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**Multi-stakeholder Performance Evaluation of
Technology-Based Systematic Service Innovations:
e-Healthcare Programs in Taiwan**

by

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Abstract

The paper demonstrates, with conceptualization and practice, the value of a multi-stakeholder evaluation model in assessing the performance of technology-based systematic service innovations, with DoIT's e-Healthcare Programs as an example. Our evaluation model can also help to identify the achievable outcome for the participating firms of different nature. In addition, based on the information obtained from the multi-stakeholder questionnaire survey, we are able to identify at least four types of R&D networking in forging systematic e-Healthcare service innovations, showing differences in the forms and performances of spillover effects. The paper develops and demonstrates a new approach to a better evaluation of systematic service innovations, than the traditional survey with a uniform questionnaire, from a multi-stakeholder point of view. It serves to enrich our understanding of the spillover effects of systemic service innovations, as well contributes to policy formation for public service innovation programs.

Keywords: systemic service innovation, business concept, business model, e-healthcare, multi-stakeholder

1. Introduction

Along with a visible global trend of promoting service innovations, since 2006, the Department of Industrial Technology (DoIT) at the Ministry of Economic Affairs (MOEA) in Taiwan started to promote technology-based service innovation in selected areas, including e-healthcare, focusing on e-healthcare services for the elderly, people with chronic diseases, and wellbeing services for the elderly. Such e-healthcare services innovations are by nature systematic service innovations.

Compared to typical manufacturing innovations, systematic service innovations have their own distinct flavors. Above all, the firm conducting systematic service innovations needs to deal with more external conditions to the firm, for example networking and interfacing with third party, cross-fertilization, market cultivation and evolution, and regulatory regimes (smart and innovation friendly regulations). What's more, systematic service innovations often involve multi-stakeholders, playing different roles in forming the systematic service solutions required.

This gives rise to an important question of how to evaluate the performance of systematic service innovations in an appropriate and comprehensive way. This issue becomes more important when we take into account the fact that the evaluation of public R&D programs in Taiwan, as in many countries, tends to rely mostly on questionnaire survey addressing only to the firm in charge of the individual R&D projects, which is arguably insufficient in capturing the complex networking relationships, as well the performance of the project, of systematic service innovations. In light of this, it is important to establish an appropriate evaluation model to approach an overall picture on the performance of the e-Healthcare Programs, at the same time exploring the complex innovation relationships within each project among the various participants through different modes of service delivery and networking. In this paper we present our experience in developing and conducting a multi-stakeholder model for the performance evaluation of the e-Healthcare Programs

The e-Healthcare Programs sponsored by the DoIT have brought together a few types of stakeholders, including hospitals, healthcare institutions, medical/healthcare device producers, information system/platform providers, in developing innovative e-healthcare services through formal and informal collaboration among those different types of players. While the hospitals and healthcare institutions involved tend to serve as the "owner" and service provider of the innovative e-healthcare services, other types of stakeholders often play their role in providing the technologies and parts of solutions required, rendering the former becoming the

technology adopters in most of the cases. In addition, the project leaders of the individual projects can be other types of the firms than hospitals and healthcare institutions. As a result, the performance evaluation based on data collected from the individual project leaders is bound to be incomplete.

2. Project performance evaluation of systematic service innovation: an literature survey

(1)Service innovation?

2. Systemic Service Innovations and Business Concept: The Research Framework

Over the last few decades, innovation in services and services in innovation has become a topic of growing importance. The existing literature started by exploring the nature and types of service innovations, while some of the recent literature has begun to address the issue of how services innovate, instead just of how innovative services are. A few studies have identified different categories and patterns of services innovations (Miles, 2000; 2005; Soete and Miozzo, 2001; Tether, 2003; den Hertog, 2000; Howells and Tether, 2004; Evangelista, 2000). This body of literature is useful in highlighting the sources for different types of service innovations and even the way different actors interact in formulating service innovations. In short, service innovations can be attributed to external technology providers (manufacturers or knowledge-intensive business service providers), service firms themselves and/or even users, with the way they interact generating different types of service innovations.

More recently, some of the literature has paid attention to a specific type of service innovations: systemic (systematic) service innovations. Chesbrough and Teece (1996) initiated discussions on systemic innovations versus autonomous innovations, in terms of the choice of innovation governance of internalization versus outsourcing in manufacturing. Systemic innovations by nature require “interrelated changes in product design, supplier management, information technology (IT), and so on”. In addition, the distinction between systemic innovations and autonomous innovation applies to not just manufacturing but also services (Vesa, 2006). In Spohrer and Maglio’s (2008) words, one challenge to this type of service innovations is “the interdisciplinary nature of service, integrating technology, business, social and client (demand) innovations”. As far as the paper is concerned, healthcare and e-healthcare can be associated with systemic service innovations (Consoli, 2007) that need to be complemented with a holistic approach to the non-technological aspects as well (den Hertog, 2001; Cabrera, Burgelman, Boden, da Costa and Rodriguez, 2004). While Chesbrough and Teece (1996) tend to hold the position that systemic innovations are

better managed in a hierarchical fashion, some authors emphasize the importance of open innovation (Maula et al., 2006; Ballon et al., 2005) and coordination of the business network across different spheres (Vesa, 2006) in generating systemic innovations. We tend to take the position that systematic services innovations require dealing with more external conditions to the firm involved than do the traditional manufacturing and autonomous service innovations. Therefore, systemic service innovations often involve multi-stakeholders, playing different roles.

As to how services innovate, a few authors have put forward different models or conceptual frameworks (To name just some, den Hertog, 2000; Keeley, 1999; Gaarder, 2003; Mahadevan, 2000), even for healthcare services (Lin et al., 2011; Omachonu and Einspruch, 2010). For example, den Hertog's (2000) well-cited paper proposes a four-dimensional model of services innovation, which highlights the significance of such non-technological factors in innovation as new service concepts, client interfaces and service delivery system/organization, plus technological options; and in that sequence. It goes without saying IBM's Service Sciences, Management and Engineering (SSME; Spohrer and Maglio, 2008). However, it is still puzzling for the practitioners to start with a good and meaningful service concept and even value proposition that can effectively address thorny problems of the clients, with "pain-relief" or "moment of truth" (Pine and Gilmore, 1999), eventually leading to "build-a-service" rather than "build-a-system".

Based on the authors' involvement in the reviewing process of the DoIT's innovative e-healthcare programs, we would like to put forward a research framework for the formation of business concept in systemic e-healthcare service innovations. A starting point for us is to examine demand for e-healthcare services under the magnifying glass.

