A S-D Logic Based Approach to Input-Output Analysis for Technology Spillover

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Abstract

Technology spillovers can generate positive effects on industries which have been an important issue within the production based (or goods-dominant logic) disciplines, such as in the manufacture industries. The input-output analysis has been considered as a good way to explore and measure the effects of technology spillover. Nevertheless, in the current service-economics and experience era, service industries play an essential role and thus the spread of the service technologies would also become an important topic to investigate. The service-*dominant logic (so-called S-D logic) underlying the service industries emphasizes customer involvement that however was not regarded in the traditional input-output analysis approach. Consequently, this paper aims to present an S-D logic based approach of the analysis in order to systematically explore and measure the effects of technology spillover in services. Furthermore, this paper uses a case study to demonstrate the contributions of the approach and its anticipated impacts to service innovation.*

1. Introduction

Technology spillovers refer to spread of technologies that are procured from an industry's or a company's innovative technology generation and have directly or indirectly positive effects on other industries' or companies' activities [9]. For example, an industry can change its ordinary role (e.g. a product-based manufacture role) to be an integrated role (e.g. a service-based firm role) through technology spillovers. Technology spillovers often take place within the innovation creation or method improvement of an industry to meliorate the firms' performances either in the same industry or across the other industries.

A company can not only increases its productivity but also create additional innovated values with its customers based on the influence of spillovers. Accordingly, it is useful to realize the approaches to technology spillovers for technology-oriented firms to make appropriate business strategies and improve existing services. Furthermore, finding out the potential opportunity of technology spillover for an industry or a company sometimes would be critical as the industry/the company can alter its business competitive position by applying the innovative technologies and advancing into new market directions.

Although technology spillovers play an important role within technology-oriented industries and companies, the consideration of technology spillovers is yet substantially based on goods-dominant logic (G-D logic). During the period of the eighties and nineties the technology was the predominant factor to influence an industry's or a company's growth. Either an industry or a company focused on its productivity to quickly response their customers' demands by adopting the new technology. The automation machine is a good example. While the leading manufacturing company adopts the automation machine to increase its efficiency and reduce the human cost and failure, the upstream and downstream companies in the same supply chain will be spontaneously affected to apply the automation machine in terms of many considerations (e.g. the kernel company's pressure, competitive advantage, and profit opportunity). Consequently, previous studies focused on G-D logic thinking to describe and analyze the effects of technology spillovers. However, in the service-economics era of the twentieth century, the adoption of technologies into services is multi-folded, such as in the design of service encounters, service delivery and service systems. The soaring research area of Service Science [7] also concerns the development of innovated service systems that are the dynamic value co-creation configuration of resources (people, technologies, information, methods, etc.). We argue that the issue of technology spillovers in services would become an important topic to explore in Service Science (given the adopted spillover technologies are utilized to co-create the value).

On the other hands, there have been a lot of previous studies focusing on what kind of approaches can appropriately analyze the effects of technology spillovers based on G-D logic. Bresnahan (1986) stated that technical advances can be considered as the measurement indicators for spillovers. Kaiser (2002) employed the Euclidean technological distance and the geographical distance to measure knowledge spillovers in manufacturing and services. Scherngell et al. (2007) applied Cobb Douglas production function and total factor productivity (TPD) to measure the impact of industry-specific knowledge spillover. Furthermore, the input-output analysis approach has been one of the

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generally adopted approaches which were discussed in past studies [2, 4, 6].

The concept behind the input-output analysis approach is that providers' investment needs to match customers' requirements. Besides, the input-output analysis approach also provides the systematical measurements for managers to implement in practice. Industries and companies can clearly examine the direct and indirect relations (such as productivity, or cost) between input investment and output productivity through the input-output analysis approach. Given that the input-output approach has a solid theoretical structure and been extensively investigated by previous research together with its advantages for implementation and execution, this study aims to use the input-output analysis approach as the grounding to provide a suitable approach of technology spillovers in services

However, G-D logic is different from the service-dominant logic (S-D logic, i.e., the value co-creation concept that underlies the design of innovated service systems). The traditional input-output analysis approach has been adopted in domains of manufacture production that are only from providers' perspectives. In contrast, S-D logic emphasizes that the importance of customer involvement during service delivery. Consequently, we can't directly utilize the traditional input-output analysis approach to measure the effects of technology spillover while considering S-D logic. In other words, how to take customer involvement into account is a critical issue of S-D logic, the adopted approaches of technology spillovers should be able to not only systematically discover the potential opportunity for business growth by spreading an innovative technology but also capably measure the effects of technology spillover within service experience territory. Accordingly, the main research question this study attempts to explorer is briefed as: "How can the input-output analysis approach be extended to incorporate the service dominant logic for the spillover issue?". In summary, this study aims to build a new approach to realize technology spillover by combining the concept of input and output analysis approach with S-D logic. Hence, the purposes of this study are 1.) To propose a S-D logic based input-output analysis approach in order to measure the effects of technology spillover in services. 2.) To uncover the potential application domains of adopting an innovative technology through the S-D logic based input-output analysis approach.

