $\sum_i D_{2i} = 1$ for i = 1, 2, 3.

4.3.4.4 Identifying the Overall Perspective Weights W_1 and W_2

To calculate the Perspective Weights W_1 and W_2, the steps are more complicated than calculating attribute weights. Surveyed data for both customers and providers have to be used together to identify composite dimensional weights and composite attribute weights first. Than perspective weight for each of twelve attribute will be calculated. Then, perspective weight W will be obtained by multiplying the composite dimension weight with composite attribute weight and with perspective weight of attribute.

4.3.4.4.1 Calculating Composite Dimension Weights and Composite Attribute Weights

(1) Use all the data collected from both customer and provider to construct the pair-wise comparison matrix (PCM) of dimension, $PCM_{D'}$. From $PCM_{D'}$, We get the weight vector of dimension, $W_D = [w_{D1}\ w_{D2}\ w_{D3}\ w_{D4}]^T$, and the related value of λ_{max} (maximum Eigen value), CI and CR. CI and CR are used to test degree of inconsistency. If CR > 0.1, then PCM_D has to be calibrated, but with

weights remaining the same. Therefore, we use PCM_D to represent PCM of dimension whether it is calibrated or non-calibrated.

(2) Use the data collected from customer and provider to construct the pair-wise comparison matrix (PCM) of attributes, $PCM_{A'1}$, $PCM_{A'2}$, $PCM_{A'3}$, and $PCM_{A'4}$ for provider, process, customer and place, respectively.

(2-1) From $PCM_{A'1}$, we get $W_{A1} = [w_{A11} \quad w_{A12} \quad w_{A13}]^T$ and the related value of λ_{max} (maximum Eigen value), CI and CR. CI and CR are used to test degree of inconsistency. If CR > 0.1, then $PCM_{A'1}$ has to be calibrated, but with weights remaining the same. Therefore, we use $PCM_{A'1}$ to represent PCM of dimension whether it is calibrated or non-calibrated.

(2-2) Similarly, from $PCM_{A'2}$, we get $W_{A2} = [w_{A21} \quad w_{A22} \quad w_{A23}]^T$.

(2-3) Similarly, from $PCM_{A'3}$, we get $W_{A3} = [w_{A31} \quad w_{A32} \quad w_{A33}]^T$.

(2-4) Similarly, from $PCM_{A'4}$, we get $W_{A4} = [w_{A41} \quad w_{A42} \quad w_{A43}]^T$.

(3) The Results of PCM and weight matrix of the above process are summarized in Table 4.15.

Table 4.15: PCM and Weight Matrix of Dimension and Attribute

Goal	**Service**											
Dimension	**Provider**			**Process**			**Customer**			**Place**		
PCM	$PCM_{D'}$											
Dimension Weights Matrix	W_D											
Dimension Weights	w_{D1}			w_{D2}			w_{D3}			w_{D4}		
Attribute	**P**	**E**	**K**	**C**	**S**	**G**	**H**	**T**	**I**	**F**	**B**	**V**
PCM	$PCM_{A'1}$			$PCM_{A'2}$			$PCM_{A'3}$			$PCM_{A'4}$		
Attribute Weight Matrix	W_{A1}			W_{A2}			W_{A3}			W_{A4}		
Attribute Weights	w_{A11}	w_{A12}	w_{A13}	w_{A21}	w_{A22}	w_{A23}	w_{A31}	w_{A32}	w_{A33}	w_{A41}	w_{A42}	w_{A43}

4.3.4.4.2 Calculating Perspective Weights for each of 12 Attributes

For each attribute, from the surveyed data, we get the PCM of perspective.

For People we get PCM_{PP}, for Equipment PCM_{EP}, for Knowledge PCM_{KP}, for Customization PCM_{CP}, for Standardization PCM_{SP}, for Contingency PCM_{GP}. From them, we get weight matrix for the first six attributes as shown in Table 4.16.