Quite often, demand for e-healthcare services is associated with the healthcare and wellbeing need of the elderly and/or people with chronic diseases. However, such a view can be oversimplified. Instead, we draw attention to a distinction between direct demand and "derived" demand, which can have something to do with the issue of who is to pay. It is well-established in economics that demand for labor is a derived demand because it is derived from the production and demand for the product being demanded. By the same token, demand for e-healthcare offered to the elderly and/or people with chronic diseases can be a derived demand for someone else or other organizations with something at stake vis-à-vis the service recipients. An obvious example is sons and/or daughters pay for their elderly parents to access e-healthcare services (B2C2C). This distinction between direct demand and "derived" demand can be useful to service design. To give an example, e-healthcare for patients

heavily depending on ventilators (for example in vegetative state) at home may mean more to the family members than the patients themselves; hence the design of such services has to take into particular account of the need of the family members. In addition, there can be a B2B2C model, as will be shown in our case studies. In fact, medical tourism can be motivated by a strategic intention to lessen the financial burden on the part of private insurance companies and national health insurance organizations in a few advanced countries, particularly those with a long waiting list for hospitalization.

A second issue is about how to specify the needs of the stakeholders involved. Services can be regarded as a bundle of activities to “transform some state, such as material goods, information goods or organizations, that is owned or controlled by the clients” (Gadrey, 2002; Spohrer and Maglio, 2008; Miles, 2001). Along this line, Miles (2001) identifies such types of services as physical services, human or personal-centered services, and information services, which in turn are often used to characterize different service sectors. However, to be more specific, from the perspective of delivering services with value proposition, service providers nowadays have to deal with the factors of physical goods, people and information in a simultaneous rather than separate way. In addition, location and timing have become important aspects to the delivery of services. Typical examples at issue are location-based services and express delivery services.

Based on the above discussions, one can argue that e-healthcare service innovations are more than the collection and monitoring of physical and medical information (vital signs). Other aspects than that of information tend to be more crucial for e-healthcare service provider to specify their value propositions. Moreover, such an issue of how crucial the service is underscores willingness to pay.

With these two revised views about direct demand versus derived demand and states to be dealt with, we propose a basic research framework, as shown in Table 1. Referring to the research framework, the authors will examine four cases gathered from the DoIT’s innovative e-healthcare programs, with an aim to throw new lights to the formation the business concept in e-healthcare service innovations.

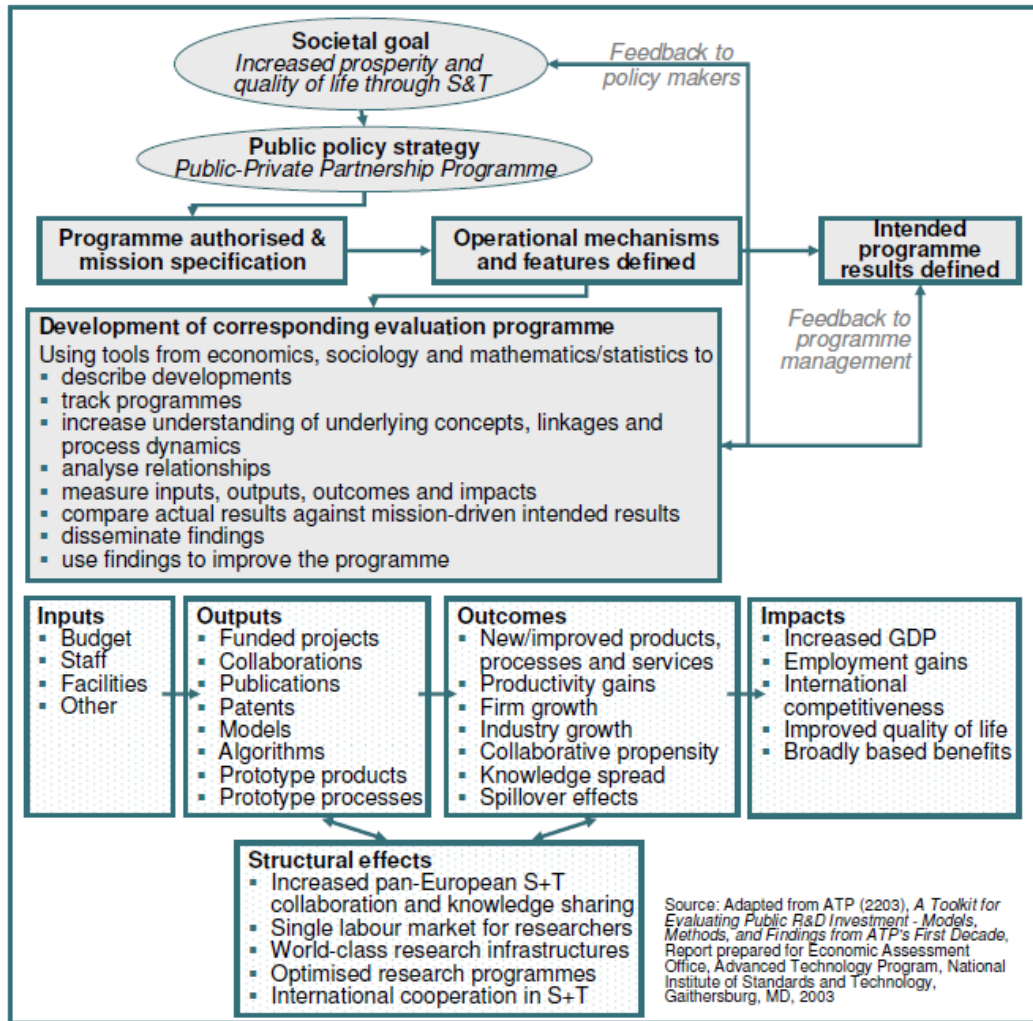


Figure 1: Evaluation logic model and indicators domains

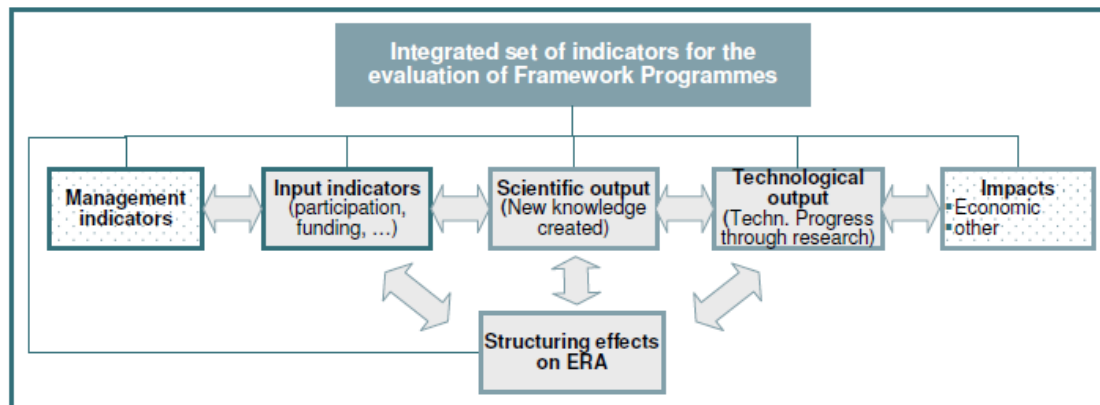
The generic descriptive roles of the indicators depicted in the bottom part of Figure 1 complement each other. Thus, the whole flow of the evaluation logic can be covered by appropriate indicator-based evidence.