This study will proceed as follows: First, we will analyze previous studies on technology spillover, input-output analysis approach and the difference between S-D logic and G-D logic. Then we will define and explain our S-D logic based input-output analysis approach in details. Next, we will propose three analysis results of a case study using S-D logic based input-output analysis approach. Following this, we will present the implications and impacts of our approach to the technology spillover and service innovation. Finally, we will provide some concluding remarks and further considerations for future research.

2. Related literature

2.1 Technology spillover

Technology spillover (or knowledge spillover) can be regarded as a positive effect which can enable an enterprise to increase the growth of economic profit by adopting a new technology (knowledge). Since information technology or knowledge of an enterprise cannot be restricted to be used by other companies. For example, either partners or competitors of the same industry can easily learn and imitate the new technology (knowledge) from an enterprise to do further applications in order to generate huge impact on themselves. Consequently, understanding the effect of technology spillover not only helps enterprises find some potential chance to increase their capabilities but also enables the industry to increase its competency. Moreover, technology spillover still has been an important issue within manufacture, information technology and business disciplines which a lot of researchers continuously attempts to find a systematical and innovative approach to precisely measure the effect of technology spillover.

For example, Los (1997) conducted an empirical research to propose a new approach in order to measure inter-industry technology spillover. Jacob and Szirmai (2002) found out that knowledge spillover would be a critical factor to influence the growth of a developing country. Los and Verspagen (2000) investigated that spillovers have a significant positive effect on productivity within different level of tech enterprises. Dietzenbacher (2000) combined the original measures with the Leontief inverse method to measure spillover of innovation effects. According to above research, technology spillovers mainly play a critical role which influences the economic activities. However, those studies were majorly applied to the manufacture production issues by analyzing the effects of technology spillovers. Hence, how to find an appropriate approach to unfold and measure the technology spillover considering the notion of service science is still an open issue. This study attempts to propose such an approach to unfold and measure the effect of technology spillovers in services.

2.2 Input-output analysis approach

The input-output approach which was created by Leontief (1936) enables managers to compute the marginal effects (i.e. outputs) of production processes in one industry sector while taking different industry

sectors (i.e. inputs) into account. In other words, the input-output approach is to realize that how many input resources one industry sector should have while producing one unit of product. There have been a lot of studies calculating the influences of technology spillovers through the use of R&D factor [5, 6].

According to OCED (2002, http://www.oecd.org/), "an input-output table is a means of presenting a detailed analysis of the process of production and the use of goods and services (products) and the income generated in that production" (as shown in Table 1). Strategic Managers of nations and industries can analyze and referee levels of the input-output relations between different industries that can help them to understand not only the role of inter-industries but also the situations between input resources and output results. Consequently, there has been economic and business research applying the input-output table to measure spillovers.

Table 1. Input-output analysis table

		Intermediate demand			Original demand			
								Summary
Intermediate input								
Original input								
	Summary							

Source from OCED (2002)

To structure the processes of the input-output analysis, this study aims to enlist the main steps of the input-output analysis approach as shown in Figure 1.

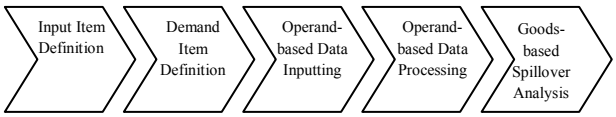

Figure 1. Steps of the input-output analysis approach based on G-D logic

- Input item definition

This step mainly needs to define two kinds of elements which are original input and intermediate input. Original input represents the total resources which industries would invest in. Intermediate input shows the resources should be generate and supported for original input. Hence, input items can be either industries within a nation (e.g. agriculture, manufacturing, or construction) or products within a manufacture chain (e.g. engine, shock absorber, or noise eliminator).

- Demand item definition

Demand items still compose two elements which are original demand and intermediate demand of industries (products). Original demand represents numbers of final products that industries need to produce. Intermediate demand can be regarded as the needs for the considerations of fulfilling original demand.