Table 4.16: PCM and Weight of Perspective for the First Six Attributes

Dimension	**Provider**						**Process**					
Attribute	**People (P)**		**Equipment (E)**		**Knowledge (K)**		**Customization (C)**		**Standardization (S)**		**Contingency (G)**	
Perspective	Cus	Pro	Cus	Pro	Cus	Pro	Cus	Pro	Cus	Pro	Cus	Pro
PCM	PCM_{PP}		PCM_{EP}		PCM_{KP}		PCM_{CP}		PCM_{SP}		PCM_{GP}	
Perspective Weight Matrix for each Attribute	W_{PP}		W_{EP}		W_{KP}		W_{CP}		W_{SP}		W_{GP}	
Perspective Weight for each Attribute	w_{PP1}	w_{PP2}	w_{EP1}	w_{EP2}	w_{KP1}	w_{KP2}	w_{CP1}	w_{CP2}	w_{SP1}	w_{SP2}	w_{GP1}	w_{GP2}

Notes: Cus = Customer, Pro = Provider

$W_{PP} = [w_{PP1}\ w_{PP2}]^T$, $W_{EP} = [w_{EP1}\ w_{EP2}]^T$, $W_{KP} = [w_{KP1}\ w_{KP2}]^T$, $W_{CP} = [w_{CP1}\ w_{CP2}]^T$, $W_{SP} = [w_{SP1}\ w_{SP2}]^T$, $W_{GP} = [w_{GP1}\ w_{GP2}]^T$.

For the remaining six attributes, the same steps are used to get Table 4.17.

Table 4.17: PCM and Weight of Perspective for the Remaining Six Attributes

Dimension	**Customer**						**Place**					
Attribute	**Human (H)**		**Thing (T)**		**Information (I)**		**Front Office (F)**		**Back Office (B)**		**Virtual Space (V)**	
Perspective	Cus	Pro	Cus	Pro	Cus	Pro	Cus	Pro	Cus	Pro	Cus	Pro
PCM	PCM_{HP}		PCM_{TP}		PCM_{IP}		PCM_{FP}		PCM_{BP}		PCM_{VP}	
Perspective Weight Matrix for each Attribute	W_{HP}		W_{TP}		W_{IP}		W_{FP}		W_{BP}		W_{VP}	
Perspective Weight for each Attribute	W_{HP1}	W_{HP2}	W_{TP1}	W_{TP2}	W_{IP1}	W_{IP2}	W_{FP1}	W_{FP2}	W_{BP1}	W_{BP2}	W_{VP1}	W_{VP2}

Notes: Cus = Customer, Pro = Provider

4.3.4.4.3 Calculating the Overall Perspective Weights

By following the steps in Table 4.18, the overall weights of perspective will be obtained.

(1) From the above steps, we already got:

Dimension Weight Matrix: $W_D = [w_{D1}\ w_{D2}\ w_{D3}\ w_{D4}]^T$;

Attribute Weight Matrix: $W_{A1} = [w_{A11}\ w_{A12}\ w_{A13}]^T$, $W_{A2} = [w_{A21}\ w_{A22}\ w_{A23}]^T$;

$W_{A3} = [w_{A31}\ w_{A32}\ w_{A33}]^T$, $W_{A4} = [w_{A41}\ w_{A42}\ w_{A43}]^T$.

Perspective Weight Matrix: $W_{PP} = [w_{PP1}\ w_{PP2}]^T$, $W_{EP} = [w_{EP1}\ w_{EP2}]^T$;

$W_{KP} = [w_{KP1}\ w_{KP2}]^T$, $W_{CP} = [w_{CP1}\ w_{CP2}]^T$;

$W_{SP} = [w_{SP1}\ w_{SP2}]^T$, and $W_{GP} = [w_{GP1}\ w_{GP2}]^T$.