Based on the possible indicator roles which were defined in Figure 1 and on practical considerations

of how available indicators are produced and how data are collected, we propose the following six indicator domains (see Figure 2):

- Indicators related to the *implementation and management of the programme*;
- indicators related to *participation in the FPs*, as well as to funding and its distribution by participants, sectors, regions, countries, etc (input indicators);
- indicators related to project and programme outputs, distinguishing between
 - scientific products and results, and
 - technological products and results,
- socio-economic, environmental and other relevant indicators measuring the *longer-term impact* of the FPs, and

∞ indicators related to the FPs' contribution to the *structuring of the ERA*.



The study on service can be traced way back to the Clark-Fisher hypothesis on the rise of the service sector (Clark, 1957), followed by Fuchs (1968) defining service in terms of coproduction. Porat and Rubin (1977) brought in the issue on the rise of the information economy. With the vast amount of studies on the topic, defining service is not an easy task. Standing from the industry's point of view, Spohrer (2008) suggested a combination of Fitzsimmons and Fitzsimmons's definition with Hill's definition into " *a time-perishable, intangible experience performed for a client who is acting as a coproducer to transform a state of the client*" has indicated the key component of services, including coproduction activity and co-creation of value, which suggested the need to take the view from of both the client and provider's perspective for service performance evaluation.

The rise in awareness on the economic importance has resulted in a significant grow in research interest in service innovation as competitive edge in the transition toward the knowledge-intensive and high technology industry. In the eyes of many people, service innovation enables provision of new experience to clients with a complex process of experience and knowledge integration. In addition, Service innovating can also be seen in the form of innovation in technology, business transaction, organizational structure and management mode, and these hidden natures of innovation makes the effectiveness of service innovation difficult to measure. (Zhang 2009)

In recent years, there has been a significant grow of research in service innovation, which mostly focus on describing the underlying mechanisms in service delivery through construction of models or conceptual frameworks for business model of service innovation, such as the "4 dimension model of service innovation" (Hertog 1995) or the " Driving force model of service innovation" derived from Michael Porter's Driving force model.

However, these business models and conceptual framework only provide us with the underlying mechanism for service delivery but from the management point of view, a performance evaluation method is needed for better project management. Yu. Et al (2007) established an evaluation system framework of service innovation strategy based on the concept of Balanced Score Card (BSC) for quality evaluation of service innovation. Xiong et, al (2009) classified the service innovation performance index into 4 category, namely the financial performance, customer's benefit, market ability and comprehensive benefits of an enterprise, and set up a service innovation performance evaluation (SIPE) index system and used the Analytic Hierarchy Process (AHP) for index evaluation. Zhang (2010) took a similar approach to establish an evaluation framework for service innovation, through constructing an index system based on the concept of knowledge value chain followed by evaluation with Data envelopment Analysis (DEA).

The above mentioned performance evaluation framework does have their limitations, Firstly, the numerical value obtained through the quantitative analysis might be useful in term of inter-project comparison or inform the service provider on the current status of the service provided. However it does not provide any substantial mean of service improvement or domain knowledge on the particular market. Secondly, the evaluations only look at the project operation and outcome from the service provider and the client's perspective. However in reality, service innovation is often in the form of systematic service innovation, where the service is provided through integration of a variety of product belonging to different providers. Take the e-Healthcare service for example, although the service is usually provided by a medical service provider such as hospital, but the provision of the e-Healthcare service is actually a collaboration of medical device provider, information system provider and communication device provider. The outcome and success of the project rely not just on the operation of the medical service provider, but the business networking and interfacing between the participating firms, whom each has their unique motive and incentive in the project involvement.

(2) Past experience in systematic evaluation

In Taiwan, the method for evaluation of Industrial technology innovation (later referred to as traditional method) was adopted from the Advanced Technology Program (ATP) under the U.S Department of Commerce. The methodology was later revised by incorporating the concept of "additionality" from the OECD and selection of appropriate indicators by screening the technology innovation evaluation schemes in Japan and Korea, OECD. The evaluation examines the different aspects of the technology innovation process, including the input, process, output, outcome and

the impact with key performance indicators, and was conducted through comprehensive questionnaire survey to the project leader for data collection.

In 2007, “the Program for Innovative Technology Applications & Services (ITAS)” funded by the DoIT was requested to conduct performance evaluation for review by the Executive Yuan. The traditional method was adopted with modification according to the characteristic of the ITAS program. However, although the evaluation result did provide a general view on the overall project performance and identified the unique characteristic such as lower Intellectual property output and shorter product commercialization time, the traditional method does show limitation in capturing the complete picture of the ITAS program due to its systematic service innovation nature. The areas where the traditional method are unable to

- Spillover effect of the participating firm: the traditional method is performed through questionnaire survey to the firm in charge of the individual R&D project. However as a single project is often in the form of joint collaboration by many firms, the traditional method is unable to provide information on the spillover effect of the remaining participating firms
- Analysis at Program level: The ITAS Program consist of approximately 15 different programs, including the RFID program, e-Healthcare program, collaborative design program and so on. The difference in the technology applied and the industry of focus resulted in diversified project outcome across the various projects. The common indicators selected for the performance evaluation does provide a general view of the project output, but is far insufficient for analysis at each project level as individual unique indicators are not included.
- Business model: The ITAS program is mean to encourage firms to involve in system innovation process and develop feasible business model, therefore understand the networking among the participants within each project would be essential.

Therefore, an additional method for performance evaluation is required to obtain the information that can demonstrate the project performance at the program level, enabling the competent authority to have an over view of the project performance, examine the status of program implementation and assist the project revision. Besides the project outputs, the complex innovation relationship within each project among the various participants through different modes of service delivery and networking is also of interest to both the competent authority and the

participating firms.