- Operand-based data inputting

After defining input items and demand items, we have to fill in the table with empirical data which is acquired from the production data in the forms of operand resources (see Section 2.3). For instance, numbers of investment per industry or numbers of cost per product is often seen in the input-output analysis approach.

- Operand-based data processing

The input-output analysis approach is to measure the inter-dependence in different industries, and therefore there have been a lot of ways to process data. For example, input coefficients and output coefficients are commonly computed to represent the levels of input investment and output products within manufacture production industries.

- Goods-based spillover analysis

The final step is to realize the effects of technology spillover based on G-D logic. Goods providers can understand the strength and weakness within the industry in order to modify the strategic policies to achieve their business goals owing to the analysis of technology spillover.

This study tries to extend the use of the input-output table to build a S-D logic based approach for unfolding and measuring the technology spillover within services.

2.3 Service-dominant logic vs. goods-dominant logic

According to Vargo and Lusch (2004a), Vargo and Lusch (2008a), and Lusch and Vargo (2008), there are two main perspectives for the considerations of services which include G-D logic and S-D logic. G-D logic focused on the end products that are tangible (goods) and intangible (services) units of output. In addition, G-D logic is centered on the physical and static resources, so-called operand resources, which need manufacture processes to make them valuable. The fundamental nature of G-D logic is that values of units of output are inset in the production processes. In other words, consumers can principally acquire values and fulfill their needs through purchasing tangible products. Enterprises of G-D logic aim to get profit maximization by selling their products. Consequently, the transactional concept is the major thought of G-D logic. However, as the main trend of the globalization extremely influence the world economics, the service mindset gradually becomes more and more important in the twentieth century. S-D logic can be considered as a new direction for enterprises to get high competency.

Comparing to G-D logic, S-D logic regards services as a process which deal with something for another object. S-D logic usually utilizes the intangible and dynamic resources, so-called operant resources, to create values. Human skills, knowledge, and experiences are the main resources to generate services. Accordingly, not only enterprises actively provide their internal operant resources but also consumers can be involved to be co-creators during production processes. Enterprises need to pay attention to relate to the environment in order to face the emergency of a global situation and cooperate with consumers. Furthermore, S-D logic sees the businesses as continuous stream of economic processes. The marketplace feedback is an important feature of services improvement to constantly achieve high financial success. Consequently, the main characteristics of S-D logic are different from good-dominant logic by above analysis (as shown in Table 2).

Table 2. Service-Dominant Logic vs. Goods-Dominant Logic

Service-Dominant Logic	Goods-Dominant Logic
Services	Goods
Intangible	Tangible
Operant Resources	Operand Resources
Value Co-creation	Value Added
Relational	Transactional
Financial Feedback	Profit Maximization

Source from Lusch and Vargo (2008a)

According to Vargo and Lusch (2008b), operant resources are the fundamental source of competitive advantage in services. Furthermore, from the service-systems orientation of service science [7], technology is an important resource engaged in the dynamic value co-creation configuration of resources. In other words, technology can be considered as one of the important operant resources to drive the service competition. Accordingly, the S-D logic based input-output analysis of technology spillover could be considered as a new research issue to be tackled within Service Science.

This study focuses on the concept of S-D logic and analyzes the effects of technology spillovers in services in order to provide a S-D logic based input-output analysis approach.

2.3.1 Technology spillover examples

In order to delineate the difference of technology spillover between G-D logic and S-D logic, we try to utilize an example of Apple (e.g. iPod). In the G-D logic, the most importance that Apple concerns about is the productivity and quality of iPods. Apple needs to draw up the outsourcing plan in order to secure the suitable manufactories with high performance and quality producing processes. For example, Apple has to choose the leading manufactories to be an alliance which have had the new technology (e.g. ARMv6) regarded as an operand resource to acquire in order to produce the processor components of iPods. Hence, in order for the quality merchandise and mass production of markets, Apple can make a profit of iPods through the effects of technology spillover by adopting high tech manufactories of the ARMv6 manufacturing technologies in the industry.

However, in the S-D logic, values creation and customer involvements play the important role within services. Apple provides their customers with many on-line services integrated through iPods with appropriate value proposing among Apple, online service providers and customers. iPod is a platform for users to download and upload their favorite music and other information and users can conveniently acquire useful messages, share personal information and communicate with other users, online service providers and Apple via Pods. In other words, iPod adopts the value-creation network model and emphasizes on the servicing and experiencing for their users by integrating a variety of operant resources of online service providers. Hence, Apple can gain a great number of users through the resource integrating effects based on the technology spillover of value-creation network.