(2) We assign Attribute-Perspective Matrix as W_{P1}=[W_{PP} W_{EP} W_{KP}], W_{P2}=[W_{CP} W_{SP} W_{GP}], W_{P3}=[W_{HP} W_{TP} W_{IP}], and W_{P4}=[W_{FP} W_{BP} W_{VP}], and Grand Attribute- Perspective Matrix as $W_{PA} = [W_{PA1}\ W_{PA2}\ W_{PA3}\ W_{PA4}\ W_{PA}]$.

(3) Then, we get the Dimension-Attribute-Perspective Matrix as $W_{DPA} = W_{PA} \times W_D = [w_{DPA1}\ w_{DPA2}]^T$.

(4) Finally, we get the normalized Perspective Weight $W_1 = w_{DPA1} / (w_{DPA1} + w_{DPA2})$ for Customer and $W_2 = w_{DPA2} / (w_{DPA1} + w_{DPA2})$ for Provider.

Table 4.18: Calculation of the Overall Weights of Perspectives

(a)-Basic **Dimension Weight Matrix**	W_D (4 x 1)											
(b)-Basic **Attribute Weight Matrix**	W_{A1} (3 x 1)			W_{A2} (3 x 1)			W_{A3} (3 x 1)			W_{A4} (3 x 1)		
(c)-Basic **Perspective Weight Matrix for each Attrib**	W_{PP} (2 x1)	W_{EP} (2 x1)	W_{KP} (2 x1)	W_{CP} (2 x1)	W_{SP} (2 x1)	W_{GP} (2 x1)	W_{HP} (2 x1)	W_{TP} (2 x1)	W_{IP} (2 x1)	W_{FP} (2 x1)	W_{BP} (2 x1)	W_{VP} (2 x1)
(d) Perspective Weight Matrix (1)	W_{P1} (2 x 3) Formed by (c)			W_{P2} (2 x 3) Formed by (c)			W_{P3} (2 x 3) Formed by (c)			W_{P4} (2 x 3) Formed by (c)		
(e) Perspective Weight Matrix (2)	W_{P1}=[W_{PP} W_{EP} W_{KP}] =(d), Formed by (c)			W_{P2}=[W_{CP} W_{SP} W_{GP}] =(d), Formed by (c)			W_{P3}=[W_{HP} W_{TP} W_{IP}] =(d), Formed by (c)			W_{P4}=[W_{FP} W_{BP} W_{VP}] =(d), Formed by (c)		
(f) Attribute-Perspective Matrix (1)	W_{PA1} (2 x 1) Formed by (e)x(b)			W_{PA2} (2 x 1) Formed by (e)x(b)			W_{PA3} (2 x 1) Formed by (e)x(b)			W_{PA4} (2 x 1) Formed by (e)x(b)		
(g) Attribute-Perspective Matrix (2)	W_{PA1}= W_{P1} x W_{A1} =(f), Formed by (e)x(b)			W_{PA2}= W_{P2} x W_{A2} =(f), Formed by (e)x(b)			W_{PA3}= W_{P3} x W_{A3} =(f), Formed by (e)x(b)			W_{PA4}= W_{P4} x W_{A4} =(f), Formed by (e)x(b)		
(h) Grand Attribute-Perspective Matrix	W_{PA} = [W_{PA1} W_{PA2} W_{PA3} W_{PA4}] (2 x 4) Formed by (g)											
(i) Dimension-Attribute-Perspective Matrix	$W_{DPA} = W_{PA}$ x W_D = $[w_{DPA1}\ w_{DPA2}]^T$ (2 x 1) Formed by (h)x(a)											
(j)Final Perspective Weights	**$W_1 = w_{DPA1}/(w_{DPA1} + w_{DPA2})$ for Customer** **$W_2 = w_{DPA2}/(w_{DPA1} + w_{DPA2})$ for Provider** **Formed by (i) and normalization**											

Chapter 5 Conclusions, Discussions, Limitations and Suggestions

This paper firstly describes the research background finding that globally service sector is increasingly important in terms of employment over work population and output over GDP. Locally in Taiwan, the Authority plans to enhance the development of service business in order to boost economic growth. From this local policy, research problem is identified as "how to develop service business", since it cannot be done by just using slogans. Therefore, for the purpose to let service providers have effective tools to make correct marketing strategies and develop good service business, this paper constructs two integrative service mathematical models, i.e. one is direct model and the other transformed model, based on which service providers can identify the prioritized attributes and thus formulate the proper marketing strategies for their firms. The models are in general called "3P+C" models.