3. Methodology: A multi-stakeholder approach

The need for a new evaluation approach

As illustrated above, the typical approach of project evaluation through questionnaire survey which address only to the firm in charge of the individual R&D projects has only revealed part of the project performance due to the multi-stakeholder nature of e-healthcare projects. Capturing the project output is not enough, the traditional method also shown incompetency in reflecting both the complex networking relationship between the participating firms and the spillover effect of the individual firm, which are in essence the key factors of success in project of systematic service innovation nature. The knowledge of the inter-relationship established within the project among the participating firms is valuable in many ways. In the eye of the competent authority, this would provide a clear understanding of the mechanisms involved and the role played by each firms, enable the establishment of a better project application and execution scheme and thus improving the overall project success rate. As to the firms interested in seeking potential opportunity in the e-healthcare project, understanding the business relationship would provide a better picture on the service or product required in a e-healthcare project, so as to build up the its capacity in establishing value creating business relationship in an e-Healthcare project.

Methodology

To conduct a comprehensive evaluation of the e-Healthcare Programs, we have developed a multi-stakeholder evaluation model with three stages.

(1)Stage 1: Comprehensive Project review and Characterization

The first stage involves intensive analyses on the features of the individual R&D projects and detailed specification of the stakeholders involved, through discussions with the senior staff on the project office and a few project reviewers. In doing so, problems associated with evaluation based on data collected from the individual project leaders are identified.

(2)Stage 2: Questionnaire and Phone Survey

In the second stage, different versions of questionnaires, though with the same themes, are developed and addressed to different types of players respectively for the individual projects. In conducting the multi-stakeholder questionnaire survey, we collect information mainly on the performance achieved by the individual players,

the interaction between them and the resultant spillover effects outside the R&D projects.

(3)Stage 3: Data Analysis

In the third stage, information collected through the questionnaire survey, phone survey, together with the project reports and additional supplementary materials are used to provide a complete picture on the operation of the project. The projects are then analyzed in both the project and the program level

(i)Project level analysis:

The project level analysis is performed by identifying the characteristic of each participating firms, followed by grouping according to the particular project involved in and finally associating the information on the service delivery, quantitative output and cash flow of the each firm to construct the model of business delivery representing the networking relationships within the systematic service innovation network. Through the Project level analysis, we can clearly identify the role played by each of the participating firm with the quantitative spill-off output. A total of 13 individual business models were constructed.

(ii)Program level analysis:

Comparisons between the 13 individual business models constructed were performed to investigate the common properties across the various projects. The purpose of the above comparison is to identify the general business model of e-Healthcare service delivery, which would later assist in the understanding of the underlying mechanisms within the project and business potential of each participating firm. In addition, the program level analysis also provides both the qualitative and quantitative project performance by all participating forms.

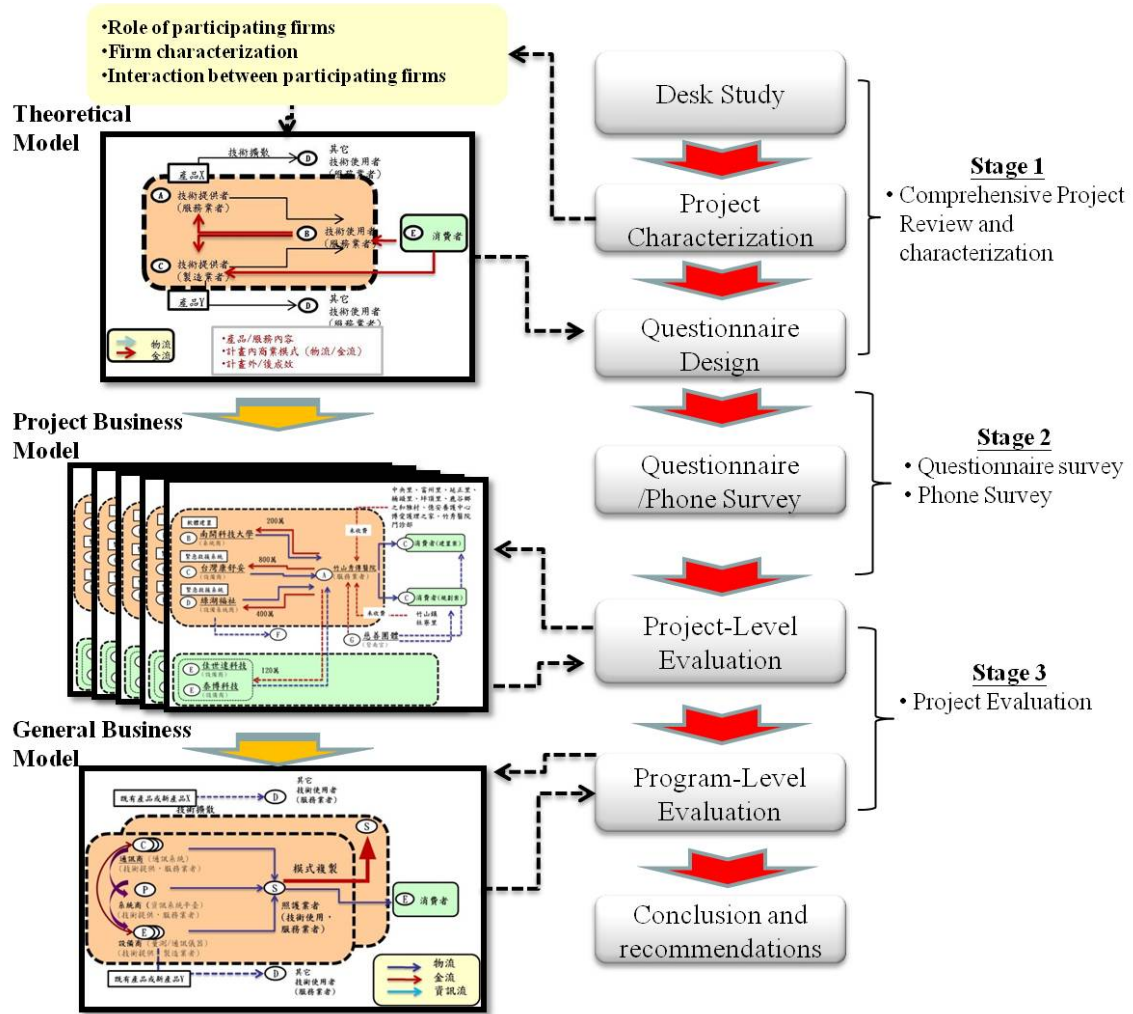


Figure1 Structure of the multi-stakeholder approach of service evaluation

4. Outcome of Multi-stakeholder approach

(1) Difference with previous studies (Vs traditional method)

As previously illustrated, the main objective of the multi-stakeholder approach is to overcome the limitation of the traditional program-specific evaluation which only reveals the project output and the impact from the project leader’s perspective and insufficient in providing the information on the underlying cooperative and service delivery mechanisms which both the competent authority and the participating firms are curious to know and essential for the planning and performance enhancement of the program.