Consequently, we use the example of Apple to delineate what the effects of technology spillover are different between S-D logic and G-D Logic.

3. Research method

As mentioned earlier, although the traditional input-output analysis approach can't be directly used to explore and measure the expected effects of technology spillover within services, this study attempts to extend this approach in terms of incorporating S-D logic into its existing analytical procedure and explicit principles while retaining its ease of usability. The extended approach not only defines the core S-D logic concept (i.e., value co-creation by providers and customers) but also sets up customer involvement as essential indicators to measure the effects of technology spillover. The approach can be described in detail by following subsections.

3.1 Service-dominant logic based approach

This study is to build a S-D logic based approach by mapping the concept and extending steps of the input-output analysis approach to those in services, resulting in the modified steps of the new approach as shown in Figure 2. The S-D logic based approach will then be described in detail as follows.

- Analyzable alternative definition

In the beginning, the initial step is to define what analyzable alternatives, which are the horizontal items (i.e. inputs) of the input-output analysis table, will be considered. These alternatives are to be examined on their relations with the topics of a specific domain under analysis. This step can take industries or products as the analyzable alternatives. For example, in

order to realize effects of technology spillover of service industries in a nation, the analyzable alternatives can include the banking service, the education services, or leisure service, *etc.* However, the alternatives are taken mainly from the service providers' perspective.

- Target value definition

Compared to the demand items definition step (which takes the same items as the input items definition step within the traditional input-output analysis), the target values are defined as what merit the aforementioned alternatives want to create for customers. This study defines target values to not only represent the value-in-use feature but also emphasize value co-creation as addressed in S-D logic (rather than just the value added as addressed in G-D logic). That is, these values can also be generated by customers. For example, "trust" is one of vital values that eBay wants to deliver to their customers by building a secure transaction platform. In addition, eBay also proposes a ranking service to its customers who can score each other on the transaction platform. This service would indirectly increase the perception of the trust value of eBay by customer involvement.

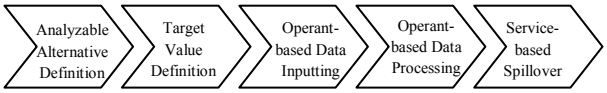

Figure 2. Steps of S-D logic based approach

- Operant-based data inputting

Since the concept of S-D logic includes G-D logic, this step of our study is to input operant-based and operand-based data by either the quantitative or qualitative methods. Hence, the data is not restricted to a specific type depending on the research topic and research resource considerations. The data can be generated not only from the providers' aspect but also from the customers' aspect. Hence, this step can also identify the indicators of customer involvement for operant-based data collecting. For example, recommendation posts of customers at a website can be considered as operant-based data for a service sector. The main difference between this step and the goods-based data inputting step is that the analytical data mainly rests on the forms of operant resources involving customer involvement.

- Operant-based data processing

After inputting data, we need to do further calculations and categorizations based on the data types in order to realize the meanings of operant-based data. For example, the data can be processed to represent a bar chart which shows the distribution results in detail (such as Figure 3) in order to enable service providers to realize the circumstance of each industry. Service Providers can plan the feasible and innovative strategies to their customers based on the implications of the chart. The data can be computed to attain certain relations such as input coefficients or inter-industry coefficients of the S-D logic based input-output analysis approach. However, the concept of this step is different from the operand-based data processing in terms of a gap function (see Section 4.2.4) defined for the evaluation of the present operation performance of service industries rather than just the inter-dependency between the input investment and the output products.

- Service-based spillover analysis

According to the results of service-based spillover analysis, we can not only realize the strength and weakness within the industry (such as goods-based spillover analysis) but also define the core values that can be co-created by providers and customers. Consequently, that will help service providers come up with innovative services to increase their competency and capability and involve customers to participate in. Finally, service providers can also explore the possible fields for adopting a new technology in services by analyzing technology spillover effects.

Although the original input-output analysis approach has been useful and straightforward for enterprises to utilize, the approach only has been solving the problems of G-D logic. Consequently, this study extends the approach to incorporate S-D logic. This study will also follow the above steps of S-D logic based approach to measure the effect of technology spillover.

3.2 Measuring the technology spillover effect

Besides the presentation of the S-D logic based approach, this study will also propose how to measure the effects of a technology spillover. To better understand the measurement, this paper uses a case study to demonstrate the measuring process. This case study is to evaluate the effects of the spillover of the Exquisite Technology [19, 20] that will be briefly described in Section 4.1. In other words, we will explore the potential spillover opportunities to adopt the Exquisite Technology through the application of the S-D logic based approach. Besides, we consider the different categories of service sectors which are defined by the directorate general of budget, accounting and statistics, which is a government authority of Taiwan, during the analysis process for the accuracy and reliability in the data. In addition, we also use performance characteristics of service sectors from the council for economic planning and development to represent the target values because of the representative and sufficiency.