To develop "3P+C' models, extensive literature reviews have been made on the service classification, open system, service paradigm evolvement and resource-based view to identify the service classification dimensions and their associated attributes to construct the 3P+C service classification model. Then from the concept of customer co-creation of new service paradigm, and the concept of best resources utilization through processes integration, together with the use of performance weight (PW) and importance weight (IW), the 3P+C integrative

service direct mathematical model and transformed mathematical model are constructed. Finally, to ensure the weights, PW and IW, are objective enough to get correct mathematical models and consequently formulate correct strategies, mathematical formulas to identify PW and IW through surveyed data and AHP method are developed.

5.1 Research Contributions

Contributions of this paper are as follows:

1. Extending Wang-Hsu model (Wang & Hsu, 1994) of service business classification to 3P+C service classification model to avoid the ambiguity created in classifying a service firm into categories of service business. The classifying object of 3P+C model is “service” instead of “service business”. The basic classifying units are 81 service modules.
2. Adding more new attributes to classify service than most of previous service classification models do, e.g. adding knowledge attribute to suit for nowadays knowledge-economic society, adding contingency process to suit for increasingly heavier IT-utilized services, and adding virtual space attribute to suit for more and more popularized Internet and network-based services.
3. Based on 3P+C classification model, customer co-creation and RBV concepts, two mathematical models are constructed so that service provider can formulate business strategies based on the two models.
4. Both mathematical models are innovative. Direct model uses service modules with IW and PW, which is customer-satisfaction-based structure. Transformed model converts classifying dimensions into operational dimensions and also uses

IW and PW to make the model be customer-satisfaction-based. The strategies formulated based on the two models will thus be customer-satisfaction- based.

5. In addition to strategies formulation, two 3P+C models can also be used for business planning and forecasting, competitor prediction and business simulation by changing the values of IW and PW.
6. The generalized 3P+C mathematical models are formalized with equations. It is easy to represent with computer software programs. The managerial implications for different service business can be pre-formulated and stored in the database. By so doing, the formulation of strategies can be computerized.
7. The feedback dimension in 3P+C model provides dynamic capability to let the formulated strategy always adapted to the change of external environment. The offered service can thus meet customer actual needs and maintain at a high level of quality, which will bring to customer's satisfaction, maintain good relationship with customers and have their loyalties.
8. 3P+C model is developed from a generic service delivery process. The applications of the two mathematical models can thus be generalized across service industry.
9. Developing formulas with AHP method to calculate the objective weights from the surveyed data.

5.2 Discussions

1. About linearity of the mathematical equations

For a single-core service, the equation of integrative service is the combination of attributes of P, E, K, C, S, G, H, T, I, F, B, and V. Each attribute

symbol such as P or E is just a representation of the meaning behind that attribute. The influence of these attributes to the service can be linear or exponential. But it does not matter whether it is linear or exponential as long as this influence characteristic keeps consistent throughout the analysis.

For multiple-core service case, the equation of the grand integrative service is the linear combination of integrative service of each single-core service. This makes sense because the same attribute of the multiple-core services offered by the same service provider in the same firm have the same influence characteristic to the service. That is, in one core-service the influence of one attribute is exponential, then in the other core services the influence of the same attribute is the same exponential. Therefore, the twelve attribute symbols in the equations can be linearly combined.