Therefore, In conjunction to the theme-specific evaluation of e-healthcare program through the multi-stakeholder approach, the research team also conducted an overall performance evaluation on the “Innovative Technology Applications and Services Program” by the DoIT through the traditional method of questionnaire

survey to the project leader. The evaluation consists of 152 different projects categorized into 15 themes, including the e-healthcare program evaluated through the multi-stakeholder approach. With the two evaluations performed in parallel, this enables us to make an apple to apple comparison between the traditional method and the multi-stakeholder approach, thus providing us the information on the practicality and feasibility of the multi-stakeholder approach. Although both evaluations covers the e-healthcare program conducted by the DoIT, the result obtained through the multi-stakeholder approach shows better in terms of project interpretation, data collection and provided new insights to the operation of the project and the interaction between participating firms. The main differences between the two approaches are illustrate as follows

(1) Data Quality

The multi-stakeholder approach which used information collected from all participating firms to describe the operation of a single project does provide us with better understanding on the project.

A. Sample Size

The total number of cases invested through the traditional method and the multi-stakeholder approach is 10 and 13 respectively. The difference is due to the investigation scope and categorization of the government subsidy program. In the case of the evaluation of the ITAS program where the traditional method is applied, the scope is set to be the projects receiving government subsidy within the last 5 years. However, in the case of the e-healthcare program evaluation which the multi-stakeholder approach was applied, the investigating project were selected according to the nature instead of the specific program it was in, and therefore included additional 3 e-healthcare project that are not included in the ITAS program. It show the data obtained through a program-specific evaluation sometimes fail to include all the relevant project for a particular theme, whereas the theme-specific nature of the multi-stakeholder seems to be more effective in terms of including all the theme-specific projects.

B. Sample Recovery

As previously mentioned, the program-specific evaluation which focus only to the quantitative output, is insufficient to describe the operation of a systematic service innovation program such as the e-Healthcare program for its multi-stakeholder nature. To overcome this methodological constrain, in the multi-stakeholder approach we included all project participating firms with custom

designed questionnaire according to the role and nature of the firm. In term of questionnaire sample recovery, the Program-specific evaluation, only managed to recover 4 questionnaires out of a total of 10, which is insufficient for performance evaluation at the theme-level. On the other hand, the thematic evaluation through the multi-stakeholder approach identified a total of 28 firms associated with the 13 e-Healthcare programs and managed to recover 26 questionnaires, making a 93% recovery rate.

There are two main reasons causing the significant difference in sample recovery, firstly the program-specific evaluation focus on the overall sample recovery rate, which 114 out of the 135 questionnaires were recovery, with an rather outstanding 84.4% sample recovery rate that is of statistical significance. However, the recovery rate for each sub-theme was not looked into. Secondly, the difference in total sampling size of 135 for the Program-specific evaluation and 28 for the thematic evaluation, making the sample recover operation much more efficient.

C. Project Interpretation

In term of project interpretation, we are looking at whether the data obtained through the questionnaire survey is sufficient enough to describe the overall theme output and the interaction between participating firms in each program. Apart from fact that the theme-specific evaluation was able to achieve higher sample recovery rate, the multi-stakeholder approach used the project final report and conducted telephone survey as additional sources of information. To our surprise, the research team uncovered 31 additional participating firms and the role each firm played in the specific project, which were not included in the project scope and unknown to the DoIT. These additional firms did play an important role in the operation of the e-Healthcare project but were not know to the authority as they were not subsidized. In summary, the multi-stakeholder approach provided much more information, enabling the estimation of the overall output of the 13 projects through 26 questionnaires and obtained the business participation of a total of 58 firms in the projects, enabling construction of complete business model for each of the project.

D. Project Relevance

The quantitative data obtained through the performance evaluation process shows the indicator used in the multi-stakeholder approach is more suitable for a theme-specific evaluation. The object of the program-specific evaluation is to obtain the overall performance of the program, therefore only the common performance indicators were used. This led to the inclusion of indicators such as intellectual property source-in and formation of new spin-off company, which were not common

output of a typical e-Healthcare program, resulted in the poor quantitative output due to the use of irrelevant indicators. On the other hand, the quantitative indicators used in the multi-stakeholder were selected through the project property evaluation process based on the individual project output and expert interview, making the indicators highly relevant to the actual project output. Use the performance output of a medical service provider as an example, the indicators that are relevant to the performance should be service income, number of people served, collaboration fee and number of collaborations formed, which some of them were not used in the program-evaluation.

E. Total Project Quantitative Output

As illustrated above, the multi-stakeholder approach out-performed the traditional evaluation approach in the areas such as sampling size, sample recovery, project interpretation and project relevance, thus improving the significance of the output data and the inability to demonstrate the spill-over effect due to the methodological constrain. A brief comparison of the quantitative data obtain by both methods are as follows

- Service Sales: Program-Specific evaluation obtained the total service sales of 118 million NT dollars whereas the multi-stakeholder approach is able to disclose a total service sales of 200 million dollars.
- Number of clients: The Program-specific evaluation only reveals the number of clients of the project leader, however the multi-stakeholder included all the participating firms into the questionnaire survey, and therefore able to capture the overall number of clients by the other project participants. The multi-stakeholder also shows flexibility data acquisition by giving the right unit according to the characteristic of the participating firm. Take the medical service provider for example, as the service is provided to patients, therefore in the questionnaire we asked for the number of patients served. However, to the project participants who provided service in the B2B basis, therefore the unit of clients is set to be the number of companies served. In additional, in the program-specific evaluation the value of product sales and items sold were used as the performance indicator, which does not apply to the medical service providers. The total number of clients served by the e-healthcare project is 45,595 people and 361 companies.

- Outside-project collaboration: the number of collaborations formed outside the project scope is an important performance indicator of a systematic service project as it represents expansion of service providing ability through broader networking and interfacing. The program-specific evaluation only managed to obtain 3 collaborations of total 6.2 million NT dollars, whereas the multi-stakeholder approach traced 346 collaborations of a total of 23.42 million NT dollars.

Program-Specific Evaluation through Traditional Evaluation method

Number of Projects	Sample size (recovery)	Direct Sales (Items)	Direct Sales (Thousand NT)	Indirect Sales (Thousand NT)	R&D investment (Thousand NT)	IP source-in (Thousand NT)	Spin-off Company (Thousand NT)	Establish New department (Thousand NT)	Investment in Product Sales (Thousand NT)	Invest In New Product Develop Applying (Thousand NT)	Investment in Personnel Training (Thousand NT)
10	10(4)	17	66,115	52,000	4,053	0	0	3,000	28,050	19,699	10,750

•One questionnaire per project and lower recover rate

•Common performance indicators across different themes were selected, resulted in under-estimated quantitative performance due to poor indicator relevance

Theme Specific Evaluation through Multi-Stakeholder Approach

Number of Projects	Sample size (recovery)	Participating firms	Firm Category	Sales (Thousand NT)		Collaboration (Thousand NT)		No. of Clients		Collaboration Partners		Sales (Items)	
				Within Project	Outside Project	Within Project	Outside Project	Within Project	Outside Project	Within Project	Outside Project	Within Project	Outside Project
13	28(26)	59	Medical service	173	234	241,248.520	23,438.572	45,595 (人)		36	346	-	-
			Equipment/system/communication	15,750	11,260	-	-	151(家)	210(家)	-	-	1,797(件)	859(件)

•One questionnaire per participating firm with higher recovery rate

•Custom made questionnaire for firms of different characteristics

•Obtain project output beyond the project scope to illustrate the spill-over effect.