Furthermore, this study will proceed to conduct two investigations by using qualitative methods including focus group interview and secondary data analysis. In the first investigation we invited five experts with the service technology background to share their

experiences and knowledge in order to calculate the spillover effects. Moreover, secondary data analysis can help us clearly identify the relations and influences in a specific service sector by reviewing and analyzing the previous research, literature, and official documentation.

4. A case study on the Exquisite Technology

This analysis of this case will follow the above S-D logic based approach. First, this study tries to realize which service industries have the strong needs of realizing the Exquisite Technology. This is to identify the potential industries which can benefit from the adoption of the Exquisite Technology according to the concept of technology spillover. Next, this study would like to compare the service sectors in a chosen target industry based on the significance of the needing for the Exquisite Technology.

4.1 Introduction of the Exquisite Technology

The Exquisite Technology is a set of appropriate approaches that aim to deliver exquisite service experiences to customers in terms of three core elements (psychological-functional interactive design, cyber-physical service tactics and application-dependent service excellence attributes). The Exquisite Technology aims at the technological transformation of service encounters in dynamic contexts, involving the modeling of service expectation management, service encounter experience management and service journey generation [19, 20]. Service expectation and experience management is modeled as a set of interactive control problems in which designated service expectation goals are achieved through dynamically designed interactions with appropriate service tactics deployed at service encounters, also leading to the generation of satisfactory service journey that can enable the participants to achieve 4D core values (Delicate, Differentiated, Deep and Dependable).

We have applied the Exquisite Technology to the exhibition service application domain and also developed an innovated exhibition service system named U2EX in order for the participants in the exhibition (i.e., visitors, exhibitors and organizers) to attain the 4D core values as follows:

- *Delicate* denotes that the services' excellent attributes enable participants in particular situations to not only provide or acquire proper services in a timely manner, but also communicate effectively with each other. In other words, services of the U2EX system for participants would result in key values, e.g. profitability, control, time, convenience etc.
- *Differentiated* shows that organizers or exhibitors can fulfill customer variation management by providing diverse exhibition services in terms of different needs. Visitors also can be served customized services via the U2EX system by exhibitors.
- *Deep* means that innovative services can invoke in all participants in the exhibition pleasurable emotions. Accordingly, visitors can enjoy their particular exhibition journeys, and their experience paths will be interactive, clickable, and visible through the U2EX platform. Meanwhile, organizers and exhibitors can smoothly complete their jobs in positive emotions.
- *Dependable* is to ensure that services of the U2EX system are reliable and elastic to enhance participants' beliefs. Based on this idea, visitors can dependably communicate with exhibitors to find the proper products. Organizers and exhibitors can deal with run-time service management (e.g. problem detection, dynamic configuration, continuous optimization) to nearly reach customer expectations.

With these aforementioned core values to enable the exquisite service experience delivery, the Exquisite Technology is expected to get pushed and disseminated to other suitable service industries or service firms. This case study then attempts to find out how the spillover of the Exquisite Technology can influence different service sectors through the S-D logic based approach of the input-output analysis.

Table 3. The analysis results of service industries

	Delicate		*Differentiated*		Deep		*Dependable*	
Wholesale & Retailing	*L*	*M*	L+	*M*	L	*M*	M	H
Hotel & Restaurant	*M*	*H*	M	H	M	H	M	H
Transportation, Warehouse & Telecommunication	*M-*	*M+*	L+	M+	M-	M+	M+	H
Finance & Insurance	*M+*	*H*	H	H	M+	H	M+	H
Real estate & Lease	*M-*	*H*	M	H	L	M+	M	H
Profession, Science & Technology	*L+*	*M*	M	H	M-	M	H	H
Education	*M-*	*H*	M	H	M	M+	L+	M
Health care & Public welfare	*M*	*H*	M	H	M-	M+	M	H
Culture, Sport & Leisure	*L*	*H*	L	H	L	H	L+	M+

(H: High, M: Medium, L: Low)

Table 4. The mapping table between scales and scores

Scale	L	L+	M-	M	M+	H
Score	1	2	3	4	5	6

4.2 The analysis of the service industries

4.2.1 Analyzable alternative definition

According to the categories of service industries of the directorate general of budget, accounting and statistics, the main service industries of Taiwan include Wholesale & Retailing, Hotel & Restaurant, Transportation, Warehouse & Telecommunication, Finance & Insurance, Real estate & Lease, Profession, Science & Technology, Education, Health care & Public welfare and Culture, Sport & Leisure. Hence, this study attempts to define these nine service industries as alternative objects for further analysis.