2. About the optimization path in 3P+C transformed model

In Schmenner Matrix, which path should be taken to get the most optimized solution? The highest profit line in the Schmenner matrix is the central diagonal from lower right to upper left. In the bank example of transformed model, from the existing position to the diagonal there are infinite numbers of straight lines (paths). Our principle to select the path is based on (1) highest profit (2) least change in the number of attribute. It is a heuristic approach. Therefore, in the example, we just change one attribute and take the path in parallel with vertical axis. This is a feasible solution instead of an “idea solution” that takes every best of each attribute and becomes unreachable solution.

3. About the performance indicator

The performance indicator used in this study is the “profit” contribution ratio of each core service. That is: Grand Integrative Service of multiple-core service = P1 (single-core integrative service #1) + P2 (single-core integrative service #2) + ... + Pn (single-core integrative service #n). The performance weights（PW）P1、P2、…and Pn are the standardized values of profit contribution ratio of those respective single-core service. By so doing, it guarantees the equation of grand integrative model is customer-satisfaction-based, since customer satisfaction is positively correlated to profit (Anderson et al., 1994). Therefore, the strategies formulated based on the model are also customer-satisfaction-based.

There are other performance indicators to be used, e.g. market share and revenue, etc. But using these indicators cannot guarantee the strategies formulated based on them are customer-satisfaction-based. For instance, a firm lowers its service price in order to get bigger market share or selling more units to get higher revenue. But due to price is too low to provide good service to customer, it makes customer very unsatisfactory.

4. Exhaustiveness of 3P+C model’s dimensions and attributes

The identification of 3P+C model’s dimension is based on the generic service process. In Table 4.5, a comparison is made to compare the coverage of dimensions between 3P+C and the previous service process-based matrix. 3P+C ‘s coverage is broader than theirs, especially in knowledge and IT related aspects. The 12 attributes are obtained from extensive review of literatures based on the identified dimensions. The 3P+C classification model is soundly structured. Comparing to the other classification approaches, 3P+C also covers broader range.

5. Easiness of understanding for practitioners

3P+C model is very straightforward, simple, and easy to understand but powerful. Comparing to other numerical models like NUMS shown in Table 2.6 that are complicated and extremely difficult to understand, 3P+C would be more useful for practitioners. Moreover, applications of NUMS are limited to mainly mass service type. 3P+C can be generalized across the whole service industry.

5.3 Research Limitations and Suggestions

This study has the following limitations which are suggested to be solved in the future studies:

1. It is difficult to test the validity of 3P+C model to verify that the strategies formulated based on it are completely correct. To test if a strategy is correct or not, the actual performance of the service firm such as profit is the best measurement. The need to be measured by actual performance makes the verification unable to do in laboratory. Therefore, to start verification, there must be service firms willing to deploy the model and formulate service strategies based on it. To see if the formulated strategies improve the performance, it takes few years. Besides, the factors that influence performance are many and the causes are complex. It is difficult to justify if the improvement is caused by the strategies.

   As a matter of fact, strategy is not like operational process that can be judged correct or incorrect. Strategy is sort of art that cannot be dichotomized into black and white. As long as the inference process to formulate the strategy is logic, structured and making sense, the strategy is a good strategy. It is better

than the strategy that is made by instinct, which can be normally working well, but with few times fails. However, these few times failure can be vital and make the firm totally collapse.

2. For the application of 3P+C model, this paper focuses on service process improvement and service marketing strategies formulation. The other applications such as service quality, service organization, service finance are not covered. This is because the author of this paper does not have sufficient domain knowledge to cover them. But they can be done in the future by cooperating with researchers specialized in those areas.
3. The application of 3P+C model should be able to extend to government and non-profit organization. This involves the selection of performance indicators which is different from those of private firms. These researches can be done in cooperation with domain experts.
4. The research problems can also be extended to service innovation issues from strategy formulation. It can be done as future research.
5. The research can start to focus more on the new web-based service such as Web 2.0 that utilize web service to aggregate internally and externally collective intellects. With Web 2.0, customers can service customers, and customers will provide comments, innovative ideas and suggestions. It is a new area of services that worthwhile to research on it. To incorporate them into 3P+C model will expand the coverage of the original studies.

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