•Selecting the key performance indicators suitable for illustration of project output

Figure2 Qualitative Comparison between the traditional evaluation method and multi-stakeholder approach

Table 1 Quantitative Comparison between the traditional evaluation method and the multi stakeholder approach

	Service Sales (Thousand NT)	No. of Client	Outside Project Sales (Thousand NT)	Outside Project Collaboration (Firms)
Traditional Uniform Questionnaire Survey	118,115	-	6,200	3 companies (6.2million NT Dollars)
Multi-Stakeholder Evaluation approach	200,244	45,595 people 361 companies	23,438	346 companies (23.43 million NT Dollars)

(2) Significance

Besides providing a better mean for capturing the overall project performance, the multi-stakeholder approach also provided insight information in describing systematic relationship between participating firms, through which evaluations can be performed at theme-level, project-level and firm-level which enable different users to glimpse into the business mechanism from different perspective and formulate market strategy according to its role and characteristic.

A. Program-Level

(a) Core elements

The multi-stakeholder approach has demonstrate the ability to provide information on the characteristic and nature of each participating firm, which in return informed us with an interesting fact that although each project differs in number and nature of the participating firms, examination on the core element provided by the participating firms shows that at least 12 of the 13 projects under evaluation is formed with a combination of medical/healthcare service, information system, medical device and communication device. The only exception occurred in a project focuses on value chain integration instead of e-Healthcare service, which in our point of view does not really function as a typical e-Healthcare program.

Another interesting fact is that the number of element provided in the project is higher than the project number, with a total of 15 medical services and 20 in rest of the elements provided in the 13 projects. By refer to the business model formed in each projects, it is clear that although one element of each is sufficient in establishing a functional e-Healthcare program, the additional elements cater for the individual project needs arose from the differentiation in service delivery and service

integration, which often contribute to the success of the project. Take a project focusing on providing e-Healthcare service for elderly people with chronic disease living in rural community for example, the cost for both vital sign measuring device and internet fee creates a significant financial burden, and therefore 2 types of vital signs devices were provided, a high-end device located at the community centre for residents to share and a individual-use device for elderly with medical history of disease such as heart attack that requires constant surveillance.

It is also noticed that firms capable of providing more than one element stands a better chance of participating in an e-Healthcare partnership. A total of 19 companies provided more than 1 element in the individual project. One of the most successful examples is a medical device manufacturer integrating communication device and provided with a custom made information system, which eliminate the need for new system development and collaboration by the providers of different elements and reducing the cost and improving the efficiency of the service provided.

Table 2 Core elements of the e-Healthcare project

Elements	Occurrence of particular element in total No. of projects	Percentage (%)	Element Occurrence	Firms providing more than 1 element
Medical/Healthcare service	12/13	92.31%	15/13	19
Information system	13/13	100%	20/13	
Medical Device	12/13	92.31%	20/13	
Communication Device	12/13	92.31%	21/13	

(b) Business Model

The theme-level evaluation also provided us with a typical e-Healthcare business mode, through which a participating firm can formulate its business strategy according to the service/device provided and the nature of the firm. The typical business model of an e-Healthcare program is as follows:

- (a) Participating partner : Including healthcare service, medical device, communication device and information system
- (b) The medical service, information system and communicator providers each provide individual product a service, whereas the medical service provider

often plays the role of system integrator and providing a total service to the customer.

- The medical service, information system and communicator providers are capable of integration additional element into the existing device
- Service delivery mode including a direct B2C model and an indirect B2B2C model which act through an intermediary service provider.
- Spill-over effect: each of the medical device, information system and communication device provider has demonstrated the ability to provide the device or system developed in the project to other users. As for the Medical service provider, the scale up process can be done by either by expanding the customer base or duplicating the business model to other medical service provider.