4.2.2 Target value definition

As mentioned earlier, target values represent that the values of service firms are resulted from technology spillover. This study uses the core values of the Exquisite Technology [20], which include delicate, differentiated, deep, and dependable, as key indicators based on the concept of the input-output approach to verify the present situation and the target situation of the above service sectors in order to find the maximum need (i.e. gap) of the service sectors between two situations (as shown in Table 3).

4.2.3 Operant-based data inputting

For operant-based data collection, this study conducts a focus group interview (with five technological experts) to discuss and assess the needs. Moreover, in order to increase the efficiency and readability of analysis this study defines six scales (i.e. H, M+, M, M-, L+, and L) to describe the actual situations. In table 3 the assessments of the present situation are represented in boldface and the target situation in italic.

4.2.4 Operant-based data processing

In order to clearly calculate the gap (i.e. the difference between the objective situation and the present situation) among these service industries, this study defines the score to represent each scale from 1 to 6 (as depicted in Table 4). Figure 3 describes distributions of the gaps of service industries.

As mentioned earlier, the purpose of this measurement is to identify the maximum difference between the present situation (i.e. present score) and the target objective (i.e. target score) within service industries. While a certain service industry has the huge gap of summary of 4D, it is a significant evidence to indicate the high potential opportunity in order to adopt a new technology. In other words, the new technology can result in positive effects (such as increasing productivity, value co-creation, or reducing business cost) for service industries. The Gap estimation function can be expressed as follows.

$$TGS = \sum_{i=1}^{n} PS_i - OS_i$$

where *TGS* represents total gap score, *PS* and *OS* respectively represent the present score and the objective score for a specific target value (i.e., a specific target value column *i*). Figure 3 describes a distribution of the gaps among the service industries. We use Culture, Sport & Leisure service industry as an example. The gap score of Delicate can be represented as *5* that is attained by H (*6*) of present score minus L (*1*) of target score. The calculations of each gap source of Differentiated, Deep, and Dependable are 5, 5, and 3 respectively. Hence, the total gap score are *18* that summarize the gap score of 4D.

4.2.5 Service-based spillover analysis

The results show that *Culture, Sport & Leisure service industry* gets the huge gap (i.e. total scores are 18) between its present situation and target situation. Besides, the GDPs of Culture, Sport & Leisure service industry are also extremely low. However, according to WTO, the Leisure service industry is particularly to generate GDPs for the developed countries, especially in Europe and North America. Consequently, this case study further analyzes the Culture, Sport & Leisure service industry for the spillover recipients of the Exquisite Technology in Taiwan.

4.3 The analysis of the different service sectors within a specific service industry

4.3.1 Analyzable alternative definition

After analyzing all service sectors, we focus on the Culture, Sport & Leisure service industry to uncover of the possibly useful spillovers of the Exquisite Technology. Hence, we try to use a commonly-seen representative to represent each service sector. For example, the movie service is to represent the Culture service sector; the Chinese Professional Baseball League is to represent the Sport service sector and the Bed and Breakfast is to represent the Leisure service sector.

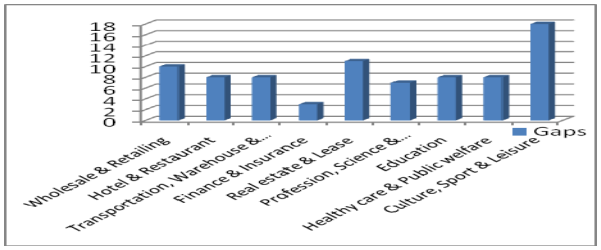

Figure 3. The gaps among service industries

4.3.2 Target value definition

According to the Council for Economic Planning and Development, there are four indicators, which include fund, innovation, marketing and facility, to evaluate the present performance of service sectors. Furthermore, this study adds an additional indicator (i.e. technology) to incorporate the technology role in the design of service systems. These five indicators can clearly represent the levels of operation fullness of a service sector. For instance, the more funds the service sector has the stronger capability the service sector gets. Consequently, this study utilizes these five indicators to be the target values in order for evaluation of their actual state in practice.

- *Fund* is to represent what capital level a service sector can be supported by enterprises, the government, or foundations.
- *Innovation* is to evaluate what level of innovation a service sector has been engaged.
- *Marketing* is to realize how a service sector promotes its services or products through the selling approaches.

- *Facility* can be as manifested as the status (e.g. integrity, comfort, convenience) of the hardware employed within a service sector.
- *Technology* is to describe what level a service sector has applied the Information Technology.

4.3.3 Operant-based data inputting

This study synthesizes these five indicators to estimate a service sector's basic situations of service delivery. In other words, these five indicators can be regarded as the main characteristics of a service sector, which is also considered as a product. This analysis is used three scales which include H (3), M (2) and L (1).

4.3.4 Operant-based data processing

In Table 5, the results show that three services all have low performance in present (e.g. Movie service scores 7, Chinese Professional Baseball League scores 6, and Bed & Breakfast scores 7).

Table 5. The analysis results of the service sectors within the Culture, Sport & Leisure service industry

	Fund	*Innovation*	*Technology*	*Marketing*	*Facility*
Movie service	L	L	M	L	M
CPBL	L	L	M	L	L
Bed & Breakfast	L	M	L	L	M

4.3.5 Service-based spillover analysis

However, Movie service focuses on the human knowledge and creative thinking, especially for the script (or drama). It is hard to deliver good services to increase the attractions or profit through the Exquisite Technology. Hence, the intelligence-based industry has a difficult threshold to apply the Exquisite Technology in terms of its nature. For Chinese Professional Baseball League (CPBL), it could be adopted by the Exquisite Technology in terms of many loyal fans and historical baseball culture. The important factor is that services of CPBL are not good enough to serve customers, and then the Exquisite Technology can easily improve this problem. Nonetheless, this service sector needs the government's support (such as setting up the policies and lows) which could influence the implementation and become more unstable. In contrast, the Bed and Breakfast service is well-designed and established by a lot of creative ideas and investments around Taiwan. The infrastructure of the Bed and

Breakfast service is also well built which includes Internet, traffic, or scenic spots etc. The Exquisite Technology can propose the integrated services to the Bed and Breakfast service providers in order to increase the numbers of customers and tourism profit. Accordingly, the Bed and Breakfast service gets the chance and the high priority to adopt the Exquisite Technology.

4.4 The analysis of a specific service sector

After above qualitative analysis from service industries and service sectors' perspectives, this study uses the Bed and Breakfast service as the example to demonstrate the quantitative way of the S-D logic based approach (as shown in Table 6).

4.4.1 Analyzable alternative definition

We firstly define alternative objects as the prominent activity and auxiliary activity which also are based on the same concept of original input-output table. Prominent activities means services that service sector would like to provide to their customers. Auxiliary activities can be regarded as necessary and supportive services that are also delivered to customers in order to fulfill the success of prominent activities. In this example of the Bed and Breakfast service, we set up reservation service and recommendation service for prominent activities. Therefore, to achieve the above services needs to build a stable infrastructure environment which supports the auxiliary activities.

4.4.2 Target value definition

In this step we define two values, including prominent values and auxiliary values, which service providers would like to co-create with their customers. Prominent values are the most important values that service providers concern about. Auxiliary values are also necessary for service providers to deliver and co-create with the customers before generating prominent values. This study assumes that Bed and Breakfast companies pay attention to information gathering and service visibility that belong to prominent values. Besides, trust and easy-to-use are two auxiliary values for service providers to take into account.

4.4.3 Operant-based data inputting

Before inputting the data to fill the table, we need to define the suitable indicators to represent the levels between alternative objects and target values based on the characteristics of specific domains. Owing to the consideration of S-D logic we try to come up with several indicators which are involved customer participations. For example, the indicator of frequencies of customer reservation can value the strength between the reservation service and information gathering. If many customers had reservations for Bed and Breakfast companies, it is obvious that customers can easily gather and find the related information for the companies. Besides, before delivering reservation service and recommendation service to customers, service providers must make sure that their basic infrastructure (i.e. hardware and software) is steady and reliable for customers to access. We also can use the indicator of numbers of transactions to express the relations between infrastructure building and trust. The more numbers of transactions the companies have, the more trust customers have.

4.4.4 Operant-based data processing

This step can also be computed to contribute to graphic analysis results and useful information

according to above quantitative data in practice. For example, we need to collect the data of above indicators (e.g. frequencies of customer reservation, or numbers of transactions) by retrieving transactional data of Bed and Breakfast companies. In addition, service providers can set appropriate weight for each indicator in order to response the influence in practice.