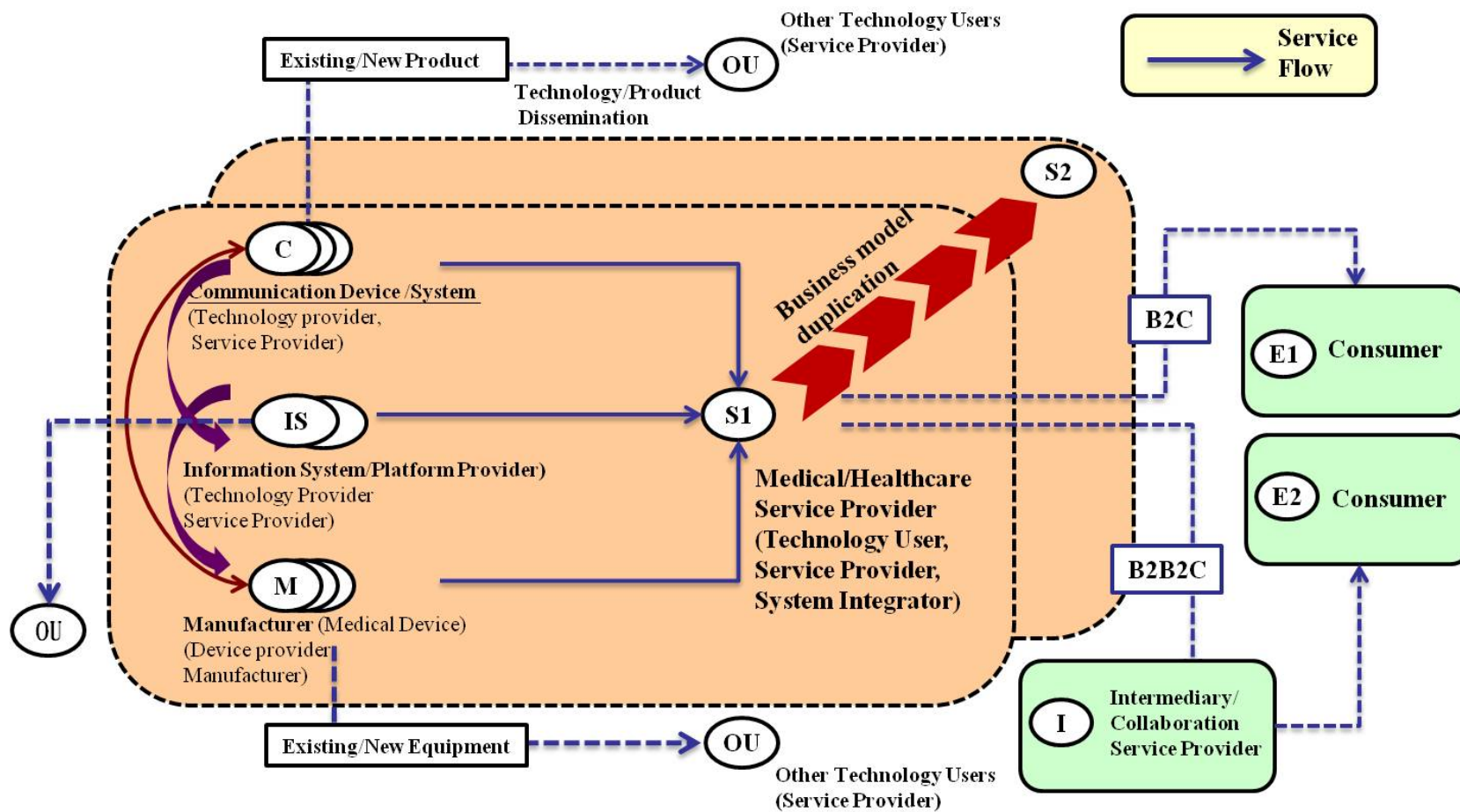


Figure3 General Business Model of service delivery of an e-Healthcare program

(C) Distinctive Features

(i) User acceptance to the service (Had better have VS Nice to have)

Prior to the analysis through the multi-stakeholder approach, it was thought that the form and amount of payment is closely related to the success of the project and project with lower fee is more acceptable to the user. The multi-stakeholder approach allows us to examining the cash flow of each project and shows that both the free and fixed payment e-Healthcare program can be successful. One major fact that governs the success of the project is the user acceptance to the service, which according to the importance to the user, is into “had better have (against the odds of what if) or nice to have for different user group.

- Had better have (against the odds of what if): typical customer include resident of rural area or patients of disease of significant impact, such as heart attack, diabetes and other critical diseases
- Nice to have : general health service to elderly or corporate.

(ii) Form or collaboration

2 forms of collaborations occurred in the project, naming the R&D based or transaction based collaboration.

- R&D based collaboration : mostly for firms wishing to explore new opportunity and entering the e-Healthcare market, developing new technology or devices for the particular e-Healthcare program through cross-sector cooperation
- Transaction based collaboration: Integration of existing devices or services to provide new e-healthcare service or improving operation efficiency.

(iii) Form or collaboration

Successful cases have shown in both the B2C and B2B2C business delivery models with varies nature of the intermediary agent for the B2B2C business delivery, including local healthcare centre, firms, charity organization, local social community and insurance company.

(iv) Approach for project participation

There are general two different approaches for firms participating in the e-Healthcare project. First is through cross-sector transaction based collaboration where companies participate with existing technology no healthcare related product is developed. Secondly by seeking opportunity to enter the e-healthcare market

through government funded project and developing healthcare products.

B. Firm-Level

Through the two different questionnaire specially designed according to the characteristic of the participating firm, the multi-stakeholder also provide us with the clues on the motivation, collaboration mode and cash flow from a two groups of participating firms, naming the medical/healthcare service provider and the medical device, information system and communication providers.

(a) Healthcare Service Provider

The healthcare service provider often plays the important role of the service integrator of the project, which means in most cases the e-Healthcare service provided is an extension of the existing service or as a tool to enhance service delivery and capacity. In the systematic service innovation business model, we are interested in exploring issues such as the participation objective, source of technology/device and the fee collection scheme, which in terms refer to the reason for engaging in the e-healthcare project, the nature of collaboration with participating firms and the cash flow in the project.

(i) Participation objective

Understanding the objective of the participating firms provide us with the information to formulate the mean to encourage firms to involve in the provision of e-Healthcare service, and the multi-stakeholder approach does capable of answering why do the healthcare-service providers are willing to engage in the e-Healthcare program. Similar to the typical service innovation program, the healthcare service providers engaged in the project include:

- Provision of total solution
- Improve customer relationship
- Expanding service area
- Improve service quality
- Improve internal operation efficiency

(ii) Source of technology/device

The source of technology/device is important because it describe the nature of business interaction between the system integrator and the participating firms, which the multi-stakeholder approach does capable to illustrate. To our surprise, most of the technology or devices were developed by the collaborating firms specifically for the particular e-Healthcare program and not through arm-length

transaction of which the system integrator simply acquiring existing technology or device. One reason for this is because each of e-Healthcare projects differs in nature and service delivery, resulting in the need for a certain degree of revision or adjustment to the device to fulfill the service and the need of the clients.

(iii) Fee collection scheme

The design of the fee collection scheme is critical in the implementation of an e-healthcare project as it affects the user acceptance of the service. The multi-stakeholder approach shows the ability in identification of cash flow between service provider and the final users. Much to our surprise, majority of the fee collection scheme by the medical service providers are through either fixed monthly fee or no additional charge. By charging a fixed monthly fee, it means the service provider not only provide an extension of the existing service, but also as an tool to foster a closer relationship with the client and expansion of customer base. In the cases where no additional charge, it can either mean the service is used for improvement of internal operation efficiency, thus compensating for the cost associated, or acting through an intermediary agency who pay for the service. An example of this is collaboration scheme with insurance company, where the service to the patient is pay for by the insurance company as extra value added service to the existing insurance scheme and a precautionary act to reduce potential medical compensation cost.

(b) Medical device, information service and communication device provider

As previously mentioned, in the past questionnaire survey focus on the performance of the project leader which is played by the medical service provider. Therefore unable to show the technology spill-over effect by the other participating firms. This resulted in the need for the multi-stakeholder approach which examines the performance output by all participating firms, including the non-medical service providers who were left out in the traditional evaluation. Most of the participating firms in this category are companies with no formal experience in e-Healthcare but seeking opportunity in expanding the product line beyond the existing market through government funded research project. Below we shall discuss the participating objective and fee collection scheme by the group of companies.

(i) Participation objective:

The participating objectives by this group of firms are very different from the medical service providers. Most companies sees the government funded project as an opportunity to development new product or service. Others were looking into increasing cross-sector collaboration opportunity and developing a new market. One

reason for this is that most participating firms are SMEs without both the domain knowledge on the e-Healthcare market and cross-sector collaboration experience. Therefore, with the government funded approximately one-third of the total cost, it encouraged companies to seek opportunity in the e-Healthcare business by reducing the risk involved.