4.4.5 Service-based spillover analysis

After the data processing, we can have the further analysis based on the specific problems and domain knowledge. For example, while the indicator of numbers of transactions shows low score that means customers do not have sufficient confidence with the service, service providers should improve their on-line transactional mechanism for attractions of customers. Consequently, the analysis results are useful for service providers to have creative service activities for service innovations. In conclusion, the purpose of this case study would like to take the circumstances of service industries in Taiwan and analyze the spillovers effects of the Exquisite Technology by using the S-D logic based input-output analysis approach. For the macro perspective of service industry, the analysis results indicate that Culture, Sport & Leisure service industry has a good possibility to benefit from the Exquisite Technology owing to the huge gap between the present position and the target. Moreover, this study uses three cases (i.e. Movie service, Chinese Professional Baseball League, and Bed and Breakfast service) to engage the further analysis and show that Bed and Breakfast service can achieve high beneficiary impacts by adopting the Exquisite Technology. Besides, for the micro perspective of service industry, we also exemplify some appropriate services to enhance the integrity of these Bed and Breakfast service firms.

5. Discussion

5.1 Managerial implication on technology spillover

As mentioned earlier, technology spillovers will generate positive effects on the industry growth. Hence, how to build a feasible approach to accurately measure technology spillovers is a critical issue to be further researched. This study proposes a S-D logic based input-output analysis approach to help managers to measure technology spillovers through a systematical analysis process. Since service firms would like to apply existing service technology to different service sectors, managers can utilize this approach to explore the potential opportunity for the adoption. The S-D logic based input-output analysis approach can provide systematic and insightful analysis results for service firms to intently concern about their possible directions of service innovation. Consequently, using this approach would not only save the superfluous cost but also reduce the additional effort. Besides, realizing the effects of technology spillover is essential for service providers to increase their business growth and capability.

5.2 Impacts to service innovation

Service innovation has been an important issue for service industries to be paid attention to. Sundbo (1997) argued that service firms need to manage their innovative activities for services within a systematical search-and-learn process. Besides, Vargo and Lusch (2008b) noted that customers are the co-creators of values. The major feature of the S-D logic based input-output analysis approach is the consideration of customer involvement during service delivery. The level of customer involvement can be represented as the level of correlations about if service firms can co-create the target values with customers. Hence, service providers have to come up with creative activities for customers to be engaged in. In addition, service providers also need to identify what kinds of essential values they would like to deliver and co-create with customers. Service providers can re-analyze the service concept and re-design their service system to create excellent service innovations for customers and themselves.

6. Conclusions

Customer involvement for value co-creation is the critical characteristic of S-D logic. Magnusson et al. (2003) stated that customer involvement has positive effects on the quality of service thought creation for service innovation. Lundkvist and Yakhlef (2004) also emphasized that developing a service system for service firms needs to involve their customers to generate innovative ideas.

Table 6. The analysis of the Bed and Breakfast service sector

		Auxiliary Value		Prominent Value		
		Trust	**Easy-to-use**	**Information Gathering**	**Service Visibility**	***Summary***
Auxiliary Activity	**Infrastructure Building**	**numbers of transactions**	**numbers of customer registrations**			
Prominent Activity	**Reservation Service**			**frequencies of customer reservation**		
	Recommendation service				**ranking scores from customers**	
	Summary					

Accordingly, service firms should find a way to involve their customers to create service values and innovations together. In the twentieth century, service industry will be the main trend of economic activity rather than traditional manufacture industry. Thus, how to measure the effects of technology spillover, especially the consideration of customer involvement, within the service discipline is quite different from the manufactures discipline. However, the input-output analysis approach is to measure the effects of technology spillover based on G-D logic that is only from providers' perspective. This study aims to propose a new approach for measuring the influences of technology spillover on the basis of S-D logic. Consequently, in order to formulate a S-D logic approach this study attempts to apply the input-output analysis approach and modify the steps, which originally embodies the production concept, to compute and relate with the concept of customer involvement. Furthermore, service providers can employ this new systematical approach to find potential opportunities to spread their service technology around to create core values with customers. Although this study contributes to academic research and service industry, there is a limitation as follows. Owing to the limited research resources this study uses the industry data of Taiwan to assess the feasibility of the S-D logic based input-output analysis approach. Hence, there are some future research directions worthy of further exploration. For instance, the S-D logic based input-output analysis approach needs to be further evaluated and revised by more research evidences in order to increase the validity and reliability of this approach. Researchers can also combine the S-D logic approach with new ideas and theories to further solidify the theoretical grounds and spurs further spillover applications.

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