(ii) Fee collection scheme

The fee collection scheme represents the business collaboration between the firm and the system integrator. Majority of the firms only received the project collaboration funding instead of charging according to the number of devices or information system provided. The result actually coincide with the participating objective of these firms and shows that the collaboration is more than promoting sales of existing products but seeking to develop new product or service and as entry ticket to the e-Healthcare business.

(iii) Role and market potential of each category of firms

The multi-stakeholder approach does not only provide a quantitative description on why firms participate in the e-Healthcare program and the mode of business collaboration with the medical service provider, by examining the after the spill effect of the project, it also provided information on the market potential of each type of company, which include:

- Medical Device manufacturer: potential in continuous supply of device to the medical service provider. However as the device is a physical product, it has higher development and production cost and existing product might not fully fulfill the need of other projects, therefore has limited chance of spreading to other projects
- Information system: Information system used in the e-Healthcare project is mostly tailor made with no in depth domain knowledge required. As it takes the form of software instead of a physical product, there is no production cost involved and can easily revised or custom made according to the service requirement, therefore facing strong competition from similar products.
- Communication device: The communication device can easily be integrated with either the medical device or the information system, therefore usually exist as a single product but more often as integrated component.

(iv) Performance of the competent authority in promoting industrial innovation

The performance of the competent authority was evaluated according to the quantitative output of the project, however the result does not reflect on the weather the competent authority had fulfilled its role as the innovation promoter. The result from the multi-stakeholder approach provided indirect evidence.

- The number of R&D based collaboration for development of new product and service suggested that the e-Healthcare program did encourage firms from different sector to involve in the e-Healthcare business.
- Although some projects fail to development a marketable new product or service, but the participating firms actually gained valuable domain knowledge and experience in cross-sector collaboration through the course the project, resulted in a productive failure.
- In some cases the project failed not because of poor business model but restrictions by the existing healthcare rules and regulations, therefore even though the DoIT has managed to encourage firm to involved in the e-Healthcare program, it is the regulating department such as the Ministry of Health or the Ministry of Interior that should took the role of promoting e-healthcare as they are capable of revising the existing rules and regulation enabling projects to move forward.

5. Discussion

Compared to typical manufacturing innovations, technology based systematic service innovations have their own distinct flavors. Above all, the firm conducting systematic service innovations needs to deal with more external conditions to the firm, for example networking and interfacing with third party, cross-fertilization, market cultivation and evolution, and regulatory regimes (smart and innovation friendly regulations). The multi-stakeholder nature of the systematic service innovation is also an important aspect of the project characteristic which the evaluation need to be address to. Take the e-Healthcare Program by the DoIT as example, have brought together stakeholders, including hospitals, healthcare institutions, medical/healthcare device producers, information system/platform providers, in developing innovative e-healthcare services through formal and informal collaboration among those different types of players.

The existing methodologies available for evaluation of service innovation, such

as the establishment of an index framework followed by quantitative analysis such as the AHP or the DEA as seen in some of the research works, or the common uniform questionnaire survey approach by governments all over the world in collecting the project economic output, all fail to address the spillover effect by the participating firms and insufficient for analysis at the program level and therefore making the evaluation result less significant in terms of total project output.

In addition, through the project and program level evaluations, the multi-stakeholder is capable of demonstrating the business model and collaborative network established in the individual projects, provided insight information in describing systematic relationship between participating firms, enable different participants to glimpse into the business mechanism from different perspective and formulate market strategy according to its role and characteristic.

Through the program level analysis, the multi-stakeholder identified the core elements, general business model and the distinctive features, including: (1) the influence to the user acceptance to the service; (2) Form of collaboration took place in the project; (3) Mode of service delivery and ;(4) Approach for the project participation, naming the cross-sector transaction based collaboration and involvement with the existing technology.

On the firm-level analysis, the multi-stakeholder helped to identify the business opportunity and the potential according the nature of the participating firm, which is very useful for firms wishing to involve in the e-Healthcare market. In the case of the medical service provider, the model enable us to explore issues such as the participation objective, source of technology/device and the fee collection scheme, which in terms refer to the reason for engaging in the e-Healthcare project, the nature of collaboration with the participating firms and the cash flow of the project which has large influence on the user acceptance of the project. As for the remaining participating firms, the multi-stakeholder also helped to identify the (i) Participation objective; (2) Fee collection scheme and ;(3) Role and market potential of each category of firms.

Lastly, the multi-stakeholder also provided an indirect review on the performance of the competent authority in promotion o the service. Take the DoIT's effort in promoting the e-healthcare program for example, the result indicated that the program did encourage companies to participate in system innovation. Although some projects fail to development a marketable new product or service, but the participating firms gained valuable domain knowledge and experience in cross-sector collaboration through the course the project, resulted in a productive failure. In

addition, some project failed not because of poor business model but restrictions by the existing healthcare rules and regulations, therefore even though the DoIT has managed to encourage firm to involved in the e-Healthcare program, it is the regulating department such as the Ministry of Health or the Ministry of Interior that should took the role of promoting e-healthcare as they are capable of revising the existing rules and regulation enabling projects to move forward.

6. Conclusion

The insufficiency of the traditional uniform survey approach in evaluating the performance of a systematic service innovation program such as the e-Healthcare program has raised the need for an additional evaluation method which not only capable of capturing the overall performance output of the project and each of the participating firm, but also sufficient to describe the complex business networking and interfacing between the individual participating firms. Therefore the research team formulated the multi-stakeholder approach of evaluation, hoping to obtain all the information required.

The analysis and comparison between the traditional approach and the multi-stakeholder on evaluation with DoIT's e-Healthcare Programs as an example, has demonstrated with conceptualization and practice, the value of a multi-stakeholder evaluation model in assessing the performance of technology-based systematic service innovations.

Besides obtaining the overall qualitative and quantitative performance of the e-Healthcare program, the evaluation model also helped in identifying the achievable outcome for the participating firms of different nature. In addition, based on the information obtained from the multi-stakeholder questionnaire survey, we are able to build up the service and cash flow took place in each of the project and identified the general R&D networking relationship between participating firms in forging systematic e-Healthcare service innovations, showing differences in the forms and performances of spillover effects.

The model also helped to identify the business opportunity and the potential according the nature of the participating firm, which is very useful for firms wishing to involve in the e-Healthcare market. Take the medical service provider for example, the model enable us to explore issues such as the participation objective, source of technology/device and the fee collection scheme, which in terms refer to the reason for engaging in the e-Healthcare project, the nature of collaboration with the participating firms and the cash flow of the project which has large influence on the user acceptance of the project.

In summary, the paper develops and demonstrates a new approach to a better evaluation of systematic service innovations, than the traditional survey with a uniform questionnaire, from a multi-stakeholder point of view. It serves to enrich our understanding of the spillover effects of systemic service innovations, as well contributes to policy formation for public service innovation programs.

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